Developing an understanding of networks in LMIC health systems: how and why networks change practices to improve service delivery and quality of care

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Abstract

Health systems are complex and plagued with challenges leading to poor quality of care, outcomes, and health systems functioning. Often approaches to health systems strengthening focus on tangible parts of the system. However, health systems are based on people and so are, by nature, relational. Many of the challenges are, at the root, also relational.

Networks are increasingly employed to tackle health system challenges by either explicitly or implicitly targeting the relational aspects of health systems. In my DPhil, I define networks as groups of facilities and/or healthcare stakeholders that are linked with an aim to change practices to improve care and health system functioning.

There is limited theory-based scholarship understanding how and why networks form, function, perform, and evolve in low- and middle-income country health systems. My DPhil addresses this knowledge gap, progressing through three linked phases.

In an extensive Scoping Review, I mapped the network literature (129 manuscripts) and developed a framework of key network components. Building on this, I conducted a Realist Review developing an initial programme theory explaining how and why networks form and function to change practices. I tested this programme theory through a Realist Evaluation on the Newborn Essential Solutions and Technologies programme network in Kenya using a multiple-methods case study comprising 33 in-depth interviews, informal meeting observations, and document review.

My findings are captured in a refined programme theory that explains how a network evolves through three phases: Initiation & Formation, Functioning & Performing, and Sustaining Change & Impact through interrelated:

- processes (identify a problem; collective vision; taking action to solve a problem; identity and culture)

- activities (knowledge and skills dissemination; cross-learning; resourcing; leadership; champions; adaptability)
- foundations (teamwork; psychological safe space; commitment; engaged, motivated, empowered, and confident network members; purposeful relationships, linkages, and partnerships)
- cross-cutting factors (communication; trust; energy, effort, passion).

The final programme theory provides a roadmap for the relational work those employing networks should perform to promote success.

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And most importantly, thank you to my parents for your unwavering support as I embark on one adventure and country after the other. I promise, this is my last degree!

Healthcare across the globe has failed so many mothers and newborns, we can, and we must do better.

Declaration

This thesis is my independent and original work, except where otherwise specified and referenced, and describes the research undertaken to fulfil the requirements for the degree of Doctor of Philosophy in Evidence-Based Health Care. It has not been previously submitted for any degree, nor is under consideration for any other degree. I first authored the following peer-reviewed publications that contain material from this thesis, this is noted in the relevant chapters:

- Kalaris K, Wong G, English M. Understanding networks in low-and middle-income countries' health systems: A scoping review. PLOS Global Public Health. 2023; 3(1): e0001387. doi: 10.1371/journal.pgph.0001387.
- Kalaris K, English M, Wong G. Developing an understanding of networks with a focus on LMIC health systems: How and why clinical and programmatic networks form and function to be able to change practices: A realist review. SSM – Health Systems. 2023; 1:100001. doi: 10.1016/j.ssmhs.2023.100001.

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Abbreviations & Acronyms

AIM	Africa Index Medicus
AMEK	Association of Medical Engineering of Kenya
Biomeds	Biomedical technicians and engineers
BMGF	Bill and Melinda Gates Foundation
CHAI	Clinton Health Access Initiative
CIFF	Children's Investment Fund Foundation
CIN	Clinical Information Network
CHO	Community Health Officer
CHW	Community Health Worker
CME	Continuing Medical Education
CMOC	Context – Mechanism – Outcome – Configuration
CPHD	Centre for Population Health and Development
EONC	Essential Obstetric and Newborn Care
ETAT+	Emergency Triage, Assessment, and Treatment plus Admission
GIC	Generic Instructors Course
HIC	High-income country
HIGH-Q	Learning to Harness Innovation in Global Health for Quality Care
HRIO	Health Records Information Officer
IT	Information Technology
KEMRI	Kenya Medical Research Institute
KEPRECON	Kenya Paediatric Research Consortium
KMTC	Kenya Medical Training College
KPA	Kenya Paediatric Association
KWTRP	KEMRI Wellcome Trust Research Programme
LGA	Local Government Authority
LMIC	Low- and middle-income country
LoA	Letter of Agreement
Med Sup	Medical Superintendent
MMR	Maternal mortality ratio
MoH	Ministry of Health
MoHCDGEC	Ministry of Health, Community Development, Gender, Elderly, and Children
MoU	Memorandum of Understanding
MRC	Medical Research Council
NBU	Newborn unit
NGO	Non-governmental organisation
NMR	Neonatal mortality rate
NoC	Network of care
NEST360	Newborn Essential Solutions and Technologies
Ob/Gyn	Obstetrics and Gynaecology
PHCB	Primary Health Care Board
PMR	Perinatal mortality rate
QCN	Quality of Care Network
QI	Quality Improvement
QRP	Quirino Respected Partners
RAMESES	Realist and Meta-narrative Evidence Syntheses: Evolving Standards

RMO	Regional Medical Officer
SDG	Sustainable Development Goals
TBA	Traditional Birth Attendant
ToT	Training of trainers
TWG	Technical Working Group
UNFPA	United Nations Population Fund
UHC	Universal Health Coverage
Unicef	United Nations Children's Fund
UK	United Kingdom
UoN	University of Nairobi
USAID	United States Agency for International Development
WHO	World Health Organization

Preface

Prior to starting my DPhil, I worked for global health organisations for 10 years across several health areas – reproductive health, HIV, malaria, maternal and newborn health, nutrition, and supply chain, mainly in Francophone West and Central Africa. At the time, I was in a perpetual dilemma of whether I wanted to be a specialist or generalist. I decided to undertake a DPhil because I wanted to pivot my career from a shift towards global health organisation management back to the programme and technical work that I am passionate about. Additionally, I wanted to develop research skills that would support my ability to undertake quality and rigorous work, whether that be in academia, global health practice, or both.

The final project I worked on at the Clinton Health Access Initiative prior to my DPhil was to define and develop a framework for a service delivery approach called networks of care. In parallel, global health actors, including the World Health Organization, World Bank, United States Agency for International Development, and Gates Foundation developed an interest in a networking approach and have supported efforts to advance networks of care and other types of networks, such as the Quality of Care Network across 11 countries and networks of practice in Ghana.

As I explored different areas of focus for my DPhil, continuing to work on networks, albeit more broadly, seemed to be an interesting, worthwhile, and valuable way to contribute to both academia and global health practice. Researching networks for my DPhil oriented me to the field of health systems research, which allowed me to unify my vast professional experiences into an expertise on health systems, resolving my professional dilemma. I decided to take a Realist approach for my DPhil because I thought it would be a useful way to look at complex systems and approaches (i.e. networks) as well as support my development of transferable research skills.

Structure of my DPhil

My DPhil has three linked phases: a Scoping Review, Realist Review, and Realist Evaluation. Figure 0.1 provides an overview of the three phases. I started with a Scoping Review, in which I developed a framework that explains the components that make up a network and mapped network uses, purposes, and stakeholders. For the second phase of my DPhil, a Realist Review, I built on the understanding of networks I had developed in my Scoping Review to develop a Realist programme theory to explain how and why networks form and function to be able to change practices in low- and middle-income country (LMIC) health systems based on the literature (including a sub-set of literature from my Scoping Review) and substantive theory. In the third and final phase of my DPhil, I tested the programme theory from my Realist Review on the Newborn Essential Solutions and Technologies (NEST360) programme network in Kenya. I refined the programme theory with primary data and additional substantive theories. From this refined programme theory, I drew out transferable learnings for initiating, forming, functioning, performing, and sustaining change and impact of a network.

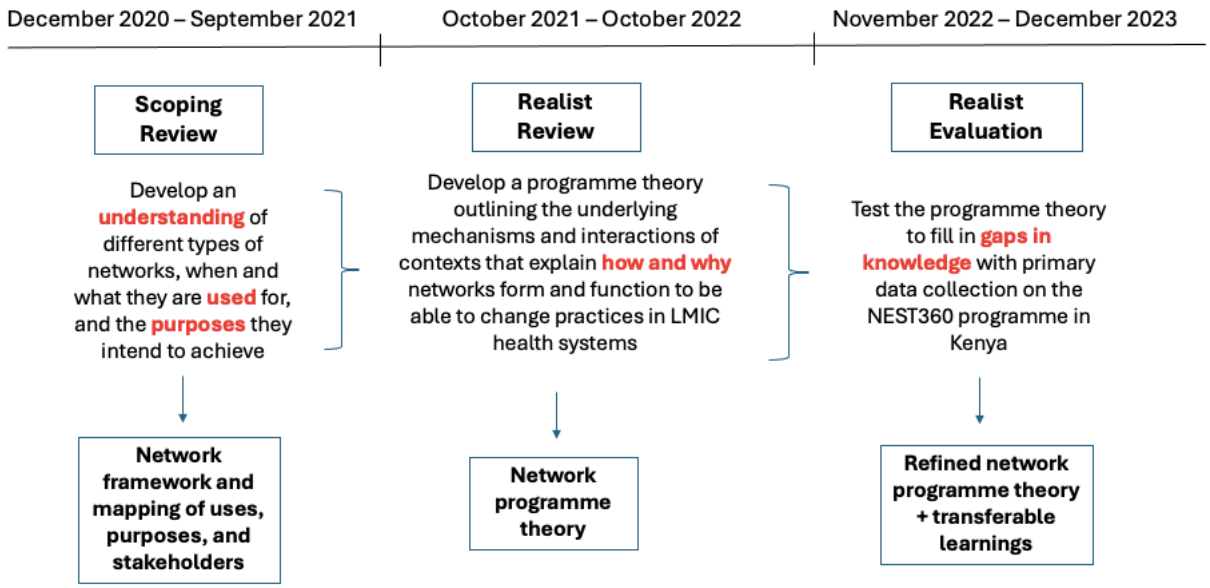


Figure 0.1 Overview of my three DPhil phases

1. Chapter 1. Introduction & Background

This first chapter of my DPhil introduces and provides background for the three phases of my DPhil. In this chapter, I situate networks within health systems as an approach to solve complex problems in complex systems, define a network in health systems, provide an overview of the existing literature, and identify relevant gaps in the literature. This chapter concludes with the aims, objectives, and research questions for the three phases of my DPhil that address identified gaps in the literature. Parts of this chapter were drawn from my published Scoping and Realist Reviews: Kalaris K, Wong G, English M. Understanding networks in low- and middle-income countries' health systems: a scoping review. PLOS Global Public Health. 2023; 3(1): e0001387 and Kalaris K, English M, Wong G. Developing an understanding of networks with a focus on LMIC health systems: How and why clinical and programmatic networks form and function to be able to change practices: A realist review. SSM – Health Systems. 2023; 1(100001). doi: 10.1016/j.ssmhs.2023.100001.

1.1 Health Systems – complex systems plagued with complex problems

Health systems are characterised by complexity. They are composed of groups of interacting individuals whose connections and relationships are dynamic, non-linear, and continually impact the context, outcomes, and behaviours of those who are part of the system.[1-4] Current understanding of complexity in healthcare is that health systems are complex adaptive systems.[2 3 5] A complex adaptive system is a "collection of individual agents with freedom to act in ways that are not always totally predictable, and whose actions are interconnected so that one agent's actions change the context for other agents."[3] Complex systems have blurry boundaries; they have interacting individuals or entities who function based on internal, often unpredictable, rules; and adapt, interact, and evolve with other systems.[3 6 7] Within these complex adaptive systems, complex interventions exist. The Medical Research Council (MRC) most recently defined an intervention as complex: "(1) because of the characteristics of the intervention itself, for example multiple components or mechanisms of change, and/or (2) because how the intervention

generates outcomes is dependent on exogenous factors, including the characteristics of recipients, and/or the context or system within which it is implemented."[8]

Health systems may function sub-optimally due to high levels of demand, limited resources, structural inertia, insufficient financing mechanisms, fragmentation, and weak governance.[9-11] This can lead to sub-standard service delivery, lack of access to services, inappropriate use of resources, poor quality of care and clinical outcomes, and low user satisfaction.[11] Even when resources are available, care may still not be optimally provided due to insufficient healthcare worker knowledge and motivation and a misalignment between norms and recommended practices.[12]

Compared to other sectors and systems, health systems have a greater range and complexity of funding models, interventions, components, and users.[13] Health systems are unpredictable[3] and different health systems respond differently to the same inputs and interventions.[13] The hierarchical model of many health systems is unable to keep up with current pressures and requirements, such as improving population health, quality of care, work life of healthcare providers, and care to vulnerable populations; lessening the cost of care and health inequalities; and tackling social determinants of health.[14 15] Furthermore, health systems are relational systems and many of the significant challenges in health systems result from the relationship problems between organisations, staff, and patients.[16] However, the most common health systems framework, the World Health Organization's (WHO) health system building blocks, does not acknowledge the importance of relationships.[17 18]

1.2 Networks – a solution to complex health system problems?

There are a plethora of approaches and interventions to tackle the problems of health systems. Interventions may target health system structures, often referred to as hardware, to for example improve infrastructure or restructure organisations, although essential improvements in patient care from these types of changes alone may be modest.[13 19] Change efforts can also be focused on the relational aspects of health systems, also known as software, which can include culture, values, norms, and improvement

methods.[13] [19] A systematic review found that positive organisational and workplace cultures were consistently associated with improvements in patient outcomes.[20] At a systems level, trust and power are important determinants of performance.[16] For change to occur, people need to be part of the decisions and activities that impact their work; communication, trust, and relationships need to be a focus.[13] [16] [21]

Clinicians and health system managers, among other stakeholders, look to approaches within their capabilities and available resources to improve service delivery, quality of care, clinical outcomes, health system functioning, and complex health system problems. Health system networks are one approach to solve these problems.[22] Networks are one of the "innovative ways to deal with complex problems confronting communities"[23] and have been brought to the forefront by health systems research as an approach to tackle health system problems.[14]

1.2.1 Defining a network

Networks are an increasingly employed approach[24] to tackle clinical and health systems' challenges with interest and momentum from ministries of health (MoHs) and global and local healthcare stakeholders.[25] Many different networks exist in the field of healthcare, ranging from global advocacy networks to service delivery networks to community-based networks. Examples of networks exist across both high-income country (HIC) and low- and middle-income country (LMIC) health systems; examples are provided in Table 1.1.

There are various network types, definitions, typologies, and frameworks in the literature but there is "no single, consensually agreed definition of what constitutes a 'network.'"[26] [27] The network literature is large and complex and the concept is often mixed with other types of collaboration, such as communities of practice or partnerships.[28] Networks are part of complex systems and are made up of many interacting components and actors with collective and divergent interests; because of this diversity within networks, network outcomes may be dependent on internal or external factors.[6] [8] Network complexity is further

elaborated in Chapter 2. Table 1.1 provides examples of the range of types of networks and their definitions.

Type of network	Definition	HIC/LMIC	Examples
Clinical network	"Voluntary clinician groupings that aim to improve clinical care and service delivery using a collegial approach to identify and implement a range of strategies across institutional and professional boundaries"[29]	HIC	A clinical network in Australia aimed to identify and introduce strategies to improve practices in newborn pain management by employing audit and feedback, benchmarking, champions, guideline updates, and cross-learning[30]
Network of care	"Group of public and/or private health service delivery sites deliberately interconnected through an administrative and clinical management model which promotes a structure and culture that prioritizes client-centred, effective, efficient operation and collaborative learning, enabling providers across all levels of care, not excluding the community, to work in teams and share responsibility for health outcomes"[31]	HIC/LMIC	Quirino Respected Partners in the Philippines links a tertiary public hospital with public and private midwifery clinics to reduce maternal and newborn morbidity and mortality through relational and operational approaches[32]
Managed care/clinical network	"Linked groups of health professionals and organisations from primary, secondary and tertiary care working together in a coordinated manner, unconstrained by existing professional (and organisational) boundaries to ensure equitable provision of high quality effective services"[33]	HIC	A managed clinical network in Scotland aimed to improve diabetes care, which was facilitated by engaged network leaders with a clear vision and commitment to collaboration[34]
Health services network	"The integration of diagnostic, therapeutic and care activities provided by different professionals and different organizations, in the hospital and in the community, that cooperate to achieve a shared mission"[35]	HIC	A health services network in Italy, focused on outpatient heart failure, integrated hospital and outpatient cardiac care by setting clinical pathways to ensure continuity of care, timely response, flexible care, continuous training, and establishing network objectives, rules, and protocols[35]
Quality improvement collaborative	"A group of professionals from a single or multiple organizations who get together to learn from one another, support and motivate each other in a	HIC/LMIC	A quality improvement collaborative in Kenya aimed to improve person-centred care for women accessing maternal and reproductive health

	structured approach with the intent of improving quality of health services"[36]		services by cross-learning and support from quality improvement facilitators[37]
Inter-organisational network	"Groups of three or more legally autonomous organizations that work together to achieve not only their own goals but also a collective goal"[38]	HIC/LMIC	The North American Quitline Consortium is a network of organisations providing counselling via telephone and other services to people trying to quit smoking[39]

Table 1.1 Examples of networks and network definitions.

Networks differ from other approaches in health systems because they focus on the relationships between their members and the willingness of their members to participate.[26] Members of networks see value in working with each other to address a mutual problem; these problems are often not solvable by a single health facility or organisation.[23 40]

Networks have been established in health systems in many countries. For example, a district level network in rural and remote areas of Nepal works to improve the local health system to provide equitable access to quality care for all mothers and newborns by engaging with community volunteers and local government to strengthen infrastructure, clinical capacity, and community engagement while ensuring local ownership of the network.[41] In Dar es Salaam, Tanzania, a tertiary-level private sector hospital linked with 22 government hospitals to address poor quality health system performance that led to excess maternal and perinatal mortality and morbidity.[42] A quality improvement network in India aimed to decrease healthcare associated infections in newborns across six public and private neonatal intensive care units.[36] In Canada, provincial strategic clinical networks worked to improve care, health outcomes, and value for money by bringing together evidence-based practices, innovation, patients, clinicians, community members, academics, and health system managers.[43]

Many networks in health systems form when groups of health system actors come together in a distinct way and work together with a specific aim. They may form organically from the bottom-up in response to a problem or more deliberately through government or external partner initiation.[26] For example, the Clinical Information Network (CIN) in Kenya links county level hospitals together to improve generation and use of health system data to strengthen the provision of care.[12] The formation of CIN was a

collaborative effort between hospitals, the MoH, a research institution, a university, and a professional association. In Metro Manila, Philippines, the Quirino Respected Partners (QRP) network created trusting relationships among providers at different levels and sectors of care by linking a tertiary-level public hospital and private and public midwifery clinics, which enabled the decongestion of the tertiary hospital and improved maternal and newborn quality of care.[32] QRP was created from the bottom-up by a clinician at the tertiary-level hospital. A provincial-level network in Cotopaxi, Ecuador strengthened the relationships between levels of care, including formally integrating community health workers and traditional birth attendants to provide better access to and coordinated quality of care for mothers and newborns.[44] The network was initiated by a donor funded project.

Networks aim to achieve a range of purposes, including to address variations in practice and outcomes,[45] improve processes and quality of care,[46] increase evidence-based practice,[47] facilitate change,[30] share knowledge and innovation,[28] and achieve joint goals.[48] Despite this diversity across networks, it is possible to identify similar characteristics among them, such as having a shared goal or vision, strong visionary leadership, communication, and trust.[28 48-50]

My interest is in the networks that form when groups of health system actors from across levels and sectors of care, entities, and geographies come together in a distinct way and work together with the aim to improve service delivery, quality of care, and health system functioning. They are not a parallel structure to the public sector health system but often represent a new, primarily relational, layer on top of or within the existing health system, thereby potentially reinforcing it. These networks differ from the geographic or vertical networks of service delivery units underlying the structure of many public sector health systems. They are supplementary system strengthening networks and are mainly clinical or programmatic in nature.

For my DPhil, I define networks in health systems as:

groups of facilities and/or healthcare stakeholders (including but not limited to all types of providers, technicians, government officials, professional associations, non-governmental organisations, and donors) linked formally or informally, horizontally or vertically, through programmes, interventions, activities, or initiatives with an aim to initiate change to improve service delivery, quality of care, and/or health system functioning.

I decided to define networks in health systems in this way because I found the existing definitions either too specific to one type of network or too general to keep within the context of health systems.

1.2.2 Why networks?

Health systems are not short of interventions, programmes, or projects, but a network approach may provide something that other types of initiatives do not. Networks can overcome problems caused by fragmented services or organisational barriers[28] and support sustainability and functioning of network entities that make up the network.[25] Cunningham et al (2012) argue that there is "something fundamentally important in harnessing collaborative efforts via networks."[51] Despite differences across health systems and their challenges, there seems to be something notable about engaging healthcare providers in a network and fostering them to work better together.[51]

Networks are claimed to be able to achieve goals or changes that may not be feasible by a single organisation or individual, leveraging collective action from network members.[26 28 38] They often work towards solving problems that necessitate complex change across different organisations.[47] Networks may effectively share knowledge and influence people's behaviour because they develop norms and values that steer and influence decisions and actions.[26] Furthermore, networks are an approach to tackle complex health system challenges because they work to identify problems, such as reasons for gaps in care, and support different network members, for example clinicians and health system managers, to collaborate to change practices.[47]

1.3 Overview of existing network literature

While the focus of my thesis is on networks in LMIC health systems, the literature in this area is mainly focused on studies of specific networks. Networks are not a new approach but much of the existing network literature comes from HICs and outside the health sector and it is therefore important to acknowledge this before focusing on my specific area of interest.

Early network research, such as Powell (1990), views networks as a distinct, and often complex, organisational form separate from hierarchies or markets.[52] While Powell places networks in a context of economic exchange, there is relevance for networks in health systems. Networks facilitate learning and information sharing, which can support ideas to quickly become actionable; provide a way to use and enhance "intangible assets," such as knowledge; have lateral communication; and have shared responsibility or accountability.[52]

Networks are prevalent in the public policy and administration literature, which argues that networks are particularly effective in tackling wicked problems.[53] Wicked problems are ill-defined, are challenging to resolve with no obvious solution, are beyond the remit of one organisation, and need a wide-ranging response from stakeholders and the public.[54 55] Literature on networks in health systems and the health sector also finds networks to be an appropriate solution to wicked problems because they bring together resources, including human resources, and improve coordination.[53 56] For my thesis, I frame health system problems as complex rather than wicked because even though health system problems have some qualities of wicked problems, such as involvement of many stakeholders and a need for behaviour change, health system problems have the potential to be solvable with the appropriate approach and resources in certain contexts.[54 55]

1.3.1 Important factors of networks

Existing research has looked at different factors for successful networks. Ferlie et al examined different healthcare networks across the United Kingdom (UK) and found that cross-organisational information and

communications technology, inter-organisational learning, and a shift from vertical to more horizontal leadership were key for working as a network.[53] In clinical networks in Australia, networks considered successful had effective leadership, formal organisational structures and processes, network principles, strategic evidence-based workplans, sufficient resources, external relationships, credibility, and the ability to undertake and evaluate network activities.[46 57] A Scoping Review on healthcare networks mostly in HICs found that network performance is dependent on the capacity of members for joint action, purposeful engagement, relatable cultures, trusting relationships, shared commitment, distributed leadership and power, and interoperable information systems.[56] Powell claims that know-how, a demand for speed, and trust are essential for networks.[52] A study on a multi-LMIC network found that sufficient health systems financing, engaged political and local leadership, coordination, motivated and trained individuals in the network, and strong data systems and data use were needed for the network to meet its objectives.[58] Networks may also need to have distinct ethics or values among network members.[59]

1.3.2 What can networks do?

Networks may be a way to better use resources, plan and address complex problems, enable joint action, develop relationships, and provide better services.[38 60-62] Many network studies highlight the importance of learning within and across the network.[12 38 40 52 53 59 60 62] Some MoHs organise their health system around networks, such as in Brazil and Ghana.[11 63] Ghana is adopting sub-district level networks to link community-based health planning and primary care services.[62 63]

In LMICs, many networks focus on improving service delivery through approaches such as strengthening mentoring systems, referral linkages, transport and communication systems, health information systems, clinical competencies, community linkages to care, health information dissemination, quality improvement activities, and documentation.[32 44 61 64 65] Importantly, but often under emphasised, networks focus on relational qualities, such as improving relationships, leadership, communication, culture, and teamwork.[12 32 66]

1.3.3 Network effectiveness

Much of the existing network literature, particularly theoretical, focuses on network effectiveness. Cunningham et al (2019), drawing on the organisational effectiveness literature, argue that effectiveness of networks is a "social construction" and that it is network members and stakeholders ensuring that the network is working towards the right objectives with the right approach.[67] There have been different approaches taken to look at network effectiveness.

Provan and Kenis (2007) define network effectiveness as "the attainment of positive network-level outcomes that could not normally be achieved by individual organizational participants acting independently." Sheaff and Schofield's (2016) definition of effectiveness focuses on the extent that a network collectively achieves its goals.[28] They also look at the effectiveness of network structures – specifically, if the network had sufficient members or relationships to reach its goal.[28] There are several different frameworks for looking at network effectiveness (Cunningham et al 2019, Turrini et al 2009, Ferlie et al 2010), though with several overlapping considerations, such as sustainability, community-level effectiveness, and achieving outcomes or goals.[67-69]

Brown et al's Systematic Review (2016) of qualitative and quantitative studies on effectiveness of clinical networks found that clinical networks can be effective for quality improvement in service delivery and patient outcomes, but found variation in clinical networks' ability to make network or system-wide change.[48] However, Belrhiti et al's Scoping Review (2024) argues that there is inconsistent evidence on network effectiveness to improve quality of care and outcomes and that there needs to be more bottom-up participative decision-making, formal governance agreements, and trusting relationships for networks to be effective.[56]

The literature on network effectiveness in LMICs is growing. An evaluation of a multi-country Quality of Care Network (QCN) looked at the effectiveness of the network through its interventions and processes: learning, action, leadership, and accountability globally and in four of the network countries.[70] The

evaluation found that the QCN was most effective at the global level with the network secretariat able to bring together network country governments and global stakeholders through in-person and virtual communication and learning platforms. Of the four areas, leadership—both global and national—was deemed most effective, while learning, action, and accountability were less effective due to challenges, including the COVID-19 pandemic, dependency on donors or implementing partners, and lack of scale-up.[70] A Scoping Study on networks of care mainly focused on LMICs and described four domains that effective networks of care operate in: 1) agreement and enabling environment (policy, financing, purposeful arrangements, buy-in, and trusting relationships), 2) operational standards (referrals, monitoring, supply and infrastructure, and workforce), 3) quality, efficiency, and responsibility (coordination of care, clinical guidance, documentation, review, benchmarking skills, measurement, and improvement) and 4) learning and adaptation (client-centredness, flexibility, extending research, evolution, and resilience).[31]

1.3.4 Network impact

Networks have the potential to impact political, organisational, and clinical levels of health systems.[71] Research on clinical networks in Australia found evidence of networks' high-impact on quality of care and system-wide change, improving services and patient outcomes, implementing evidence-based practices, collaborations, and partnerships.[49 57] However, this may be predicated on better perceptions of network management and leadership by network members.[49] A Systematic Review on inter-organisational multi-level healthcare networks found that they were mainly focused on quality of care.[72] Another Systematic Review on clinical networks found that they had a positive impact on quality of care and patient outcomes when they had sufficient resources, credible leadership, efficient management, effective communication strategies, and collaborative trusting relationships.[48]

In LMICs, there is evidence of networks improving outcomes, particularly for maternal and newborn health. A network in six provinces in Indonesia, responsible for over half of all maternal deaths in the

country, reduced the case fatality rate from any maternal complication by 50% in network hospitals (on average 5.4 to 2.6 deaths/1000 cases of obstetric complications) and very early neonatal mortality by 21%.[73] In a network in three states in northern Nigeria with the highest maternal mortality ratios (MMR), the MMR was reduced by 37%, neonatal mortality rates (NMR) by 43%, stillbirth rate by 15%, and perinatal mortality rate (PMR) by 27%.[74] Similar achievements were seen in a network in Northern Province, Zambia, one of the provinces with the poorest health performance, with decreases in MMR of 41%, NMR of 45%, and PMR of 43%.[64] Networks have also been an approach to achieve Universal Health Coverage (UHC) and improve primary healthcare. A district-level network in Madagascar saw declines in under-five mortality by 19% and newborn mortality by 36%.[75] Care-seeking for childhood illnesses increased 51% in areas of the district that were part of the network, while it slightly decreased in non-network areas of the district.[76] There is also evidence of networks improving quality of care. In a network for maternal and newborn care in Ecuador, there was an increase in the number of women who received counselling on newborn care (8% to 26%), danger signs (12% to 23%) and family planning (6% to 18%); similar improvements were not seen in the comparison area. Health centres in the network met clinical standards for first antenatal visits (56% to 90%) and newborn ambulatory visits (73% to 88%). Clinical quality improved for outpatient maternal postpartum visits at health centres (68% to 98%) and hospitals (0% to 81%). Active management of the third stage of labour improved in hospitals (68% to 97%) and half of network hospitals (from 13%) were completely compliant with inpatient immediate emergency neonatal standards.[44]

1.3.5 Network governance

Research on HIC country networks has paid attention to different forms of network governance. Provan and Kenis (2007) describe three models of governance: shared governance, single organisation governance, and external governance by a network administrative organisation.[38 77] Van der Wert et al's (2022) Systematic Review, using Provan and Kenis' models of network governance,[38 77] on inter-organisational multi-level healthcare networks found that a brokered form of governance was most

common.[72] Networks with brokered governance are either led by a single organisation or by a separate network administrative organisation that makes decisions and determines resource allocations.[72] Benefits of this type of governance are that it can build trust and enable collaboration during the network's initiation and formation[78] and helps to manage different network partners.[79 80] Belrhiti et al's recent Scoping Review on collaborative governance (the decision making, management processes, and structures that bring together diverse stakeholders to collectively achieve a public purpose[81]) in healthcare networks found the need for a balance between top-down and bottom-up decision making, formal arrangements, and strategic governing entities to initiate participative decision-making, collaboration, and ownership on the part of network members.[56] Governance is necessary to ensure network members work together, that conflict is managed, and necessary resources are obtained and used efficiently and effectively.[38]

1.4 Gaps in the literature

The network literature elucidates several knowledge gaps and areas for future research. Provan (2007) suggests that networks need explanations that go beyond "dyadic approaches" brought from organisation theory and management literature due to their complexity.[38] There is sparse literature that explains how networks form, function, perform, and evolve,[28 38 53 82] as well as the psychological and relational impacts on network members in these network processes, such as feeling commitment and involvement.[52 60 72] An emphasis is placed on the need for qualitative methods and middle range theories to explore networks.[28 53] Despite the existing wide-ranging research on networks outlined above, there are several gaps in the network literature, which my DPhil addresses:

1) While networks are an approach that have been used in health systems in many countries, most of the published literature, both empirical and theoretical, is focused on examples from HICs and therefore does not adequately take into account the specificities and complexities of health systems in LMIC settings.[83]

2) Literature, both peer-reviewed and grey, is most often focused on one type of network and there is limited research that looks across network types.
3) Most of the literature evaluates the clinical outcomes of the network and there is less understanding, particularly from LMIC networks, on how and why they are formed, function, perform, and how changes and impact are sustained, or not.
4) The literature identifies multiple factors, described above, that are present when networks have impact or are effective, however with limited consideration for how these factors relate to each other.
5) There is a limited explanation as to why, for whom, and when these factors are important. Understanding this, along with gap #4 would provide a roadmap on what people need to pay attention to when considering a network approach in health systems.

1.5 Aims, objectives, and research questions

In this chapter, I outlined what networks are, how I define them for my thesis, what the literature suggests they are used for and can achieve, and identified research gaps. In this section, I outline the specific aims, objectives, and research questions of the three phases of my DPhil.

1.5.1 Scoping Review

My Scoping Review, by looking at the existing research on the different types of networks in health systems, aimed to set an initial field of inquiry on networks in LMIC health systems. The objectives of my Scoping Review were to: 1) perform a systematic search of published and grey literature on networks in LMIC health systems; 2) map and summarise network types, definitions, stakeholders, characteristics, uses, purposes, and other key findings relevant to networks in LMIC health systems; 3) identify gaps in the literature related to networks in LMIC health systems; and 4) propose an operational typology of networks in LMIC health systems. The research question guiding my Scoping Review was:

- What is a network, when are they used, what are they used for, and what purposes are they intended to achieve in LMIC health systems?

This first phase of my DPhil provided me with a broad understanding of the existing literature and enabled me to identify how and where my DPhil could contribute to the network literature. It helped me to begin to develop a deeper understanding of networks in health systems and was an early analytic step in preparation for my Realist work.

1.5.2 Realist Review

The second phase of my DPhil drew on the identified literature and my evolving understanding of networks developed during my Scoping Review. My Realist Review focused on developing a programme theory outlining and explaining the underlying mechanisms and interactions of contexts that explain how and why a network's formation and functioning enable quality care and services and improved clinical outcomes in LMIC health systems.

The research questions guiding my Realist Review were:

1. How does a network's formation and functioning enable it to improve and provide quality care and services in LMIC health systems?
2. Why does the way in which a network forms and functions enable it to improve and provide quality care and services in LMIC health systems?
3. What are the mechanisms in a network's formation and functioning that provide a platform for the improvement and provision of quality care and services in LMIC health systems?
4. What contexts trigger the mechanisms within a network's formation and functioning that lead to improvements and the provision of quality care and services in LMIC health systems?

1.5.3 Realist Evaluation

The aim of my Realist Evaluation was to further uncover and understand the processes involved in the initiation, formation, functioning, performing, and sustaining change and impact of an internationally

supported programme network in a LMIC health system that is intended to change practice to improve quality of care and services. My evaluation employed a multiple-methods case study of the Newborn Essential Solutions and Technologies (NEST360) programme in Kenya. Details on my study design are provided in Chapter 5. I aimed to explore if there were changes in practice to improve quality of care and services and if so, what they are and what enabled the changes. Additionally, I assessed whether the programme theory from my Realist Review was able to explain why, in what context, and for whom these changes happened or if the programme theory needed modification based on the data collected.

The objectives of my Realist Evaluation were to:

1. Test (confirm, refute, or refine) the Realist programme theory (developed in my Realist Review) on the NEST360 programme in Kenya to further develop an understanding of the processes involved in the initiation, formation, functioning, performing, and sustaining change and impact of the programme's network that enable changes in practice to improve quality of care and services.
2. Use the refined programme theory to identify transferable lessons and best practices for MoHs, health system managers, clinicians, and health sector partners interested in establishing or scaling up networks, intending to change practices to improve quality of care and services.

Using NEST360 in Kenya as a case study to test the explanatory value of the programme theory, my research questions were:

1. What are the changes in practice to improve quality of care and services in NEST360's programme network?
2. What are the processes involved in the initiation, formation, functioning, performing, and sustaining change and impact of the network that enable changes in practice?
3. How do the processes involved in the initiation, formation, functioning, performing, and sustaining change and impact of the network enable changes in practice?

4. What activities are used for network initiation, formation, functioning, performing, and sustaining change and impact to enable changes in practice?
5. What are the mechanisms in the processes involved in the initiation, formation, functioning, performing, and sustaining change and impact of the network that enables changes in practice?
6. What contexts trigger the mechanisms in the processes involved in the initiation, formation, functioning, performing, and sustaining change and impact of the network that enables changes in practice?

In summary, this first chapter explains how health systems are complex systems with complex problems and how networks are an approach to solve these problems. I introduced networks in health systems with their definition and rationale, an overview of the existing literature, and research gaps. The chapter concluded with my research aims, objectives, and questions for the three phases of my DPhil. In the next chapter, I explain the methodological approach for my DPhil, Scientific Realism, and my rationale for using this approach.

2. Chapter 2. Methodology

The overarching methodology of my DPhil is Scientific Realism and its application to evidence synthesis and evaluation. As described in the Preface and Chapter 1, my DPhil consists of three phases, a Scoping Review, a Realist Review, and a Realist Evaluation. This chapter includes an overview of Scientific Realism, my rationale for employing Scientific Realism as the methodology for my thesis, and an explanation of how the Scoping Review supported the application of this methodology.

2.1 Realism

Realism, in the philosophy of science, has been progressed by different philosophers, such as Lakatos (1970), Hesse (1974), Bhaskar (1975), and Harré (1972, 1986).[84] My thesis follows the methodological principles of Scientific Realism and the pragmatic application of these principles to evidence synthesis and evaluation, as initially established by Pawson & Tilley in Realistic Evaluation (1997).[84] This chapter covers the following: Scientific Realisms' ontology, epistemology, and understanding of causation, complexity and Realism, programme theory, Realist Review/Synthesis and Evaluation, the rationale for using Scientific Realism, and the rationale for undertaking a Scoping Review. Each of the aforementioned are introduced and explained individually but are also woven together in this chapter to explain and justify the methodological rationale of my thesis.

2.1.1 Scientific Realism

Philosophically, Scientific Realism draws on concepts from both positivist (ontologically) and constructivist (epistemologically) paradigms, however, differs from both paradigms in its view that the world is an open system.[85] Realists argue that the approach allows us to move beyond the limitations of the empiricist view (held by many positivists) and the subjective relativism of constructivist positions.[86] Pawson & Tilley (1997) take the view that social research cannot depend exclusively of experimentation within a closed system because experiments alone cannot explain social phenomena and programmes are implemented in a constantly shifting social world.[84 87] Therefore, we can only make slow and imperfect progress in gathering

knowledge about the social world and our understanding will always be partial.[87] While Scientific Realism is often seen as a more pragmatic and applied application of Realism, it differs from a pragmatic paradigm which argues that the viability of scientific knowledge comes from pragmatic or utilitarian functions instead of its truth value.[86] Since the publication of Pawson & Tilley's seminal work on Realist Evaluation, the term Scientific Realism is no longer in common usage.[88] In my thesis I decided to use the term Scientific Realism to refer to the underpinning assumptions and principles that underlie Pawson & Tilley's approach of Realist Review and Evaluation.

Ontology

The establishment of an ontology is important because it is not possible to make knowledge claims about the world unless we know what it is that we are making claims about. One school of Realism that has most explicitly articulated its ontology is Bhaskar's Critical Realism. Scientific Realism shares an ontological understanding with Critical Realism. This ontological stance agrees with positivism on the existence of a mind-independent reality - that the world exists external to our perceptions and experiences of it.[86] However, Realism disagrees with positivism on the assumption that unobservable things do not exist or matter because they cannot be measured, observed, or experienced.[86 89]

Scientific Realism, similarly to Critical Realism, stratifies reality into three domains – the real, the actual, and the empirical (Figure 2.1).[90-92] The empirical domain is where we experience and can observe what happens in the real and actual.[92] However, the existence of something is not dependent on whether we observed it or not in the empirical domain. In other words, things exist mind-independently of us.[92 93] Below the empirical is the domain of the actual, where things occur because of the mechanisms that exist in the real.[92] Mechanisms in the real may be physical, social, or psychological and exist whether or not we can experience or observe them.[86 90 94] These mechanisms lie dormant in the real until certain contexts come along to trigger their latent causal powers.[94] The real exists regardless of our knowledge of it.[90]

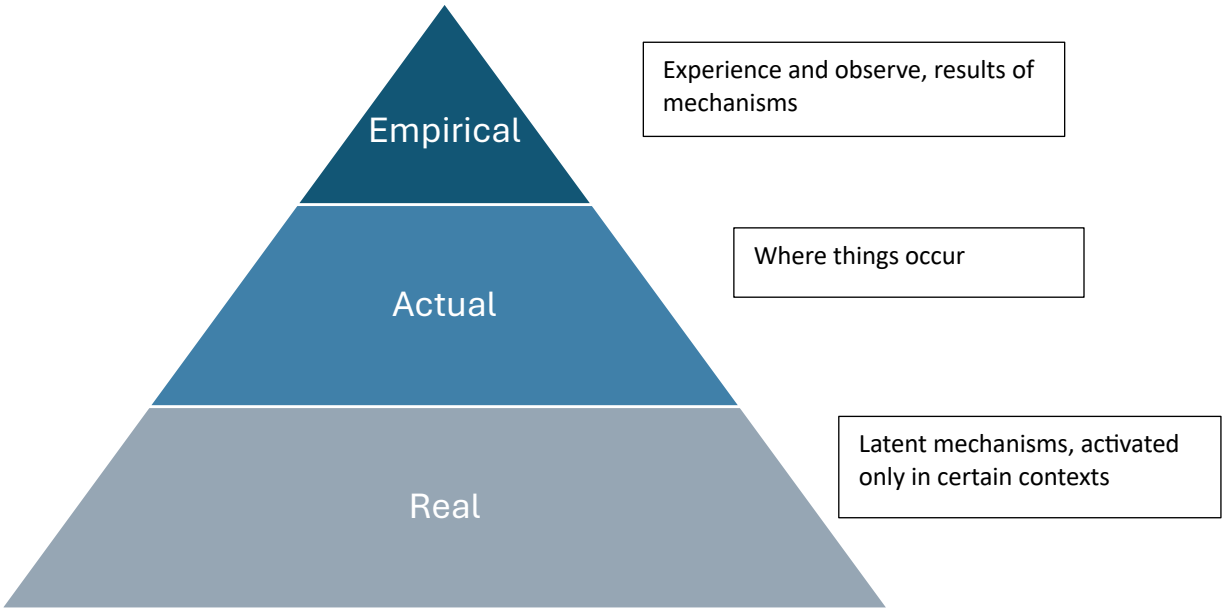


Figure 2.1 Realist stratification of reality.

Epistemology

Epistemologically, Scientific Realism's consideration of knowledge aligns with the constructivist stance on the importance of experiences and interpretations in understanding a phenomenon and that knowledge and theories are social constructs.[85 86] However, it must be remembered that Scientific Realists assume that it is an independent reality that we are experiencing or interpreting. Scientific Realists usually seek to develop theories that explore causal explanations about this mind-independent domain of the actual.[85 86] Scientific Realism does not assume that we can discover the final truth about the domain of the actual (or real) because we have limited ways in which to experience or interpret these domains.[93] Instead, each study undertaken is an attempt to develop a better and better understanding of it.[93]

While philosophically, Scientific Realism draws from Critical Realism, as described above, one of the more significant differences between Scientific Realism and Bhaskar's Critical Realism is around how the research should be conducted. Scientific Realism uses data to understand how programmes work and develops theories of programmes at the middle-range (see 2.1.4 Programme theory and 2.1.5 Realist Review and Evaluation). However, Critical Realism focuses on developing an understanding not by using empirically collected data (primary or secondary) but with the use of a priori certainties.[95]

2.1.2 Scientific Realist understanding of causation

Scientific Realism's understanding of causation is generative, which differs from the secessionist stance of positivism.[84 96] Causation is seen to happen 'internally' and therefore it is not always observable.[84 97] In contrast to the secessionist view, Scientific Realism does not see interventions as directly causing outcomes but that it is the reasoning and responses of recipients to contexts that makes things work.[84] Causation happens through certain contexts triggering underlying causal powers (i.e. mechanism) located in individuals or groups, which exist in the domain of the real (as described above).[84]

Outcomes

In the application of Scientific Realism, research outcomes of interest may be intended, unintended, intermediate, unplanned, or unexpected. Realist research aims to understand how outcome patterns or changes in outcome patterns are produced through uncovering the mechanisms, which produce the outcomes when triggered in certain contexts.[98]

Mechanism

Mechanisms are what make a programme work;[84] they are a key part of the causal explanations of how and why a phenomena of interest produces outcomes.[97] Pawson & Tilley (1997), drawing on the work of Bhaskar, conceptualise mechanisms as existing in the domain of the real.[84] Mechanisms are the interaction between the context created or altered by a programme and how actors interpret and act upon the context; mechanisms are latent and their operation is context dependent.[97]

There is no set way to determine what mechanism causes an outcome of interest. The fact that they exist in the domain of the 'real' and are therefore hidden makes it difficult to uncover them.[85] Mechanisms often need to be inferred from the data and may contain concepts that are not explicitly stated in the empirical data.[99] The identification of mechanisms usually follows identifying the outcome of interest and can require working backwards to uncover what triggers a reaction from participants in the phenomenon of interest.[84] Mechanisms do not always produce the same outcomes in different settings as they are

context sensitive and within a different setting, different contexts may be present.[97 100] This is a feature of open systems.[101]

Context

Contexts are elements of the programme environment that may or may not trigger the mechanism.[100] It is "the contextual conditioning of a causal mechanism which turns or (fails to turn) a causal potential into a casual outcome."[84] Context is important because it can change an outcome by activating or disactivating the generative powers.[100 102] There are many different types of contexts, which include material, social, and spatial elements of social situations as well as psychological, organisational, economic, and technical aspects, including the norms, values, and the interrelationships found in them.[84 100] Contexts may function at all levels and they interact and influence each other.[100] Pawson (2004) categorised four types of context: 1) individual capacities; 2) interpersonal relationships; 3) institutional setting; and 4) the wider infrastructural and welfare system.[103] The Realist and Meta-narrative Evidence Syntheses: Evolving Standards (RAMESES) II Project further specified that context: 1) includes pre-existing intervention conditions; 2) consists of multiple layers; 3) is made up of multiple factors; 4) activates or disactivates mechanisms; and 5) may form new contexts through its interaction with the mechanism.[100] In programmes, context may encompasses elements of the situations into which the programme is introduced that affect the functioning of the programme mechanisms.[100] Programmes can change contexts, which may lead to different mechanisms and outcomes.[100]

Context-Mechanism-Outcome Configurations

Context – Mechanism – Outcome Configurations (CMOCs) are a heuristic used to explain generative causation in Realist Reviews and Evaluations.[84] CMOCs support a "comprehensive examination of complexity in evaluation studies across different levels of social reality."[104] In its simplest form, they are analytical statements that explain in which context a mechanism was triggered to produce an outcome.[84] These statements are supported by either primary or secondary data. Data informs interpretations of what

is functioning as a context, mechanism, and outcome and are formed into these configurations to show which mechanisms are triggered by which context to produce certain outcomes within the programme theory. CMOCs can be 'tested' (confirmed, refuted or refined) through subsequent studies.

2.1.3 Realism and complexity

Building on the complexity of health systems from Chapter 1, a Realist approach is particularly appropriate for evaluation in complex systems[105] and of complex programmes. This is because Realism understands causation to be generative and therefore programme participants have the potential to affect change.[106] In the Science of Evaluation (2013), Pawson describes the Realist perspective of complexity through seven concepts: volition, implementation, context, time, outcome, rivalry, and emergence (VICTORE).[88] These concepts are defined and illustrated in 2.1.6 Rationale for Scientific Realism.

The second part of the Medical Research Council's (MRC) recent definition of complex interventions, cited in Chapter 1, "because how the intervention generates outcomes is dependent on exogenous factors, including the characteristics of recipients, and/or the context or system within which it is implemented"[8] is an important justification for using a Realist approach. For a complex intervention, any approach used to make sense of it should have an explicit and transparent way of linking context to outcomes, which Realist approaches clearly do through the use of CMOCs. The complexity of networks is described in 2.1.6 Rationale for Scientific Realism.

2.1.4 Programme theory

The use of the term 'theory' has been contested throughout the history of social science.[84] One definition of theory is that it is a set of beliefs and assumptions that underpin a programme's activities.[107] Every programme has a theory, whether it is articulated or not. A programme theory can help to "understand and capture what a program really can do for a social problem."[108] They "are the ideas about how the program causes the intended or observed outcomes"[109] and may be a way to provide plausible explanations of why a specific intervention works or does not in particular circumstances.[84 110] Programme

theories can provide guidance for the formation of a programme, explain how the programme is supposed to work, explain changes produced by the programme, make programme delivery more transparent, and can establish if activities will produce the desired changes.[108 111] Programme theory is different to a theory of change, which is a set of hypothesised pathways that lead to change and are often used as an intervention roadmap.[112] While theory of change uses similar terms (context, mechanism, and outcome) to Realist research, unlike Realism, theory of change is not underpinned by generative causation.

A programme theory is specific to a phenomenon and not a grand theory about how the universe works. The development and testing of programme theories is the cornerstone of Realist research. When programme theories are at a middle-range level of abstraction, the theory is able to be tested and generalised across different contexts.[109] Merton (1968) defined middle-range theories as those that "lie between the minor but necessary working hypotheses that evolve in abundance during day-to-day research and the all-inclusive systematic efforts to develop a unified theory that will explain all the observed uniformities of social behaviour, social organization, and social change."[113] Realist programme theories have an even stronger warrant to generalisability as they are based on the understanding of mechanisms, which are latent and may also operate in a setting.

2.1.5 Realist Review and Evaluation

Realist Review (also referred to as synthesis) and Evaluation draw on Bhaskar's approach to Critical Realism, Scientific Realism, theory-driven evaluation (Chen & Rossi 1980), middle-range theory (Merton 1968), and programme theory. The approaches aim to understand what works, for whom, in what respects and to what extent, under what circumstances, and how.[93] Realist Review and Evaluation seek to understand causation in phenomenon or social programmes, initiatives, or interventions.[98] Social programmes—or social systems—are "interplays of individual and institution, of agency and structure, and of micro and macro social processes."[84] Realism in evidence synthesis and evaluation acknowledges that actors respond differently to interventions in diverse circumstances and that programmes are not

universally successful, working better in certain contexts than in others.[84] The approach is regularly used to make sense of complex social programmes or interventions[114] because the approach provides both practical knowledge about social programmes and an opportunity to investigate social structures.[104] One critique of Pawson & Tilley's Realist approach is it focuses on analysing measurable events and behaviours instead of hidden real causes, however, Parra (2023) argues that this is because of misapplication of the approach and not because of philosophical or methodological inconsistencies.[104]

Within these approaches is an assumption that all programmes and interventions have underlying theories explaining how and why they produce certain outcomes, which may or may not be explicit.[110] Realist programme theories are developed to explain what works, for whom, in what respect, to what extent, and how, using the concepts of context, mechanism and outcome (as described above). They are a form of 'middle-range theory' because they are specifically expressed at the level of abstraction that permits empirical testing.[115]

The Realist approach to synthesis and evaluation helps to develop an understanding of how and why programmes work in what contexts and can lead to various outcomes in different circumstances, which can have broader implications for the implementation of social programmes, initiatives, or interventions. A Realist Review develops and tests (i.e., confirms, refutes, or refines) a programme theory from secondary data and Realist Evaluation does so using primary data. Collected data, either from the literature or from primary sources, is interpreted to identify what mechanisms are triggered in what contexts to produce the observed outcomes.[84]

2.1.6 Rationale for Scientific Realism

Health systems are complex systems "composed of many interdependent, heterogenous parts that self-organize and co-evolve."[116] Networks, implemented in a complex (health) system, can be considered complex interventions because they are made up of many interacting components and actors (individuals

and entities) with collective and divergent interests.[6 8] The outcomes produced through networks may be dependent on factors internal to the network as well as factors outside of its control.[8]

Networks are social systems, which are defined by Pawson & Tilley (1997) as the intersections of individuals and institutions, of agency and structure, and micro and macro social processes.[84] The Realist approach is often employed to make sense of complex social interventions and programmes, and networks are a suitable candidate for the Realist approach to research. As explained in 2.1.3, Realism & complexity, Realists describe complexity through seven concepts: volition, implementation, context, time, outcome, rivalry, and emergence (VICTORE).[88] Table 2.1 applies the Realist understanding of complexity to networks in health systems to exemplify how networks meet Pawson's criteria of complex interventions.

Concept	Brief explanation of the concept	Application to networks in health systems
Volition	People make choices	Networks are composed of stakeholders who make decisions on what, how, and when to implement activities to set-up and run a network. Stakeholders can be an individual, institution, or organisation. In a network, a stakeholder may be represented individually as well as within an institution or organisation.
Implementation	Programmes have long implementation chains	There are many different activities, relationships, and steps involved to set-up and run a network. A network may take time to form and start functioning.
Context	Pre-existing from micro to macro levels, influences outcomes	Networks involve all levels and sectors of the health system, and these have different contexts that can affect the network in different ways.
Time	Programmes and interventions come from somewhere	Networks are not a new approach in health systems and there is relevant existing research that can be drawn on to understand them. Networks are often developed from or linked to prior relationships or existing structures.
Outcome	Desired, undesired, predictable, unpredictable, intermediate	Networks can support the production of clinical outcomes, health system outcomes, and network specific outcomes. These outcomes may be intended or an unintentional by-product of the network. However, there may be things that are beyond the networks control that enable it to arrive at the desired outcomes.

Rivalry	Interactions with other programmes or interventions	A multitude of interventions and programmes occur in health systems; networks do not function in isolation.
Emergence	Things change	Health systems and networks are dynamic and subject to change.

Table 2.1 Explanation of networks in health systems as complex interventions, using Pawson's VICTORE framework.

In the literature there are examples of successful outcomes attributed to networks, however, as described in Chapter 1, there is a gap in the literature in terms of understanding how and why networks are initiated, form, function, and perform to produce the documented outcomes. Taking a Realist approach to research enabled an investigation into unpacking and understanding the inner workings of networks.

2.2 Scoping Review

Prior to undertaking my Realist Review and Evaluation, I completed a Scoping Review on networks in low- and middle-income country (LMIC) health systems (Chapter 3). This was a preparatory phase to achieve a better understanding of the literature, which also provided an initial source of data for my Realist Review. As I elaborate in Chapter 3, which reports the methods and results of my Scoping Review, I followed Arskey and O'Malley's (2005) approach to Scoping Reviews. Arskey and O'Malley provide four reasons to undertake a Scoping Review: 1) examine the extent, range, and nature of research activity; 2) determine the value of undertaking a full systematic review; 3) summarise and disseminate research findings; and 4) identify research gaps in the existing literature.[117] I decided to undertake a Scoping Review for reasons one and four.

Scoping Reviews are a particularly useful approach when the body of literature is of a "large, complex, or heterogeneous nature not amenable to a more precise systematic review,"[118] as is the case with networks. The method allows for the organisation, mapping, and summarisation of the literature, which enabled the identification of key characteristics, stakeholders, purposes, and uses of health system networks and the gaps in knowledge.[117] Furthermore, networks are a complex intervention put into a complex system (a health system) and Scoping Reviews help to "clarify a complex concept and refine subsequent research inquiries."[119]

I undertook an initial review of the published literature and identified one Scoping and two Systematic Reviews on health system networks.[31 48 50] The Scoping Study on networks of care drew on high-income country (HIC) and LMIC literature to develop a definition and framework for this service delivery approach.[31] The two Systematic Reviews focused mainly on studies from HICs, one on clinical networks and the other on quality improvement collaboratives.[48 50] Given the specific focus on one type of network of these reviews and the varied literature on networks in health systems, I determined that a new Scoping Review would be a useful approach to map and summarise the current literature and extend what is known about networks by looking across different network types in preparation for my Realist Review. My Scoping Review looked at different types of networks in health systems, focusing primarily on LMIC examples and relevant HIC literature that my supervisors and I were already aware of or was identified as relevant during the search process.

In summary, in this chapter I set out my thesis methodology and provide an overview of Scientific Realism, including the ontology, epistemology, and understanding of causation, Realism and complexity, my rationale for employing Scientific Realism as the methodology for my thesis, and an explanation of how my Scoping Review supported the application of this methodology. The next chapter presents the methods and results of the first phase of my thesis, a Scoping Review on networks in LMIC health systems.

3. Chapter 3. Methods & Results – Scoping Review: Understanding networks in low- and middle-income countries' health systems

This chapter presents the methods and results for the first phase of my DPhil, a Scoping Review on networks in low- and middle-income country (LMIC) health systems. In my Scoping Review, I systematically searched six databases of peer-reviewed literature and purposively searched grey literature on networks in LMIC health systems to map the different types of networks to develop an understanding of what they are, when and what they are used for, and the purposes they intend to achieve. From the selected literature, I charted data on network definitions, characteristics, stakeholders, uses, and purposes. I drew on existing frameworks and based on the selected literature developed a five-component framework (form and structure, governance and leadership, mode of functioning, resources, and communication) to broadly characterise a network. The framework and mapping of uses, purposes, and stakeholders was a first step towards further understanding the nature and purposes of networks. My Scoping Review helped to expand the breadth and depth of the network literature and set a foundation for my Realist Review and Evaluation. A version of this chapter was published in PLOS Global Public Health: Kalaris K, Wong G, English M. Understanding networks in low- and middle-income countries' health systems: a scoping review. PLOS Global Public Health. 2023; 3(1): e0001387.

3.1 Introduction

As I explained in Chapter 1, networks are an increasingly common approach to improve quality of care, service delivery, clinical outcomes, and health system functioning. There is no one type of network and a diverse array of networks have been established to solve complex health system problems. Undertaking a Scoping Review as a first step on this topic provided me with an understanding of the vast network literature and laid the foundations for my Realist Review and Evaluation.

3.1.1 Rationale

In Chapter 2, Methodology, I provide my rationale for using the Scoping Review method and how this complements my subsequent Realist Review and Evaluation. There is, however, more broadly relevant justification for undertaking a Scoping Review on networks in LMIC health systems.

The literature on networks in health systems is diverse and there is currently no overarching mapping of the existing evidence or a common description of what makes up health system networks. As networks become a more frequent approach to improve quality of care, service delivery, clinical outcomes, and health systems' functioning it is important to understand the key components that facilitate their work towards achieving these changes. This common understanding can inform future efforts to develop and scale networks in health systems by enabling a more targeted consideration of the key aspects of a network that need to be put in place.

Mapping out the uses and purposes of existing networks can help to signal to health system stakeholders and researchers when a network would be a useful approach. Without a clear understanding of when, for what, and why a network is useful, there could be missed opportunities to reach the health system's clinical and programmatic goals. On the other hand, the ineffective use or functioning of a network could lead to an inefficient use of resources.

3.2 Methods

3.2.1 Protocol and registration

My Scoping Review was conducted in accordance with the original five phase Scoping Study framework developed by Arksey and O'Malley (2005) and I took into consideration additional recommendations on Scoping Reviews from Levac et al. (2010) and Peters et al. (2015).[117-119] I developed a protocol (Appendix 3A) and registered it with the Open Sciences Framework on 8th February 2021.[120] Methods and results are reported according to the PRISMA Extension for Scoping Reviews.[121]

3.2.2 Eligibility criteria

My literature search process focused on health system networks. As described in Chapter 1, I defined networks as groups of facilities and/or healthcare affiliated stakeholders linked formally or informally, horizontally or vertically, through programmes, interventions, activities, or initiatives with an aim to initiate change to improve service delivery, quality of care, and/or health system functioning. The development of the eligibility criteria for the network concept was an iterative process; as I became more familiar with the literature, I refined the eligibility criteria to identify the most relevant literature. During the screening process, I further expanded the exclusion criteria as it became clearer what would be relevant to answer my research question. Included types of networks were mostly clinically or programmatically focused, excluding, for example, networks that were purely research or academic networks, advocacy networks, disaster management networks, database or registry networks, laboratory or diagnostics networks, and family or home care networks. As I updated the eligibility criteria, I applied updates to all retrieved literature.

Literature from high-income countries (HICs) and LMICs, as classified by the World Bank for the 2021 fiscal year[122] and published between 2000 to 2021, was eligible for inclusion. Based on my initial review of the published literature, I selected this timeframe to prioritise the most recent and relevant literature. The two previously mentioned Systematic Reviews in Chapter 2 searched the literature from 1996[48 50] but each included only one study prior to 2000, while the Scoping Study searched the literature from 2009.[31] While the focus of this review is on networks in LMICs, limited research focused on these geographies has been published and so HIC literature returned during the search process or that I was already aware of was screened for eligibility and included if relevant to the LMIC literature. I considered HIC literature relevant if it met the eligibility criteria and included similar or complementary information on or examples of health system networks as the LMIC literature. The search process was open to peer-reviewed and grey literature in all languages but I prioritised those published in English and French based on my language skills. Based on prior research (described in the Preface) and a preliminary review of the literature I had done, I was

aware that examples of networks, in LMICs in particular, may be published in grey literature, such as government, non-governmental organisation (NGO), or donor documents but not in a peer-reviewed journal. The complete eligibility criteria are available in Table 3.1.

Inclusion	Exclusion
• Related to health system networks • Networks: groups of facilities and/or healthcare stakeholders (including but not limited to all types of providers, technicians, government officials, professional associations, NGOs, and donors) linked formally or informally, horizontally or vertically, through programmes, interventions, activities, or initiatives with an aim to initiate change to improve service delivery, quality of care, and/or health system functioning • Health systems: structures, processes, and people responsible for managing health programmes and services that provide care for a population • HICs and LMICs	• The programme, intervention, activity, or initiative occurs only in one facility or locality among only one group of actors • Research or purely academic networks • Networks focused on research capacity building • Communities of practice • Advocacy networks • Disaster management networks • Database/registry networks • Trial/study networks • Social networks • Family/home care networks • Palliative care networks • Laboratory networks • Diagnostics networks • Disease surveillance networks • Telemedicine/eHealth/mHealth interventions • Accreditation interventions • Integrated community case management interventions • Integrated management of childhood illnesses interventions • Mobile unit outreach • Faith-based organisation sector • General studies on Universal Health Coverage (UHC) • Primary Health Care networks that were limited to the peripheral level of the health system

Table 3.1 Literature eligibility criteria.

3.2.3 Information sources

I searched five databases for relevant literature on 3rd February 2021: Medline (Ovid), EMBASE (Ovid), Global Health (Ovid), Cochrane Library, and Web of Science Core Collection and a sixth, Global Index Medicus' Africa Index Medicus (AIM) on 4th February 2021. From Global Index Medicus, I only searched the AIM database due to database capabilities to process the search strategy; because the review focused on LMICs; and because it is the region of focus for my Realist Evaluation. I selected these databases with the aim of searching with both breadth and depth. Searching several different databases allowed me to

cast a wide net of journals that might publish literature on networks in health systems. For grey literature, I searched the websites of bi- and multilateral organisations, NGOs, and global initiatives. Additional details on the information sources are in section 3.3.1 Selection of sources of evidence. As part of my Realist Review (Chapter 4), I ran a modified update search of my initial search strategy on Medline, EMBASE, Global Health, and the Web of Science Core Collection on 27th April 2022.

3.2.4 Search

A preliminary review of the literature helped me to develop the aims and objectives of the review, the research questions, and the eligibility criteria. I iteratively developed the search strategy through four steps outlined in Figure 3.1. Initial database searches guided the development of the search strategy and expanded the eligibility criteria. I piloted and then ran the search strategy on the six databases. The final search strategy is provided in Appendix 3B. It returned both peer-reviewed and grey literature and I purposively collected additional grey literature.

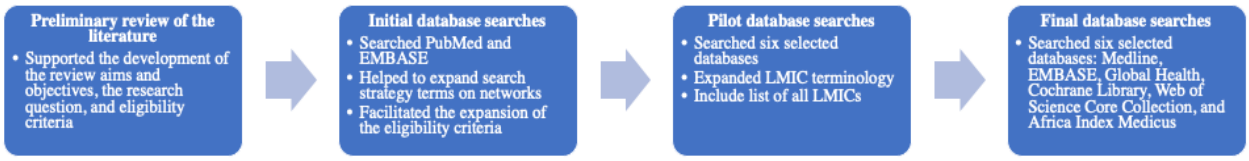


Figure 3.1 Search strategy development steps.

Most of the grey literature provided additional examples of LMIC networks not published in peer-reviewed journals. I searched websites of initiatives: the Quality of Care Network and the Small and Sick Newborn Implementation Toolkit; multilateral organisations: World Health Organization (WHO), the World Bank, the United Nations Children's Fund (UNICEF), and the United Nations Population Fund (UNFPA); bilateral organisations: United States Agency for International Development (USAID); and NGOs: CARE, Clinton Health Access Initiative (CHAI), FHI360, Management Sciences for Health, and Path.

3.2.5 Selection of sources of evidence

I imported all citations into EndNote X9.3.3/2020 (Clarivate Analytics, PA, USA) and then into the web application Rayyan[123] and removed duplicates after importing into both tools. When I imported citations into Excel to randomise a sample for the second reviewer, I identified additional duplicates and undertook a third manual round of deduplication.

I screened titles and abstracts against the inclusion and exclusion criteria in Rayyan. The second reviewer screened and reviewed a random sample of 15% of the titles and abstracts also in Rayyan. At the completion of screening, I discussed discordant decisions in the sample with the second reviewer to reconcile differences.

Once the screening of titles and abstracts was complete, I retrieved the full text of selected titles and abstracts and assessed them against the inclusion and exclusion criteria. I noted the reasons for exclusion at the full text review stage for reporting. Grey literature was reviewed for inclusion according to the same criteria as the published literature. The second reviewer reviewed 15% of the literature selected for full text review and I reconciled discordances with the second reviewer's sample through discussion.

3.2.6 Data charting process and data items

I charted relevant data and insights from the selected literature using the data charting tool in Appendix 3C. The data charting tool facilitated the charting of key information from the included literature and findings and insights relevant to the review question. It contained the following categories: source citation, intervention country, aim/purpose, methods, intervention, stakeholders, type of network, network definition, network characteristics, network use, network purpose, and other key findings or data relevant to the review question. I piloted the data charting tool with a sample of the selected literature for full text review to ensure that it captured all necessary categories of data. At this point, I added an 'outcome/findings column' to the tool and then I re-reviewed already reviewed papers to collect this information.

The second reviewer charted data for the 15% sample of included literature. Data charting by the second reviewer aimed to check that I applied the charting process in a consistent manner. I provided examples of data charting and category definitions to the second reviewer to clarify the type of information for each category of the tool. A mini-reconciliation and debriefing was held with the second reviewer to make sure they were following the inclusion and exclusion criteria and charting the data as intended.

I used the same data charting tool for the grey literature. If more than one document was included for the same network example, I combined the charted data in the tool to consolidate repeated information. Data items are defined in Table 3.2.

Category	Definition
Source citation	Publication bibliographical information
Intervention country	Country where the study took place or the focus of the publication
Aim/purpose	Goal or objective of the study, review, or publication
Methods	Methods of the study, review, or other type publication
Intervention	Description of the project, programme, or activities that were the focus of the study, review, or other type of publication
Outcome/findings	Results, findings, or key insights from the study, review, or other type of publication
Stakeholders	Key people, roles, committees, entities, or structures involved in the intervention
Type of network	Name of the network as reported by the authors
Network definition	Definition of the network as stated by the authors
Network characteristics	Key descriptors, elements, and activities of the network
Network use	What the network does
Network purpose	Why was the network created or what was the overall goal
Other key findings or data relevant to the review questions	Potentially relevant or important information not included in another category

Table 3.2 Data charting categories and definitions.

3.2.7 Synthesis of results

Following my careful appraisal of the available literature, it was apparent that defining distinctly different types of networks and creating a typology as planned would not be feasible because of the diversity of networks reported in the literature meeting the eligibility criteria. Instead, to guide data synthesis, I identified network typologies and frameworks on different types of networks (managed networks, research/academic network,[69] clinical networks,[29 48] inter-organisational networks,[28] public sector networks[68 124]) from the selected literature and through snowballing. I compared these typologies and

frameworks, presented in Table 3.3, and identified four common network components from these frameworks and typologies and compiled them into a new draft framework.

Author	Type of network	Typology / Framework	HIC / LMIC	Framework elements
Ferlie et al., 2010	Managed networks Research/academic networks	Typology	HIC	• Complexity of context • **Network form** • **Resource base** • **Formalisation** • Range of stakeholders • **Processes and skills**
Brown, Patel et al., 2016	Clinical Networks	Typology	HIC	• Definition • Membership • **Governance and management**
Sheaff and Schofield, 2016	Inter-organisational networks	Characteristics	HIC	• Environment • **Structure** • **Process** • Outcomes
Provan and Milward, 2001	Public sector organisational networks	Network effectiveness frameworks	HIC	• Effectiveness criteria
Turrini, 2010	Public networks	Network effectiveness frameworks	HIC	• **Structural** • **Functioning** • Contextual
Brown, Haines et al., 2016	Clinical network	Domains to measure features of clinical networks	HIC	• Engagement of multidisciplinary clinicians • **Leadership** • **Strategic and operational management** • External support • Network value
Gunst, 2016	N/A	Clinical governance framework	LMIC	• **Governance** • Services • **Critical support functions** • Quality

Table 3.3 Existing network frameworks and typologies identified.

Bold text in Table 3.3 contributed to the development of the proposed framework. I did not include context, environment, and outcomes in the proposed framework because they will be investigated in depth in my Realist Review (Chapter 4).

To understand how the identified network components are operationalised in practice, I mapped charted data onto each of the four components of the draft framework and grouped similar data together under each component; I labelled these data groups practical characteristics. I noted the frequency of

occurrence in the literature of each practical characteristic. Throughout this analysis, I remained open to emerging components, resulting in a final framework with five components that was simple, high-level, and flexible enough to accommodate many practical characteristics and applicable to the range of networks in health systems. This process is outlined in Figure 3.2 and the final framework is presented in the results section.

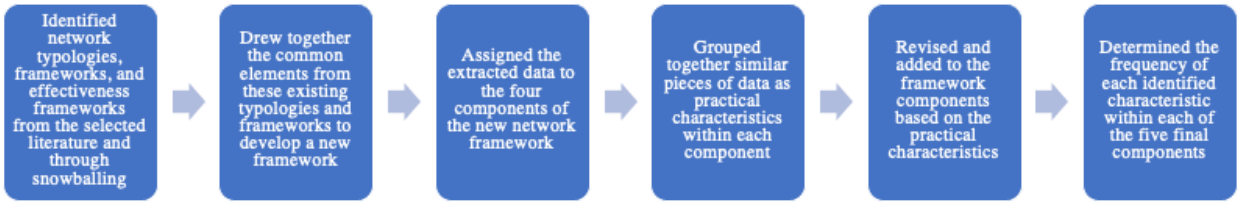


Figure 3.2 Process of synthesising the charted data.

In a distinct but complementary approach to answer the remainder of the research question on the uses and purposes of networks, I mapped the charted data on network use and purpose, grouped similar data, and reported the frequency within each data group. I then synthesised these groupings of mapped data into overarching categories of uses and purposes. During the data charting, I decided to include network stakeholders as an additional data item. Stakeholder data was charted and synthesised following the same process.

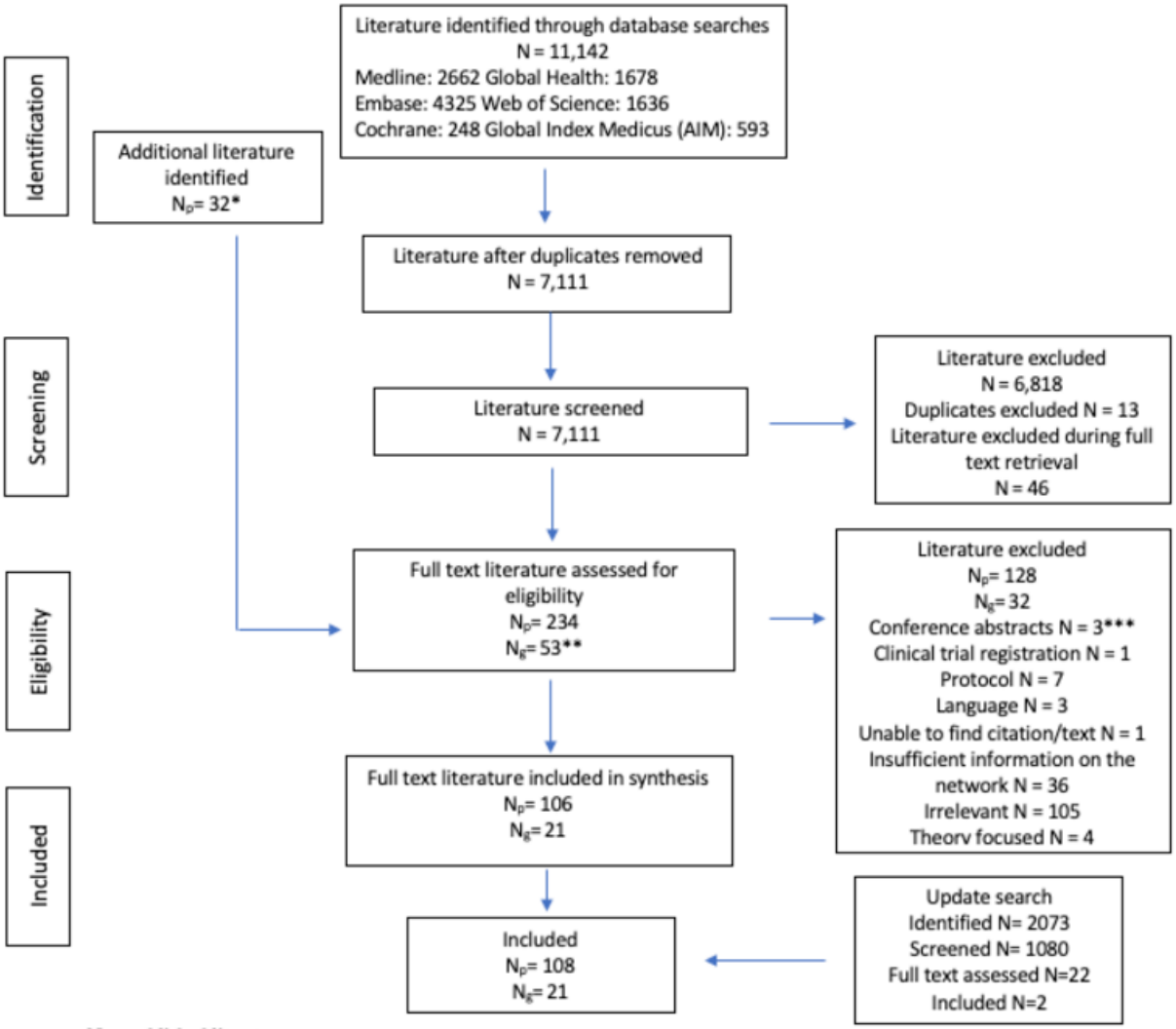
3.3 Results

3.3.1 Selection of sources of evidence

My final database searches obtained 11,142 results (Medline: 2662; Embase: 4325; Global Health: 1678; Web of Science: 1636; Cochrane: 248; Global Index Medicus (AIM): 593). I imported all citations into EndNote and removed 605 duplicates. The remaining 10,537 citations I imported into Rayyan and deduplicated again, removing a further 2,693 duplicate citations. I did a third manual round of deduplication in Excel from which I identified 733 duplicates. Titles and abstracts of 7,111 citations were screened according to the eligibility criteria in Table 3.1. During the title and abstract screening, I identified an additional 13 duplicates. My database searches resulted in 7,098 unique citations**.** 6818 pieces of

published literature were excluded during title and abstract screening and 46 were excluded during full text retrieval because they did not meet the eligibility criteria in Table 3.1. The screening resulted in 234 pieces of published literature for full text review.

I assessed 234 full text peer-reviewed pieces of published literature for eligibility according to the same inclusion – exclusion criteria used in the screening; this included 32 pieces of published literature that had been previously identified or were linked to conference abstracts and clinical trial registrations returned in the database searches. 106 peer-review published literature sources were eligible. I reviewed 53 pieces of grey literature against the same inclusion – exclusion criteria; this included 30 pieces of grey literature returned from the database searches. 21 documents met inclusion – exclusion criteria. The selected grey literature covered 15 discrete network examples. Literature was excluded for the following reasons: irrelevant (105), insufficient information on the network (36), study protocol (7), theory focused (4), language (3), and unable to find citation/full text publication (1). The update searches identified two additional pieces of literature that met the eligibility criteria. Figure 3.3 provides an overview of the selection of the sources of evidence.



N_p = published literature
N_g = grey literature
*Includes 24 previously identified pieces of literature, four identified during the grey literature search, and four from abstracts and clinical trial registrations retrieved from the database searches
**Includes 30 pieces of grey literature that were identified during the screening of the results from the database searches
***Three conference abstracts identified during the full text review were moved to the grey literature review and therefore excluded twice

Figure 3.3 Evidence selection process.

3.3.2 Characteristics of sources of evidence

Characteristics of the selected literature are detailed in Appendix 3D. The selected literature employed many different methods, including project overviews (32), quantitative studies (17), case studies (15), qualitative studies (15), reviews (12), and mixed methods (6) in the peer-reviewed literature and reports

(7), briefs (7), manuals (4), and working papers (3) in the grey literature. Grey literature was included where it added new information.

Over half (57%) of the selected literature was focused on LMICs; this was expected based on the targeted search strategy. Africa was most heavily represented in the literature with 36 discrete inclusions of African countries, followed by North America (34), Asia (22), Central and Latin America (16), Australia (11), and Europe and the United Kingdom (UK) (8). There were eight global level sources and one which was not geographically specific. Two publications from Latin America included both HICs and LMICs. Figure 3.4 shows the literature breakdown by geography and literature type.

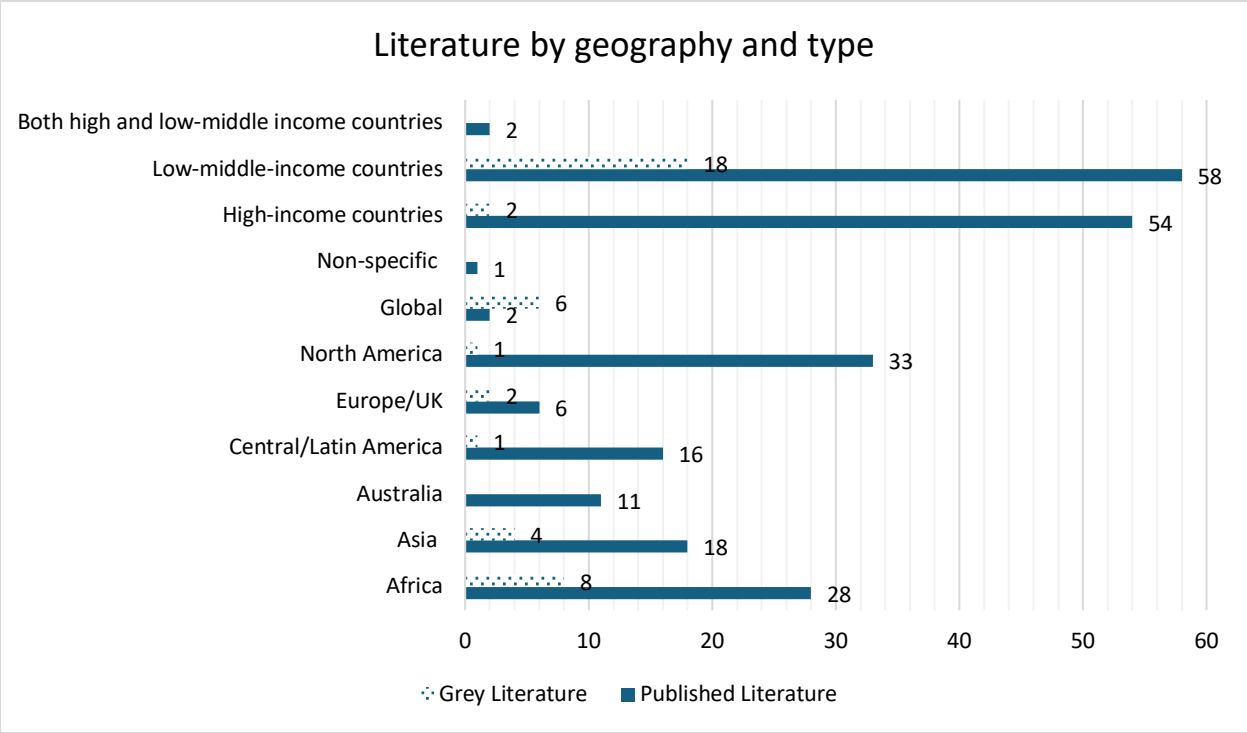


Figure 3.4 Literature by geography and type included in the peer-reviewed and grey literature.

Low-middle income countries include Africa, Asia, and Central/Latin America (except for two pieces of literature). High-income countries include North America, Europe/UK, Australia, and two pieces of literature from Latin America.

3.3.3 Results of individual sources of evidence

The framework, presented below, helps to describe the overarching components that make up a network. Based on the literature, health system networks can be described by five common components: form and

structure, leadership and governance, mode of functioning, resources, and communication. The components are supported and illustrated by operational examples from the charted data on network characteristics. Mapping reported network uses and purposes from the literature answered when and what networks are used for and what purposes they intended to achieve in health systems. Network stakeholders were also mapped. Appendices 3E and 3F link the network components, practical characteristics, uses, purposes, and stakeholders to the individual sources of evidence.

Components and characteristics

Based on my systematic literature search and the richness of the charted data, I did not find that any of the identified typologies or frameworks were sufficient to describe a network and its components in a comprehensive manner. This was because the identified typologies and frameworks focused on specific types of networks, each with some but not all of what seemed to be the essential network elements. I identified four key common components from the existing typologies and frameworks: form and structure, governance and leadership, mode of functioning, and resources. Communication emerged as a new key component when I mapped the data against the four components. I derived component labels from existing typologies and frameworks or from key words in the network literature. Each component is supported by practical characteristics that provide operational examples of how the component manifests in networks. Descriptions of the components are summarised in Table 3.4.

Component	Description
Form and Structure	The form of a network explains how the network was created. In a top-down or mandated approach, a government or clinical structure projects the network out to potential members. A bottom-up or organically developed network emerges from its members based on identified needs in their context. The network structure explains the linkages, horizontal or vertical, between different network members or stakeholders, including clinical entities, providers, or health system administrators and managers.
Governance and Leadership	Network governance refers to how the network is managed and administered, and decision-making processes employed to manage the network. The network leadership includes the level and form of leadership needed to effectively manage the network. Level of leadership refers to type, seniority, and experience of the leader. Form of leadership refers to the structure of the leadership team, for example a hybrid clinical and management leadership team or a network management committee.
Mode of Functioning	A network enacts its purpose through management and clinical functions. Management of a network includes monitoring compliance and accountability, while the clinical functions refer

	to the implementation and operationalisation of policies and programmes and the coordination of clinical care.
Resources	Based on the existing typologies and frameworks, the two main types of resources available to networks are human resources and financial resources. These take different forms depending on the context and purpose of the network. This component was expanded during the analysis to include information technology (IT), commodities, and equipment.
Communication	A fifth component, communication, was added during the analysis. Communication encompasses communication infrastructure as well as modalities and strategies. This component interlinks the four other components.

Table 3.4 Network component descriptions.

The component mode of functioning had the greatest number of different practical characteristics (27), followed by form and structure (23), governance and leadership (18), resources (18), and communication (4). Table 3.5 list the practical characteristics by component with the number of references supporting each practical characteristic. The most frequent practical characteristics are labelled in blue. Table 3.6 details the five or six most frequent practical characteristics of each network component supported by examples from the literature. These most frequent practical characteristics are also shown in Figure 3.5.

Form and Structure -Creation of the network: top-down/mandated vs. bottom-up/organic -Linkages between entities		**Governance and Leadership** -Leadership level -Leadership form -Management of network -Governance/ decision-making processes		**Mode of Functioning** -Management: monitoring compliance, accountability -Clinical: policy/programme operationalisation, care coordination		**Resources** -Human resources -Financial		**Communication**	
connecting across levels of the health system and entities	42	network meetings	37	knowledge / information sharing / education / learning	67	human resources	43	between network members	24
established vision, mission, shared values, targets, rules, roles, responsibilities, culture	35	network leadership / management	31	guideline / standards / protocols uptake / adherence	57	IT	38	communication infrastructure	12
network agreements / network mapping	30	working /sub-groups / task forces	23	data collection, analysis, use, quality	56	commodities / equipment	14	strengthening communication	5
partnerships / links to external stakeholders	29	government leadership / oversight	21	quality improvement	51	funding	13	effective strategies	4

linkages / engagement / alignment with government	20	network manager / coordinator / facilitator	18	care pathways / models of service delivery promotion / implementation	47	governme nt funding	12		
trust	17	local / clinical champions	16	training and/or supervision	45	supportive policies	12		
multidisciplinary	16	steering / coordinating committees / groups	15	feedback - performance / performance management / care processes	35	transport	11		
horizontal / lateral network	15	core leadership committee / team	13	work plans / strategic planning / project development	25	infrastruct ure	9		
relationships / links between teams / internal	15	clinical leader - network coordinator / voluntary co-chairs	12	revise / standardise patient forms / records systems / tools	24	cost reduction / savings	9		
link community to network	11	decision-making	12	mentoring / coaching	24	financial incentives	8		
bottom-up / local / organic / informal	7	interdisciplinary / effective / open / multi governance	12	coordination	23	administra tive / operationa l support	8		
standard / formalised organizational structure	7	hybrid leadership - clinical (general - specialisms), programme / operational, executive	10	changes in practice or service delivery	19	financial subsidies / free services	5		
patient / family / consumer engagement	6	community / local leadership / ownership in activities	9	monitoring	17	UHC / insurance	4		
vertical structures	6	focal point mid-level managers - clinical leaders	8	reporting	16	pay-for-performan ce / results	4		
created on existing relationships	6	executive support / strategic and technical assistance	7	assessment / evaluation	14	financial manageme nt support	4		
voluntary clinician / hospital involvement	6	governance structure	6	collaboration	14	resource sharing	3		
combination of top-down and bottom-up	6	stakeholder management	6	accountability	10	service payments	2		
mandated / top down on policy and strategic direction	4	administrative core / support	3	performance comparison / benchmarking	10	non-financial incentives	2		
coordination body	2			quality of care	9				

peer-to-peer network	3			role clarification / orientation of new providers on preferred practices	8				
multi-organizational	2			maternal and perinatal death surveillance and review	7				
open membership	2			audit and feedback - data	5				
supra-network	1			leadership training / enhance skills / relationship building	4				
				clinical audit	4				
				teamwork	4				
				shared responsibility	2				
				mentorship and training - management	1				

Table 3.5 Network components with corresponding practical characteristics.

The number of references in the selected literature are shown for each characteristic.

Component	Most frequent practical characteristic	# of references	Example from the literature	Example citation
Form and Structure	Connecting across levels of the health system and entities	41	• Network actors mapped referral pathways to link public and private referral hospitals and community health centres and providers • Set connections between different levels of staff and health system managers	Hyre A et al. Expanding Maternal and Neonatal Survival in Indonesia: A program overview. International Journal of Gynecology & Obstetrics. 2019; 144. doi: 10.1002/ijgo.12730.
	Established vision, mission, shared values, targets, rules, roles, responsibilities, culture	35	• Social franchise network offered services under a common brand with a specific social mission	Syengo M et al. Private Providers' Experiences Implementing a Package of Interventions to Improve Quality of Care in Kenya: Findings from a Qualitative Evaluation. Global Health-Science

				and Practice. 2020; 8:3, 478-487. doi: 10.9745/GHSP-D-20-00034.
	Partnerships and links to external stakeholders	29	• Created partnerships and linkages with the regional diabetes associations, MoH, specialists, partner organisations	Diallo MM et al. Access to diabetes care in sub-Saharan Africa: Results of a diabetes health network in Guinea. Medecine des Maladies Metaboliques. 2013; 7:3, 272-276.
	Network agreements and mapping	29	• Established a MoU with MoHCDGEC, a LoA with RMO, and a LoAs with sites where providers are placed to establish and govern functioning of network	D'Mello BS et al. Averting Maternal Death and Disability in an Urban Network of Care in Dar es Salaam, Tanzania: A Descriptive Case Study. Health Systems & Reform. 2020; 6:2. e1834303. doi: 10.1080/23288604.2020.1834303.
	Linkages, engagement, and alignment with government	30	• Created strong relationships with the MoH, which was solidified through MoUs • Held annual joint planning with district • Developed informal relationships with civil authorities • Performed joint supervision	Cordier LF et al. Networks of Care in Rural Madagascar for Achieving Universal Health Coverage in Ifanadiana District. Health Systems & Reform. 2020; 6:2, e1841437. doi: 10.1080/23288604.2020.1841437.
Governance and Leadership	Network meetings	36	• Held monthly meetings between TBAs, CHWs, and health centre staff • Held monthly QI team meetings	Broughton E et al. Evaluation of an intervention to improve essential obstetric and newborn care access and quality in Cotopaxi, Ecuador. Frontiers in Public Health. 2016; 4:247. doi: 10.3389/fpubh.2016.00247.
	Network leadership and management	31	• Local network leadership ensured success of the network	Nahimana E et al. Race to the Top: evaluation of a novel performance-based financing initiative to promote healthcare delivery in rural Rwanda. Global Health Action. 2016; 9:1, 32943, doi: 10.3402/gha.v9.32943.
	Working groups and taskforces	23	• Developed national task forces for strategic insight, coordination, and oversight	Gudlavalleti VSM et al. Public health system integration of avoidable blindness screening and management, India. Bulletin of the World Health Organization.

			• Established technical expert groups to support decision-making and implementation	2018; 96:10, 705-715. doi: 10.2471/BLT.18.212167.
	Government leadership and oversight	21	• Apex CHOs supervised TBAs (linked to PHCB) • LGA held data review meetings to monitor care within the network	Fasawe O et al. Applying a Client-centered Approach to Maternal and Neonatal Networks of Care: Case Studies from Urban and Rural Nigeria. Health Systems & Reform. 2020; 6:2, e1841450. doi: 10.1080/23288604.2020.1841450.
	Network manager, coordinator, or facilitator	18	• Clinical coordinators managed interdisciplinary QI team • Regional coordinators supported clinics • National coordinators	Chan BTB et al. A programme to improve quality of care for patients with chronic diseases, Kazakhstan. Bulletin of the World Health Organization. 2020; 98:3, 161-169. doi: 10.2471/BLT.18.227447.
Mode of Functioning	Knowledge and information sharing, education, and learning	65	• QI collaborative learning sessions held to share progress, ideas, best practices, and lessons learned	Dougherty G et al. Reaching the First 90: Improving Inpatient Pediatric Provider-Initiated HIV Testing and Counseling Using a Quality Improvement Collaborative Strategy in Tanzania. Journal of the Association of Nurses in AIDS Care. 2019; 30:6, 682-690. doi: 10.1097/JNC.0000000000000066.
	Guideline, standards, and protocols uptake and adherence	56	• Data shared for the implementation and evaluation of strategies to improve guideline uptake	Akech S et al. Magnitude and pattern of improvement in processes of care for hospitalised children with diarrhoea and dehydration in Kenyan hospitals participating in a clinical network. Tropical Medicine and International Health. 2019; 24:1, 73-80.
	Data collection, analysis, use, and quality	56	• Revived and expanded community-based health management information system to report births and deaths • LGA data review meetings to report	Sloan NL et al. Advancing Survival in Nigeria: A Pre-post Evaluation of an Integrated Maternal and Neonatal Health Program. Maternal and Child Health Journal. 2018; 22:986-997. doi: 10.1007/s10995-018-2476-3.

			trends and gaps to solve data quality issues, identify implementation issues, and share successes	
	Quality improvement	50	• QI collaborative improved person-centred care for maternal health and family planning services	Giessler K et al. Perspectives on implementing a quality improvement collaborative to improve person-centered care for maternal and reproductive health in Kenya. International Journal for Quality in Health Care. 2020; 30:10, 671-676. doi: 10.1093/intqhc/mzaa130.
	Care pathways and models of service delivery promotion and implementation	46	• Implemented referral network with ambulance transport	Tayler-Smith K et al. An ambulance referral network improves access to emergency obstetric and neonatal care in a district of rural Burundi with high maternal mortality. Tropical Medicine & International Health. 2013; 18:8, 993-1001. doi: 10.1111/tmi.12121.
Resources	Human resources	43	• Mid-level managers act as the network's focal points and play "boundary spanning roles" from clinical to management	Irimu G et al. Approaching quality improvement at scale: a learning health system approach in Kenya. Arch Dis Child. 2018. doi: 10.1136/archdischild-2017-314348.
	IT	38	• mHealth platform used for perinatal monitoring and referral by TBAs	Martinez B et al. mHealth intervention to improve the continuum of maternal and perinatal care in rural Guatemala: a pragmatic, randomized controlled feasibility trial. Reproductive Health. 2018; 15:120. doi: 10.1186/s12978-018-0554-z.
	Commodities and equipment	14	• Network provided infrastructure, equipment, and supply chain support	Cordier LF et al. Networks of Care in Rural Madagascar for Achieving Universal Health Coverage in Ifanadiana District. Health Systems & Reform. 2020; 6:2, e1841437. doi: 10.1080/23288604.2020.1841437.
	Funding	13	• Business support interventions enabled access to the Medical Credit	Syengo M et al. Private Providers' Experiences Implementing a Package of Interventions to Improve Quality of Care in Kenya:

			Fund, linking providers to banks for low-interest rate loans to procure equipment and upgrade facilities	Findings from a Qualitative Evaluation. Global Health-Science and Practice. 2020; 8:3, 478-487. doi: 10.9745/GHSP-D-20-00034.
	Government funding	12	• Municipality funds used to pay contracted providers and invest in health activities, including the continuation and expansion of network initiatives	Bhatta S et al. The Logarithmic Spiral of Networks of Care for Expectant Families in Rural Nepal: A Descriptive Case Study. Health Systems and Reform. 2020; 6:2. doi: 10.1080/23288604.2020.1824520.
	Supportive policies	12	• Existing policies encouraged facility-based births and provision of high-quality maternal and neonatal care	Hyre A et al. Expanding Maternal and Neonatal Survival in Indonesia: A program overview. International Journal of Gynecology & Obstetrics. 2019; 144. Doi: 10.1002/ijgo.12730.
Communication	Communication between network members	22	• Communication between the network members helped to facilitate trusting relationships between network members of different cadres, sectors, and levels of care	Vergara MT et al. Building Trust to Save Lives in a Metro Manila Public-Private Network of Care: A Descriptive Case Study of Quirino Recognized Partners in Quezon City, Philippines. Health Systems & Reform. 2020; 6:2, e1815473, doi: 10.1080/23288604.2020.1815473.
	Communication infrastructure	11	• 24-hour communications network was implemented to facilitate referral	Tayler-Smith K et al. An ambulance referral network improves access to emergency obstetric and neonatal care in a district of rural Burundi with high maternal mortality. Tropical Medicine & International Health. 2013; 18:8, 993-1001. doi: 10.1111/tmi.12121.
	Strengthening communication	5	• The audit of a referral network strengthened communication for referrals	Awoonor-Williams JK et al. Conducting an audit to improve the facilitation of emergency maternal and newborn referral in northern Ghana. Global Public Health. 2015; 10:9, 1118-1133. doi: 10.1080/17441692.2015.1027247.

	Effective communication strategies	4	• Regular meetings were held between different cadres of providers	Mullany LC et al. The MOM Project: Delivering maternal health services among internally displaced populations in eastern Burma. Reproductive Health Matters. 2008; 16:31, 44-56. doi: 10.1016/S0968-8080(08)31341-X.

Table 3.6 Most frequent practical characteristics by network component with examples from the selected literature.

Acronyms: MoH: Ministry of Health, MoU: Memorandum of Understanding, MoHCDGEC: Ministry of Health, Community Development, Gender, Elderly, and Children, LoA: Letter of Agreement, RMO: Regional Medical Officer, TBA: Traditional Birth Attendant, CHW: Community Health Worker, QI: Quality Improvement CHO: Community Health Officer, PHCB: Primary Health Care Board, LGA: Local Government Authority

Form and Structure

How a network is formed and structured has implications for how a network is governed and led, its management and clinical functions, how network members communicate, and the key resources it needs to function. While networks are formed in different ways and have various structures, in the HIC literature, networks developed from the bottom-up, for example, clinician-led networks in Australia or through a mixed top-down/bottom-up approach may be more successful than those formed by a top-down approach, such as managed clinical networks in the UK.[33 48 49] The process of creating linkages across different levels and sectors of the health system and how these link actors, illustrates how networks are structured and form. [22 40] For example, a maternal-newborn health network in Indonesia linked public and private referral hospitals and community health centres and providers. To create the network, facility staff, district officials, and civil society mapped the most efficient referral pathways which were reinforced with a communications system. Linking providers at different levels of facilities through mentoring teams created connections beyond the referral pathways, and district health system data working groups connected health facility staff to district officials. The linkages extended to the community level with maternal and child health motivators working to address issues related to maternal and newborn survival. These linkages and relationships generated trust and a shared vision among network actors, increased motivation and performance, and contributed to results achieved by the network.[61]

Governance and Leadership

The governance and leadership of networks play an important role in the establishment and ongoing functioning of a network. Networks are governed and led through various mechanisms depending on their structure, use, purpose, and members. One common way networks are governed is through network meetings, which vary in type, frequency, and participation, to support network management and administration. Network meetings differ in approach, but most are a means to collaborate, coordinate, and share information. Horizontally structured networks are more likely to employ meetings as a way of coordination and collaboration; for example, the Clinical Information Network (CIN) in Kenya links county-level hospitals around a central network coordinator, holds regular meetings for network members to exchange and learn from each other, and promotes local midlevel clinical management.[12] A hybrid horizontally–vertically structured maternal-newborn health network in Ecuador employed different network meetings to implement network activities. The network held several meetings to engage local government representatives on national priorities and laws; monthly meetings between TBAs, CHWs, and health centre staff to review the status of pregnant women in the community and to address potential barriers to quality care; and monthly quality improvement team meetings focused on improving access and quality of services and to review and resolve issues at the community and hospital levels. These meetings aimed to engage network actors from the community and different levels of clinical and health system management in the implementation and running of the network. This approach helped transform fragmented healthcare services into a "coordinated, cooperative entity."[44]

Network leadership takes different forms. In vertical or mandated networks, leadership is more centralised, which can lead to power struggles in decision-making and implementation of network activities between the central network administrators and clinician network members.[33] Horizontal networks are more likely to have distributed leadership. A QI collaborative in the United States had multiple layers of leadership: a leadership team responsible for network project infrastructure, a steering

committee to develop structure for projects and coordinate project selection, a project development team to provide clinical guidance on project design, a project management team to track progress and organise monthly meetings and learning sessions, and facility advisors to provide oversight and feedback to sites.[125]

Mode of Functioning

A network's mode of functioning describes what the network does to try to achieve its purpose, for example through knowledge and information sharing, education, and learning activities. QI initiatives are common examples in the literature of using knowledge, information sharing, and learning activities to work towards goals. A QI collaborative in Tanzania, aiming to improve provider-initiated HIV testing and counselling and linkages to care and treatment, held regular learning sessions for the participating sites to share progress toward aims, change ideas, plan–do–study–act cycles, lesson learned, and best practices. The way in which a network functions enables the implementation of "locally appropriate process-focused change interventions that lead to sustained system improvements."[126] Networks will also develop or revise guidelines, standards, and protocols and promote their uptake and adherence as a way to work towards achieving their purpose. For example, in Kenya's CIN network, members were engaged in the development of national clinical guidelines and promoted and distributed the guidelines throughout the network. By championing their use, the members ensured the guidelines trickled down to junior clinicians and broke down previous barriers hindering guideline uptake.[127]

Resources

Networks need different types of resources to function, mainly human resources, IT, commodities and equipment, funding, and supportive policies. In HIC literature, different aspects of human resources were cited as one of the key elements that made a network effective or successful, such as sufficient staffing, engaged network members, or strong network leadership.[29] [48] [49] A network can provide staff with additional roles, in the case of clinicians acting voluntarily as network co-chairs in clinical networks in Australia [29] or they may need to recruit a dedicated network coordinator.[46] Human resources are a key

element in LMIC networks as well; for example, networks in Nepal, Tanzania, and Madagascar filled gaps in clinical staffing by working with local government to support recruitment and short-term salaries.[41 42 128] Human resources are critical to network functions and achieving success. In Kenya's CIN, the county hospitals' mid-level managers act as the network's focal points and play "boundary spanning roles" with clinical and management responsibilities.[129] The success of the network lays with these focal points and potentially their ability to build skills in leading multidisciplinary teams.[129]

Communication

Successful communication between network members contributes to reaching network aims. In HIC studies of clinical and service delivery networks, communication is highlighted as a key to network success.[48 51 130] The importance of this concept is also exhibited in the LMIC literature. In Metro-Manila, Philippines, a network linking a tertiary public hospital and public and private midwifery clinics improved communication between levels and sectors of care. An on-call Obstetrics and Gynaecology clinician carries a dedicated phone line for the network so information on referred patients can be shared to prepare the tertiary hospital and confirm unit capacity. Chat groups of network participants were set up to communicate information on network meetings and share updates affecting the network, such as hospital renovations that may reduce unit capacity. Communication between network members helped facilitate the growth of trusting relationships between different cadres, sectors, and levels of care, which enabled the timelier transfer of pregnant women from midwifery clinics to more complex care and the out-bound referral of low-risk cases from the crowded tertiary hospital.[32]

These proposed components and characteristics help to explain what a network is and describe what is reported about their importance. The components outline the key elements that make up a network and the practical characteristics provide operational examples of how these components manifest in existing networks.

Network uses and purposes

There is significant overlap in the results on reported network uses and purposes and it was challenging to differentiate between them due to the way networks are reported in the literature. I mapped network uses to 32 concepts and network purposes to 19 concepts. These groups of concepts were summarised into five overarching categories: improving and providing quality care and services, improving the health system, improving provider capacity, improving patient use and experience, and improving outcomes (purpose only). I labelled categories to represent the similar concepts contained within each category. The largest category, improving and providing quality care and services, contained concepts related to the offering and coordination of quality care, improving access to care, and quality improvement. Concepts around changes to aspects of the health system, facilitating referral, and fostering partnerships composed the category improving the health system. Improving provider capacity contained concepts specific to changes in clinical practice, the uptake of standard guidelines, and building capacity and skills. The improvement of patient use and experience represented concepts mainly around the increased uptake of services and sharing of information between providers, patients, and caregivers. Lastly, the category improving outcomes focused on improvement in clinical outcomes. Table 3.7 and Table 3.8 list the uses and purposes of networks by category, respectively, from the reported literature. Appendix 3F contains the reported uses and purposes by category linked to specific literature references.

The following examples highlight some of the network uses and purposes. In Ecuador, a multi-level maternal and newborn health service delivery network aimed to "improve access to and quality of EONC [Essential Obstetric and Newborn Care] across the care continuum."[44] Shared-care networks for child cancer care in Ghana and Bangladesh worked to coordinate care to enable patients to access care closer to their homes. [131] Networks often aim to foster changes in practice, for example the CIN in Kenya works to improve use of standard guidelines in paediatric and newborn care.[132] Care networks in Brazil strengthen both systems for primary care and specific priority health areas. [133] [134] In Nepal, a network of

safety's central purpose is to improve maternal and newborn survival in underserved rural parts of the country. [41]

Improving and providing quality care and services	Improving patient use and experience
provide/improve/expand care/services (31)	increase use of care (11)
improve/provide quality and efficiency of care (16)	foster flow of knowledge and share best practices among providers/organisations/caregivers (8)
to change aspects of the health system/service delivery (14)	generate consumer demand (2)
increase access to care (12)	**Improving the health system**
overcome obstacles/gaps to provision of basic services/interventions (9)	to change aspects of the health system (14)
respond to specific health problems (9)	foster partnerships/teamwork/linkages (7)
promote standard/evidence-based approaches to care (8)	facilitate/improve referral (7)
implementation of QI initiatives (8)	collaboration (6)
facilitate/improve referral (6)	to facilitate coordination and cooperation (6)
to meet people's needs (6)	platform for problem solving (5)
manage patients/care (6)	studies/research/generate evidence (5)
collaboration (6)	develop/implement/improve models of care/UHC (5)
platform for problem solving (6)	coordinate complex care/continuum of care (5)
coordinate complex care/continuum of care (5)	shift culture of the network (3)
introduce new technologies/innovations (5)	use data and evidence to guide decision making (3)
decentralisation of care/distribution of cases (2)	improve governance (3)
streamline patient pathways (1)	decentralisation of care/distribution of cases (2)
consultation (1)	streamline patient pathways (1)
deliver care benefits (1)	improve documentation (1)
Improving provider capacity	
uptake of standard guidelines/change clinical practice (16)	
to build capacity/skills (9)	
foster flow of knowledge and share best practices among providers/organisations/care givers (8)	
foster partnerships/teamwork/linkages (7)	
shift staff attitudes (1)	

Table 3.7 Reported network uses by category with corresponding number of references from the selected literature.

Improving and providing quality care and services	Improving provider capacity
provide optimal/high/improve quality care (52)	to foster practice change/uptake evidence-based practices (10)
to transform/improve delivery of services (17)	provide information/teaching resources to providers (3)
address access to care (17)	provider feedback (1)
address challenges to providing care (8)	**Improving patient use and experience**
reduce/improve referral (6)	improve participation/information/experience to patients/ clients (10)
contain/reduce healthcare costs (6)	increase uptake/use of services (3)
coordinate care (4)	**Improving outcomes**
provide integrated patient/family centred care (4)	improve outcomes (46)
improve coverage of services (3)	reduce hospital admissions/stays (3)
Improving the health system	reduce incidence of complication (2)
to transform/improve delivery of the system (17)	
reduce/improve referral (6)	
contain/reduce healthcare costs (6)	
linking of stakeholders/network entities (6)	
coordinate care (4)	
provide integrated patient/family centred care (4)	
improve coverage of services (3)	
improve generation and use of health data (2)	

Table 3.8 Reported network purposes by category with corresponding number of references from the selected literature.

Network stakeholders

Many different stakeholders participate in networks, including a range of clinical providers, health system administrators and managers, government members, professional associations, partner organisations, and communities. Networks can be a unique opportunity for stakeholders to enable them to "work across institutional, professional, and geographic boundaries to identify and address common priorities and develop collaborative solutions." [43]

Clinicians are reported to be key in establishing and running networks, such as clinical networks in Australia.[49] They often play a hybrid or boundary-spanning role between clinical and management

responsibilities, as in the CIN in Kenya,[129] or act as a network co-chair in partnership with a health system manager, like in clinical networks in Australia. [49] Certain studies note that it is important to have a clinician in a leadership role and "influential and passionate clinical leaders" are necessary to build effective networks.[57] Appendix 3F contains reported stakeholders linked to references from the literature.

3.3.4 Synthesis of results

Based on the analysis of the selected literature, networks in health systems are generally characterised by five components: form and structure, governance and leadership, mode of functioning, resources, and communication. The framework components and illustrative practical characteristics provided here aim to make the network concept more concrete. These framework components create a foundation for the network that supports the network's ability to work towards achieving its purpose. As reported in the literature, these components are most often expressed in networks as being formed and structured by connections across levels of the health system and entities; are likely to function mainly through sharing knowledge and information or education or learning initiatives; have established communication between network members; employ network meetings to govern and lead the network; and see human resources as their key resource. The components manifest differently depending on the network context and purpose. Network contextual differences were to a certain extent accounted for by summarising the data to a higher level of abstraction through the network components. Figure 3.5 shows the proposed network framework and most frequent practical characteristics. These most frequent practical characteristics are highlighted in blue in Table 3.5, above.

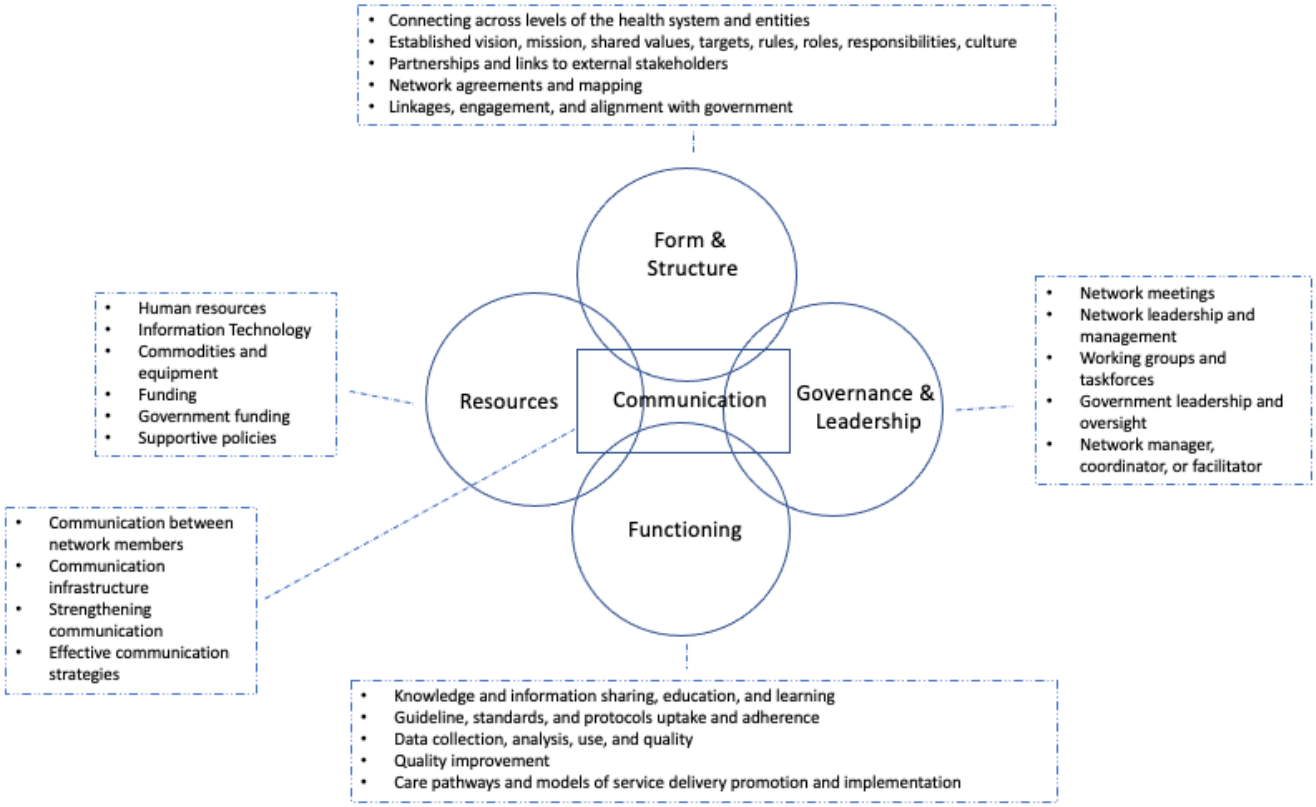


Figure 3.5 Proposed new network framework: components and key practical characteristics.

3.4 Discussion

3.4.1. Summary of findings

My Scoping Review systematically searched peer-reviewed and grey literature on networks in health systems. Based on 129 pieces of selected literature, my Scoping Review proposes a framework that broadly characterises the components of networks, maps practical characteristics of these components, maps the uses and purposes networks are employed for in health systems, and identifies common stakeholders involved in networks with a focus on LMIC health systems.

The network framework is based on diverse network examples that span geographic and clinical focus. Corresponding practical characteristics for each component illustrate how networks are operationalised in practice. While there are many different network definitions and types, with the framework and

illustrative practical characteristics, I was able to make more concrete the understanding of what makes up a network.

The network framework components are interlinked. How a network is structured can have implications for how it is governed and led; for example, a mandated or top-down network is more likely to have a command-and-control form of governance, compared to a network developed by network members.[33] Network governance and leadership are important to ensure that a network works towards achieving its goals[46 57] and reflects how its management functions. A network cannot function without adequate resources; this includes human resources, financial resources, infrastructure, and policy.[48 57] The types of resources required depend on the network. Networks formed from the bottom-up are often started without financial resources,[32 65] though may require resources to grow. Finally, effective communication is needed to share the network vision and principles to stakeholders [46] and is required for the sharing and learning that is key to sustaining them.[32 128] Communication effectuates the four other components, without which the network may be at risk of sub-optimal functioning.

By mapping common networks uses, purposes, and stakeholders, I was able to gain initial insight into why and when a network would be a useful approach in a health system and the key stakeholders involved. While uses and purposes of networks are specific to their context, the fact that I could summarise and identify commonalities implies that there are underlying reasons for taking a network approach. Many different stakeholders are involved in networks; they play and contribute to the network in various roles and responsibilities, depending on the context, purpose, and functioning of the network.

Health systems are complex systems and networks have become a more frequent approach to solving problems, often complex themselves, in health systems, particularly in LMICs. Understanding what makes up a network and why a network is established can support undertaking a network approach, and thereby enable a more considered use of network resources, leading hopefully to more rapid clinical and public health gains.

3.4.2 Strengths and limitations

My Scoping Review has several strengths. I systematically searched the literature, identifying and mapping relevant peer-reviewed and grey literature, and created a large evidence-base of health system network examples. The network framework is based on an analysis of literature across different networks, suggesting broader applicability than frameworks developed for specific network types. My Scoping Review builds on and expands the knowledge from previous reviews, frameworks, and typologies.

There are several limitations to my review. Due to the volume of literature on networks, I limited the search strategy to LMICs. Relevant HIC literature that I was already aware of or that was returned during the database searches, I reviewed. I retained HIC network examples when they provided insights relevant to networks in LMICs, particularly through study methods used less in the LMIC literature included in my Scoping Review, such as qualitative studies, different types of reviews, and theory-based evaluation. These methods produced findings which held relevant insights for LMIC networks. However, this approach could have missed relevant HIC literature. Secondly, I did not consider many types of networks beyond the scope of networks in health systems. For example, I did not include networks that were linked through financing; while financial resources are an important piece of network formation and functioning, this Scoping Review focuses on networks in LMICs, which may not be financially linked, and may be composed of facilities with services that require patient out-of-pocket payments. There could be relevant learnings from these excluded networks. The selected literature was limited to English and French based on my language capabilities, potentially excluding relevant literature in other languages, particularly literature from Latin America in Portuguese and Spanish. While I searched grey literature to try to identify examples of networks not in the peer-review literature, my search was not exhaustive and there may have been examples I missed, particularly from networks at lower levels of the health system. Furthermore, there is no standard way to report on networks. Therefore, there was significant variability in breadth and depth of information in the literature; many examples did not describe in detail how or what they did. During the evidence

selection process, this variance led to excluding potentially relevant examples of networks due to insufficient information reported. Considering that 129 pieces of peer-reviewed and grey literature were selected based on the eligibility criteria, these limitations should have been mitigated to some extent as I judged the charted data sufficient to answer the research question and I reached information saturation.

In the literature, many networks are reported with similar names, though there may be considerable variability among them. This made the development of a network typology unfeasible, and I analysed the charted data at a higher level of abstraction than planned. Additionally, based on how networks are reported in the literature, it was difficult to untangle the network uses and purposes as intended. Despite these limitations, the network framework and mapping were able to provide an answer to the research question.

3.4.3 Comparison with existing literature

My Scoping Review differs from other reviews and studies on health system networks because it looks across a diverse range of network examples in the literature, with a specific focus on LMICs. Previous Scoping and Systematic Reviews focused on one type of specifically defined network: clinical networks, networks of care, QI collaboratives, and clinical social franchise networks.[31 48 50 135-137] Carmone et al's (2020) Scoping Study on networks of care developed a definition and evidence base for this service delivery focused concept based on LMIC and HIC literature.[31] Four Systematic Reviews determined the effectiveness of clinical networks in HICs, clinical social franchise networks in LMICs, and QI collaboratives in both HICs and LMICs.[48 50 135 137] My Scoping Review mapped the literature to describe a network, its uses and purposes, and the key stakeholders involved, which provides a common approach for thinking about different types of networks in health systems. By doing this, I aim to go beyond explanations or results from specific types of networks to identify common features present across them and illustrate how these features happen in practice as well as to summarise the main reasons networks form and who partakes.

It acknowledges that there are many diverse networks in the literature but tries to show that it is possible to identify what they share in common.

Compared to the frameworks and typologies identified in the literature and summarised in Table 3.3, my proposed framework is more applicable to diverse health system networks because of the more comprehensive way it captures the core elements of a network. This is because the framework is based on a comprehensive search, eliciting a significant amount of data, which I synthesised to produce the framework. All but one of the identified frameworks and typologies was HIC focused; the selected literature in my review included mostly LMICs literature and therefore this proposed framework may be more relevant to networks in these settings.

My Scoping Review highlights gaps in the literature on networks in health systems. Few studies look across network examples and so there are limited studies comparing different types of networks. While my searches were focused on health system networks in LMICs, there is relatively limited literature in these geographies and so there is a need for more reporting on networks in LMIC health systems. Furthermore, much of the HIC and LMIC literature focuses on reporting clinical outcomes and less so on explaining what the network is, how it was established, how it functions and what people did; these elements are important for understanding how a network works and should be carefully characterised when establishing a network and reporting on its uses and effects. Both peer-reviewed and grey literature should consider incorporating these aspects in future publications.

My Scoping Review is the first conceptualisation, to my knowledge, of the common elements that make up networks and first mapping of uses, purposes, and stakeholders in LMIC networks. It is a first step towards further understanding what networks are, when and what they are used for, and the purposes they intend to achieve in health systems. My review also served as a mapping and clarification exercise to support my Realist Review (Chapter 4) and Realist Evaluation (Chapter 5) on understanding how and why networks work to change practices.

In summary, this chapter provided the methods, results, and a brief discussion on the first phase of my DPhil, a Scoping Review on networks in LMIC health systems. I systematically searched the peer-reviewed and grey literature on networks in LMIC health systems. Based on the data, I proposed a framework that provides the main components of a network and examples of how they manifest in practice and mapped network uses, purposes, and stakeholders. This first phase of my DPhil provided me with a foundational understanding on networks in LMIC health systems from which to base my Realist Review and Evaluation. The next chapter, Chapter 4, provides the methods and results for my Realist Review, which explains how and why networks are formed and function in a way that allows them to change practices.

4. Chapter 4. Methods & Results – Realist Review: Developing an understanding of networks with a focus on low- and middle-income country health systems: how and why networks form and function to be able to change practices

The second phase of my DPhil was a Realist Review that built on the results of my Scoping Review (Chapter 3). Existing studies show that networks can improve the provision and quality of services and health system functioning but there is limited evidence explaining how and why networks are established and work to achieve their reported results. I undertook a Realist Review to explore this, following Pawson's five steps for Realist Reviews. As a starting point, I used the literature from my Scoping Review and then completed additional searches. I developed Context-Mechanism-Outcome configurations (CMOCs) from the extracted data to refine the initial programme theory with causal explanations. Organisational and social movement theories supported identifying mechanisms and brought additional explanatory power to the programme theory. The programme theory explains how networks are initiated, formed, and function in a way that sets them up for network leadership and committed, engaged, and motivated network members to emerge and change practices, which may lead to improved quality of care, service delivery, and clinical outcomes through the following phases: identifying a problem; developing a collective vision; taking action to solve the problem; forming purposeful relationships, linkages, and partnerships; building a network identity and culture; and creating a psychological safe space. A version of this chapter was published in Social Science & Medicine – Health Systems: Kalaris K, English M, Wong G. Developing an understanding of networks with a focus on LMIC health systems: How and why clinical and programmatic networks form and function to be able to change practices: A realist review. SSM – Health Systems. 2023; 1(100001). doi: 10.1016/j.ssmhs.2023.100001.

4.1 Introduction

4.1.1 Rationale for the review

The existing literature on health system networks is diverse and mainly focused on clinical achievements of the network with limited documentation in the literature of how they form and function. There are few studies of how any type of network evolves[138] or robust descriptions of them, which enable the exploration of how and why networks are—or are not—able to do what they set out to achieve. In my Realist Review, I developed a programme theory drawing on the literature and sociological and organisational theory, which offers an explanation of how and why networks are initiated, form, and function to be able to change practices in order to improve and provide quality care in low- and middle-income country (LMIC) health systems. The programme theory could provide useful insights into the key phases a network may go through in its development for governments and organisations supporting or interested in forming a network in their health system. This is important because "only by developing an understanding of how networks can successfully be formed and evolve can network and public health planners, funders, and participants begin to make the decisions required to ensure that networks fulfil their promise."[39]

4.1.2 Focus of the review

My Realist Review builds on my Scoping Review, Chapter 3, in which I developed a framework broadly describing the key components of a network and mapped network uses, purposes, and stakeholders with a focus on the LMIC literature. In the mapping of network uses and purposes, I identified improving and providing high-quality care and services as the main use and purpose of networks, which helped to guide the objectives and research questions for my Realist Review.[139]

Chapters 1 and 3 provide a more general overview of networks in health systems. For my Realist Review, I focus on networks of clinical practice and health programme implementation with coordinated actions around a shared agenda or goal. There may be overlap between these networks and other types of cross-organisational collaboration, which I did not include in my review. For example, communities of practice, which are made up of people with a shared interest or problem who exchange knowledge and information to deepen their learning and understanding of an issue, may support members' independent actions at

their own facility or organisation and not necessarily the implementation of coordinated actions around a shared agenda or goal.[140]

After initial immersion in the literature and developing a broad conceptualisation of networks from inception to impact, I felt there was an opportunity to focus on a network's formation and functioning. My process of focusing is described in the Methods section. This process also helped specify my review objectives and questions, provided in Chapter 1, on the formation and functioning of networks.

4.2 Methods

4.2.1 Rationale for a Realist Review

While the literature on health system networks is diverse, it is mostly focused on reporting clinical outcomes achieved by the network and less on how the network develops and works to produce those outcomes. Generating an understanding of how networks develop and function can help to inform future initiation, functioning, or scale-up of networks. The Realist approach is particularly appropriate to develop this type of understanding as its core aim is to generate an understanding about a complex intervention.[114] As described in Chapter 2, networks can be considered complex because they are made up of many interacting components.[6] They exist within complex health systems, which are "composed of many interdependent, heterogeneous parts that self-organize and co-evolve."[116] Realist research works well with complex social programmes or interventions.[114] [88]

Few Realist Reviews have studied networks in health systems[141] [142] [136] or focused on LMIC health systems in general. Using the Realist approach for this setting is an opportunity to generate new insights that could inform research and programme implementation beyond this scope of work. Networks are centred on interpersonal relationships[60] and therefore need an approach—such as a Realist approach—which is focused on the reasoning, response, and reaction of those involved in the phenomena under study.[84] Therefore, my Realist Review contributes to the knowledge base methodologically, by applying the Realist

approach to evidence synthesis to an understudied topic, and content-wise with a focus on networks in LMIC health systems.

My Realist Review, undertaken between October 2021 and October 2022, followed the five steps outlined by Pawson in The Science of Evaluation (2013), summarised in Figure 4.1.[88] It was an iterative process that moved forward and back between the different steps. I developed and registered a review protocol with PROSPERO (CRD42021286452)[143] in Appendix 4A. My results are reported according to the Realist and Meta-narrative Evidence Syntheses: Evolving Standards (RAMESES).[144]

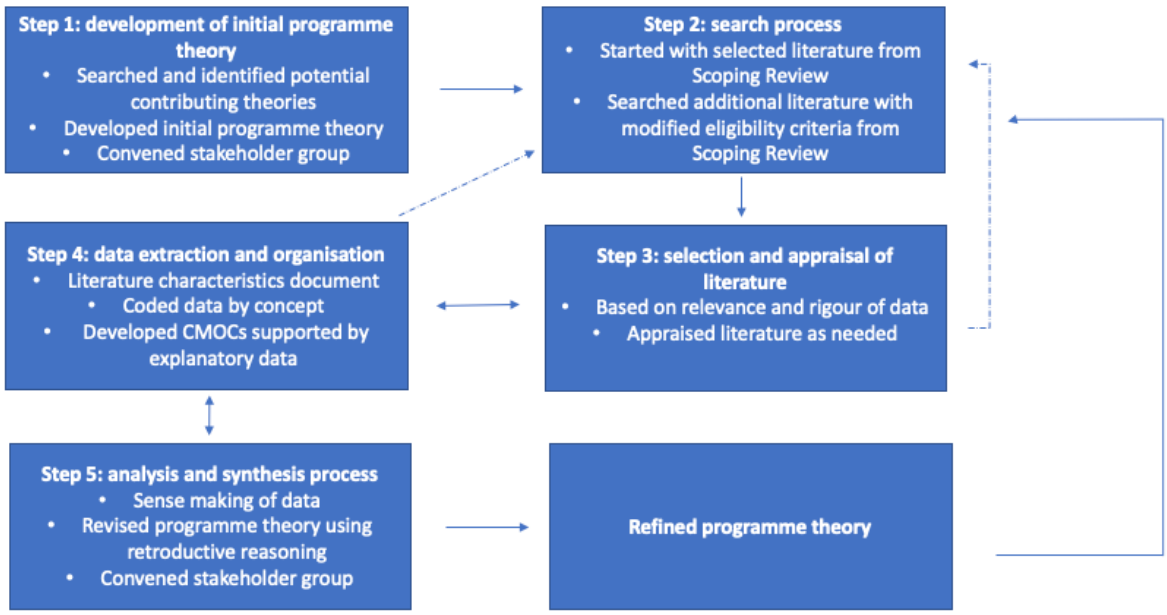


Figure 4.1 The Realist Review steps showing the iterative nature of the review process.

Dotted lines represent the return to the search process from later steps.

4.2.2 Development of the initial programme theory

The first step of my Realist Review was to draft an initial programme theory. I built on my preliminary thinking with input from my supervisors about how and why networks develop and work to improve quality care and services and by consulting the LMIC literature from my Scoping Review (Chapter 3) to draw out relevant insights. Additionally, I considered initial substantive theories, mainly used in other studies on networks. I recruited stakeholders from global health, academic, and research institutions to

provide insight and guidance into the Realist Review process and my evolving thinking. Stakeholders were identified through my and my supervisors' professional contacts. They provided feedback and advice on the initial programme theory, specifically around leadership, culture, and sustainability of networks. Developing the initial programme theory was an iterative process, until I felt that I had arrived at a point where it would be helpful to progressively review the literature.

4.2.3 Search Process

As I had recently completed a mapping of the literature in my Scoping Review, Chapter 3, I had 127 pieces of selected peer-reviewed and grey literature to start with (see Chapter 3 for details on this search process and Appendix 3B for the search strategy). Following review and analysis of the Scoping Review literature, I determined additional data were needed because of gaps in the analysis and undertook additional searches. Furthermore, because my Scoping Review searches had been performed a year prior, I needed to run update searches to identify any relevant published literature within the last year.

I modified the search strategy from my Scoping Review to exclude four search terms (quality improvement collaborative, clinical governance, quality improvement programme, and collaborative improvement network) due to the narrower focus of my Realist Review (Appendix 4B). These terms were excluded because quality improvement programmes and collaboratives are a discrete and timebound intervention that follow a prescribed set of steps and therefore may or may not form and function as networks do. Clinical governance was excluded as it is a broader concept than networks.

I searched four databases (Medline, Global Health, Embase, and Web of Science) using the modified search strategy on the 27th April 2022. Subsequently, I searched the reference lists of included papers and tracked citations of included papers using Google Scholar and PubMed.

I searched for substantive theories to identify transferable concepts that might help unlock aspects of the programme theory. My search process for supporting theories was an iterative sense-making process. I began by reviewing included literature to identify relevant theories from other studies, suggestions from

my supervisors, targeted searches of key concepts in the programme theory, and through snowballing from other theories.

4.2.4 Selection and appraisal of the literature

Literature selection was based on relevance to the programme theory and rigour. The eligibility criteria in Table 4.1 was narrowed from my Scoping Review eligibility criteria with additional exclusion criteria as my review became more focused. I excluded several types of networks because they had specific differentiating characteristics from other network examples, as described in Table 4.1. The literature needed to be considered rigorous and I undertook quality appraisal when necessary.

The literature selection was an iterative process. I reviewed literature from my Scoping Review in waves based on its likelihood to contribute relevant information to the programme theory and building of causal explanations. The literature from LMICs was prioritised as this was the focus of my review. I included limited high-income country (HIC) literature from my Scoping Review where it provided generic insights to support the causal explanations and where there was not LMIC supporting data, but where I judged that I could make justified inferences about the transferability of the causal explanations. Substantive theories were selected based on their relevance to the programme theory and where they could provide deeper explanations into the programme theory and help infer mechanisms.

I appraised a number of studies where the CMOC had data from only one supporting source. There were 15 CMOCs that had only one supporting source; these CMOCs came from 10 sources. These sources were case studies, qualitative studies, mixed methods studies, and one reflective piece. I used Stake's Checklist for assessing the quality of case study reports,[145] the Critical Appraisal Skills Programme Qualitative Studies Checklist,[146] and the Mixed Methods Appraisal Tool for appraisal.[147] The reflective piece was unable to be appraised. Literature appraisals are available in Appendix 4C.

Inclusion	Exclusion
• Related to health system networks • Networks: groups of facilities and/or healthcare stakeholders (including but not limited to all types of providers, technicians, government officials, professional associations, non-governmental organisations (NGOs), and donors) linked formally or informally, horizontally or vertically, through programs, interventions, activities, or initiatives with an aim to initiate change to improve service delivery, quality of care, and/or health system functioning • Health systems: structures, processes, and people responsible for managing health programmes and services that provide care for a population • HICs and LMICs	• The programme, intervention, activity, or initiative occurs only in one facility or locality among only one group of actors • Research or purely academic networks • Networks focused on research capacity building • Communities of practice • Advocacy networks • Disaster management networks • Database/registry networks • Trial/study networks • Social networks • Family/home care networks • Palliative care networks • Laboratory networks • Diagnostics networks • Disease surveillance networks • Telemedicine/e-health/m-health interventions • Accreditation interventions • Integrated community case management interventions • Integrated management of childhood illnesses interventions • Mobile unit outreach • Faith-based organisation sector • General studies on universal health coverage (UHC) • Primary Health Care networks that were limited to the peripheral level of the health system • *Quality improvement collaboratives*: quality improvement collaborations, quality improvement programmes, and collaborative improvement networks were added to the exclusion criteria for the same reasons they were excluded from the search strategy as described above. • *Quality improvement programmes* • *Collaborative improvement networks* • *Social franchise networks*: social franchise networks were excluded because they often have a different focus (marketing health products). In the scoping review there were very few examples of social franchise networks identified and the examples contributed little relevant information. • *Telehealth networks*: telehealth networks were excluded as the focus was often specific to only the virtual interaction.

Table 4.1 Eligibility criteria.

Italics show additions to the exclusion criteria for my Realist Review.

4.2.5 Data extraction and organisation

I imported the literature into NVivo QRS International, version 12, a data management software tool for qualitative analysis. Starting with literature that was most likely to hold the most relevant information to explain different aspects of the programme theory, I reviewed and coded the literature in waves. I deductively coded literature with a list of concepts based on the initial programme theory and my familiarity with the literature and coded inductively as well. Already coded documents were reviewed when new codes emerged. Figure 4.2 provides an overview of the data extraction, organisation, analysis, and synthesis processes.

4.2.6 Analysis and synthesis processes

The analysis and synthesis processes were iterative. It was also a process of learning by doing as this was my first experience undertaking a Realist Review. First, I reviewed the data within each code and recoded data to more appropriate codes or discarded data where necessary. I then grouped data by concept with a brief description to explain what the group of data was about and how it fit into the programme theory. For each piece of data, I considered 'what does this piece of data tell me?,' which required some reorganisation of data into different concept groups. As my familiarity with the data increased, I wrote more detailed narratives for each concept group. I iteratively developed CMOCs for each concept group, starting by identifying the outcome and context from the data and then employing retroductive reasoning to help identify mechanisms.[99] This process continued until I had reviewed all the selected literature.

At this point, I decided to focus on the first part of the programme theory – on the initiation of a network — because this part of the programme theory had less existing research and I judged that the initiation of a network may be more transferable across diverse networks. Through a more focused and evolved understanding of the programme theory, I revisited the selected literature to identify any additional relevant data. I continued to refine the CMOCs, specifically to bring them up to a higher level of abstraction

and used substantive theories to help infer mechanisms and further explain parts of the programme theory.

I revised and reorganised the CMOC narratives and data by organising them into the key steps that should be considered for each concept group. I continued to iteratively revise the CMOCs, narratives, and programme theory with substantive theories until theoretical saturation was reached and the initial programme theory was sufficiently refined explanation-wise.

I convened the stakeholder group to present and discuss the refined programme theory to support sense-making. They provided insights into the direction and focus of the programme theory, specifically around leadership, collective vision, energy and effort, culture, and the importance of network initiation. The stakeholder group also provided insights on the direction of my Realist Evaluation (Chapter 5) to test the programme theory, particularly sustaining the network.

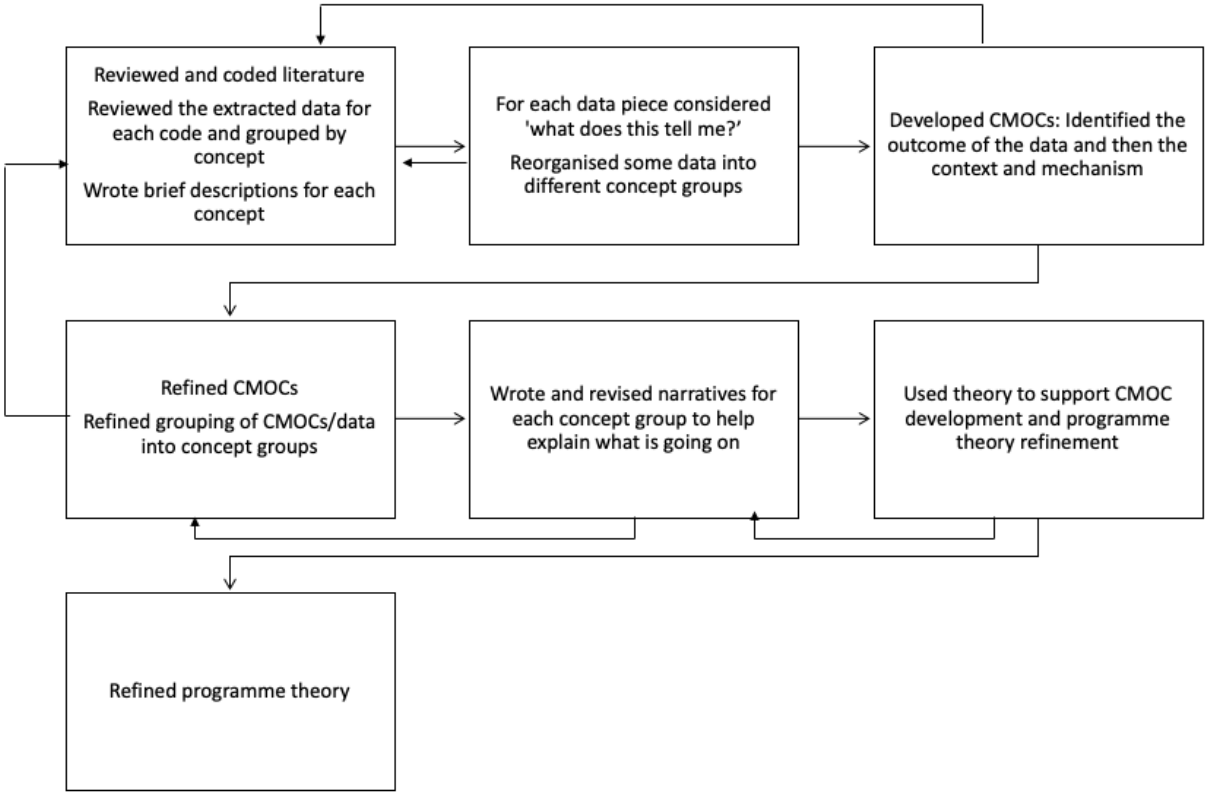


Figure 4.2 Overview of data extraction and organisation, analysis, and synthesis processes.

4.3 Results

4.3.1 Selected literature

The evidence selection process is outlined in Figure 4.3. 32 pieces of literature were selected from 1,245 unique pieces of literature that were identified through the search processes. Of the 127 pieces of peer-reviewed and grey literature from my Scoping Review, I excluded 17 sources due to the refined eligibility criteria. After I assessed full text articles for eligibility, I selected 25 pieces of literature (22 peer-reviewed, 3 grey literature).

The modified update searches of four databases returned 2073 pieces of literature, of which 993 were duplicates. I screened titles and abstracts and assessed 22 studies for eligibility, however, I only reviewed 15 full text articles because six publications were not available in English or French and another was unobtainable. From the full text review, I selected two pieces of literature; from one of these studies, I identified two additional pieces of literature and included them based on relevance. From searching the reference lists of included literature, I identified 25 pieces of literature, assessed five full text for eligibility, and included three. Through the citation tracking of included literature, I identified five pieces of literature and assessed four for eligibility, however I included none.

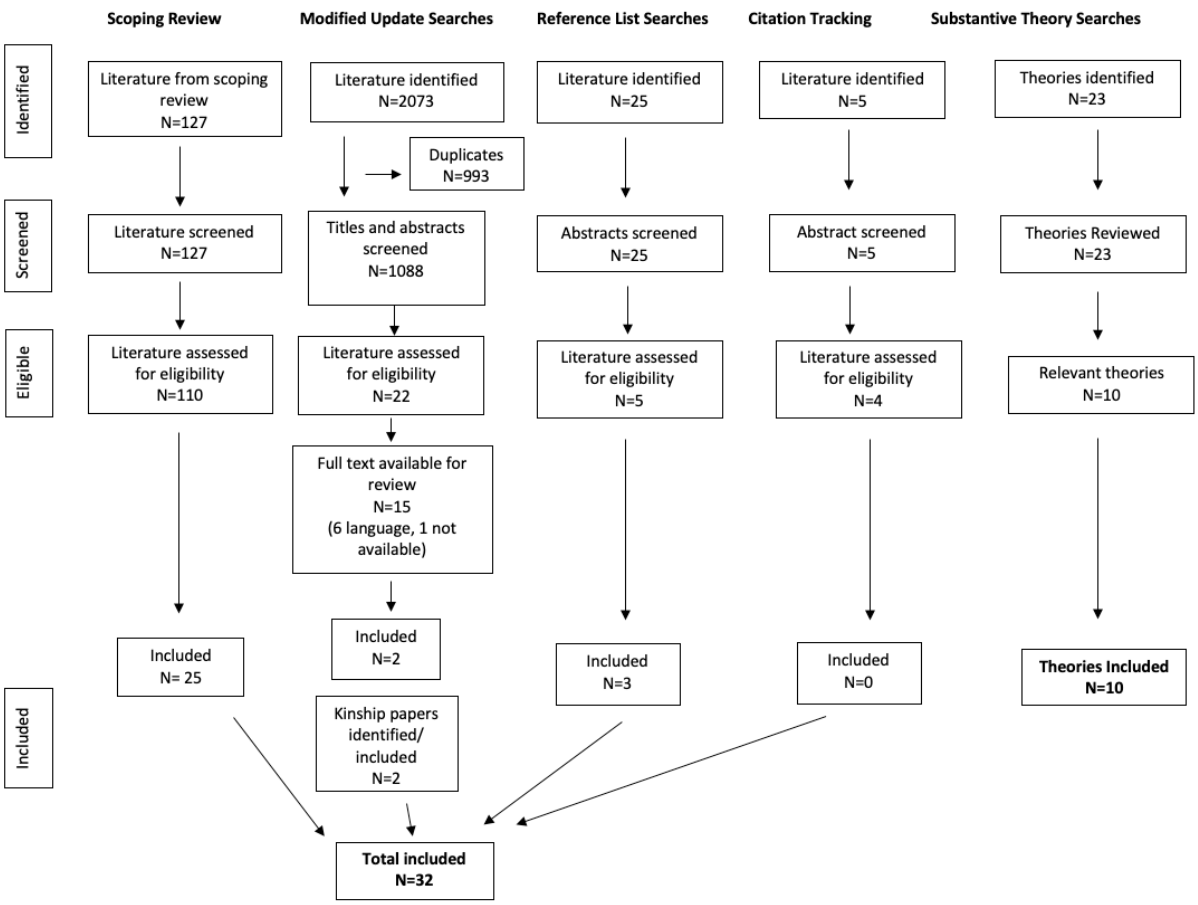


Figure 4.3 Realist Review PRISMA. Evidence selection process from Scoping Review literature and additional searches.

Through the iterative search process and refining of the programme theory, I identified and selected the theories and concepts in Table 4.2 to support and further explain the programme theory.

Theory/Concept	Key Author	Overview
Theory of Collective Behaviour	Smesler 1962	• Explanation for the formation of social movements • Social movements start with the experience of a strain, a generalisable belief rises identifying the source of the strain, a precipitating event occurs, leadership gives the movement direction, social control mechanisms can affect the direction of the movement
Collective Identity Approach from New Social Movement Theory	Melucci 1995	• Shared identity is developed through common experiences and emotions and the development of a common perspective or understanding
Leadership in social movements	Ganz 2010	• "accepting responsibility to enable others to achieve shared purpose in the face of uncertainty" • Five leadership practices: relationship building, storytelling, devising strategy, structuring social movements, and catalysing action

Theory of Planned Behaviour	Ajzen 1985	• When the behaviour is not under self-control, an individual has greater perceived control over the behaviour if they think they have the resources and opportunities to perform the behaviour; they may have lower intentions to perform the behaviour if they lack resources and opportunities, even if they have a favourable attitude toward performing the behaviour
Self-Efficacy Theory	Bandura 1977	• Individual's belief in their ability to enact behaviours is needed to arrive at a certain outcome
Small Group Development Theory	Tuckman 1965	• Model that conceptualises changes in the behaviour of groups • The model has four stages: forming (coming together, developing relationships), storming (resistance to the newly formed group), norming (developing cohesiveness, new standards), and performing (the group is functional and executes tasks)
Organisational Culture Theory	Schein 1990; Schein, Bennis, Blake 1965	• "Set of shared mental assumptions that guide interpretation and action in organisations by defining appropriate behaviour for various situations"
Organisational Commitment Theory	Porter 1974; Meyer, Allen 1991	• "Attachment to the organisation, characterised by an intention to remain in it; an identification with the values and goals of the organisation; and a willingness to exert extra effort on its behalf" • Types of commitment: affective, continuance, normative commitment
Collective Intelligence Theory	Malone, Bernstein 2015; Malone, Woolley 2020	• "Groups of individuals acting collectively in ways that seem intelligent" • Explains extrinsic and intrinsic motivations
Psychological Safe Space	Edmondson 2004	• "Individuals' perceptions about the consequences of interpersonal risks in their work environment" • "A climate in which the focus can be on productive discussion that enables early prevention of problems and accomplishment of shared goals, because people are less likely to focus on self-protection"

Table 4.2 Substantive theories used to refine the programme theory.

4.3.2 Literature characteristics

Complete characteristics of the included literature are available in Appendix 4D. Of the 32 included pieces of literature, 24 were focused on LMICs, two on middle-income and HICs, and six on HICs. They represented a mix of study designs: nine case studies, six qualitative studies, five programme overviews, four evaluations, two reports, and one observational study, mixed methods study, and Realist Evaluation. The three pieces of grey literature were all short programme overviews. There are a plethora of different

types of networks and it is difficult to neatly categorise them all.[139] Of the included studies, there were five on networks of care and the Clinical Information Network (CIN), three on referral networks and public healthcare networks, and two on primary care networks and clinical networks.

4.3.3 A network programme theory

The programme theory contains 58 CMOCs supported by 185 sections of data from 32 pieces of literature. A complete list of CMOCs and all supporting data are available in Appendix 4E. The programme theory explains how networks are initiated, formed, and function to enable network members to change practices, which may lead to improved quality of care, service delivery, and clinical outcomes. There is not one clear measure of network success, but much of the literature features networks reported to be successful in either their operation or outcomes. Therefore, my review helps to understand how networks could be set-up and function to have a chance at success.

The programme theory has two sub-theories – a network initiation theory and a network change theory. My Realist Review focused on the network initiation theory because it was where I felt there was less existing understanding. If health system actors do not consider certain elements when forming a network, that network might be less likely to successfully perform and enact its mission. In the network change theory, the network is more susceptible to forces and circumstances outside of the network members' and leaderships' control, potentially hindering their ability to change practices, which was not well elaborated in the literature. An overview of the programme theory is provided in Figure 4.4.

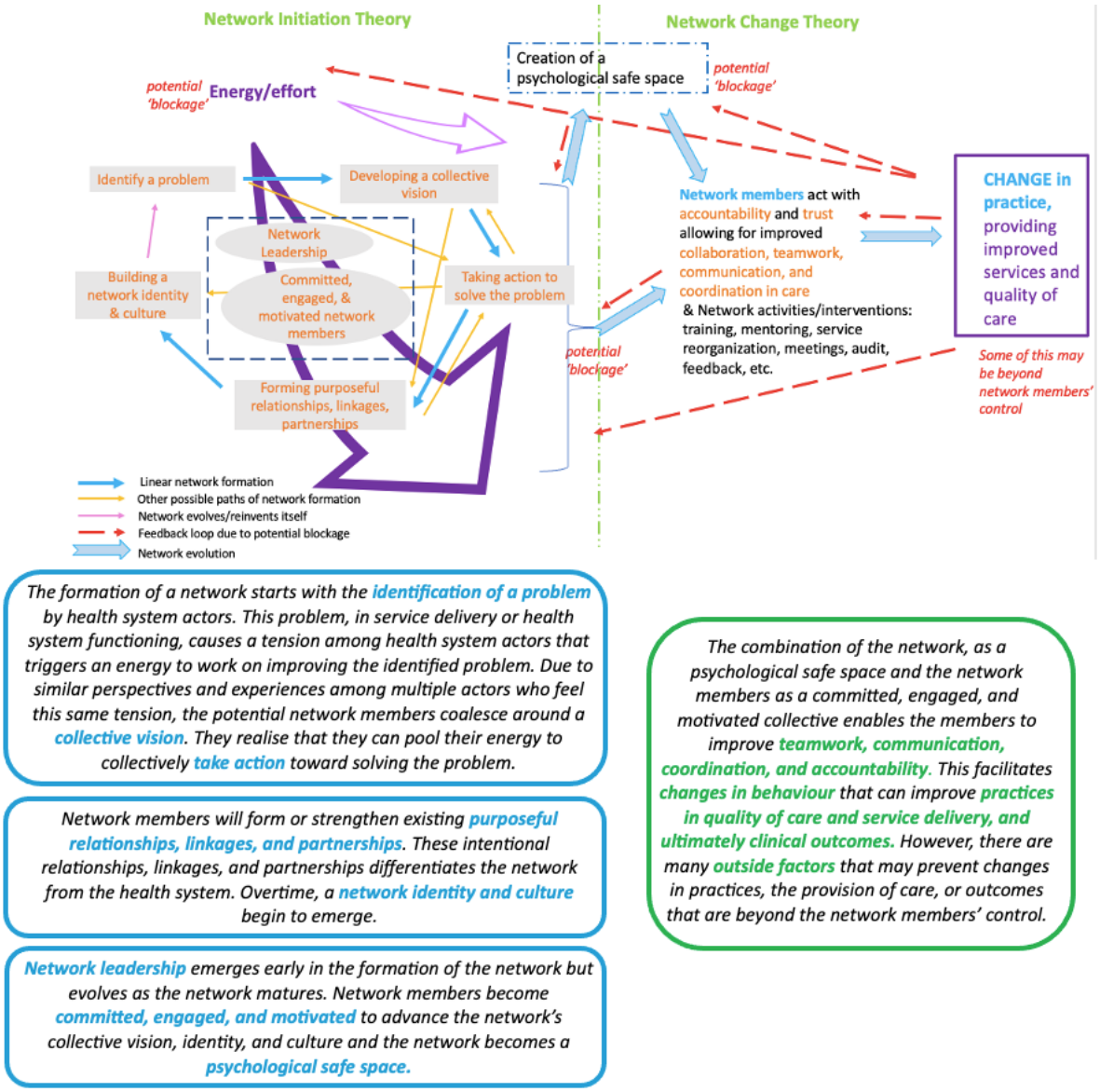


Figure 4.4 Network programme theory.

My findings below provide detail of what underpins the programme theory and are grouped into nine different sections, each underpinned by CMOCs in Table 4.3 - Table 4.11. I provide an illustrative piece of data for one CMOC in each section of the programme theory in Table 4.3 - Table 4.11. Appendix 4E has all the supporting data for the CMOCs. The programme theory is presented in a sequential or temporal way, however in reality, following *Identify a problem* these sections happen in parallel or varying permutations of order.

Identify a problem

Networks often form around a problem in clinical care, service delivery organisation, or health system management. A mismatch between expectations of a norm and reality, either at the individual or organisational level, surfaces the problem. These problems are often identified by clinicians, health system administrators, and other health system stakeholders, who may have an initial energy to start 'doing something about it,' stemming from their frustration that the problem causes or excitement of potentially taking action. The dissatisfaction experienced by health system actors varies, for example, clinicians may feel frustrated due to a lack of resources, which limits their ability to provide high-quality care and undermines their motivation (CMOC 1A).

Problems are not normally felt in isolation and other health system actors are likely to experience similar strains. As potential network members coalesce around the identified problem, others are drawn to their cause. This is because the idea comes from the potential network members themselves and so there is a willingness or realisation that they can do something about the problem (CMOC 1B). Potential network members have collective experiences and perspectives related to the identified problem and when they share these, drawing on their collective knowledge, they are better able to find a solution (CMOC 1C). When problems are identified by individual stakeholders, networks often form from the bottom-up, while when the problem is recognised by health system administrators or outside stakeholders, it may be triggered through a top-down approach (and may be linked, for example, to Ministry of Health (MoH) targets). Over time, networks formed from the top-down may shift to being driven from the bottom-up and networks developed from the bottom-up may become formalised or integrated.

Once in existence, networks can be used to identify additional problems and as a result, may continually reinvent themselves to stay relevant. The identification of problems within a network may occur in clinical practice, through learning sessions and coaching visits, or through approaches that seek to identify barriers or challenges to uptake in care or service use (CMOC 1D).

There are insufficient detailed data in the literature explaining how the identification of a problem leads to the initiation of a network and why this process needs to occur. However, looking to relevant substantive theory, it is possible to identify concepts that help explain why the identification of a problem is essential to initiate a network.

Smelser's (1962) Theory of Collective Behaviour is an underemployed explanation of the formation of social movements (Table 4.2).[148 149] Smelser argues that social movements start when a group of people experience a 'strain.' This strain can be considered akin to a problem identified by groups of clinicians, health system administrators, patients/users, or other health system stakeholders. These individuals all feel similarly about the problem and coalesce around it to do something. Smelser argues that following the emergence of the strain, a generalisable belief rises, which identifies the source of the strain and suggests actions to rectify it. In the formation of a network, the generalisable belief comes from frustrations that the problem causes or the belief that the status quo is not good enough and emerges as a collective desire to solve the identified problem. This generalisable belief may also have roots in a vocational calling or professional identity. Smelser reasons there should be a precipitating event to help form the collective behaviour. In the formation of a network, there may not be one major event, but the repeated occurrence of the same strain or problem causes the clinicians, administrators, stakeholders, or patients/users to arrive at a tipping point. Furthermore, according to Smelser, some form of leadership is needed in all social movements, which is consistent across networks despite different leadership models. Lastly, Smelser's theory explains that 'social control mechanisms'—resulting from the actions of those in power—could have an impact on the direction of the movement. Networks' ability to change practices may be constrained by outside influences, such as political influences or the ability to get support and resources, which can affect network impact and success. The role of leadership in networks and 'social control mechanisms' in the absence of non-network committed stakeholders are discussed later.

1A	When potential network members feel a sense of dissatisfaction (misaligned with expectations or values) with an issue (e.g. in clinical care, service delivery organisation, or health system management) (context), they will have the energy, excitement, and motivation to do something about it (outcome) because of their frustration (mechanism)
1B	When a network is in the initial stages and potential network members reflect together on problems (context), they will recruit others to the cause (outcome) because there is a realisation that they can be part of the solution to some degree (mechanism)
1C	When potential network members share and discuss their collective experiences, emotions, understanding, or perspectives for a commonly felt problem (context), they are better able to understand what needs to be done and find solutions (outcome) because they have more knowledge to draw on (mechanism)
1D	When members in an established network feel it is safe to critically examine and reflect on existing practices (context), they are able to identify new problems and potential solutions (outcome) because they feel enabled to challenge the status quo or feel in a psychological safe space to be able to challenge the status quo (mechanism)
	"During learning sessions and coaching visits, implementation problems were observed, such as the incomplete use of flowsheets, data entry errors, incorrect techniques in patient self-management discussions and confusion about interpreting guidelines, algorithms or indicators. The traditional learning model of attending a single lecture would probably not have resulted in similar improvements" (Chan et al 2020)

Table 4.3 CMOCs for Identify a problem.

Developing a collective vision

The development of a collective vision among network members is key to its success. There are three central parts to a collective vision: agreement around the identified problem, the intention to act, and initiating planning for actions to do something about the problem and further solidify the formation of the network. Network members' willingness to work towards this collective vision may depend on extrinsic factors, such as policies, organisational practices, and working environment, or intrinsic factors, like personal values, job expectations, and self-esteem.[150] Extrinsic factors may be more likely to drive network members willingness in networks initiated through top-down approaches. When network members agree to a vision, it can help them to focus on network actions and act as a supportive mechanism to reach the network's goals.

Once a problem has been identified, potential network members begin to develop a collective vision. This occurs through a process of collective sense-making, resulting in the identification of commonalities. It is a process of negotiation and clarification that may happen through interactions among network members, initial network meetings, and guidance from network leadership (CMOC 2A). Commonalities can be

developed through sharing lessons and best practices, open communication, and working together to solve problems, which leads to the development of a collective vision. However, differences in perspectives can inhibit the development of a collective vision and working together (CMOC 2B). Another context that leads to the development of a collective vision is when network members have common professional or vocational identities or callings and so they likely have similar experiences, understanding, and perspectives which helps them create a collective vision because they understand where other network members are coming from (CMOC 2C).

Once potential network members have developed a collective vision, they need to put in effort to commit to it and operationalise it. This may happen when network members have a similar perceived reality because the collective vision is based on shared experiences, emotions, perspectives, and understanding (CMOC 2D). Network leadership often has an important role in getting network members to commit to the collective vision. Leadership may employ approaches such as using clear communication, advocacy, and promotion of the collective network vision as well as helping set collective goals and supporting network members (CMOC 2E). Furthermore, networks often use Memorandums of Understanding (MoUs) to solidify the network with purposeful agreements, objectives, and clear roles and responsibilities and as a mechanism to hold network members accountable (CMOC 2F).

An established collective vision helps potential network members to form collaborative relationships and take coordinated action because they are aligned with a common understanding and perspective of the network (CMOC 2G). As the network evolves, the initial collective vision may change over time, particularly as established networks identify new problems and reinvent themselves. If a network does not have a collective vision or if network members do not follow it, then the network may be less functional. If network members do not adhere to the collective vision, there may be resistance to network activities. A collective vision may not form if the network is dominated by individual interests or if there is a divergence of beliefs (CMOC 2H).

Smelser's Theory of Collective Behaviour (Table 4.2) argues the need for a 'generalisable belief' to form a social movement,[148] which can be considered analogous to the development of a collective vision focused around the problem the network aims to solve. The second theory that supports the development of a network's collective vision is the Collective Identity Approach from New Social Movement Theory (Table 4.2). This theory posits that a shared identity is developed through common experiences and emotions and the development of a common perspective or understanding.[151-153] A collective identity is the basis from which a network's collective vision is formed to target the problem that the network aims to address (i.e. the generalisable belief). The collective vision emerges from the identified problem because potential network members have common experiences, perspectives, and understanding around the problem; as a result, the vision will be collective and grounded in a common perspective or understanding.

Tuckman's (1965) Small Group Development Theory conceptualises changes in the behaviour of groups (Table 4.2). It has four stages: forming (coming together and developing relationships), storming (resistance to the newly formed group), norming (developing cohesiveness and new standards), and performing (functioning and executing tasks).[154 155] The norming phase helps explain how network members progress from developing a collective vision, to the vision becoming a norm, to network members internalising and adhering to the collective vision.

Network members must put in 'work' to develop, internalise, and adhere to the collective vision. Tuckman's theory explains some of this 'work' behind the creation of group norms, which includes acceptance of other group members, developing a sense of being as a group, identification with the group, agreed upon group action, cooperation, mutual support, having a collective mindset or feeling, and having a common goal and group spirit.[154] This 'work' also resonates with aspects of the Collective Identity Approach, such as identifying and articulating commonalities among each other, collective sense-making, and having common perspective and understanding.[151-153] There is overlap with the Collective Identity

Approach in articulating some of this work that needs to be done. When the collective vision is a norm of the network, it can help lead to changes in practices.

2A	When potential network members engage in an open process of collective sense-making around a problem (context), they can identify what they share in common (outcome) because they learn about each other's experiences, emotions, understandings, or perspectives (mechanism)
	"An initial formative event was a consensus meeting to establish the CIN's vision and mission. It was attended by partner representatives and a focal team from each hospital, comprising a paediatrician, a nurse heading the paediatric ward and the officer in charge of health records and information. This meeting helped align participants' goals drawing on shared values and resources as part of collective meaning-making and resulted in vision and mission statements." (Irimu et al 2018)
2B	If potential network members identify and articulate commonalities among each other (context), then this enables the development of a collective network vision (outcome) because they understand each other's perspectives (mechanism)
2C	When network members have common professional or vocational identities or calling (context), this facilitates the development of a collective network vision (outcome) because they are more likely to have common professional ideals or identities (mechanism)
2D	If the collective vision of a network is based on shared experiences, emotions, perspective, and understanding among the network members (a similar specific way in which reality is perceived) (context), then this will lead to commitment to the collective vision (outcome) because network members feel represented (mechanism)
2E	If the collective vision of a network is communicated and explained by network leadership in a way that appeals to professional ideals and values shared by network members (context), then this will lead to commitment to the collective vision (outcome) because network members feel engaged (mechanism)
2F	When formal agreements have been negotiated and agreed between network members (context), then the network members will be more likely to follow a collective vision (outcome) because this helps network members to understand their roles and responsibilities (mechanism)
2G	When potential network members establish and agree to a collective vision (context), this purposefully links them into a network (outcome) because they have common understanding and perspectives on what the goals of the network are (mechanism)
2H	If there is no collective vision or if network members do not follow the network's collective vision (context), then they will be less successful in implementing network activities (outcome) because network members do not feel committed to the network (mechanism)

Table 4.4 CMOC for Developing a collective vision.

Taking action to solve a problem

Once potential network members have identified a problem and started to form a collective vision, they reach a tipping point in collective will that prompts them to jointly take action to try to resolve the problem. This cooperation distinguishes the ability to do something about the problem from not being able to get initiatives off the ground.

When potential network stakeholders realise that collective action is needed to solve the identified problem, they will seek out those with common experiences. Potential network stakeholders may come

from different geographies and professions but the realised need for collective action towards the identified problem transcends these differences (CMOC 3C). In a network formed from the bottom-up, potential network members will recruit likeminded colleagues to solve the problem because with collective action, they will be more likely to do something related to the identified problem. The recruitment might occur through communicating and collective sense-making around the problem or a realisation on the part of potential network members that working together positively supports the ability to achieve a shared goal. While, in a top-down network, a sense that collective action is still needed will come from a health system administrator or manager who may mandate colleagues to participate in the network (CMOCs 3A, 3B). When network members have clearly identified what and how a problem needs to be solved, opportunities to share and work together as a network facilitate their ability to take action. This helps with problem-solving and identifying new solutions (CMOC 3D).

While the literature is sparse in this area of the programme theory, substantive theories provide initial insight into understanding how potential network members take action. Drawing on the Collective Identity Approach from New Social Movement Theory (Table 4.2), as with social movements, network members share common experiences and develop a common perspective or understanding through working in the same health system, geography, or technical area. When network members have a collective identity, it enables a sense of collective agency. The existence of collective agency may explain how groups of individuals as part of a network act, instead of continuing with the status quo.

Ajzen's (1985) Theory of Planned Behaviour extends the Theory of Reasoned Action (Fishbein, Ajzen 1975[156]) (Table 4.2), which argues that when a desired behaviour is under one's own control, an individual's behavioural intentions are based on their belief in the likelihood that performing a specific behaviour will lead to a certain outcome. When the behaviour is not under self-control, the Theory of Planned Behaviour posits that an individual has greater perceived control over the behaviour if they think they have the resources and opportunities to perform the behaviour; they may have lower intentions to perform the

behaviour if they lack resources and opportunities, even if they have a favourable attitude toward performing the behaviour.[157] This links with Bandura's (1977) Self-Efficacy Theory, regarding an individual's belief in their ability to enact behaviours, which are needed to arrive at a certain outcome (Table 4.2).[158] While Bandura's theory is focused on the individual, it can be postulated that when individuals are part of a collective, this helps the individuals believe they can be effective together and so group-efficacy could be achievable at a lower threshold than on an individual level. These theories help to explain that if network members believe that they collectively have the ability and resources, such as a collective identity, to solve the identified problem, they are more likely to do so. This moves potential network members from identifying a problem with the intention to do something about it to taking action towards solving the problem.

3A	In a bottom-up network, when potential network members realise they alone are unlikely to be able to solve a problem (context), they will recruit likeminded colleagues for their cause (outcome) because they believe collective action is needed (mechanism)
3B	While in a top-down/more directed network, when health system administrators or managers realise that they need diverse health system actors to be able to solve the problem/meet the target (context), they will recruit/mandate/encourage colleagues they perceive to be capable to their cause (outcome) because they believe that collective effort/action is needed (mechanism)
3C	When potential network stakeholders think collective action is needed to solve the identified problem (context), they will seek out other individuals with common experience or perspectives (outcome), because they believe such people may be willing to help them (mechanism)
	"In 2013, in the face of the ongoing challenge to reduce maternal death, the head of the Obstetrics and Gynecology (Ob/Gyn) Department at QMMC decided to take a proactive approach by designing a program to decongest the maternity ward with the aim of improving quality of care and outcomes. The Quirino Recognized Partners (QRP), as a Network of Care, identified public and private lying-in clinics within first a seven, then a ten-kilometer, radius around the hospital. These were identified as potential "spokes" in a hub-and-spoke model. Identifying clinical sites to partner with was the first step in the process of creating a group of intentionally interconnected maternity care touch points within a defined catchment area. This group, the nascent Network of Care, defined common goals while distributing maternity cases rationally among the facilities and to achieve better outcomes for the women and newborns in their care. QRP is a public–private partnership, uniting the public hospital, some public health centers, and a host of private birth centers run by entrepreneurial midwives. Together, the partners distribute maternity cases by risk profile and location, communicate fluidly, and share monitoring information to track performance of the Network of Care." (Vergara et al 2020)
3D	When members in an established network have access to resources that will help them solve the problem they have identified (context), they may be more prepared/more likely to intend to take action (outcome), because they believe they have a more realistic chance of success (mechanism)

Table 4.5 CMOCs for Taking action to solve a problem.

Developing purposeful relationships, linkages, and partnerships

Purposeful relationships are at the heart of a network, and in a well-functioning network, health system relationships, linkages, and partnerships are likely to be purposeful and strong. Networks can thus potentially solve an important health systems problem: "health systems are inherently relational and so many of the most critical challenges for health systems are relationship problems."[16] The relationships reinforced and built while forming a network, particularly one from the bottom-up, can support improvements in service delivery.[65] Additionally, these relationships, linkages, and partnerships within the network are grounded in the network's collective vision.

This next phase of the programme theory begins with understanding how networks develop purposeful relationships, linkages, and partnerships. The purposefulness with which these relationships are formed differentiates network relationships from standard health system or programme interactions. When relationships, linkages, and partnerships are formed with purpose around an aim, they can support the health system to provide care and services in a way that it might not be able to otherwise. For network members to ensure that they have necessary and functional relationships, they need to adhere to and believe in the network's collective vision, be willing to develop relationships, and have the time to invest (CMOCs 4A, 4B). The existence of prior relationships can be useful to develop deeper network relationships because network members are familiar with each other, but it is not a pre-requisite (CMOC 4C). However, there are examples of how a lack of pre-existing relationships are a hinderance to network functioning. The existence of artefacts, such as documented MoUs, roles and responsibilities, and procedures and processes, may help network members create and sustain the right kind of relationships (CMOC 4D). While some relationships may exist prior to the development of the network, the network creates opportunities to strengthen these existing relationships and establish new ones through, for example, trainings with network members from different cadres or locations (CMOC 4E).

Purposeful relationships, linkages, and partnerships developed through the network can help to improve communication between network members (CMOC 4F). When relationships are created through mutual understanding or collective vision, they can help to bridge gaps between network members, as well as between network members and external stakeholders. Mutual understanding helps them overcome differences and bridging the gaps between network members can help them become engaged, motivated, and part of a collective identity. It is important for the network to have productive relationships with external stakeholders to prevent them from acting, as Smelser referenced, as a 'social control mechanism' that inhibits the development of the network or implementation of network activities (CMOC 4G).

Tuckman's Small Group Development Theory's stages of forming helps explain the process of network members coming together and developing initial network relationships (Table 4.2). As network members orient themselves with other members and the network, they establish new ties between each other and with the network leadership; these ties signify a shift from potential network members to a network group with shared social capital. New Social Movement Theory's Collective Identity Approach[153] and Organisational Culture Theory[159-161] (Table 4.2) argue that pre-existing relationships are important to form a collective identity and culture. This lends itself to forming productive network relationships, however successful relationships can be formed without pre-existing relationships through the process of forming as described by Tuckman.

4A	When network members believe in the network's collective vision (context), then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because they are more willing to work with and value working with people whom they identify as being likeminded (mechanism)
4B	When network members are open to and able to invest time in developing relationships and linkages through the network (context), then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because they have a better understanding of each other (mechanism)
4C	If network members have strong pre-existing relationships (context), then this helps ensure that network members have purposeful and co-operative working relationships (outcome) because they are already familiar with each other (mechanism)
4D	If there are artefacts in place that outline the roles and responsibilities of network members (context), then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because there is a common understanding among network members about what they are expected to do (mechanism)

4E	When a network creates opportunities for relationship building between network members (context), this may help in the creation of purposeful and co-operative working relationships and improve existing working relationships (outcome) because they get to know each other's personality, skills, ways of working, and motivations better (mechanism) *"The informants perceived that joint training meetings had an impact on interactional factors, since personal knowledge between physicians was allowed; thus, collaboration was favoured: "This close relationship among people working here is fostered, because we no longer perceive them so distant…we perceive them as members of the same team…attitude towards the patient changes when you know that he is received by someone you know" (Professional Platform/Primary Care)." (Lopez-Vazquez et al 2021)*
4F	When network members have established purposeful relationships (context), this helps to improve communication between network members (outcome) because they are familiar with each other (mechanism)
4G	When purposeful linkages and strong working relationships are established between network members or between network members and external stakeholders (context), this bridges gaps between network members or network members and stakeholders (outcome) because of mutual understanding (mechanism)

Table 4.6 CMOCs for Developing purposeful relationships, linkages, and partnerships.

Network Leadership

Leadership is an essential part of the network and can "help overcome some of the 'wicked problems' inherent in achieving changes at scale, particularly if they can effectively engage sets of practice leaders who together embrace the change efforts."[132] Network leaders are often described as needing to be "visionary, strategic, and trusted"[57] and have soft skills.[129] According to Tuckman's Small Group Development Theory, leadership emerges during the forming stage when a group may have an initial dependence on the leader (Table 4.2).[154]

While there is not one standard leadership model across networks, for the purposes of this programme theory, it is important to understand what leadership does within a network to set it up and keep it going; what they do to make sure that the network achieves its aims; how networks cultivate and grow leadership; and leadership challenges or blockages to network initiation and functioning. Furthermore, network leadership plays an essential role in supporting the establishment of a psychological safe space, which is discussed in a later part of the programme theory.

Network leadership plays an important role in setting-up a network and supporting its ongoing functioning. They have an operational and organisational role to play, including project management, coordination, convening meetings, and implementing workplans. Network leadership builds linkages and

relationships within networks and between the network and external stakeholders. They have a central role in both formal and informal communication internal and external to the network (CMOC 5A). Network leaders are responsible for communicating the network vision and principles, as well as acting as knowledge brokers (CMOC 5B). Leadership also plays a supportive role towards network members, for example by providing feedback and supporting collaboration (CMOCs 5C, 5D).

Network leaders play an important role in the implementation of network tasks and activities through network coordination, dedicating time to the network, and showing that they can get things done. This can engage and motivate network members because it fulfils their need to feel that they are involved in something positive (CMOC 5E). When network leaders dedicate time to support the formation and the ongoing functioning of the network, they may encourage network members to become more committed, engaged, and/or motivated (CMOC 5F). When network leadership actively engages their members in network activities, this can support a network to become more successful (CMOC 5G).

Network leadership helps members achieve what the network was set-up to do by providing support; influencing, championing, promoting, and encouraging practices; mentoring and providing feedback; and creating a positive environment that makes members feel part of a network and allows them to fulfil a latent desire to practice better (CMOCs 5H, 5I). The literature indicates that there are different activities and behaviours that leadership can use to create a welcoming and inclusive environment for network members, for example, senior clinicians checking-in with providers about patient care and offering help, providing encouragement and support, and recognising network members (CMOC 5J).

It is also important that as networks grow, they cultivate leadership. Networks can be used to develop leadership at different levels of the health system. When networks initially form, they often have dynamic and engaging leadership. Overtime, the network will need to cultivate leadership throughout the network to support its ongoing functioning. In some networks, having distributed leadership may be important for optimal network functioning and success (CMOC 5K).

Leadership can present challenges to network initiation and functioning. When a network relies too much on the presence or vision of one network leader, this can hinder a network's development, functioning, and sustainability (CMOC 5L). Similarly, an important role of a network leader is to get network members to develop and agree upon a shared vision, and if they are not able to do this, then the network might not function optimally, and network members might not be engaged (CMOC 5M).

The literature on social movement leadership is an underdeveloped area of Social Movement Theory. Historically, social movement leadership has been conceptualised as a charismatic and bureaucratic authority and there is often a lack of differentiation between authority structures, leaders, and movement members' interactions in the exercise of leadership.[162] Smelser's Theory of Collective Behaviour states that social movements need engaged leaders to provide the movement with a sense of direction (Table 4.2).[149] Ganz (2010) suggests that social movement leadership can be understood as "accepting responsibility to enable others to achieve shared purpose in the face of uncertainty"[163] (Table 4.2). This form of leadership is enacted through five practices: relationship building, storytelling, devising strategy, structuring social movements, and catalysing action,[163] which resonate with aspects of leadership in networks. For example, network leaders have an important role in facilitating relationship building within the network and communicating the network vision (storytelling). Network leaders are central in the organisation and operation of networks, which can be considered akin to structuring social movements, and motivating network members to take action (catalysing action). Ganz also highlights the importance of leadership development in social movements,[163] and the cultivation of leadership throughout a network is essential to support its ongoing functioning.

5A	When networks have a member(s) that clearly takes on a leadership role, focuses on building linkages between potential network members and stakeholders, and creates communication channels (context), this helps the network to form (outcome) because it brings people together (mechanism)
	"Participants were unanimous about the critical importance of the role of the network manager in contributing to network success. Participants from the high- and moderate- impact networks frequently attributed the success of their network to the work and skills of the network manager. As well as project management, communication, organisational, coordination and leadership skills network managers also needed high credibility, be able 'to talk the language of networks', that is to communicate the vision and

	principles of networks to a range of clinical and policy stakeholders, and to have good interpersonal skills. To lay the groundwork for later success the network manager had to 'hit the ground running' in the early stages of a network's development. One participant attributed the success of their network to the activities of their network manager in the early stages of the network's history: They built links; met with all key players and created formal and informal communication channels between diverse bodies. Effective network managers also: Provided a hub around the network's clinical specialty and engaged with key stakeholders and the broader clinical base formally and informally." (McInnes et al 2015)
5B	When networks have a member(s) that clearly takes on a leadership role, communicates the network's vision, and helps to set collective goals (context), this helps to bring network members around the collective vision and to move forward in the same direction (outcome) because they have the same understanding (mechanism)
5C	When networks have a member(s) that clearly takes on a leadership role and actively coordinates network members (context), this helps the network to form (outcome) because there is a central figure bringing people together (mechanism)
5D	When networks have a member(s) that clearly takes on a leadership role and provides support and feedback to network members (context), this can help the network function and take more appropriate action towards the identified problem (outcome) because network members are engaged and see what they need to do to help achieve the vision (mechanism)
5E	When networks have a member(s) that takes on a leadership role and gets things done (context), network members develop greater commitment, engagement, and/or motivation (outcome) because they believe belonging to the network is worthwhile (mechanism)
5F	When networks have a member(s) that takes on a leadership role and dedicates time to setting up and the functioning of the network (context), network members develop greater commitment, engagement, and/or motivation (outcome) because they believe belonging to the network is worthwhile (mechanism)
5G	When networks have a member(s) that clearly takes on a leadership role and actively engages network members (context), network members develop greater commitment, engagement, and/or motivation (outcome) because network members feel part of the network (mechanism)
5H	When network leadership consistently and regularly supports and provides resources to network members (context), this helps network members act to achieve the network's collective vision (outcome) because the network members feel empowered (mechanism)
5I	When network leadership consistently and regularly promotes, encourages, or champions practices, or influences network members to take up certain practices (context), this helps network members to adopt these practices (outcome) because it allows network members to fulfil a latent desire to practice better (mechanism)
5J	When network leadership creates a welcoming and inclusive environment within the network (context), members feel more able to critically discuss issues and suggest possible solutions (outcome) because network members feel that they are in a psychologically safe environment (mechanism)
5K	When networks have processes in place to identify and enable those with the necessary skills, motivations, or attitudes to take on leadership roles (context), this may support network functioning and may lead to changes happening (outcome) because the network can draw on a wider pool of engaged resources (mechanism)
5L	If a network is highly dependent on a few people to implement network activities (context), then it is at risk of being unsustainable (outcome) because of burnout and/or loss in those tasked with implementation (mechanism)
5M	When network leadership is not able to get the network to develop and agree on a shared vision (context), then it is at risk of not performing well and becoming unsustainable (outcome) because members are unclear as to what the network is for (mechanism)

Table 4.7 CMOCs for Network Leadership.

Building a network identity and culture

A network develops an identity and culture throughout the process of network initiation and it continues to evolve as the network shapes itself through working to solve the identified problem. The existence of a network identity and culture may facilitate commitment to the network.

This part of the programme theory looks at how as network members coalesce around a collective vision to solve the identified problem, a distinct network identity and culture emerges. Some elements of the network's identity are driven by their collective identity, which comes from common experiences and emotions and developed common perspective or understanding, but the network also needs to create opportunities to enable the identity and culture to grow. A network's culture and identity are not static and they will evolve over time as the network matures and attempts to tackle different problems (CMOC 6A). Network members' identification with a network can be a motivating factor for wanting to belong (CMOC 6B). A network identity can then form when network members identify with each other and the network vision (CMOC 6C). As a network establishes itself, it begins to create a network culture. This culture is based on the network identity developed among network members when they connect, share experiences, and learn from each other in an open and safe environment (CMOC 6D).

The development of a network identity and culture starts with a sense of collective identity. A shared identity emerges between network members from common experiences, perspectives, or understandings. Collective identity facilitates the development of a collective vision and may help to explain why people choose to participate in a network, particularly if there are no clear extrinsic motivations. According to New Social Movement Theory's Collective Identity Approach, people join social movements because they believe in the movement's aims, but also because they identify with the movement, which becomes part of their individual identity, and with time the movement develops its own collective identity[151-153] (Table 4.2). The same could be said for networks. A network forms a new identity that is specific to and distinguishes the network from other groups with which network members may be affiliated. The network

identity does not replace existing identities of network members but adds a new layer of a collective professional identity. It is from this network identity that the culture of the network grows.

A network culture can replace existing 'negative' cultures within health facilities or organisations to which network members belong. These pre-existing cultures may not align with the network's collective vision to solve the identified problem. Existing cultures may in fact be a cause of the identified problem. When network members are motivated by the collective vision, the network might need to shift existing cultures in the network to create a network culture that is in line with the collective vision (CMOC 6E).

It takes time and deliberate effort on the part of network members and leadership to form an organisational culture because there needs to be stability and common history among members. An organisational culture can be described as a "set of shared mental assumptions that guide interpretation and action in organizations by defining appropriate behavior for various situations"[161] (Table 4.2). It helps members make sense of and give sense to what the organisation is about. Pre-existing relationships can help develop a network culture, which develops over time as members solve both internal and external problems. If a network lacks a culture, members might not want to remain.

Tuckman's Small Group Development Theory's stages of forming (orientation and development of relationships) and norming (developing cohesiveness, new standards) also support explaining network identity and culture development[154] (Table 4.2). The process of network members coming together and developing relationships, i.e. forming, is necessary for them to develop a specific identity and culture. This leads into the norming phase when network members feel a sense of belonging to the network, facilitated by its collective identity and culture. The network identity and culture are tangible manifestations of the collective vision that can be vehicles for network recruitment and spread the network's norms.

6A	When network members with a collective identity come together to solve a shared problem (context), this makes them feel fulfilled (outcome) because of a sense of shared purpose (mechanism)
6B	When network members feel fulfilled from working with likeminded people in a network (context), they want to belong to the network (outcome) because they feel it is worthwhile (mechanism)
6C	When network members identify with other members and the network's vision (context), they develop a network identity (outcome) because it gives them a sense of purpose (mechanism)

6D	When a network creates opportunities for members to connect, share experiences, and learn from each other in an open and safe environment, (context), this creates a positive network culture and a feeling of belonging to the network (outcome) because they feel respected and valued (mechanism)
6E	When network leadership and members identify that the network's culture is not aligned to existing cultures (context), then they may attempt to change the pre-existing cultures and instil a culture (outcome) because they do not identify with the existing ones (mechanism)
	"These various changes were associated with a new culture of engagement with clinical guidelines and the intensification of in-service "drills," providing the software mechanisms which brought the pre-existing hardware strategies to life: It has also sensitized people about using the guidelines. People had guidelines but they were kept in the drawers, they were kept in the offices, locked up there … it has cultivated a culture of reading, reading the guidelines and discussing the guidelines. (DCST member)" (Schneider et al 2020)

Table 4.8 CMOCs for Building a network identity and culture.

Commitment

Commitment to the network is necessary for the network to be able to solve the identified problem and ensure the sustainability of network changes and impact. For a network to function and enact the collective vision, commitment is needed from network members and often from outside stakeholders as well. The network's collective vision, identity, and culture may facilitate commitment to the network. A network's leader may also play a role in gaining commitment from network members.

This phase of the programme theory starts with understanding how to harness commitment from network members. When networks form from the bottom-up, support from leadership and the co-creation of a network vision and goals exemplify how to get commitment from network members. The existence of shared experiences and perspectives among network members may also facilitate their commitment because the network's collective vision, identity, and culture has grown from these same shared experiences and perspectives. When network members see the network's value and use, especially if it aligns with their own concerns or views on change, they may increase their commitment to the network. Network members in top-down formed networks may also identify with the network's collective vision, identity, and culture due to shared experiences and perspectives (CMOC 7A). When networks are formed from the top-down, institutional support may help to ensure commitment of time and resources to implement network activities and the participation of network members (CMOC 7B).

Committed network members are more likely to take action on the identified problem and adhere to and enact the collective vision. Committed members enable networks to have improved coordination, communication, and data use for clinical care (CMOC 7C).

Health system stakeholders not part of the network may also play an important role in the ability of a network to develop, function, and achieve success. When these stakeholders are committed to the network, it is easier for the network to form and function and the stakeholders are less likely to exert the 'social control mechanisms' described by Smelser that constrain the direction or growth of a movement[148] [149] (Table 4.2).

Networks employ various techniques to generate commitment from non-network stakeholders, for example, by establishing MoUs, incorporating network activities into government policies and plans to mobilise local funding, advocacy by network leadership, meetings, and information sharing. Additionally, prior relationships that fostered trust between network members and outside stakeholders can generate network commitment from outside stakeholders. If outside stakeholders are not committed to the network, this can have a negative effective on network development and functioning (CMOC 7D).

When outside network stakeholders are committed to the network, they are more likely to support its functioning and the sustainability of network initiatives, sometimes extending them to additional geographies or leveraging additional resources. For example, local governments recruit and contract healthcare workers and invest in infrastructure, drugs, and materials for facilities in the network. They may also take ownership of network initiatives, such as a data collection system that can be expanded beyond the geographic boundaries of the network (CMOC 7E).

Organisational commitment is defined as the "strength of an individual's identification with and involvement in a particular organisation" and is characterised by belief and acceptance of the values and goals of the organisation, willingness to expend effort on the organisation's behalf, and a desire to stay with the organisation[164] [165] (Table 4.2). If a network has a collective vision, network members are more

likely to be aligned and committed to the network. A network approach may be a way to improve larger organisational commitment because it brings value and purpose based on the collective vision to what might otherwise be a sub-optimally functioning system. However, there could be potential unintended consequences of less diversity of opinion if the network only brings in people with similar experiences, perspectives, and understandings, though those with similar experiences could still have different perspective and understandings.

Organisational Commitment Theory (Table 4.2) posits that various factors affect commitment to an organisation, including the environment, positive and purposeful relationships and connections, and structure. Networks can be a means to recognise network members, which may increase their motivation and subsequently augment their commitment to the network. Previous engagement among stakeholders may support ownership of network activities,[129] as well as strong and engaged network leadership.

Organisational Culture Theory (Table 4.2) argues that an organisational culture creates a sense of belonging to the organisation, which may be a reason why people decide to commit to the network. When there is an alignment between the network culture and personal values and identities, this may also facilitate commitment and network functioning.[166]

Collective commitment might also be formed during Tuckman's stages of 'forming' and 'storming'[154 155] (Table 4.2). When network members come together to figure out how they are going to work together, this can be a basis for garnering collective commitment. Network members that participate in these stages of network development might feel more or easier network commitment than if they joined at a later stage.

7A	When network members identify with the network's collective vision, identity, and culture (context), they are more likely to be committed to the network (outcome), because they believe in and value the vision, identity, and culture (mechanism)
7B	When networks members have support from leadership/administration/stakeholders (context), they are more likely to be committed to the network (outcome), because they feel valued (mechanism)
	"The 'institutional support' of network managers emerged in all five countries as the main organizational factor that influenced implementation of the interventions... In Chile, and in Brazil with the occasional interruption, it was identified as a facilitator that remained stable throughout the process. In Mexico, it

	was strengthened following political change; in Colombia, it was weakened; and in Uruguay, it remained frail. It was considered key in terms of whether the resources needed (professionals' time and materials) were available to implement the interventions (and in Brazil and Mexico also to solve operational problems…): '...there was support from the managers to protect these (allocated project) schedules, that normally doesn't happen with this kind of more low-scale project' (Professionals' inter-level working group, Chile); As for the managers, there was no interest. Not little interest, no interest! There should have been more coordination on our part, more involvement, because it depended exclusively on us (Healthcare manager, Colombia)." (Vargas et al 2 2020)
7C	If a network has committed members (context), then they are more likely to act on their identified problem and collective vision (outcome) because members are willing to put in the energy and effort (mechanism)
7D	When influential outside stakeholders are actively engaged in network processes (context), then they are more likely to be committed to the network (outcome) because they can be helped to understand the collective vision of the network (mechanism)
7E	When influential outside stakeholders are committed to the network and actively engaged in participating (context), then it may be easier for the network to achieve its aims (outcome) because network members feel empowered (mechanism)

Table 4.9 CMOCS for Commitment.

Engaged and motivated network members

Engaged and motivated network members are key to ensure network functioning and that the network meets its goals. A network does not necessarily need financing to run but without active network members who dedicate time to the network, it will not get off the ground.

Networks create various opportunities for network members to become engaged and motivated. For example, network meetings provide opportunities to discuss audit reports, collectively identify problems and solutions, and build soft skills. Clinical improvement and learning opportunities, such as mentoring, professional development, clinical education, and learning from other network members, also help to develop motivated and engaged network members. Financial incentives and non-material incentives, like the recognition of good performance, can be motivational factors. Network leaders that improve management practices, are in boundary spanning roles, or rotate leadership can bring legitimacy and value to the network, thus encouraging participation and engagement.

Network members may be engaged and motivated to be part of the network when they feel like they are getting something out of it, demonstrating continuance commitment. However, if the network does not provide extrinsic motivations, network members are less likely to be committed to the network and its activities. When network members feel an emotional connection to the network or their personal identity

aligns with the network's identity and culture, they are likely to be committed to the network, exhibiting affective commitment (CMOCs 8A – 8C).

If network members' professional values or normative beliefs align with a network's vision, identity, or culture, for example a vocational or professional calling or peer group norms, they will exhibit normative commitment to the network. The existence of a shared goal can engage and motivate network members, bringing out their normative commitment to the network. However, if the network members do not have the resources that enable them to change practices, they cannot enact their vocational calling and this can demotivate them. Or, if network members feel they cannot live out their normative attachment because they do not feel they have the power to change practices, this can be demotivating and weaken commitment (CMOC 8D).

When a network shows its members that it can affect change, this motivates members to be part of the network because they can see results and the value of what they are committing to (CMOC 8E). When network members are engaged and motivated participants in a network, this can support the implementation of activities to bring about change (CMOC 8F).

Network members' commitment to a network will be an indication of the extent of their motivation and engagement. Organisational culture (Table 4.2) plays a role in getting and keeping network members engaged and motivated. Organisational Commitment Theory (Table 4.2) explains three types of commitment: affective, continuance, and normative.[167] Network members who have affective commitment will have stronger engagement and motivation to participate in the network because their goals and values align with the network, which can be extended to the network vision, identity, and culture, and a desire on the part of the individual to be part of the network. A network culture can generate a sense of belonging to the network and be a reason why network members are committed.

Some network members may take part because of a moral obligation, which may stem from a professional or vocational calling; with this normative commitment, they will also be engaged and motivated. If

network members feel normative commitment to the network, they might feel morally obliged to commit to the culture. Similarly, if the source of normative commitment is a peer group norm, it may be hard for individual network members to reject the peer group norm and not commit to the network.

Affective and normative commitment will create engagement with the network and motivation to be actively part of it and work towards the collective vision. Since networks have a collective identity, network members may be motivated to participate even without material incentives or coercion; the identity itself is an appealing incentive, according to the Collective Identity Approach from New Social Movement Theory[152 153] (Table 4.2). However, a network member who has a continuance type of commitment to the network may be engaged or motivated because they get something from the network but will not be committed if they are faced with what they feel is a better option.

Collective Intelligence Theory[168] may explain the extrinsic and intrinsic motivations of network members (Table 4.2). When network members are affectively or normatively committed to the network, they are more likely to have intrinsic motivations for participating in the network. If there is a network culture that network members feel like they belong to, either because it aligns with their beliefs or they feel a moral obligation to it, then they will be affectively and normatively committed to the network and therefore be intrinsically motivated. If network members are intrinsically motivated, they may be more likely to stay with the network and more positively contribute to its formation and functioning. However, if network members have continuance commitment to the network, they are more likely to be extrinsically motivated and may leave, if they find something that better motivates them either intrinsically or extrinsically; they have the weakest commitment to the network.

8A	When network leadership provides opportunities for network members to be supported, recognised, and learn (context), this creates engaged and motivated network members (outcome) because they derive direct benefits (mechanism)
8B	When a network member gets 'emotional' benefits (positive feelings) or feel a sense of purpose from being part of the network (context), they are likely to be highly committed (outcome) because it is fulfilling for them (mechanism)

8C	When network members' personal identity strongly aligns with a network's identity and culture (context), then this will result in engaged and motivated network members (outcome) because they feel they belong (mechanism)
8D	When network members actively participate in network change practices that align with the professional values they live by (context), this creates engaged and motivated network members (outcome) because it helps them to fulfil their moral obligation or vocational calling (mechanism)
	"Many doctors and nurses we interviewed were motivated by providing good patient care—"the most satisfying thing about my job is when I see my children [patients] going home healthy" (Paediatrician, 10)—and/or developing younger colleagues—"the satisfying thing has been teaching younger colleagues; to see the transformation from a doctor who had just learnt the theoretical knowledge to actually being able to apply it at the bedside" (Paediatrician 11)." (McGivern et al 2017)
8E	When a network can show its members that it can affect some change (context), members are more likely to continue their engagement with it (outcome) because of they can see its value (mechanism)
8F	When engaged and motivated network members are provided with the resources and opportunity to act (context), then they will attempt to enact changes in practices (outcome) because they feel empowered to change practice or work towards solving the problem (mechanism)

Table 4.10 CMOCs for Engaged and motivated network members.

Creating a psychological safe space

Psychological safety (Table 4.2) describes "individuals' perceptions about the consequences of interpersonal risks in their work environment."[169] A psychological safe space has "a climate in which the focus can be on productive discussion that enables early prevention of problems and accomplishment of shared goals, because people are less likely to focus on self-protection."[169] It promotes team learning, improves team performance, dictates how valued and comfortable team members feel, and facilitates collaborative work, particularly navigating uncertainty and change.[169] When a member of a group feels psychologically safe they feel they can take action without fear of negative consequences. It can also lessen hierarchy.

Through the process of network development, a psychological safe space can be created. Network leadership plays an important role in enabling the network to create a psychological safe space. For example, network leaders can set a positive example and encourage network members to feel psychologically safe, helping to cultivate an equal and non-hierarchical network environment (CMOC 9A). Purposeful non-hierarchical relationships developed by network members are another foundation for network members to feel psychologically safe (CMOC 9B).

When network members have worked to develop a collective vision, identity, and culture, this creates a launching ground for the emergence of a psychological safe space. A network as a psychological safe space facilitates its capability to change practices because network members may be better able to improve the organisation of service delivery, ensure the presence of necessary infrastructure, provide effective mentorship and supervision, or feel empowered to provide high-quality care (CMOC 9C). When a network has created a psychological safe space, network members will be able to raise concerns or problems without fear of negative repercussion, will feel more comfortable being innovative, and will be better able to collaborate across the network. This is important because it can help network members change practices (CMOCs 9D-9F).

Edmondson (2004) describes several antecedents that can promote and influence the development of psychological safety: leadership, trusting and respectful horizontal relationships, opportunities to practice as a team, a supportive organisational environment, and informal group dynamics.[169] Psychological safety is more likely to be created in a network that has formed from the bottom-up because there is more natural commitment to the collective vision and likely less institutionalised hierarchy or imposed leadership. When a group has psychological safety it impacts learning, improvement, and feedback-seeking behaviours, enables members to raise concerns or problems without fear of reprisal or embarrassment, encourages innovative behaviour and innovation, and fosters boundary spanning.[169]

Psychological safety is important in the work environment in order for employees to feel secure and be able to change their behaviour.[170] A network aims to create a psychological safe space with its engaged and motivated network members who are committed to a collective vision. The identity and culture developed by network members can facilitate the development of a psychological safe space because network members already have common ground and understanding. When network members feel psychologically safe, they are more equipped to work towards changing practices. If a network is not a psychological safe space, then it will be less likely to solve the problem it set out to achieve.

9A	When network leadership is available and approachable, invites input and feedback, and models openness, fallibility, and non-judgmental behavior (context), then this promotes a network's psychological safety (outcome) because network members feel empowered and not threatened when they speak up or make a mistake (mechanism)
	"The network is led by inspiring, dynamic leaders. Many participants credited the leadership with creating a positive, empowering culture. Several participants described this as the result of equal and non-competing power dynamics, enabling the team to function optimally: "…we don't have that hierarchical structure, we have more of a flat line I believe, when it comes to the allied health professionals and physicians in our model. There is that flat line respect and a flat line understanding that there's a fit, you're doing what is helping me, right. It's like part of it, you're part of the team" (Provider FG #2)." (Sibbald et al 2020)
9B	When network members form trusting and respectful horizontal relationships (leading to flattened hierarchy) (context), then this promotes a network's psychological safety (outcome) because network members feel equal (mechanism)
9C	When a network has a shared network identity and culture that promotes a psychological safe space (context), then network members are more likely able to learn, improve, and seek feedback (outcome) because they feel empowered and feel a reduced fear of negative consequences (mechanism)
9D	When a network is a psychological safe space for network members (context), it enables members to openly raise concerns or problems (outcome) because they know they will be supported and there will not be negative repercussions (mechanism)
9E	When a network is a psychological safe space for network members (context), it encourages innovation and innovative behaviour (outcome) because members know they will be supported and there won't be negative repercussions (mechanism)
9F	When a network creates a psychological safe space for network members (context), it enables them to more easily collaborate across the network's facilities, levels, and sectors of care (outcome) because they already have a common ground and understanding (mechanism)

Table 4.11 CMOCs for Creating a psychological safe space.

4.4 Discussion

4.4.1 Summary of findings

My Realist Review developed and refined a programme theory, presented in Figure 4.4, that provides an explanation of how and why networks are initiated, form, and function in a way that enables them to change practices. The programme theory is supported by 58 CMOCs and 10 substantive theories to further understanding of the underlying mechanisms and interactions of context that produce the observed outcomes – steps to initiate and set up a network so that network members can change practices. While I present the findings in a linear way, in practice the phases of the programme theory may happen in parallel, overlapping, or in different orders.

4.4.2 Strengths and limitations

The amount of rich data that I identified to support the CMOCs and refine the programme theory is a strength of my review, suggesting that the explanatory insights are supported by relatively strong evidence. Additionally, the use of several substantive theories helped to support retroductive reasoning to infer mechanisms where needed. The formation of a stakeholder group to provide insights at different phases of my review also increased its robustness.

My Realist Review had several limitations. Compared to the breath of literature on health system networks identified in my Scoping Review[139] (Chapter 3), I included a relatively small proportion of that literature. This is because much of the literature reports on the clinical outcomes the network produced and not the details of how and why network members formed and ran the network. Therefore, there may have been useful examples of networks that I excluded because of the dearth of information that was reported on their formation and functioning.

There are 16 CMOCs for which I have less confidence in the strength of the knowledge claim. For CMOC 2D, I was unable to identify supporting data from the literature, however, the CMOC makes logical sense in the programme theory and the progression of the explanations. There are 15 CMOCs that have only one supporting source of evidence. For these CMOCs, I undertook an appraisal (Appendix 4C) to assess the credibility of the methods used to generate the data, thus helping to inform the confidence that I might have in these CMOCs.[171] The outcomes of the appraisals did not necessitate any qualifications on the relevance of these CMOCs. However, there are limitations with appraisal: the subjective nature of quality, the existence of multiple tools for the same type of study, and the dependence on the detail of the reported information for appraisal.[129] Furthermore, there was one source—a reflective piece—for which an appraisal tool does not exist.

I included relevant HIC literature to support LMIC literature and to fill in gaps where there was a dearth of evidence from LMICs. There are six CMOCs supported by only HIC literature. There are a number of limitations related to the selected HIC literature. First, I included HIC literature in my Scoping Review

(Chapter 3) because it was returned during that search process or I was already aware of the literature and believed it to be relevant to LMICs. As I did not systematically search the HIC literature, there may be relevant HIC literature to the programme theory that I missed. Secondly, Realists argue that mechanisms may be transferable because 'people are people' and while the relevant mechanism for some CMOCs were inferred from the HIC literature, the contexts that trigger the mechanisms may be different in LMICs.[97] The strength of the knowledge claim for these CMOCs is therefore less certain because of the lack of LMIC supporting data needed to better understand these mechanisms and the contexts that trigger them, which may be similar or different across LMICs and HICs. Furthermore, the substantive theories are drawn mostly from empirical research and sociological and organisational thinking in HICs. As I used these theories to further explain CMOCs developed mainly from LMIC literature, there is a possibility that with these theories I may have identified mechanisms that are not relevant to LMIC settings. This is a persistent problem with theories and why I planned a Realist Evaluation (Chapter 5) to collect primary data in a LMIC to test the programme theory.[172] The fact that there are a subset of CMOCs with limited evidence suggests that there are areas where further primary research on networks is needed that employs approaches that bring explanations of how and why networks form and work in the ways that they do.

Despite the inclusion of literature from HICs, three-quarters of the literature was from LMICs and therefore, it is reasonable to assume that my findings are relevant to LMICs. Mechanisms, as conceptualised in Realist research are assumed to be widely occurring causal forces and hence may be found to operate in HIC as well as LMIC settings and visa-versa, though they are context dependent.[173] For example, CMOC 5K "When networks have processes in place to identify and enable those with the necessary skills, motivations, or attitudes to take on leadership roles (context), this may support network functioning and may lead to changes happening (outcome) because the network can draw on a wider pool of engaged resources (mechanism)" is supported by data from networks in Australia, Kenya, and South

Africa. In Chapter 5, my Realist Evaluation results explain if these mechanisms are, as assumed, operating more widely.

I did not investigate or refine the second part of the programme theory, the network change theory, to the same extent as the network initiation theory. This was due to the size and complexity of the programme theory, the need to focus to achieve a greater depth of analysis, and the theory's focus on topics where there is more existing research, for example teamwork and communication. Furthermore, this part of the programme theory is more subject to the 'social control mechanism' explained in Smelser's theory of collective behaviour (Table 4.2) and therefore may be less under the influence of the network members. However, there is still work to be done on this section of the programme theory within the contexts of health system networks in LMICs; for example, trying to better understand the 'social control mechanisms' that may influence the network and the role that power plays in networks. The role of power may be particularly relevant for networks with regards to network leadership, the forming of relationships, and the creation of a psychological safe space.

Examples of networks in the literature are mostly successful examples and therefore a limitation of my review is that there is insufficient information on when things do not work. Only four parts of the programme theory had negative CMOCs (developing a collective vision, leadership, commitment, and engaged and motivated network members). So, while networks may be a useful approach, there may be challenges and unintended consequences. As networks with challenges may fail and are likely not reported, people do not know what caused them to fail and therefore cannot take those things into consideration when forming networks. One potential unintended consequence of networks is that they may encourage groupthink.[174] [175] [176] Networks need buy-in and commitment to the collective vision, identity, and culture and this often comes from having similar experiences and perspectives. Those with different perspectives may be deterred from participating in the network or within a network may be hesitant to provide opposing ideas. This could lead to network members being reluctant to accept new

ideas and change and subsequently potentially limit a network's ability to evolve, be resilient, and achieve its goals.

Additionally, because I drew from network examples in different countries to develop the programme theory, I was not able to take into consideration specific socioeconomic, cultural, and political factors for the different settings. As my review was focused on the relationships and interactions between network members that lead to the formation and functioning of a network, I only considered meso- and macro-level factors when they were relevant to the causal explanations within the programme theory, as other reviews have.[177 178] However, socioeconomic, cultural, and political factors, among others, may play an important role in network formation and functioning and my Realist Evaluation (Chapter 5) provided an opportunity to consider some of these factors in the programme theory.

4.4.3 Comparison with the existing literature

There are few studies employing a Realist approach to understand a network. Aunger et al (2022) undertook a Realist Review and Evaluation of inter-organisational collaborations, which included networks between different organisations as well as mergers, strategic alliances, joint ventures, and buddying collaborations.[141 142 179] While the review included, but was not specific to healthcare, and focused mainly on examples from the United Kingdom, the authors touch on some similar themes, such as trust, leadership, culture, stakeholder involvement, information exchange, and communication.[141 142] Their programme theory's main focus was on linkages of trust to risk tolerance and faith as drivers of collaborative behaviour for the functioning of organisational collaborations. [141 142 179] In contrast, my programme theory considers a detailed progression of what is needed for network initiation and functioning.

My findings resonate with the literature on network effectiveness, which also points to the need for a network to have a shared identity that starts with identifying a common problem. Network effectiveness literature posits that those involved in a network feel part of a community, which is similar to the network

relationship and psychological safe space phases of the programme theory. Additionally, they point to the emergence of a solution and mission, akin to the development of a collective vision related to the identified problem part of the programme theory.[39]

The programme theory also resonates with findings from networks beyond the healthcare literature, particularly education and public administration. Russell et al (2017) studied the evolution of network improvement communities in education.[180] These networks were also focused on a common goal or aim linked to an identified problem, how it was produced, and how it should be improved, and were intentionally designed to bring stakeholders together.[180] Russell et al developed a framework to guide the development of these networks which included "leading, organising, and operating the network" and "fostering the emergence of culture, norms, and identity consistent with network aims."[180] The authors found that "leadership in networks is rooted in the ability to foster commitment to a common vision and motivate others to engage with it."[180] Leadership, commitment, a common vision, motivation, culture, and identity are all key parts of my programme theory.

Findings from public administration networks touch on similar concepts as the programme theory. These networks also form because there is a problem with the status quo. Building relationships, trust, norms, and commitment are found to be central to the development of these networks.[60] The idea that network members realise they need to take collective action to solve the problem is also present.[23] It is possible that the programme theory can provide relevant insights for networks in other fields.

The substantive theories I drew from were mainly from the fields of sociology and organisational studies. This is because the CMOCs focus on the relationships and interactions of network members at the microlevel and how this supports network formation and functioning. I felt that the selected theories provided relevant explanatory value for understanding network formation and functioning. However, I could have also drawn from existing network theories, such as Social Network Theory. Concepts from Social Network Theory could be relevant for the programme theory, particularly homophily when looking

at group formation.[181] Social Network Theory may be more pertinent for comparing networks or a deep-dive into a network functioning and performance, which could be an area for future work.

In summary, this methods and results chapter presented the Realist programme theory that offers an explanation for how networks form and function in a way that sets them up to be able to change practices. Each phase of the programme theory indicates something that the network must go through to create committed, motivated, and engaged network members and leadership working in a psychological safe space. Network members are then able to change practices to improve quality of care and services. This programme theory provides an explanation for how many clinical and programmatic networks in LMICs form and work and why they work in these ways. The programme theory draws on the substantive theories from sociological and organisational studies fields to provide greater depth to the causal explanations. While there is limited Realist research on networks, I identified one Realist Review on inter-organisational collaboration that had resonating themes. Beyond the healthcare literature, several phases of the programme theory resonated with educational and public administration networks, implying that my findings may be relevant to other disciplines. The programme theory, developed in this phase of my DPhil, was tested in a Realist Evaluation on the Newborn Essential Solutions and Technologies programme network in Kenya for the third phase of my DPhil. My evaluation methods and results are presented in the next chapter.

5. Chapter 5. Methods & Results – Realist Evaluation: Developing an understanding of the processes involved in the formation and functioning of networks to change practices: learnings from a Realist Evaluation of the Newborn Essential Solutions and Technologies programme in Kenya

This final results chapter provides the background, rationale, methods, results, and a brief discussion of the third phase of my thesis, a Realist Evaluation. My Realist Evaluation tested the programme theory developed in my Realist Review (Chapter 4) through a multiple-methods case study of the Newborn Essential Solutions and Technologies (NEST360) programme in Kenya. The refined programme theory explains how a network evolves through three phases: Initiation & Formation, Functioning & Performing, and Sustaining Change & Impact through a set of dependent processes, activities, foundations, and cross-cutting factors. These complex components are important for the successful implementation of NEST360's programme activities, impact the success of the programme, and may sustain changes in practice that improve quality of care and service delivery for small and sick newborns.

5.1 Introduction

5.1.1 Newborn care

Despite a substantial decline in global child mortality over the last 30 years, significantly less progress has been made in the reduction of newborn mortality. Globally, in 2020, newborn deaths made up 47% of all under-5 deaths, up from 40% in 1990, as declines in under-5 mortality have outpaced declines in newborn mortality.[182] Sub-Saharan Africa has the highest rate of newborn mortality (27 deaths/1000 live births) and accounts for 43% of newborn deaths globally.[182] Newborn deaths are primarily due to preventable causes, such as preterm births and intrapartum complications, including birth asphyxia, infections, and birth defects.[182]

Globally, almost 80% of births are facility based.[182] While access to care still remains an issue, newborn deaths are mainly due to the quality of care provided. One million newborn deaths could be averted each

year in high-quality health systems.[183] However, health facilities lack the technologies, equipment, and trained staff needed to provide high-quality care for small and sick newborns.[184]

5.1.2 Newborn care in Kenya

In Kenya, while under-5 mortality notably declined by nearly two-thirds between 2003-2022 (from 115 to 41 deaths/1000 live births), newborn deaths only declined by one-third (from 33 to 21 deaths/1000 live births),[185] which is still well above the Sustainable Development Goal (SDG) target of at most 12 or fewer deaths/1000 live births by 2030.[186] 51% of all under-5 deaths occur during the newborn period[185] and over 50% of sick newborns lack access to a health facility able to provide appropriate care.[187] Improvements in the availability and quality of newborn care are essential to reduce newborn mortality, as 71% of newborn deaths could be reduced with high-impact low-cost interventions.[188]

5.1.3 Newborn Essential Solutions and Technologies

The NEST360 programme is a multi-country multi-stakeholder programme aiming to implement high-quality, safe, inpatient care for small and sick newborns. In phase one of the programme (2019-2023), NEST360 supported four countries, Kenya, Malawi, Nigeria, and Tanzania, with plans to support additional countries in subsequent phases of the programme. NEST360 works with governments, bi- and multilateral organisations, global health donors and organisations, civil society, academic institutions, and the private sector. The programme provides hospital in-patient newborn units (NBUs) with multifaceted support, including a bundle of medical devices (e.g. CPAP machines and radiant warmers). Figure 5.1, Table 5.1, and Table 5.2 provide an overview of NEST360's investments. NEST360 also works globally to improve market access for these medical devices and to develop global public materials, such as an Implementation Toolkit for small and sick newborn care.[189]

Figure 5.1 Support provided by NEST360 to NBUs.

In Kenya, NEST360 supports 13 hospitals in 11 counties in the central and western regions of the country. NEST360 is an example of a network initiated and supported by external organisations with aims to engage and empower national and country level partners. It is a large, complex programme with external financial support to build the network. NEST360 tries to build networks at the country and facility levels amongst clinicians, biomedical engineers (biomeds), the Ministry of Health (MoH), and other stakeholders. Figure 5.2 summarises NEST360 actors and their roles.

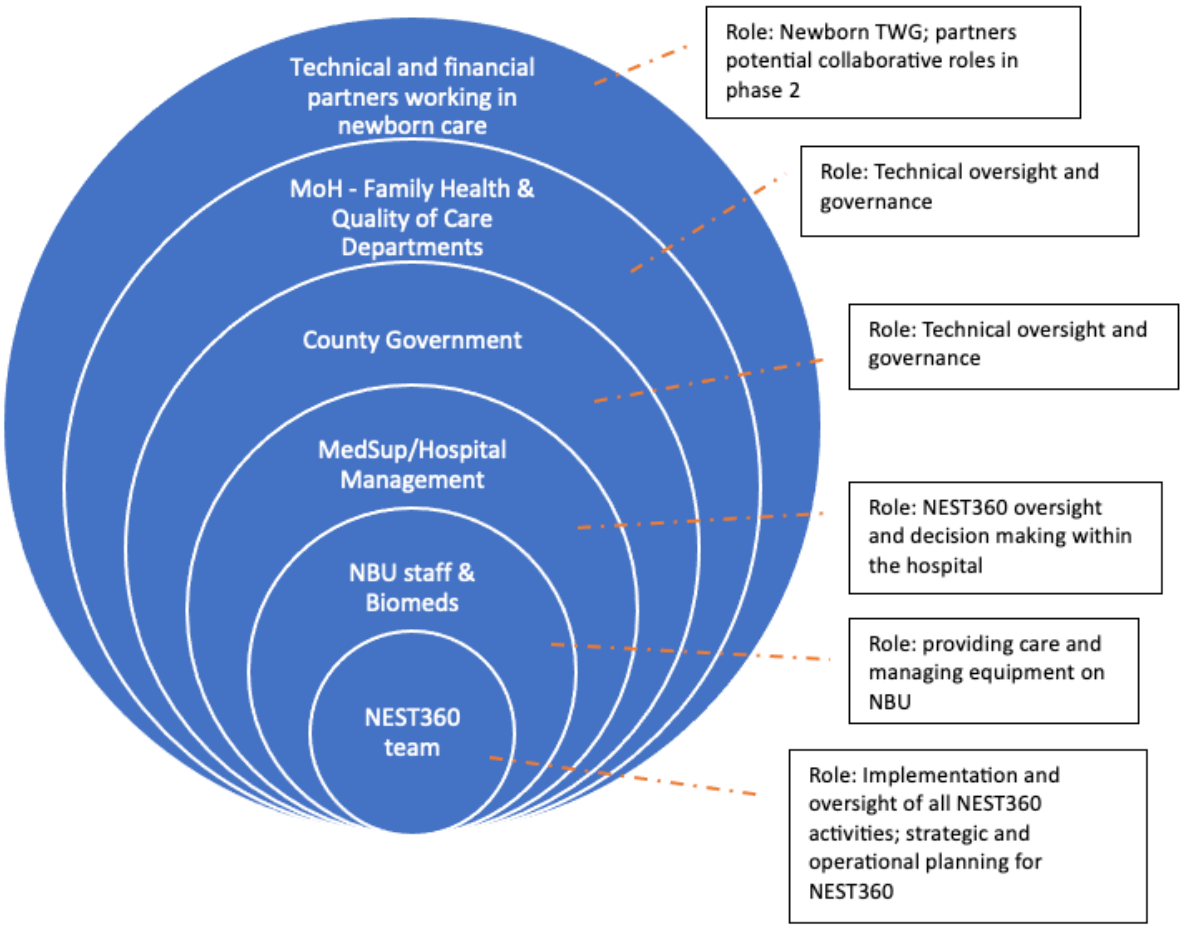


Figure 5.2 NEST360 actors and roles.

Acronyms: TWG: technical working group; Med Sup: medical superintendent

Applying the proposed network framework from my Scoping Review[139] (Chapter 3), the most common network practical characteristics for the NEST360 network are reflected in Table 5.1.

Network framework component	Application to the NEST360 network
Form & Structure	• NEST360 creates connections across the health system among Level 5 hospitals (and by extension Level 4), teaching entities, and the MoH and partnerships with other organisations • NEST360 developed a collective vision • A network culture has emerged • Memorandum of Understandings (MoUs) set the engagement between network hospitals and NEST360 Kenya
Governance & Leadership	• Network meetings • MoH national and county engagement in the network • Network initiators and organisers facilitate the network

Mode of Functioning	• Knowledge and information sharing, education, and learning and quality improvement (QI) activities are central components of the network • The network facilitated updating guidelines and protocols for newborn care • Network dashboards support data collection, analysis, and use
Resources	• Financial resources, medical devices, parts, consumables, and human resources capacity
Communication	• NEST360 strengthened communication within the network through WhatsApp groups • Created opportunities for ongoing communication among network members

Table 5.1 Proposed network framework from my Scoping Review applied to NEST360.

Over its first five years, in collaboration with the MoH, NEST360 has leveraged opportunities to develop networks between clinicians, nurses, biomeds, and hospital administrators to facilitate training, equipment support, and other capacity strengthening activities. These opportunities are highlighted in Table 5.2.

Activity	Materials
Integration of NEST360 materials into the national curricula: NEST360 clinical training integrated into the Newborn Emergency Triage Assessment and Treatment plus Admission (ETAT+) course	https://kenyapaediatric.org/etat-course/ NEST360 Clinical Modules https://nest360.org/project/clinical-modules/ NEST360 Clinical Scenarios https://nest360.org/project/clinical-scenarios/
Pre-service and in-service training and training materials for clinicians and nurses: ETAT+ course	
Adaptation of in-service training: During the COVID-19 pandemic, in-person newborn care trainings transformed into a three-day virtual training for facilities with two days in-person practical sessions	
Pre-service and in-service training and training materials for biomedical engineers and technicians: Biomedical training and training of trainers at Kenyatta University on repair and maintenance of NEST360 technologies	NEST360 Technical Modules https://nest360.org/project/technical-modules/ NEST360 Technical Scenarios https://nest360.org/project/technical-scenarios/
Generic Instructor Courses: Training clinical and non-clinical healthcare professionals as instructors	Generic Instructor Course https://nest360.org/project/gic/ https://nest360.org/kenya-holds-gic-for-pre-service-and-clinical-mentorship/
Adaptation of clinical mentorship: During COVID-19, webinars open to all healthcare workers	
Quarterly clinical mentorship and supportive supervision: Mentors provide quarterly mentorship and supportive supervision to clinicians and nurses. Mentors are a network of newborn care champions in hospitals across the country	https://nest360.org/kenya-holds-gic-for-pre-service-and-clinical-mentorship/
Quality improvement: Quarterly QI visits focused on clinical, biomedical, data systems, and governance; transitioning to being led by the MoH	

Clinical – Biomedical linkages: NEST360 created and strengthened linkages between clinicians and biomeds	

Table 5.2 Examples of NEST360 opportunities for relationship building.

A Committee of Experts, led by the MoH's Department for Family Health and including partners such as United States Agency for International Development (USAID), United Nations Children's Fund (UNICEF), and Path, guides NEST360 implementation and leverages learnings from NEST360 to inform changes to national policy. These quarterly meetings facilitated the integration of NEST360 educational materials into national curricula and the adoption of guidance for a standard NBU layout. Further details on NEST360 are available in Appendix 5A.

5.1.4 Rationale

My Realist Evaluation builds on my Scoping Review on networks in low- and middle-income country (LMIC) health systems (Chapter 3) and my Realist Review (Chapter 4) that developed a programme theory on how networks form and function to change practices.[139 190] As detailed in Chapter 4, my Realist Review drew on studies of networks in LMIC health systems and a selection of relevant high-income country (HIC) literature and substantive theories to develop and refine the Context – Mechanism – Outcome configurations (CMOCs) contained within the programme theory. This literature-based programme theory, which looked across many different types of networks is therefore relatively generic. My Realist Evaluation tested this programme theory to confirm, refine, or refute it using primary data collected from the NEST360 network. From the refined programme theory, I drew recommendations for initiating, forming, functioning, performing, and sustaining changes and the impact of externally initiated and supported networks in LMIC health systems. My rationale for using the Realist approach to evaluation is detailed in Chapter 2.

While NEST360 is present in four countries, my evaluation focused on the NEST360 programme in Kenya. This was to achieve sufficient depth in the data collection and analysis that would be difficult to reach across the four countries without extensive resources and time. The methodological approach of Realist Evaluation enables the analysis of the behaviour of the mechanisms that make NEST360 'work' under

different contexts. Any understanding developed could potentially be transferable to other countries, if the same mechanisms are also in operation.[88] Additionally, pre-existing relationships with stakeholders and the MoH in Kenya facilitated access to hospitals, interview participants, and meetings, as well as logistics.

5.2 Realist Evaluation design and methods

5.2.1 Realist Evaluation design and rationale

My Realist Evaluation was a multiple-methods single case study to confirm, refute, or refine the programme theory. A case study is an in-depth exploration of a complex phenomenon in its environment.[191] The case study approach in a Realist Evaluation allows for refining the programme theory across contexts and deepening an understanding of causal processes.[192] My case is the NEST360 programme in Kenya and a case study was appropriate to evaluate the NEST360 network because the contexts across the NBUs is varied. To understand the case, I sampled participants at NEST360 organisations based in Nairobi, four Level 5 county hospitals part of NEST360, and at the Kenya Paediatric Association (KPA) conference who work in NEST360 hospitals. Data collection methods consisted of semi-structured Realist interviews, programme document review, and fieldnotes. The data analysis confirmed, refuted, or refined CMOCs from my Realist Review and developed new CMOCs to refine the programme theory. My evaluation took place from January to December 2023. The evaluation protocol is available in Appendix 5B.

5.2.2 Ethics and research governance

My evaluation falls under the ethics approval of the study Learning to Harness Innovation in Global Health for Quality Care (HIGH-Q). The study has ethical approval from the Oxford Tropical Research Ethics Committee at the University of Oxford (OxTREC Reference 26-21) and the Kenya Medical Research Institute (KEMRI) Scientific and Ethical Review Unit (Protocol No. KEMRI/SERU/CGMR-C/229/4203). Written

informed consent was obtained from all participants interviewed. Data was anonymised, all identifiers removed, and participants given unique study codes.

5.2.3 Data management

My evaluation followed the data management plan of the HIGH-Q study. I audio recorded interviews with an encrypted digital voice recorder and uploaded them to a secure and encrypted file space at the KEMRI Wellcome Trust Research Programme (KWTRP) and deleted them from the recorder. Interviews that I held on Microsoft Teams were recorded and uploaded to the University of Oxford's secure OneDrive server. Recordings were transcribed verbatim by a transcriber or using otter.ai. Otter.ai is an AI tool that can transcribe audio and video files and is approved for transcription services by the University of Oxford.[193] I then reviewed transcripts for accuracy and cleaned them. Recordings were archived and will be destroyed at the end of the HIGH-Q study. I kept a separate document containing interview identifiers in a separate secure file on the University of Oxford OneDrive server. My fieldnotes from interviews and informal meeting observation notes were anonymised. I typed and stored fieldnotes on the University of Oxford's OneDrive server and subsequently shredded paper documents. All files are stored on secure servers at the KWTRP or the University of Oxford and are accessible only to specific researchers with password-protected access. I anonymised interview data as FI ## (formal interview and a corresponding number) and I did not provide interviewee details in reporting my results, such as professional background, to avoid risking deanonymisation. Any references to names or locations in the data have been redacted. Most documents reviewed are publicly available and have been referenced as such.

5.2.4 Phase I: Initial programme theory development

The initial programme theory is the programme theory I developed in my Realist Review[139] (Chapter 4), which explains how and why networks in health systems are initiated, form, and function to be able to change practices, leading to improved quality of care and service delivery. I used 32 pieces of peer-

reviewed and grey literature and 10 substantive theories to develop 58 CMOCs and refine the programme theory.

5.2.5 Phase II: Programme theory testing

Testing the programme theory aimed to uncover and understand the processes involved in the NEST360 network initiation, formation, functioning, performing, and sustaining changes and impact. Data collection centred around the different phases of the programme theory, providing data to further confirm, refine, or refute CMOCs from my Realist Review.

Data collection and sampling

My evaluation included three methods of data collection: semi-structured Realist interviews, programme document review, and fieldnotes from meetings, informal interviews, and reflections. I kept a fieldwork journal to document reflections and reflect on my positionality and potential biases. This is particularly important for Realist research as, unlike with interviews in the grounded theory tradition, the interviewer abandons neutral territory in order to engage with participants.[194]

1) **Semi-structured Realist interviews:** Semi-structured Realist interviews were my main source of data collection. Realist interview questions are based on the programme theory to understand how, where, when, and why the programme works or does not work. Realists draw on experiences from study participants because they can provide information on programme processes and outcomes.[84 194]

   I developed an interview guide which included 1) questions on the participant's role in, experiences with, and views of the programme; 2) examples of the participant's specific experiences of the programme that targeted different aspects of the programme theory; and 3) tested specific elements of the programme theory. Early interviews were more exploratory and became more specific throughout the data collection process. Interview questions evolved as I started to understand the case in greater depth and fieldnotes and post-interview reflections were used to identify areas that seemed most relevant to explore in later interviews. My interview guide is in Appendix 5C.

Prior to starting the interviews, I held informal introductory conversations with members of the NEST360 Kenya team; this enabled me to purposively sample and select interview participants from the NEST360 organisations and the MoH. Participants included NEST360 researchers and implementers based internationally and in Kenya, NEST360 partners, and Kenya MoH representatives. Four hospitals were selected with the HIGH-Q study team based on the criteria in Table 5.3. At each of these four hospitals, interview participants were purposively sampled and selection was in consultation with the HIGH-Q study team. Participants included biomeds, hospital administrators, and NBU clinical and nursing staff. Purposively sampling enables the selection of information rich cases that best provide insights relevant to the research questions.[195] I conducted additional interviews with participants from three other hospitals in the NEST360 network during the KPA annual conference, but due to logistical and time constraints, I was unable to visit those hospitals. As I began to understand the case to a greater degree, sampling was informed by parts of the programme theory to be able to test it. I sought as much variation as possible from the types of interviewees to provide the contrasts necessary to draw out learnings. Further details on the participants and hospitals are in section 5.3.2.

Criteria	**Rationale**
Part of NEST360 and HIGH-Q	NEST360/HIGH-Q programme documents
Geographical mix	Kenya MoH classification
Well – poor performing	Guidance from HIGH-Q Kenya team
Likely to have relevant information	Guidance from HIGH-Q Kenya team

Table 5.3 Pre-defined selection criteria for hospitals.

The number of participants was based on the concept of Information Power, which is a way to approach sample size for qualitative interviews. Information Power argues that the larger the information power in a sample, the fewer study participants needed in the sample and the less information power the sample holds, the more study participants needed.[196] Information power is determined by the study aim (narrow vs. broad), sample specificity (degree of participant characteristics specific to study aim), use of existing theories in the study (specific theories used vs. limited use of theories), quality of the interview (focused and clear interview vs. unfocused and

ambiguous), and approach to analysis (cross-case vs. in-depth).[196] A study has sufficient information power if the results show the development of new knowledge based on the study aim.[196]

I found this approach to sample size appropriate for my Realist Evaluation as the case focused on a specific network, NEST360. Since my aim was to understand how NEST360 works, all participants needed to have specific knowledge of and experiences with the network. Additionally, the programme theory from my Realist Review is underpinned by existing theories.

I completed 33 formal interviews. Participants were contacted either by the HIGH-Q team or me following introductions. This source of data helped uncover the processes behind the initiation, formation, functioning, performing, and sustaining of the changes and impact of NEST360 as a network and how participants understand and see the network working. My sample had enough information power to revise the programme theory from my Realist Review and address my research objectives.

2) **Document review:** I identified programme documents and reports from NEST360 globally and specific to Kenya. Programme documents and reports include annual NEST360 programme reports, quarterly NEST360 newsletters, and NEST360 blog posts. This source of data provided background information on the NEST360 programme, particularly to provide an understanding of how the programme intended to work and its achievements. The list of analysed documents is in Appendix 5D.
3) **Fieldnotes from meetings, informal interviews, and reflections:** I informally observed two NEST360 meetings, one online and one in-person. The selection of meetings was based on their relevance to the programme theory. Meetings were identified and selected with guidance from the HIGH-Q Kenya team. This source of data provided insights into interactions and communication between the different network members and how they work together. At the beginning of my data collection, I held three informal interviews which helped to orient the formal interviews, one of which was formally

interviewed later. Fieldwork reflections helped me to understand how the data was potentially evolving the programme theory.

Data analysis

Interview transcripts, programme documents, and fieldnotes were imported into NVivo QRS International, a data management software tool for qualitative analysis. I reviewed transcripts again for familiarisation and to understand emerging patterns in the data. The data analysis process was iterative. I reviewed and analysed interview transcripts, programme documents, and fieldnotes in waves, starting with data that were most likely to hold the most relevant information. Data were coded deductively with codes developed from the initial Realist Review programme theory and inductively coded with new codes that emerged from the data that were relevant to my research questions. I rereviewed already coded transcripts and documents when new codes emerged.

I reviewed coded data and grouped the data with existing parts of the programme theory and CMOCs I developed in my Realist Review. I then considered if the data confirmed, refuted, or refined each existing CMOC. To do this, I identified parts of the data that were relevant to and helped to assess the CMOC. Table 5.4 provides an example of this. In this example, the primary data added nuance to the context and outcome and helped to revise the mechanism (red text), so the CMOC became more encompassing and reflective of a causal explanation that may be more organisational than individual focused.

The data elucidated parts of the programme theory that I had not found in the literature during my Realist Review. I grouped data that was relevant to the overall theory but not yet represented by a specific section or CMOC in new sections or in new sub-sections of existing parts of the programme theory to potentially elaborate new aspects of the programme theory. To develop new CMOCs, I follow the same processes as in my Realist Review (see Chapter 4, section 4.2.6). I iteratively revised, consolidated, and repositioned CMOCs to where they made most sense in the programme theory and with the supporting data.

	Review CMOC		Evaluation CMOC	Result
5L	If a network is highly dependent on a few people to implement network activities (context), then it is at risk of being unsustainable (outcome), because of burnout and/or loss in those tasked with implementation (mechanism)	**5M**	If a network is highly dependent on a few people or leaders to implement network activities or leaders that support their implementation (context) then it is at risk of being unsustainable or functioning poorly (outcome) because the leadership structure is fragile (mechanism)	Refined
"When [redacted] was handling this, I think she was more how do you call it? She was she was more hands on, which she was more involved. And so, it's made you feel better. And I think when when her influenced stopped, I don't know what exactly happened, I don't so now, it's a bit like the touch somehow, the energy, like it went away, don't necessarily know what happened when the energy went away something from. So now, I think the activities are just been done without, even then used to have, I think the clinical services manager that is [redacted] will come around." (FI 10)				
"Because you know, most of these positions are quote unquote political with every leadership that comes there will always be a change. And then of course, that's changed again. Again, they want to shuffle leadership in hospitals. So sometimes they think as part of their handover, they don't even handover those things. As I told you go to a hospital and then we are not aware of the programme. Right, right. Right. You have to keep reintroducing ourselves." (FI 14)				
"So, the major changes are staff turnover, which is a very negative, has a very negative impact to the programme. I think the other day the Med Sup for [redacted] was moved, I think it was last week we have [redacted] who has been moved. So, every time, and I think this is a gap we have like, we have to call but I assume the previous Med Sup is the one who is there. Then you are calling and then they are like 'no I think that Med Sup went,' and you are also shocked." (FI 16)				

Table 5.4 Example of CMOC revision.

5.2.6 Phase III: Theory consolidation

I iteratively refined the programme theory with CMOCs that I revised or developed based on interpretations from the primary data collected. Substantive theories from my Realist Review were reconsidered for applicability to the revised programme theory and data. I investigated additional theories to further conceptualise the underlying mechanisms acting within the programme theory and to provide analogy (i.e. to help understand how the programme theory fits with what is already known). These theories were identified by searching for and exploring theoretical understanding around new parts of the programme theory, for example, Empowerment Theory and teamwork, and additional theories that would support existing parts of the programme theory (e.g. Culture Typology). As the programme theory evolved with the primary data, I purposefully searched for organisational theories that would provide analogy to

parts of the programme theory, such as Relational Coordination Theory and Relational Systems and Organisational Resilience. Table 5.5 provides an overview of the additional substantiative theories that I used to support the refinement of the programme theory. Substantive theories from my Realist Review are in Chapter 4, Table 4.2.

Theory/Concept	Key Author	Overview
Empowerment Theory	Zimmerman 2000	• Individual: Beliefs about self-competence, efforts to enact control, understanding of the environment; developed from engagement in activities and organisations; self-efficacy • Organisational: provide members opportunities for skill building and to take on additional and meaningful roles; shared responsibilities; support from peers and a social identity; shared leadership and decision-making • Community: skills, desires and resources to improve the community, including identifying needs and strategies to address them and taking action to address them
Culture Typology	Quinn & Cameron 2011	• Four types of culture in organisations • Clan: collaboration, high engagement and commitment from members, values relationships and teamwork, promotes shared values and goals, empowers members to facilitate commitment and loyalty to the organisation • Hierarchy: procedural, structured, controlling • Market: results and external orientated, competitive, goal-focused • Adhocracy: entrepreneurial, dynamic, risk-taking leaders, innovative
Relational Coordination Theory	Bolton, Logan, Gittell 2021	• Stakeholders coordinate work through processes of communicating and relating across roles to achieve desired outcomes • Organisational structures may or may not support these processes • Relational and work process interventions
Relational Systems & Organisational Resilience	Bartel & Rockmann 2024	• Better relationships in an organisation can better handle situations and enact resilient responses • Strong relationships support members' attention in crises • Positive attention to relationships in an organisation; the value of interpersonal relationships to the organisation is recognised and resources are allocated to cultivate relationships • Communication styles shape relationships
Teamwork	LaFasto & Larson 2001	• Components that increase team effectiveness • Members, relationships, problem-solving, leadership, and organisation environment
Action Theory	Bowey 1972	• Different types of relationships between organisation members and the organisation's goals • Commitment to the goals • Acceptance of the goals as part of the organisation with an obligation to contribute to goals, however they have other

		aims which they desire to achieve by being part of the organisation • Aims are unclear or flexible and members may engage in discussing their direction • Disagreement with the goals but must remain organisation members

Table 5.5 Additional supporting substantive theories.

As I began to better understand the data and add more details to the programme theory developed in my Realist Review, it became increasingly messy. Iterations of the programme theory are in Appendix 5E. The diagram shifted into a programme theory framework table, which better reflected the complexities of the revised programme theory, and from there I was able to develop a simplified diagram representing the revised programme theory. This process enabled me to further refine the programme theory.

I reconvened the stakeholder group from my Realist Review (see Chapter 4 sections 4.2.2 and 4.2.6) to present and obtain external input on the revised programme theory to support sense-making. The stakeholders felt that the revised programme theory resonated with their knowledge of and experiences with different networks. They provided input on the place of trust in the programme theory, network sustainability, psychological safety, resourcing across network levels, and how to define the success of networks.

5.3 Results

5.3.1 Details of the case

The case is the NEST360 network described in section 5.1.3 and Appendix 5A.

5.3.2 Details of study participants

I interviewed 33 individuals in formal semi-structured Realist interviews. The breakdown of their affiliations is shown in Table 5.6.

NEST360 Global	**NEST360 Kenya**	**MoH**	**NEST360 Hospitals**	**NEST360 Partners**	**Total**
4	6	2	18	3	33

Table 5.6 Details of study participants.

The 18 hospital interviewees were from seven hospitals, four of which I visited, shown in Table 5.7.

NEST 360 Hospital	Number of Interviewees	Hospital Visited
Hospital A	4	X
Hospital B	5	X
Hospital C	3	X
Hospital D	3	X
Hospital E	1	
Hospital F	1	
Hospital G	1	
Total	18	4

Table 5.7 Study participants by hospital.

5.3.3 Revised network programme theory

A network evolves through three phases: Initiation & Formation, Functioning & Performing, and Sustaining Change & Impact through a set of dependent processes, activities, foundations, and cross-cutting factors. The network processes—identify a problem, collective vision, taking action to solve a problem, and identity and culture—are dynamic and active processes that continue throughout network evolution but manifest in different ways across the phases. Network activities, such as knowledge and skills dissemination, cross-learning, resourcing, leadership and champions, and adaptability, are undertaken for the network to initiate, form, function, perform, and sustain changes and impact. At the foundation of networks are teamwork; a psychological safe space; committed, engaged, motivated, empowered, and confident network members; and purposeful relationships, linkages, and partnerships. Present throughout the programme theory are communication, trust, and energy, effort, and passion. Figure 5.3 illustrates the revised programme theory and sets out the interrelations between the concepts and processes outlined above. Figure 5.4 describes each of these processes, activities, foundations, and cross-cutting factors. Appendix 5F links the different parts of the programme theory to the CMOCs.

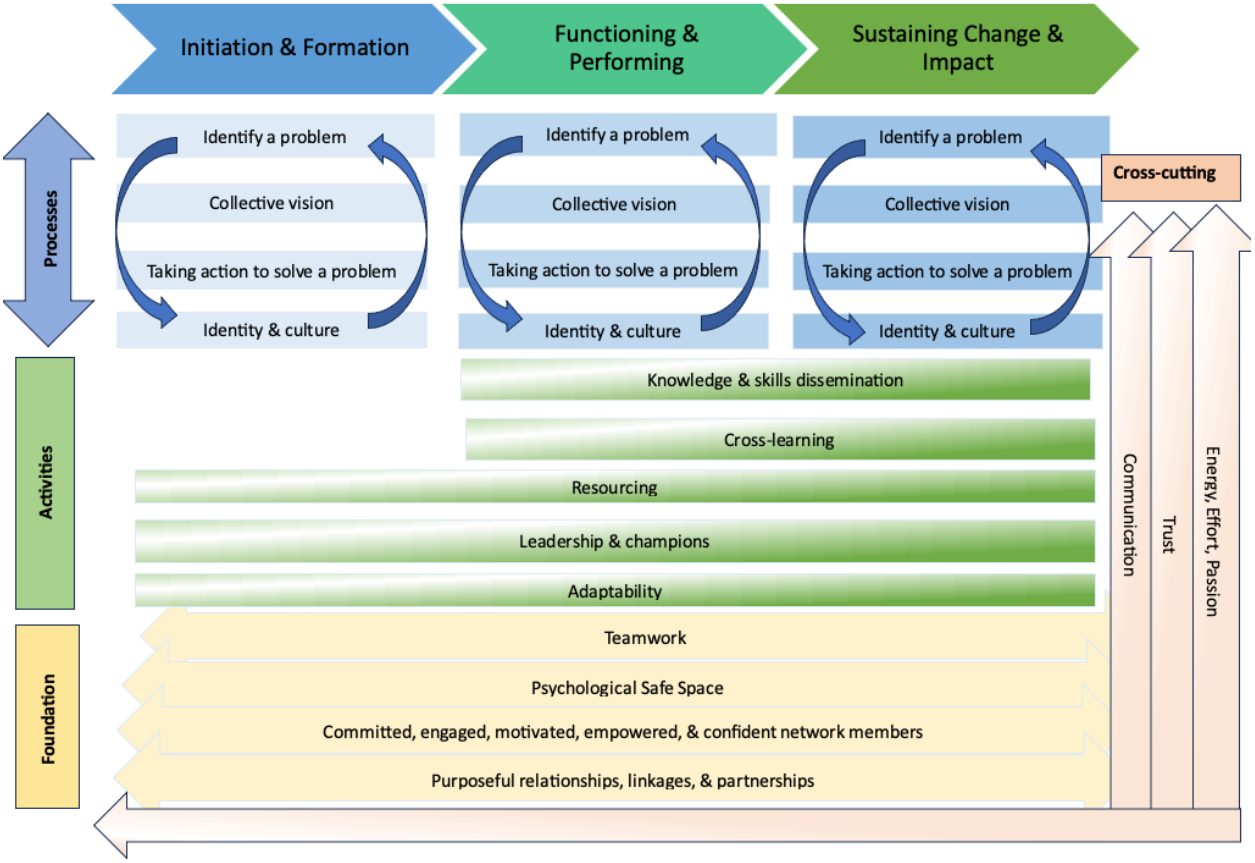


Figure 5.3 Refined network programme theory.

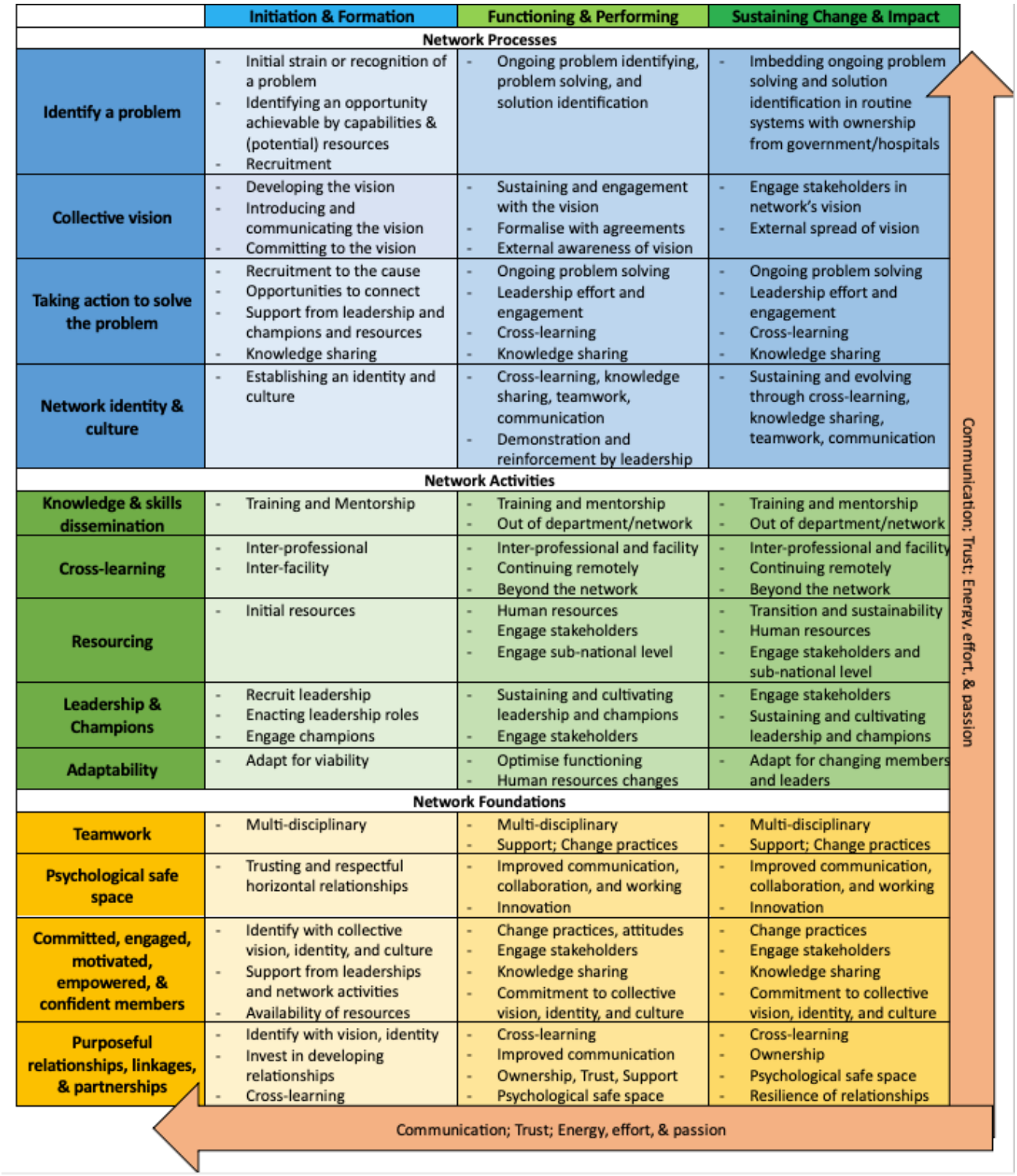


Figure 5.4 Programme theory framework with descriptions of processes, activities, foundations, and cross-cutting factors.

From analysing the primary data, I refined the programme theory from my Realist Review with 143 CMOCs. Based on the primary data, I was able to confirm 18 CMOCs, refine 30 CMOCs, and develop 95 new CMOCs (55 in existing and 40 in new parts of the programme theory) based on the evolved understanding that the primary data brought to the programme theory (see Table 5.8 and Table 5.9). I was unable to assess 9 CMOCs from my Realist Review based on the primary data, likely because they are more relevant to networks that are formed organically or from the bottom-up, while my case is an externally initiated and supported network. Additional supporting substantive theories to further explain the CMOCs and programme theory are in Table 5.5. Appendix 5G shows how the CMOCs from my Realist Review were refined with the primary data.

	Confirmed	Refined	Unable to assess	New	Total
# of CMOCs	18	30	9	95 Existing buckets: 55 New buckets: 40	152

Table 5.8 CMOCs supporting the revised programme theory.

Part of programme theory	Confirmed	Refined	Unable to assess	New	Notes
Network Processes					
Identify a problem	1 (1E)	2 (1D, 1H)	1 (1A)	6 (1B, 1C, 1F, 1G, 1I, 1J)	1D no data but refined
Collective vision		7 (2A, 2B, 2C, 2E, 2I, 2K, 2L)	1 (2M)	8 (2D, 2F, 2G, 2H, 2J, 2N, 2O, 2P)	2A, 2B no data but refined
Taking action to solve a problem	1 (3D)	3 (3A, 3B, 3C)		10 (3E, 3F, 3G, 3H.1, 3H.2, 3H.3, 3I, 3J.1, 3J.2, 3K)	3A no data but refined
Identity & culture	2 (6A, 6C)	2 (6G, 6H)	1 (6B)	3 (6D, 6E, 6F)	
Network Activities					
Knowledge & skills dissemination				5 (14A – 14D)	Evaluation only, 14B has a sub-CMOC
Cross-learning				6 (13A – 13E)	Evaluation only, 13B has a sub-CMOC
Resourcing networks				5 (16A – 16E)	Evaluation only
Leadership	1 (5I)	7 (5C, 5E, 5F, 5J, 5K, 5L, 5M)	5 (5B, 5D, 5G, 5H, 5Q)	9 (5A, 5N, 5O.1, 5O.2, 5O.3, 5P, 5R, 5S, 5T)	
Champions				7 (11A – 11G)	Evaluation only

Adaptability				5 (15A – 15E)	Evaluation only
Network Foundations					
Teamwork				6 (12A – 12F)	Evaluation only
Psychological safe space	4 (9B, 9C, 9D, 9E)	2 (9A, 9F)			9A no data but refined
Commitment	2 (7A, 7E)	3 (7C, 7H, 7K)		6 (7B, 7D, 7F, 7G, 7I, 7J)	
Engaged & motivated network members	4 (8B, 8C, 8D, 8F)	1 (8A)		4 (8E, 8G, 8H, 8I)	
Empowered & confident network members				6 (10A – 10F)	Evaluation only
Purposeful relationships, linkages, & partnerships	3 (4B, 4C, 4E)	3 (4G, 4J, 4O)	1 (4A)	9 (4D, 4F, 4H, 4I, 4K, 4L, 4M, 4N, 4P)	

Table 5.9 Breakdown of CMOCs confirmed, refined, unable to assess, and new.

The reference for which CMOC is confirmed, refined, not assessed, or new are listed in parentheses.

Network processes

This first section of the programme theory explains the processes that networks undertake to initiate, form, function, perform, and sustain impact and change (see Network Processes in Figure 5.3 and Figure 5.4). They are underpinned by the refined CMOCs in Table 5.10 - Table 5.13. I have provided one piece of illustrative data for one CMOC in each network process and additional illustrative data supporting the CMOCs is available in Appendix 5H.

Identify a problem

Building on the results from my Realist Review, the primary data confirmed *identifying a problem* as the initiation of a network. However, the primary data indicated that this is coupled with network initiators seeing an opportunity in the problem and believing that they have the capabilities and resources (or potential to obtain or reallocate resources) to do something about the identified problem. Smesler's Theory of Collective Behaviour (Table 4.2) remains relevant to this part of the programme theory and the feeling of a strain around a problem, but the primary data adds that seeing an opportunity in the problem and a belief in capabilities and resources needs to be present as well. This belief in capabilities and

resources links to Bandura's Self-Efficacy theory and Ajzen's Theory of Planned Behaviour (Table 4.2). Depending on the network, these drivers of network initiation can exist within the same or different people. In an externally initiated network, the ability to see that opportunities exist within their capabilities and resources may more likely come from someone external, who feels the strain of the problem less acutely but has a broader perspective on it. These external network initiators need to present the opportunity to potential network members in a way that is attractive for them to commit to the network (see Commitment).

However, in a network that is formed organically or from the bottom-up, individuals may feel the strain of the problem but also see opportunities to change within their abilities and resources. The sense of dissatisfaction and/or frustration about the problem and the ability to see an opportunity will ignite the network initiators to do something about the problem (i.e. forming a network). The ability to see an opportunity in the problem may be latent within potential network initiators and not activated until they have the means to do something about it, such as resources or external support. This is relevant because the composition of network members may be important for the network's ability to form, function, and perform (CMOCs 1A, no supporting data, 1B – 1C, new).

Network initiators will then recruit other people, particularly potential leaders or champions, into the cause and collectively work to understand what they need to do to solve the *identified problem*. Depending on the network, this may be people who directly feel the strain or who see the magnitude of the problem. Network initiators engage with potential network members to support forming the network and start to generate their commitment to solving the problem through the network (CMOCs 1D, refined, 1E confirmed, 1F – 1G, new).

Empowerment Theory's approach to community empowerment (Table 5.5) may reflect these additional dimensions to this part of the programme theory.[197] When potential network members have the capabilities, desires (linked to the strain or understanding of the problem), and resources to engage in

change this may lead to network formation. As a network, they can identify needs, develop approaches to tackle them, and take action to improve them, as empowered communities do.

In the case of NEST360, the problem is high preventable newborn morbidity and mortality, which is a well-recognised global problem and one of the SGDs (Target 3.2.2).[186] NEST360 is an example of an externally initiated network; the initiators at a United States based university understood and saw the magnitude of the problem, but they also knew they had the capabilities and potential access to resources to do something about it. The healthcare workers, biomeds, and hospital administration that feel the strain and frustration of the problem, as in most hospitals in Kenya, lacked access to the medical devices and training to substantially act on the problem.

While networks may be formed in response to the *identification of a problem*, once in existence, well-functioning networks can be employed to identify additional problems and may continually reinvent themselves and stay relevant. Networks use different approaches to continue to identify smaller problems that contribute to the larger problem/collective vision. The *identification of problems* within a network may occur in clinical practice, through learning sessions, during mentoring and coaching visits, using QI tools, or through approaches that search out to identify barriers or challenges to uptake in care or service use (CMOCs 1H, refined, 1I – 1J, new).

The NEST360 network puts in effort to continually *identify problems* and take action to improve them. This includes the QI dashboard and visits, audits, and mentorship visits. Transferring responsibility for these network activities from the programme and over to the national and country governments and hospital administrations will support sustaining impact and change.

1A	When potential network members feel a sense of dissatisfaction (misaligned with expectations or values) with an issue (e.g. in clinical care, service delivery organisation, or health system management) (context), they will have the energy, excitement, and motivation to do something about it (outcome) because of their frustration (mechanism)	No supporting data
1B	When potential network members feel a sense of dissatisfaction (misaligned with expectations or values) with an issue (e.g. in clinical care, service delivery organisation, or health system management) (context), they will get annoyed/angry/fed up (outcome) because of their frustration (mechanism)	New

1C	In the formation of an externally initiated network, when future network members/leaders/initiators are helped to believe that improvement/change with an issue (e.g. newborn care, morbidity, and mortality) is achievable (context), they will have the energy, excitement, and motivation to do something about it (outcome) because they feel doing so is a worthwhile use of their time and energy (mechanism)	New
1D	When a network is in its formation stage and potential network members reflect together on problems (context), they will recruit others to the cause (outcome) because there is a realisation that they can be part of the solution (mechanism)	Refined
1E	When potential network members share and discuss their collective experiences, emotions, understanding, or perspectives for a commonly felt problem (context), they are better able to understand what needs to be done and find solutions (outcome) because they have more knowledge to drawn on (mechanism)	Confirmed
1F	In a setting with change potential, when network initiators meet and select others who share and amplify their concerns about the identified problem (context), this helps form ties that support network formation (outcome) because the shared concerns about the identified problem are mutually reinforced (mechanism)	New
1G	When the network initiators get input from potential network members on the magnitude and resources needed to begin solving the identified problem (context), this starts to generate commitment from potential network members (outcome) because the potential network members feel their perspective and experiences are respected and valued (mechanism)	New
1H	When members in an established network feel it is safe to critically examine and reflect on existing practices together (context), they are able to identify new problems and potential solutions (outcome) because they feel enabled to challenge the status quo (mechanism) and/or feel in a psychological safe space to be able to challenge the status quo as a team (mechanism) *"Even the other year our unit was get the cleanest and the best organised and it's amazing because one you go to the other units you find the doctor will just write and go away. But here there is a lot of teamwork. For all of us the cleaners, the nurses, the nutritionist, because actually one of the other things that is...being that teamwork has really helped us to identify the problem and be able to ask yourself, who should solve this problem? How can we solve as a team? So, like one of the problem, one time we discovered was our babies were not gaining weight and they were taking very long in the unit we did a a small study. And the next question was, who should we include in this? So, when we sat down with our team, we discovered we only have two nurses in the unit per shift. Sometime this shift has 75 babies. So, you've got imagine if there are 75, you may be having 20 or 15 that are critical in CPAP or… So, when we looked at it, we were like, No, we need more staff. So, then we asked ourselves, with... with a team, we have a WhatsApp group now for the newborn unit. So, in the WhatsApp, we asked ourselves, who do you think we can add in this group, and we decided we need a nutritionist. So, we work with the administration, and we are given a nutritionist, just for the newborn who has been very instrumental in helping mothers helping calculate feeds, observing babies who are not feeding, gaining weight well, which has also really helped us." (FI 05)*	Refined
1I	In an externally initiated network, when there is support and partnership from network initiators and organisers (e.g. through quality improvement and mentorship activities) (context), this can help to continue to identify problems that are within the network member's capacity to change and determine appropriate solutions (outcome) because the network members feel in a psychological safe space to be able to challenge the status quo as a team (mechanism)	New
1J	When the network enables members to regularly identify problems they can work together to address (context), this supports network functioning (outcome) because they can appreciate the value of the network (mechanism)	New

Table 5.10 CMOCs for Identify a problem.

Collective vision

Network members develop a *collective vision* through a process of collective sense making, identifying what they have in common, and sharing common perspectives. When network members have a similar professional or vocational calling, this can facilitate developing a *collective vision*. In a top-down or externally initiated network, the *collective vision* is more likely to come from the external network initiators and so the first three CMOCs (2A-2C) from my Realist Review around how to develop a *collective vision* may be less important, but still relevant. A network will introduce its vision to additional members, particularly when the network is formed from the top-down or initiated by external stakeholders; this new finding was informed by the primary data (CMOC 2D). Once potential network members are introduced to the *collective vision*, they may commit to the network because of shared experiences, pre-existing relationships, and a process of collective sense making. Leadership and resourcing the network play a role in eliciting support for the *collective vision*. This area of the programme theory was further elaborated with primary data and resulted in the formation of five new CMOCs (2D, 2F-2H, 2J) and the refinement of two CMOCs (2E, 2I). The *collective vision* can help link members as a network (CMOC 2K, refined) and the existence of MoUs can support commitment to the *collective vision* and network formation (CMOC 2L, refined). If there is no *collective vision* then the network may be less successful; however there were no primary data to support this claim from my Realist Review (CMOC 2M). Network members may also work to get broader awareness and support to the cause or vision from stakeholders outside of the network (new CMOCs 2N-2P).

The substantive theories from my Realist Review – Smesler's Theory of Collective Behaviour[148 149] and the Collective Identity Approach from New Social Movement Theory[151-153] (Table 4.2) continue to be relevant with the primary data. Tuckman's Small Group Development Theory's first three stages (Table 4.2) have greater importance for the revised programme theory.[154] In terms of forming, the network initiators put in effort to introduce the vision to potential network members and support their commitment to the vision

and participation in the network. This is particularly needed when the network is externally initiated or supported. Storming may arise here if the network initiators do not introduce the *collective vision* with care; however, the primary data did not show any indication of storming, so this is speculation. The primary data further supports that norming helps to explain how network members progress from developing a *collective vision* to the vision becoming a norm of the network.

NEST360's *collective vision* was developed by the external network initiators (NEST360 Global). However, because the vision focused on a global problem (preventable newborn morbidity and mortality) that is particularly acute in Kenya, it resonated with potential network members, which made them more likely to commit to the *collective vision*. Early on in network formation, the network initiators (NEST360 Global) and the network organisers (NEST360 Kenya team) put in effort to introduce the *collective vision* to potential network members (hospitals) to generate commitment to the vision. While the *collective vision* came from the network initiators (NEST360 Global), it was based on a shared understanding and perspective with potential network members of the challenges with small and sick newborn care. Pre-exiting relationships between potential network members in NBUs and network organisers (NEST360 Kenya team) helped to generate commitment to the *collective vision* because there was pre-existing trust. Creating opportunities for potential network members to be heard and discuss the *collective vision* helped them to feel ownership of the vision. The network hospital leaders, medical superintendents, have varying degrees of involvement in the network. However, their commitment to the *collective vision* was generated with engagement from network leaders and champions. When network leadership (NEST360 Global and NEST360 Kenya team) communicated and explained the network vision to potential network members, they focused on the problem that the network tries to solve and the network hospitals are facing. In the early stages of the network, NEST360 provided resources to hospitals to support renovations to NBUs; this also generated commitment to the *collective vision* because network members saw that the network was doing something. MoUs between the network hospitals and network organisers (NEST360 Kenya) helped

to solidify commitment to the *collective vision*. The NEST360 network has also been able to create broad awareness and support around its *collective vision* from outside the network, from government and health sector partners, which supports an enabling environment for the network and network activities.

2A	When potential network members or network initiators engage in an open process of collective sense-making around a problem (context), they can identify what they share in common (outcome) because they learn about each other's experiences, emotions, understandings, or perspectives (mechanism)	Refined
2B	If potential network members or network initiators identify and articulate commonalities among each other (context), then this enables the development of a collective network vision (outcome) because they understand each other's perspectives (mechanism)	Refined
2C	When potential network members and/or network initiators have common professional or vocational identities or calling (context), this facilitates the development of a collective network vision (outcome) because they are more likely to have common professional perspectives and values (mechanism)	Refined
2D	When network initiators introduce the idea/intention of the network to potential members when the network is forming and recruiting network members (context), this will generate early commitment to the collective vision (outcome) because potential network members understand the network's purpose (mechanism)	New
2E	If a network's collective vision is based on shared experiences, emotions, perspectives, and understanding among the potential network members and network initiators (a similar specific way in which reality is perceived) (context), then this will lead to commitment to the collective vision (outcome) because potential network members feel represented (mechanism)	Refined
2F	If potential network members know each other prior to network formation (context), this can help generate commitment to the collective vision (outcome) because there is existing trust between the potential network members (mechanism)	New
2G	When potential network members engage in an open process of collective sense-making around a problem (context), this generates a sense of ownership around the collective vision (outcome) because potential network members feel heard/represented (mechanism)	New
2H	When network leaders/champions consult and engage hospital/facility leadership (context), this generates commitment to the collective vision from the administrative hierarchy even if they have no leadership role within the network (outcome) because they understand its value (mechanism)	New
2I	If the collective vision of a network is communicated and explained by network leadership in a way that appeals to professional ideals and values shared by potential network members (context), then this will lead to commitment to the collective vision (outcome) because potential network members feel engaged (mechanism)	Refined
2J	When the network provides resources to support making changes to the physical infrastructure of facilities within the network (context), this encourages potential network members to commit to the collective vision (outcome) because potential network members feel that the network is doing something for them (mechanism)	New
2K	When potential network members agree to an existing collective vision (context), they will be more willing to take on activities to enact the collective vision (outcome) because they have an understanding of what is expected of them (mechanism)	Refined
2L	When formal agreements have been negotiated and agreed between network members (context), then the network members will feel solidified in a network and be more likely to follow a collective vision (outcome) because the agreements help network members to understand their roles and responsibilities (mechanism)	Refined

2M	If there is no collective vision or if network members do not follow the network's collective vision (context), then they will be less successful in implementing network activities (outcome) because network members do not feel committed to the network (mechanism)	No supporting data
2N	When the network makes an effort to disseminate its vision to solve the identified problem beyond the network (context), then non-network stakeholders (e.g. partners, donors) will be more aware of the network (outcome) because network members have advocated for its purpose (mechanism)	New
2O	When the network engages with government officials and takes their inputs into consideration (context), greater support is generated for the network and network activities (outcome) because there is closer alignment of vision between the network and the government, and government officials feel valued and respected (mechanism) *"I would say it's probably the same things we struggle with within the broader CIN network is to what degree is Ministry involved what degree are professional associations involved. You can only engage Ministry people to a certain degree because the person responsible for child and newborn also have very many other things they're looking after. NEST is not the only newborn the only important thing in the newborn space. So, they have to look after people who do like KMC, all these resuscitation courses, they have to look at guideline development, how to partner with colleagues in child health and maternity so they're also spread pretty thin. And, and you can only engage them to a certain degree. So, there's a lot of effort to make sure that they're part of the meetings. They have a lot of the technical input, there is a lot of effort to ensure people being involved in quality improvement and Ministry people, Ministry sanctioning, pretty much leading being put on the driver's seat when there is like a proper technical meeting happening around NEST. So, it's not a NEST meeting it's a Ministry meeting. But that's I guess that's the most you can do. I can't I have no no magic bullet for it. I think it's just continually and but I think it's also I think one way is to, if there is a way of helping the Ministry get part of the NEST activities funded by government so that there is an activity in their work plan that aligns with NEST, then there is sort of joined at the hip in some way, in some way. So, I don't know what that activity would be. But I think that's if there is a way of advocating to get somethings funded by central government. One is a commitment. It's one is is a sign that the government is interested and sees the value of it and is investing in it. So even people in government see, can read that, and therefore see this as an important deliverable." (FI 32)*	New
2P	When network leadership/organisers are engaged in government meetings (e.g. technical working groups) (context), this can improve the enabling environment for the identified problem/collective vision (outcome) because more stakeholders are aware of and engaged with the problem/vision (mechanism)	New

Table 5.11 CMOCs for Collective vision.

Taking action to solve a problem

Consistent with my Realist Review, this part of the programme theory begins with the need to recruit others to join the collective vision. In a bottom-up network, members will continue to recruit colleagues to the collective vision, particularly those who are likeminded, capable, and willing to help to support *taking action*. As my evaluation is focused on an externally initiated network, there were no data to support this CMOC (3A, modified based on totality of data), but it may have relevance for the network

initiators (NEST360 Global). In an externally initiated network, the energy and effort put in to recruit others ensures a diverse mix of skills and competencies (CMOC 3B, refined). Network members will also seek out those with common experiences or perspectives (CMOC 3C, refined).

The intention to *take action* will be supported by the existence of resources, opportunities for meetings to coordinate efforts, teamwork within and across cadres and organisations, supportive leadership, platforms for communication, and purposeful activities, such as QI and mentoring (CMOC 3D, confirmed, 3E - 3J, new). As the network evolves, members need to continually *take action* to address the identified problem, potentially by tackling smaller problems that contribute to the larger problem causing the strain that initiates the network. The support that network members receive to *take action* builds their capabilities and willingness to solve problems that may support the network as it evolves and adapts overtime (see Adaptability). However, if network members fail to make progress towards solving the problem, this may undermine the relationships and support the network provides and discourage network participation (CMOC 3K, new). When network initiators see the opportunities and resources related to the identified problem (see Identify a problem), this influences their intention and willingness to collectively *take action* on the identified problem and therefore distinguishes doing something about the problem from not getting initiatives off the ground.

The supporting theories from my Realist Review — Collective Identity Approach from New Social Movement Theory,[151-153] the Theory of Planned Behaviour,[156] and Self-Efficacy Theory[158] (Table 4.2) — are still relevant to this part of the refined programme theory.[156] Ajzen and Bandura's theories help to explain that if network members believe that collectively they see the opportunity and have the resources to solve the identified problem, they will have more intention to perform the behaviour, (i.e. form the network), and they are more likely to do so.

In the NEST360 network, NEST360 Global recruited a diverse mix of partners with complementary skill sets and expertise to organise the network in Kenya. Within network hospitals, NBUs recruited other hospital

staff to support their unit in working towards the collective vision. The resources (equipment, parts, and training) NEST360 provides encouraged network hospitals to *take action* because with the necessary resources, they had more capacity to improve care for small and sick newborns. The feeling of working as a team within and across facilities, NEST360 network meetings, support from NEST360 Kenya for mentoring, QI, and training, and network WhatsApp groups all supported the hospitals in *taking action* towards changing their newborn care practices.

3A	In a network formed from the bottom-up when network members realise they alone are unlikely to be able to solve a problem (context), they will recruit likeminded colleagues for their cause (outcome) because they believe collective action is needed (mechanism)	Refined
3B	In an externally initiated network when network initiators and organisers realise that they need diverse health system actors to be able to solve the problem/meet the target (context), they will recruit/mandate/encourage colleagues they perceive to be capable of helping their cause (outcome) because they believe a collective approach is needed (mechanism)	Refined
3C	When network members think collective action is needed to solve the identified problem (context), they will seek out other individuals with common experiences or perspectives (outcome), because they believe such people may be willing to help them (mechanism)	Refined
3D	When members in an established network have access to resources that will help them solve the problem they have identified (context), they may be more prepared/more likely to intend to take action (outcome) because they believe they have a more realistic chance of success (mechanism)	Confirmed
3E	When an externally initiated network is forming and opportunities are provided to network members to meet, discuss, and find solutions to problems (context), this will support network members to take action and shape an identity and a sense of belonging (outcome) because they are able to coordinate their work and work together	New
3F	When network members of different roles/cadres/units/organisations work together as a functioning team (context), this enables them to take collective action towards solving the problem (outcome) because they have a common understanding of what needs to be done (mechanism)	New
3G	When network leadership or organisers are supportive of network members taking action (context), network members will be more likely to take practical and concrete action to solve problems (outcome) because they feel their efforts are valued and worthwhile (mechanism)	New
3H	1. When trained network members are provided with support (e.g. quality improvement and mentoring) that is relevant to the problem they are addressing (context), they are more able to take practical and concrete action to solve problems (outcome) because they feel empowered (mechanism)	New
	2. When information that makes challenges visible emerges from supportive activities (e.g. quality improvement and mentoring) (context), network members feel a greater need to address the problem (outcome) because they feel accountable to network leaders/organisers (e.g. mentors, quality improvement team)	New
	3. When network members take practical action as a team (context), this mobilises the network members' efforts and resources (outcome) because they feel internal accountability towards other network members (mechanism)	New

3I	When network members are provided with a platform for them to easily communicate (e.g. WhatsApp groups) (context), they are more able to take practical and concrete action to solve problems (outcome) because they can access and gain the knowledge and reassurance they need (mechanism) *"This was part of the initial plans, and I'm happy that it got it kicked off well. After the training, in fact it usually starts before the training, so that we're able to do communication early enough to enable them to prepare well. After the training, we do have a WhatsApp group for ease of quick communication. Sometimes they even learn from themselves in those WhatsApp groups. And the good thing is that we do have biomedical WhatsApp groups, clinical team also has theirs. And then we have common shared groups of the focal the focal persons. These are the these are the to go to people that link the programme team that normally and [redacted], and even the other directors and the facility teams. So, they're the people who if we needed to get any updates, quickest possible, they're the people that we go to. So, we have also another common WhatsApp group for such kind of teams. So, this has both biomeds and clinical paediatricians. It's a mix of all those people. Then separate from that we have biomedical team aside, clinical team WhatsApp group aside, within the NEST's much larger team. We also have cross-country. I mean, we have a common group for the cross-country teams. Like the training managers, both clinical and technical, we have one that is common for all the four countries. And of course, led by the country liaison team that's now [redacted] and [redacted] again separate from that they do have clinical aside for the four countries. And then we have another technical one for the NEST engineers for the four countries together with Hatch team in that composition. So that's how we we are able to address issues quick as possible. Because sometimes, you will find in some other cases like for example, let me give you an example of a device. We have a device the Billidx Bilirubinometer machine. So far, we've experienced two errors that have been encountered in the field, Tanzania, Nigeria, Kenya. Malawi is yet to report. And those two errors do not exist within the user manual. They are not there. So, we whoever experiences it is free to post on WhatsApp, and we try to discuss it there. If it's something that somebody already encountered and was able to manoeuvre around you can share how that you were able to do that."* (FI 15)	New
3J	1. If network leaders/organisers continue to put effort and work into solving the identified problem (context), this supports network members to make progress towards changes in practice/improvements (outcome) because they feel encouraged to do so (mechanism)	New
	2. When efforts are made to provide consistent support to network members from network leadership/organisers (e.g. through quality improvement and mentorship) (context), it promotes network members to take action (outcome) because network members develop a bond with those providing support (feeling part of a larger team) and feel empowered by and accountability to them (mechanism)	New
3K	If, despite the support provided, network members fail to act or make progress (context), this starts to undermine the relationships between network members and those providing support (outcome) because those providing support feel the network members do not value their efforts (mechanism)	New

Table 5.12 CMOCs for Taking action to solve a problem.

Identity and culture

A network's identity and culture comes from a feeling of collective identity among network members that is interlinked with identifying with the network's collective vision. When network members come together to work towards a shared problem, they get a sense of fulfilment (CMOC 6A, confirmed) and potentially

belonging; however, the latter was not supported by primary data (CMOC 6B). When network members identify with other network members and its vision, they will develop a *network identity* (CMOC 6C, confirmed). If the network celebrates contributions made by those network members who had previously felt unrecognised in their work environment prior to the formation of the network, this can give them an *identity in the network* as important network members (CMOC 6D, new). When the *identity of a network* is linked with network initiators or partners providing resources to the network, this may create a separate and potentially unsustainable *identity,* not integrated into the health system (CMOC 6E, new). The demonstration and reinforcement of the *network identity* by network leadership, champions, and members can help other network members to adopt the *identity* (CMOC 6F, new). A network creates opportunities for members to connect, share experiences, and learn from each other in an open and safe environment, which creates a positive *network culture* and a sense of belonging to the network (CMOC 6G, refined). Network members can also shift negative or unsupportive pre-existing cultures to better align with the *network's culture* (CMOC 6H, refined).

The three substantive theories from this part of my Realist Review continue to be relevant with the primary data: New Social Movement Theory,[151-153] Organisation Culture Theory,[159 161] and Tuckman's Small Group Development Theory[154] (Table 4.2). Another view on organisational culture, Culture Typology, developed by Quinn and Cameron, posit there are four different types of culture in organisations: clan, hierarchical, market, and adhocracy[198] (Table 5.5). Networks try to create a clan culture, which focuses on collaboration, has high engagement and commitment from members, values relationships and teamwork, promotes shared values and goals, and empowers members to facilitate commitment and loyalty to the organisation.[198] Networks, however, exist within health systems, which are hierarchical in culture. Hierarchical cultures are procedural, structured, and controlling.[198] Certain networks, particularly those that are formed from the bottom-up, may have elements of adhocratic culture, which is entrepreneurial with risk-taking leaders.[198] When networks change pre-existing cultures, this is likely a movement from a

hierarchical to clan culture, which can decentralise power and authority to midlevel managers and distribute leadership.

NEST360 aims to create a clan culture in the network, even though it is not something that the network initiators and organisers explicitly set out to do. The creation of *identity and culture* are important to how a network functions and performs and therefore is worthwhile to build. NEST360 created a *network identity and culture* that stems from network members' passion for newborn care. Network hospitals and members feel part of a *culture* to improve newborn care. The provision of resources, for example training, equipment, and mentoring activities, helped to create a separate *network identity,* but this may make the *identity and culture* less sustainable when these resources are no longer provided to the network hospitals. However, NEST360 creates opportunities across network hospitals for members to connect, which reinforces a sense of belonging to the network and spreads its *culture*. Findings also show that for some network hospitals, a positive pre-existing *culture* that aligns with the network's vision can positively support the development of a *network identity and culture*.

6A	When network members with a collective identity come together to solve a shared problem (context), this makes them feel fulfilled (outcome) because of a sense of shared purpose (mechanism) *"And you see, you are part of that NBUs. It's NBUs this machine is not working, you see in you you are part and parcel of that. And when everything goes well, you know that everything is okay, today we are okay. You feel good. Because you know that newborn that premature baby will be there maybe for one week, two weeks, and if they are, okay. Now with that you see now, in your profession, you are something you are proud proud of." (FI 24)*	Confirmed
6B	When network members feel fulfilled from working with likeminded people in a network (context), they want to belong to the network (outcome) because they feel it is worthwhile (mechanism)	No supporting data
6C	When network members identify with other network members and the network's vision (context), they develop a network identity (outcome) because it gives them a sense of purpose (mechanism)	Confirmed
6D	When a network celebrates the contributions made by previously unrecognized/ unacknowledged hospital unit/facility leaders (context), this gives hospital unit/facility leaders an identity in the network as important network members (and in the hospital/facility) (outcome) because their expertise and role is now more valued by others (mechanism)	New
6E	When the identity of a network is linked with network partners/initiators providing resources to the network (context), the network has a separate identity that may make it less sustainable (outcome) because the network partners/initiators have not put in sufficient effort to integrate the network in the health system (mechanism)	New

6F	When network leadership and members consistently and regularly demonstrate and reinforce the network identity (context), this helps other network members adopt the network identity (outcome) because of role modelling (mechanism)	New
6G	When a network creates opportunities for members to connect, share experiences, and learn from each other in an open and safe environment (context), this creates a positive network culture and a feeling of belonging to the network (outcome) because members feel respected, valued, and acknowledged (mechanism)	Refined
6H	When local network leadership and members recognise that the network's culture is not aligned to existing cultures in their environment (context), then they may attempt to change the pre-existing cultures to make room for the network culture and practices (outcome) because they no longer identify with the pre-existing culture and see value in the network culture (mechanism)	Refined

Table 5.13 CMOCs for Identity and culture.

Network activities

Networks undertake certain activities for Initiation & Forming, Functioning & Performing, and Sustaining Change & Impact (see Network Activities in Figure 5.3 and Figure 5.4). There may be other activities that networks undertake but based on the primary data and my Scoping and Realist Reviews, the ones described below are likely the most important. Of these activities, only leadership was present in my Realist Review; the other activities emerged from primary data analysis, however, the literature from my Realist Review supports this evolved understanding of the programme theory and the inclusion of these network activities. The concept of Relational Coordination, which is a theory about how stakeholders coordinate by communicating and relating to achieve outcomes[199] (Table 5.5), lends itself to different aspects of networks, particularly the network activities that I have identified. The underlying CMOCs for these network activities are provided in Table 5.14 - Table 5.19 and I have provided one piece of illustrative data for one CMOC in each network activity and additional illustrative data supporting the CMOCs is available in Appendix 5H.

Knowledge and skills dissemination

Disseminating *knowledge and skills* is one of the main ways networks perform. In my Scoping Review (Chapter 3) under the framework component 'Mode of Functioning,' the most frequent practical characteristic was 'knowledge/information sharing, education, and learning.'[139] When a network *disseminates knowledge and skills* by creating training opportunities, this can change and improve

practices related to the identified problem (CMOC 14A). Network members may feel more supported and capable and may be more likely to adopt new practices through mentorship activities (CMOC 14B.1, 14B.2). Network members may also *disseminate knowledge and skills* to other departments within the network facility, which improves linkages between departments (CMOC 14C). When network members create links with non-network facilities, this also creates opportunities for sharing *knowledge and skills* (CMOC 14D).

Disseminating knowledge and improving the skills of clinicians, nurses, and biomeds is an important aspect of the NEST360 network. One of the first activities the NEST360 Kenya team undertook was to update the ETAT+ protocols. This was the basis for the in-service and pre-service training for clinicians and nurses and incorporated aspects of NEST360 supported device usage. Pre-service and in-service training materials on NEST360 supported devices were developed for the biomeds. Biomeds were trained on the maintenance and repair of devices as well as usage. The network created a training course to train trainers in teaching skills as well as content (General Instructors Course), while mentors helped to instil the *knowledge and skills* learned through the trainings. NBUs have integrated maternity and postnatal wards into the facility trainings and Continuing Medical Education (CMEs) which has improved their relationships with other departments with which they often liaise. Staff at facilities that refer (often Level 4 hospitals) to the NBUs in the network are often included in CMEs and facility trainings.

14A	When the network adequately shares knowledge and skills throughout the network by creating training opportunities (context), this changes/improves practices around the identified problem (outcome) because network members are more capable (mechanism) *"And then, of course, there has been a lot of change of practice change in practice in terms of like, maybe I'll give an example for jaundice. In every NEST hospital, you will notice jaundice or phototherapy is our game changer. Previously, people actually just thought phototherapy is just putting baby under the light. They didn't know it had to be measured. So, a lot of places actually had lights that were on but we're not giving the required irradiance. So now that people are measuring, people are telling you babies are just within one to two days, they're out. Previously, we'd had babies staying on photo for a week or more and all that. But now they realise, well actually we had to measure this." (FI 14)*	New
14B	1. When network members disseminate knowledge and skills through mentorship activities (context), network members feel supported and capable (outcome) because they develop the knowledge and skills needed to do their job well (mechanism)	New

	2. When network members regularly disseminate knowledge and skills through mentorship activities (context), network members are more likely to adopt new practices (outcome) because the mentors continuously reinforce the practices (mechanism)	New
14C	When network members include colleagues in other hospital/facility departments in knowledge sharing opportunities (context), this improves linkages between network members and other departments (outcome) because they respect and value the help provided (mechanism)	New
14D	When network members include providers in non-network facilities in knowledge sharing opportunities (context), this supports their ability to improve practices (outcome) because they develop essential skills and knowledge (mechanism)	New

Table 5.14 CMOCs for Knowledge and skills dissemination.

Cross-learning

A common activity that networks use to perform is *cross-learning* within and across network facilities. Within facilities, networks facilitate inter-professional *cross-learning* by bringing together network members from different professions and departments to share their experiences on problems and solutions (CMOC 13A). When a network makes an effort to connect members from different facilities, this helps them to learn new approaches to solve problems better and facilitates inter-facility learning in the network (CMOC 13B.1, 13B.2). This learning occurs through network meetings, supportive supervision, mentoring, QI activities, webinars, and creating linkages across network facilities. Network meetings are one of the main opportunities for *cross-learning* and can help network members to solve problems better (CMOC 13C). *Cross-learning* can continue remotely through WhatsApp and other communication platforms because of the purposeful relationships that have been established between network members at different facilities through network meetings and activities (CMOC 13D). When networks in different geographies are connected, this provides more opportunities for network members to learn how to solve problems better (CMOC 13E).

Cross-learning is an important network performing activity to highlight because it is a common way that practices are changed in networks. When a network brings together members, there are opportunities both for *cross-learning* and developing professional relationships (see Purposeful relationships, linkages, and partnerships). Continued *cross-learning* may be more likely when purposeful relationships or

connections have already been established. *Cross-learning* can take different shapes and levels of formality over the evolution of a network.

By providing opportunities to connect network members within and across facilities, the NEST360 network formed purposeful relationships and linkages among network members (see Purposeful relationships, linkages, and partnerships) and created opportunities for *cross-learning*. Through inter-professional trainings, clinical and biomedical network members have established better working relationships and learnt from each other, which has improved the overall care provided on the NBU. The NBU has established better linkages with the labour and postnatal wards and included those providers in their trainings and CMEs. The NEST360 network has also accomplished *cross-learning* across hospitals in the network through network review meetings, supportive supervision, mentoring, and QI activities, which provides opportunities for network members to exchange with or visit different hospitals in the network. NEST360 has also instituted network webinars, some of which have been open to external participants, providing another avenue for *cross-learning*. Network meetings are a key opportunity for *cross-learning* and provides nurses, clinicians, and hospital administrators opportunities to share experiences, learnings, and challenges with each other. Network members also use WhatsApp groups to continue learning from each other in-between more formal learning opportunities. While this research is only focused on NEST360 in Kenya, *cross-learning* also occurs among the larger four-country network, though less frequently than through the networks within countries.

13A	When the network brings network members together from different professions within the same facility to share their experiences on problems and solutions (context), this facilitates intra-facility cross-professional learning (outcome) because they understand the value of different roles in achieving the shared desirable change/outcomes and feel their challenges are acknowledged and inspired by different approaches from their peers (mechanism) *"And then the educational piece, which is also very heavy. I think it's it's unique in a way. Because the first one we do is to provide a course that brings together the clinicians and the biomeds and that allows cross collaborative learning. And what we've seen happen with that is at the facility then there's a lot of collaboration between the nurses and the biomeds and so the nurses telling us that sometimes they're able to see when a device is not working and they can call the biomeds. So that's something that was not happening before." (FI 18)*	New

13B	1. When the network makes an effort to connect network members from different facilities in the network (context), this facilitates inter-facility learning (outcome) because they feel their challenges are acknowledged and inspired by different approaches from their peers (mechanism)	New
	2. When the network makes an effort to connect network members from different facilities in the network (context), this helps them learn new approaches to better solve problems (outcome) because network members can share their experiences and knowledge and see their own work/setting in a new light (mechanism)	New
13C	When the network brings together network members through meetings (context), this helps them to better solve problems (outcome) because they learn from each other (mechanism)	New
13D	When network members have created purposeful relationships through network meetings and activities (context), they are able to continue their cross-learning remotely (e.g. WhatsApp) (outcome) because they have an already established bond (mechanism)	New
13E	When the network makes an effort to connect network members with networks in other geographies (within or across countries) (context), this helps them to better solve problems (outcome) because network members can share their experiences and knowledge (mechanism)	New

Table 5.15 CMOCs for Cross-learning.

Resourcing networks

Networks require different *resources* to be initiated, form, function, perform, and ultimately be sustained or sustain the changes in practice and impact. These resources can be tangible, such as financial resources, human resources, infrastructure, medical devices, and pharmaceutical products or intangible, such as time of network members. Networks will need varying levels of *resourcing* at different times in the network's evolution. External *resources* may not always be available to a network and a network that relies on external *resources* will likely need alternative sources of these *resources* for the network to continue to perform and sustain the changes in practice. External *resources* may be transitioned out of networks overtime to support a gradual increase in local *resources*.

If the network exists in an under-resourced health system, this may make sustainability of the network and network activities challenging (CMOC 16A). Network sustainability may also be challenging when a network is heavily dependent on external *resources* and not sufficiently integrated into the health system (CMOC 16B) or when the network does not have sufficient human *resources* required to changes practices and sustain the network impact (CMOC 16C). When the network shares the collective vision with stakeholders, such as partner organisations, this can help sustain the network and extend the network's reach (CMOC 16D). Furthermore, if the network makes an effort to engage local or sub-national

government in the network and the collective vision, they may be able to use their skills and *resources* to support network activities and sustainability (CMOC 16E).

The Kenya health system is plagued with financial, pharmaceutical, consumables, equipment, and human *resources* challenges. While the NEST360 network has provided significant financial *resources*, infrastructure upgrades, equipment, parts, consumables, and capacity building activities (e.g. training, mentoring, QI) into the health system, as NEST360 begins to transition direct *resource* support from existing network hospitals, there may be challenges for the health system to match the level of *resource* input provided by NEST360. Furthermore, the network hospitals are understaffed and so existing staff may have challenges in sustaining the changes in practice and network activities. As NEST360 moves to transition direct support from existing network hospitals, the network organisers (NEST360 Kenya team) are engaging with stakeholders and county governments to help sustain network activities and the network's reach.

16A	When the health system is insufficiently resourced (context), transition and sustainability of the network and network activities may be challenging (outcome) because there is limited capacity to sustain the network's impact (mechanism)	New
16B	When an externally initiated network is heavily dependent on external resources and not sufficiently integrated into the health system (context), this will make transition and sustainability of the network and network activities challenging (outcome) because the health system and stakeholders may not be able to prioritise absorbing the required investment (mechanism)	New
16C	When the network does not have sufficient human resources required to change practices and sustain the changes (context), this will make transition and sustainability of the network and network activities challenging (outcome) because the network has limited capacity to institutionalise its impact (mechanism) *"But you see, now we also think that the biggest challenge because I still believe that figure can come down, if you only have if you only have enough human resource because now so yeah, you have a single nurse. Let's say you have within five, five CPAPs. See remember, the CPAP needs to be monitored. At least every hour. Lactic acid is not kinking of the tubes, there is no secretions. Now you only have one nurse. So even if you have to put five babies on CPAP, most likely monitoring is not possible, and this same same nurse then is supposed to titrate leads." (FI 10)*	New
16D	When the network shares the collective vision with stakeholders (e.g. partner organisations) outside the network (context), this can help with sustainability and extending the network's reach (outcome) because they can understand the value of the network (mechanism)	New
16E	When the network makes efforts to engage local/sub-national government in the network and the collective vision (context), members can use their skills and resources to support network activities and sustainability (outcome) because they appreciate the value of the network (mechanism)	New

Table 5.16 CMOCs for Resourcing networks.

Leadership

Network leaders have a formal responsibility in network operations and decision making. *Leadership* differs depending on if the network was initiated from the top-down, by external stakeholders, organically, or from the bottom-up. As I collected the primary data on a network initiated by outside global health partners, I revised the CMOCs to take this background into consideration. I was unable to confirm, refute, or refine five of the CMOCs from the initial programme theory from the primary data (5B, 5D, 5G, 5H, 5Q), which may be because these CMOCs are more relevant for networks that are initiated from the bottom-up or form organically. From the primary data, I identified other important aspects of *leadership* in networks that did not emerge from the literature in my Realist Review. These aspects were added in nine new CMOCs (5A, 5N-5P, 5R-5T). The primary data confirmed one CMOC (5I) and refined seven (5C, 5E, 5F, 5J-5M).

In networks that are initiated and/or supported by external organisations, they will recruit *network leaders* they believe have the competencies to contribute to network formation and functioning (CMOC 5A). In order to set up the network and keep it going, network leaders enact *leadership* capabilities and communicate the network's vision and goals to bring network members around the vision and move forward in the same direction (CMOC 5C). *Network leaders* provide support and feedback to network members to support network functioning to take action to solve the identified problem (CMOC 5E). *Network leaders* can influence network members to develop greater commitment, engagement, and/or motivation when they get things done (CMOC 5F).

In order to support the network to work towards the collective vision, *network leadership* will consistently and regularly support and provide resources to network members (CMOC 5I). *Network leaders* and members can influence other network members to adopt network practices by promoting, encouraging, and championing practices (CMOC 5J). *Leadership* can create a welcoming, supportive, and inclusive

network environment, which can support network members to seek support to improve knowledge, skills, or manner of working (CMOC 5K).

A network needs to grow and cultivate *leadership*, which can happen when networks have processes in place to identify and enable those with the necessary skills, motivations, or attitudes to take on *leadership* roles (CMOC 5L). There can be challenges with *network leadership* when a network is highly dependent on a few people or organisations to implement or support network activities, there is misalignment between *network leaders*/organisations, there are *leadership* changes within the network, *leaders*/organisations exit the network, and new *leaders*/organisations introduce new working practices (CMOC 5M – 5O). Changes to non-network stakeholder *leaders*, whose commitment to the network is important for network functioning, can also undermine network functioning (CMOC 5P). Networks can mitigate these *leadership* challenges, such as new network *leadership* putting in effort and network organisers leveraging their influence and effort among others in the network (CMOCs 5R – 5T).

Smelser's Theory of Collective Behaviour,[148 149] Tuckman's Small Group Development Theory,[154] and Ganz's theorising on *leadership* in social movements[162 163] (Table 4.2) continue to be relevant in the revised programme theory. Additionally, networks are relational systems[200] (Table 5.5) and functioning networks are an example of when relationships are prioritised and reinforced by *leaders*.

There are different layers of *leadership* in NEST360: NEST360 Global (Rice University and partners), NEST360 Kenya (Aga Khan, KWTRP, Kenya Paediatric Research Consortium (KEPRECON)), and *leaders* at the hospitals (medical superintendents) and within the NBU (nurse-in-charge, paediatricians). Each of these *leaders* enact different *leadership* capabilities in different parts of the network that are important for network initiation, formation, functioning, performing, and sustaining change and impact. One participant saw *leadership* as an important success factor: *"so leadership to me was one one big unaccounted for factor in the success of this programme" (FI 31)*. This statement links to one of my overall findings in the evaluation – that there are many other factors that need to occur or be in place (that make

up the network) for the central activities that NEST360 has put in place to work. Among the NEST360 Kenya *leadership* (network organisers), there were several changes in partner organisations. This made implementation of network activities challenging, delayed, and frustrating for the team providing support to the hospitals, who remained mostly the same.

5A	Networks, initiated and supported by outside organisations/partners (context), will recruit organisations or individuals into leadership positions that they think are competent for network formation and functioning (outcome) because they believe these organisations or individuals understand what the network needs to succeed (mechanism)	New
5B	When networks have a member(s) that clearly takes on a leadership role, focuses on building linkages between potential network members and stakeholders, and creates communication channels (context), this helps the network to form (outcome) because it brings people together (mechanism)	No supporting data
5C	When networks have a member(s) that enacts leadership capabilities, communicates the network's vision, and helps to set collective goals (context), this helps to bring network members around the collective vision and to move forward in the same direction (outcome) because they have the same understanding of the network's value (mechanism)	Refined
5D	When networks have a member(s) that clearly takes on a leadership role and actively coordinates network members (context), this helps the network to form (outcome) because there is a central figure bringing people together (mechanism)	No supporting data
5E	When networks have a member(s) that enacts leadership capabilities and provides support and feedback to network members (context), this can help the network function and take more appropriate action towards the identified problem (outcome) because network members feel empowered to take action to work towards achieving the vision (mechanism)	Refined
5F	When networks have a member(s) that enacts leadership capabilities and gets things done (context), network members develop greater commitment, engagement, and/or motivation (outcome) because they believe belonging to the network is worthwhile (mechanism)	Refined
5G	When networks have a member(s) that takes on a leadership role and dedicates time to setting up and the functioning of the network (context), network members develop greater commitment, engagement, and/or motivation (outcome) because they believe belonging to the network is worthwhile (mechanism)	No supporting data
5H	When networks have a member(s) that clearly takes on a leadership role and actively engages network members (context), network members develop greater commitment, engagement, and/or motivation (outcome) because network members feel part of the network (mechanism)	No supporting data
5I	When network leadership consistently and regularly supports and provides resources to network members (context), this helps network members act to achieve the network's collective vision (outcome) because the network members feel empowered (mechanism)	Confirmed
5J	When network leadership and members consistently and regularly promote, encourage, or champion practices or influence network members to take up certain practices (context), this helps other network members to adopt these practices and sustain them in the network/unit (outcome) because of role modelling (mechanism)	Refined

5K	When network leadership creates a welcoming, supportive, and inclusive environment within the network (context), members feel more able to seek support to improve knowledge, skills, or manner of working (outcome) because network members feel that they are in a psychological safe environment (mechanism)	Refined
5L	When networks have processes in place to identify and enable those with the necessary skills, motivations, or attitudes to take on leadership roles from a wider pool of engaged human resources (context), this may support network functioning and may lead to changes happening (outcome), because the network is able to create a distributed form of leadership across the network (mechanism)	Refined
5M	If a network is highly dependent on a few people or leaders to implement network activities or leaders that support their implementation (context), then it is at risk of being unsustainable or functioning poorly (outcome) because the leadership structure is fragile (mechanism)	Refined
5N	When there is misalignment of priorities between network leaders/partner organisations (context), then one leader/partner organisation may feel they need to leave the network (outcome) because they do not feel they are moving in the same direction (mechanism)	New
5O	1. When there is a leadership/partner organisation change within the network and a new leader/partner organisation comes in (context), this can jeopardise maintaining the network's collective vision, existing relationships, and functioning (outcome) because the new leader/partner organisation is external and has not assimilated into the network (mechanism)	New
	2. When a leadership change within the network introduces new working practices in the network (context), this can disrupt network activity implementation and functioning (outcome) because network members need to learn about new practices (mechanism)	New
	3. When a leadership change within the network introduces new working practices without first discussing and negotiating these with network members (context), network members can become frustrated (outcome) because their experience and expertise in the network is not valued (mechanism) *"I'll honestly say that it has impacted it has okay let me say it has had an impact on the programme as such that the implementation slowed down at some point, yeah. As a programme manager, I think I can say for any programme manager something that can be frustrating is when you lack… to do something to to implement, to be able to implement, you know. So like, for example, when we move from CPHD, of course, there is a way there was a system on how, you know, you are running a programme, and then move to the next let me say stage where we are out of CPHD, and we have to continuously maintain the programme. And then just as when we are getting the momentum and coming up with systems to be able to implement smoothly, then another transitioning comes on board where we moved now to, I don't know Strathmore University. And then of course, then they have their own policies, they have, you know. Everywhere you go with a partner, they have their policies and system on how they're doing things. So, when you have a programme that is running that has to continue running and on the other side, you have to start abiding afresh, to the other partners, policies and system of how they're doing things you're used to doing… if anything comes up with any programme implementation there has to the flexibility. So, you realise when something comes in between the planned activities in that particular month, now, having moved to having joined another partnership here, it becomes difficult to manage anything else that comes in between. So that was quite frustrating, especially the one that you're given restriction when it comes to timelines, you cannot do this at this time, we are time bound we cannot organise a training...*	New

	and because you've moved to the new partnership, and they feel like no we are time bound we are not able to book a conference space for you, we are not able to organise transport for you, I mean it becomes frustrating. Then just as we are settling again, another transitioning happens now from Strathmore to now having to partner with a consultant, you know, to support us with the finance systems, the operation system, basically when it comes to logistics and you know finance. And then just as we are also picking up that momentum, now we have to transition again. Now we are currently in Aga Khan. I mean, it can be frustrating for any programme implementation because even now at Aga Khan they now have, of course, even that consultant had his own system and ways of doing things. This affects a lot the flexibility on how they programme activities can be implemented. And of course, now getting into Aga Khan now fully transitioning to Aga Khan, where now finance has to be, of course, operated by them, logistics, and when you want something to be to be done, there's a lot of bureaucracy of how things are going to be improved, approved. Sorry. And so that for that particular activity to take place, I mean, it's when you start settling down, you have to start over again. I mean, it's that kind of a cycle. So, we've been oscillating around transitioning more than how focusing on you know, programming implementation and ensuring quality of what we desire to achieve. Yeah, so I think that has also affected a little bit of the quality, but even so with that I can say, I can tap our backs, I mean, as the NEST Kenya team that we've actually managed to push through a lot of activities. I mean, just just becoming flexible ourselves, putting the frustrations aside, and, you know, trying to keep that focus and and yeah, moving on…transitioning has had an effect big an impact big time on programme implementation. Yeah, and it can be very frustrating." (FI 20)	
5P	When non-network health system leaders, whose buy-in/commitment to the network is important for network functioning, change (context), this can disrupt network activity implementation and functioning (outcome) because it puts at risk relationships essential for network functioning (mechanism)	New
5Q	When network leadership is not able to get the network to develop and agree on a shared vision (context), then it is at risk of not performing well and becoming unsustainable (outcome) because members are unclear as to what the network is for (mechanism)	No supporting data
5R	If network members take appropriate action to mitigate any disruption leadership changes might bring (context), then the network is more likely to keep functioning (outcome) because the impact of any disruptions are minimised (mechanism)	New
5S	When there is a change of leadership within the network and new network leadership puts in efforts to maintain network functioning (context), network members feel that it is still worthwhile to be part of the network (outcome) because they feel the leaders value the network (mechanism)	New
5T	When hospital/facility leadership sees the effort that the network is making and the changes that have resulted (context), this encourages them to take action to work towards the collective vision (outcome) because they understand the value of the work (mechanism)	New

Table 5.17 CMOCs for Leadership.

Champions

Network champions are important for initiating a network, its formation, ongoing functioning and performing, and sustaining change and impact. *Champions* may or may not be a formal network leader or have a formal leadership role in their facility/organisation, though they are respected by their colleagues,

may regularly provide support, and are advocates for the network cause. *Champions* have the skills, passion, and energy to take action and support and motivate other network members. Their passion aligns with the network's collective vision and they put extra energy into making things happen. *Champions* may emerge in networks because networks have a clan culture or aim to build one[198] (Table 5.5). The existence of a collective vision and psychological safe space in functional networks may facilitate the roles of *champions*.

At network formation, network members who are passionate about the problem and believe in the collection vision may emerge as *champions* (CMOC 11A). As the network evolves, *champions* may be identified and nurtured by network leaders (CMOC 11B). When *network champions* are capable and willing to take on additional responsibilities within the network, they play an important role in supporting the network to take action towards the identified problem and cultivating committed, engaged, and motivated network members. They support training, mentoring, and changing practices (CMOCs 11C, 11D). *Champions* may have pre-existing relationships that they bring to the network that help the network take action (CMOC 11E). However, when *champions* leave the network, there can be unintended consequences for these relationships and the network (CMOCs 11F, 11G).

From the network's initiation, *champions* have played an important role in the NEST360 network. Early NEST360 *network champions* were passionate, respected people who had a good understanding of the context of the network hospitals and engaged well with the hospitals. They were key in forming the initial network relationships. As the network began to function, additional *champions* emerged in the network hospitals, who became trainers and mentors for the network. *Champions* have helped staff in the NBU change their practices of care. Some *champions* have brought with them relationships that are beneficial to network functioning, for example from the national or county ministries of health. Over time, some *champions* have transitioned out and left a void. For example, one of the network hospitals felt a reduction in the energy and enthusiasm around network activities following a *champion's* departure.

11A	When a network provides a platform for members who are passionate and believe in the collective vision (context), they are willing to be champions (outcome) because doing so enables them to initiate change (mechanism)	New
11B	When network leaders identify and nurture influential and capable network members and support their leadership capabilities (context), this creates network champions (outcome) because they have the support to enact their skills and passions (mechanism) *"If you're going to create a network, you're going to create a movement, you need to identify key movement makers, key game changers. People who genuinely care about what is happening and you will find them they are not necessarily the leader. In fact, if you should look beyond the leader. People who have some form of influence in their unit have been very helpful and across the country that's one of the things that has helped me, once I'm able to identify them, then it's easy to work with them." (FI 29)*	New
11C	When network champions are capable and willing to take on additional responsibilities within the network (context), they will train and mentor network members (outcome) because they see the value and have the skills and passion to do so (mechanism)	New
11D	When network champions are capable and willing to take on additional responsibilities within the network (context), they will help change practices (outcome) because they see the value and have the skills and passion to do so (mechanism)	New
11E	When network champions have pre-existing relationships that they bring to the network (context), this helps the network take action (outcome) because these relationships bring with them extra resources (e.g. access to people, lending legitimacy to the network) (mechanism)	New
11F	When network champions leave the network (context), this may result in a loss of relationships important to the network (outcome) because these are personal to the champion (mechanism)	New
11G	When network champions leave the network (context), this may result in a loss of energy to take action in the network (outcome) because network members feel less motivated and encouraged (mechanism)	New

Table 5.18 CMOCs for Champions.

Adaptability

Networks are initiated, form, function, and perform in complex open systems (i.e. health systems) and environments. Events may occur in a network's environment, for example, an earthquake or the COVID-19 pandemic, which hinder its formation, functioning, and performance. Networks will need to adapt to form and undertake activities to work towards achieving their collective vision and sustain change and impact they achieve.

When there are unforeseen circumstances that are out of network members' control that affect network formation, the network must *adapt* to be viable. If network members are passionate, innovative, committed, reflexive, and seek the input of others, this can help the network *adapt* its activities and functioning to continue to work towards the collective vision (CMOCs 15A, 15B). Network members and the skills and competencies that they contribute to the network are essential to network formation,

functioning, and performing. When network members are moved to non-network facilities, the remaining network members will have to work to restore those same competencies within the network (CMOC 15C). Networks may also experience changes in network organisers or leadership that can influence network activity operations and financing and network members will have to *adapt* to continue implementing network activities (CMOC 15D). As the network becomes more established and responsibilities shift to different network members, this can help the network *adapt* to support network sustainability (CMOC 15E).

The NEST360 network has had to *adapt* during its formation and throughout its performing. During the network's formation, the network had to significantly *adapt* its plans and activities because of COVID-19 related restrictions. At the beginning of the pandemic, the network ran a series of webinars on newborn care for the network and others interested. This led to modifying in-person trainings for clinicians and nurses on newborn care and devices to a hybrid format with three-days of virtual lectures followed by two-days of in-person practical training. Training for biomeds was conducted virtually and followed-up with mentorship during device installation and continued remote support. Meetings were moved online and tools such as Zoom and WhatsApp were leveraged to facilitate virtual trainings, meetings, and communication.

NEST360 network members are reflective on how network activities are being undertaken and take into account network hospital feedback to make changes along the way, for example with the QI visits. The network has had to continually *adapt* to changes among trained staff on the NBU and biomeds. Despite pro-active efforts to avoid this, many network hospitals have lost clinical, nursing, and biomedical staff. In response, remaining NBU and biomedical staff and mentors train the replacement staff on-the-job to avoid loss of skills needed to work towards the collective vision. The NEST360 network has also had to *adapt* to changes in the organisations that make up the network organising and leadership team (NEST360 Kenya). These changes have been challenging to network organisers (NEST360 Kenya team), who have largely

remained the same, and required them to *adapt* to changing operational and financial processes to support network hospitals and activities. As the network evolves, the NEST360 Kenya team is making an effort to shift responsibilities for certain network activities, for example QI visits, to the counties and national MoH.

15A	When passionate, innovative, and committed network members face circumstances in the network's operating environment that are out of the network's control and affect the network forming (context), the network adapts its activities to be able to continue to work towards the collective vision (outcome) because the network members believe in the value of the network and its collective vision (mechanism) *"So the first trainings we did, we piloted that the guidelines, the training in in [redacted] hospital and in [redacted] at that time, I'm the one who was doing the clinical part and [redacted] was doing the the nursing part. And then we had a medical engineer and oh now I remember what happened. So, you are now to scale-up in the other count...in the other facilities and we had COVID. Yes, somehow now, things just couldn't work the way we had planned, although we had planned for our for our training in May for the for the instructors because we wanted people to help us instruct but now but now that that could not happen.* *And so, when now came to training the NEST programme because we had done very many webinars and even even the webinars, the nurses who do their parts, the engineers who do their part, and the clinical would do their their part. So, we used...three players that are put even in the webinars and demonstrate the use of machines, demonstrating how you do the procedures on the webinars. And then at that time, I thought, I can we can try a training, NEST training just in a webinar because of this contact. And then we did three days and who visited from from from morning to evening to six there and we will … because it was very interactive so that people don't sleep.* *So, we're able to do virtual trainings, we did the second one, it was successful. And at that time, we were to lose money if we have not done any trainings. That yeah, there was no carry forward of the money in January, right. And I just wondered, I'm going to let Kenya down? No, I can't. And I just organised, we organised three trainings training simultaneously three hospitals, online, each with a team of trainers. So the the the three days we did we did together and that's in each of the facilities and all the sessions the theory sessions will be given by three people from the three different hospitals because when they go to the hospitals for practicals you don't want people to get lost to not have not to have rehearsed. So that training we had about 12 trainers for the plenary session. And then on after three days, they went onsite each each team so we had [redacted] and we had [redacted] and we had [redacted] they all went at site. And they now conducted the the hands-on experience on on the machine. I think to me that is the greatest things I'll always remember where I took a risk. And, that time what happened, we hadn't prepared the guidelines and I we said 'No, we can they can look at the guidelines for the from the from the phone PDF guidelines.'" (FI 30)*	New
15B	When network members are reflexive and seek out input from others on network activity implementation (context), the network can adapt its functioning (outcome) because the network members develop a better understanding of the actions they need to take to work towards solving the identified problem (mechanism)	New
15C	When skilled and capable network members leave network facilities (e.g. move to non-network facilities) (context), network members work to restore those same competencies within the	New

	network (outcome) because they recognise the value and importance of those skills in the network (mechanism)	
15D	When there are changes in network organisers or leadership that influence network activity operations and financing (context), network members will adapt to continue implementing network activities (outcome) because of their resilience and commitment to the network (mechanism)	New
15E	As the network becomes more established and responsibilities shift to different network members (context), this helps the network adapt to support network sustainability (outcome) because it creates network resilience (mechanism)	New

Table 5.19 CMOCs for Adaptability.

Network foundations

Network processes and activities are underpinned by teamwork; a psychological safe space; committed, engaged, motivated, empowered, and confident network members; and purposeful relationships, linkages, and partnerships (see Foundations in Figure 5.3 and Figure 5.4). Purposeful relationships, linkages, and partnerships; committed, engaged, and motivated network members; and a psychological safe space are part of the programme theory from my Realist Review; while teamwork and empowered and confident network members have emerged from the primary data. The CMOCs underpinning this part of the programme theory are in Table 5.20 - Table 5.25. I have provided one piece of illustrative data for one CMOC in each network foundation and additional illustrative data supporting the CMOCs is available in Appendix 5H.

Teamwork

Networks can improve *teamwork* among network members within and across network facilities. Existing levels of *teamwork* within networks can help the network to form and function. When network members have opportunities, such as multidisciplinary team meetings, trainings, and inter/intra-facility QI and mentoring activities to learn and work together, this can improve multidisciplinary *teamwork* (CMOC 12A). *Teamwork* between different types of professions or specialities can improve in the network through interprofessional training opportunities (CMOC 12B). When there is improved *teamwork* in the network, network members can better support each other and do not feel alone in their job (CMOC 12C). Network members who feel part of a well-functioning team feel they can take the initiative to provide care and take

action to change practices (CMOCs 12D, 12E). In an externally initiated network, *teamwork* between the network organisers or between network organisers and members can result in better implementation of network activities because they support each other (CMOC 12F).

In a network, *teamwork* emerges in the latter two phases of Tuckman's Small Group Development Theory[154] (Table 4.2) — norming and performing — when network members set out processes and (new) ways of working. For the network to optimally function and perform, *teamwork* is needed among network members and potentially with those outside the network who may influence its functioning as a way to mitigate potential blockages (i.e. Smesler's social control mechanisms,[148 149] Table 4.2). The existence of psychological safety[169] (Table 4.2), which can be created by a network, helps to promote *teamwork*. Pre-existing *teamwork* in a network may also help to build psychological safety.

There are many different models of *teamwork* and the *teamwork* literature is vast. One model that is particularly applicable to networks is the LaFasto and Larson model (2001)[201] (Table 5.5). Their characteristics of *teamwork* and collaboration are reflected in functional and performing networks. Networks enable members to reinforce these characteristics to ensure the presence of *teamwork*. For example, networks provide training and mentoring opportunities to improve the skills and competencies of network members. Strong relationships, commitment to the collective vision, positive culture, and supportive leaderships are key in networks and can help build *teamwork* in the network.

The NEST360 network put in significant effort to establish and strengthen *teamwork* within and across network facilities. It was able to accomplish this through multidisciplinary meetings that included clinicians, nurses, biomeds, and hospital administrators, trainings across the network and within facilities, and intra-and inter facility QI and mentoring activities. *Teamwork* was built and strengthened between clinical network members and the biomeds. Their relationships and ability to work together is one of the noteworthy changes in practice in the network. The network has also improved *teamwork* between the maternity and newborn units. *Teamwork* has enabled care practices to improve on NBUs because network

members feel empowered to enact their role (also see CMOC 10E). Strong *teamwork* among the network organisers and *teamwork* between them and network hospitals has enabled them to better implement and support network activities.

12A	When network members have opportunities to learn and work together (context), this improves multidisciplinary teamwork (outcome) because they get to know each other better (mechanism)	New
12B	When the training provided to network members is multidisciplinary (context), this enables interprofessional teamwork among network members (outcome) because they understand each other's roles and capabilities (mechanism) *"So, for the good things I would say that right now NEST has is one of the programmes that has really promoted collaboration between the clinicians and the biomedical team. Initially before NEST came onboard there was that bit of there was no, you know, teamwork. And there was quite a bit of do I call it miscommunication or something. So, NEST has through these trainings that we do together, NEST has been able to bring together both the clinicians and the technical team to work together. And you see once a facility has brought in two or three people from working on the same things, then there is that bond that is created. And when they go back, they kind of work together because of what they have been trained from NEST." (FI 17)*	New
12C	When network members feel they are part of a well-functioning team (context), they support each other and do not feel alone in their job (outcome) because they feel responsible and accountable to each other (mechanism)	New
12D	When network members feel they are part of a well-functioning team (context), network members feel that they can take the initiative to provide care (outcome) because they feel empowered and understand each other's roles and capabilities (mechanism)	New
12E	When network members feel they are part of a well-functioning team (context), network members feel that they can take action to change practices (outcome) because they feel responsible and accountable to each other (mechanism)	New
12F	In an externally initiated network when there is teamwork among network organisers (context), this will enable better network activity implementation (outcome) because they support each other in their work (mechanism)	New

Table 5.20 CMOCs for Teamwork.

Psychological safe space

Primary data collection confirmed (CMOCs 9B-9E) or refined (CMOCs 9A (refined based on totality of data), 9F) all CMOCs, but did not add any additional dimensions to this part of the programme theory. The primary data reinforces that creating a *psychological safe space* is an important part of a network. A *psychological safe space* is formed and promoted when network members form trusting and respectful horizontal relationships (CMOC 9B). Once a network has created a *psychological safe space*, network members are more likely to learn, improve, seek feedback, and openly raise concerns and problems (CMOCs 9C, 9D). A *psychological safe space* encourages innovative behaviour and innovation in the

network (CMOC 9E). It enables network members to more easily communicate and collaborate across facilities, levels of the health system, and sectors of care (CMOC 9F).

My Realist Review suggests that *psychological safety*[169] (Table 4.2) is more likely to be created in a network that formed from the bottom-up because there is more natural commitment to the collective vision and likely less hierarchy or imposed leadership. A more hierarchical culture in the workplace and society at large may be a hinderance to establishing *psychological safety.*[202 203] However, in networks that are formed from the top-down or externally initiated, there are approaches that network initiators, leadership, and organisers can take so that a *psychological safe space* is created in the network and therefore shift the hierarchical culture. These approaches include being available, supportive, and non-judgemental. The qualities of relational coordination[199] (Table 5.5) are akin to the existence of a *psychological safe space*.

NEST360 has put in effort to create *psychological safe spaces* within the network. Inter-and intra-facility network meetings have helped to create teamwork and flatten hierarchies. This has enabled network members to share openly and freely experiences and challenges and identify ways to change practices. The network has been able to create an environment where network members do not feel a sense of fault finding but of improvement. Network facilities can be innovative and share what they have learned with other facilities in the network, for example different models of QI. Communication has also improved between network facilities and the lower-level facilities that refer to them and between the MoH and network hospitals.

9A	When network leadership/organisers are available and approachable, invite input and feedback, and model openness, fallibility, and non-judgmental behaviour (context), then this promotes a network's psychological safety (outcome) because network members feel empowered and not threatened when they speak up or make a mistake (mechanism)	Refined
9B	When network members form trusting and respectful horizontal relationships (leading to flattened hierarchy) (context), then this promotes a network's psychological safety (outcome) because network members feel equal (mechanism)	Confirmed
9C	When a network has a shared network identity and culture that promotes a psychological safe space (context), then network members are more likely able to learn, improve, and seek feedback (outcome) because they feel empowered and a reduced fear of negative consequences (mechanism)	Confirmed

9D	When a network is a psychological safe space for network members (context), it enables members to openly raise concerns or problems (outcome) because they know they will be supported and there won't be negative repercussions (mechanism)	Confirmed
9E	When a network is a psychological safe space for network members (context), it encourages innovative behaviour and innovation (outcome) because members know they will be supported and there won't be negative repercussions (mechanism)	Confirmed
9F	When a network creates a psychological safe space for network members (context), it enables them to more easily communicate and collaborate across the network's facilities, levels, and sectors of care (outcome) because they already have a common ground and understanding (mechanism) *"Hospitals that we've done mentorship programme…so that we have direct communication with them, direct communication, that is from the sub-county to the newborn unit. So that is one thing that shows that the referral facilities know they know what they're doing. And sometimes they can just call us for, you know for what we do. We've just delivered that baby with birth asphyxia or a baby with congenital abnormalities. What do we do and know, as mentors as mentors were able to give them information, we're able to to sometimes we correct them, and sometimes to encourage them in terms of so many things. So, one thing that they're receptive, very receptive." (FI 07)*	Refined

Table 5.21 CMOCs for Psychological safe space.

Commitment

A network must work to get *commitment* from network members and outside stakeholders. The primary data added additional explanations for how networks cultivate *commitment* from network members, supported by five new CMOCs (7B, 7D, 7F, 7G, 7I, 7J), and while I had no primary data to support CMOC 7J, it made sense within the programme theory. Two CMOCs were confirmed (7A, 7E) and three refined (7C, 7H, 7K) by the primary data.

Commitment to a network is generated from network members when they identify with the network's collective vision, identity, and culture (CMOC 7A); when their professional identity/calling aligns with the network vision (CMOC 7B); when they have support from leadership/administration/stakeholders (CMOC 7C); when the network enables members to achieve professional norms (CMOC 7D); and when network members feel they get emotional benefits or a sense of purpose from the network (CMOC 7E). When a network shows results from dedicated network members' efforts, this can generate *commitment* from network hospital leadership (CMOC 7F). If network initiators or organisers promote the network's efforts to the global community, this can also increase *commitment* from network members (CMOC 7G). Networks with *committed* members are more likely to act on their identified problem and collective vision

(CMOC 7H). *Committed* network members may take action to disseminate knowledge to other members and those external to the network, which extends network benefits within and beyond the network (CMOC 7I). When influential outside stakeholders are actively engaged in network processes then they are more likely to be *committed* to the network (CMOC 7J) and it may be easier for the network to achieve its aims (CMOC 7K).

The four substantive theories that support this part of the programme theory from my Realist Review, Organisational Commitment Theory,[164 165] Organisational Culture theory,[159 161] Tuckman's Small Group Development Theory,[154] and Smesler's Theory of Collective Behaviour[148 149] (Table 4.2) are consistent with the revised CMOCs from the primary data. My Realist Review highlighted that Tuckman's stages of 'forming' and 'storming' may be important for generating *commitment,* but the primary data also points to the importance of the 'performing' stage. For example, when the network shows results to hospital leadership, this can generate the leaders' *commitment* to the network because they see the value in what the network is doing. *Commitment* from non-network stakeholders in the network environment continues to be important to ease threats of 'social control mechanisms'[148 149] (Theory of Collective Behaviour, Table 4.2) that may impact network forming, functioning, and performing.

NEST360 has worked to cultivate *commitment* from the NBUs, hospital leadership, and national and county MoHs. Network members feel proud and positive about being part of the NEST360 network. The support provided by the NEST360 Kenya team in terms of training, mentorship, and ad hoc support to the network members helps them feel a sense of belonging. With the *commitment* that network members feel towards the network, they are motivated to act on the collective vision. At the start of the NEST360 network, the network initiators and organisers did not put in sufficient effort to engage the county government in network processes, which led to mixed interest and *commitment* in the network. The effects of this lack of engagement are now starting to be seen as NEST360 begins to reduce the level of support to the initial 13 hospitals in the network. For example, MoUs were put in place with the network hospitals instead of

the counties and so as county leadership changes, they are often unaware of the network. NEST360 has however, engaged the MoH in network activities, particularly QI, which the MoH has taken a notable leadership role in.

7A	When network members identify with the network's collective vision, identity, and culture (context), they are more likely to be committed to the network (outcome) because they believe in and value these (mechanism)	Confirmed
7B	When network members' professional identity/calling align with the network vision (context), they are more likely to be committed to the network and enact affective commitment (outcome) because they professionally value/find importance in the network vision (mechanism)	New
7C	When networks members have support from network leadership/organisers (context), they are more likely to be committed to the network (outcome) because they feel valued (mechanism)	Refined
7D	When networks enable members to achieve professional norms (that are part of their professional identity) (context), they will be committed to the network (outcome) because of affective commitment (i.e. the alignment between their professional and the network's norms) (mechanism)	New
7E	When a network member gets 'emotional' benefits (positive feelings) or feel a sense of purpose from being part of the network (context), they are likely to be highly committed (outcome) because it is fulfilling for them (mechanism) *"Let's say we feel proud to be part of NEST, we feel we refer ourselves as the NEST hospitals. And because it came and changed how we do things. It's changed how we, you know, we perceive things, it's changed our outcomes. So, we are very proud to be part of it. I must say, it's like, yeah, it's like a movement sort of. So, first of all, you are always motivated to do the best you can, you're motivated to make a difference for that child. And, you know, you stop doing things just the way you were doing them before, because now you know, better. So, I think it's more than just adding the group of people but from within, they found it changed in you. And then when you come together as a group, I think it's more of a movement. We want to make a difference for the children. So, I hope that can continue." (FI 23)*	Confirmed
7F	When a network shows network hospital/facility leadership it can improve care practices (context), this can generate commitment from leadership (outcome) because they see the network's value (mechanism)	New
7G	In an externally initiated network, when the network initiators promote the efforts and accomplishments of the network to donors and the interested global community (context), this increases network member commitment to the network (outcome) because network members feel their efforts are acknowledged and valued (mechanism)	New
7H	If a network has committed and proud members (context), then they are more likely to act on the identified problem and collective vision (outcome) because members are willing to put in the energy, effort, and passion (mechanism) (modified)	Refined
7I	When committed network members take action to disseminate knowledge to network members and others outside the network (context), this extends network benefits to network members and others outside the network (outcome) because of a greater availability of knowledge and skills (mechanism)	New
7J	When influential outside stakeholders are actively engaged in network processes (context), then they are more likely to be committed to the network (outcome) because they can better understand the collective vision of the network (mechanism)	No supporting data

7K	When influential outside stakeholders (often specific individuals within an organisation) are committed to the network and actively engaged in participating (context), then it may be easier for the network to achieve its aims (outcome) because network members feel empowered (mechanism)	Refined

Table 5.22 CMOCs for Commitment.

Engaged and motivated network members

Engaged and motivated network members are integral to ensure a network functions and works towards its collective vision. Primary data collection confirmed (CMOCs 8B-8D, 8F) and refined (CMOC 8A) the first section of this part of the programme theory on how a network develops *engaged and motivated network members*. In the second section of this part of the programme theory, the primary data contributed four new CMOCs (8E, 8G-8I) to understanding how *engaged and motivated network members* and engaged stakeholders contribute to the networks' goals.

When network leadership provides opportunities for network members to be supported, recognised, and learn, this creates *engaged and motivated network members* (CMOC 8A). If personal identity strongly aligns with network identity and culture or network members actively participate in network change practices that aligns with their professional value, this can also develop *engaged and motivated network members* (CMOC 8B, 8C). When a network shows that it can affect change, network members are more likely to continue to engage with the network (CMOC 8D). Networks that leverage affective or normative professional commitment to work toward the networks' goals will likely have more engagement from network members (CMOC 8E).

Engaged and motivated network members contribute to network goals. When *engaged and motivated network members* are provided with resources and the opportunity to act, they will attempt to enact changes in practices (CMOC 8F). If *engaged and motivated network members* that are committed to the network's collective vision are faced with issues beyond their control, they will not be deterred from continuing to engage in the network (CMOC 8G). When *engaged and motivated network members* are

moved out of the network, this will leave a gap in the network (CMOC 8H). The network may also engage non-network stakeholders to improve network activity implementation (CMOC 8I).

The substantive theories from my Realist Review, Organisational Commitment Theory and the Collective Identity Approach from New Social Movement theory[152 153] (Table 4.2) continue to apply to this revised part of the programme theory. Network members' type of commitment (affective, normative, continuance) to a network is an indication of the extent of their motivation and engagement[164 165 167] (Table 4.2). These types of commitment align to Action Theory's explanation of relationships between organisation members and the organisation's goals[204] (Table 5.5). Network members may commit solely to the collective vision (goals) as in affective or normative commitment, or they may accept the collective vision but have other objectives for being part of the network, as in continuance commitment.

Network members in NEST360 are *engaged and motivated* for different reasons that span affective, normative, and continuance commitment. NEST360 has created affective commitment to the network through the types of people they have recruited. Many NEST360 network members have affective commitment to the network because they have a professional calling or identity towards newborn care that has led them to be passionate network members. These network members – particularly when they are champions — can spread a sense of affective commitment. Some network members may have normative commitment to the NBU and network based on feelings of a moral obligation; however, this was challenging to differentiate from affective commitment.[165] NEST360 has brought significant resources to the hospitals in the network and so there are likely network members who have continuance commitment to the network. As a result of these different types of commitment, it has *engaged and motivated network members* to change practices around newborn care. However, when these *engaged and motivated network members* are transferred to other hospital departments or out of the hospital, gaps are felt in the NBU. NEST360 also engages with non-network stakeholders to support activity implementation.

8A	When network leadership provides opportunities for network members to be supported, recognised, and learn through training, equipment provision and support, and facility renovations (context), this creates engaged and motivated network members (outcome) because they derive direct benefits and feel like they belong to the network (mechanism) *"I'd say equipping the unit is is a big improvement. Because without the NEST programme probably, even now we will not be having CPAP equipment, people will not be knowing how to utilise the equipment. There's also been a lot of training in terms of our staff being capacity built to know how to take care of a neonate, to know how to take care of premature. And the thing about monitoring the different pathways in terms of achievements, setting targets, also has made sure that we are kept on our toes in terms of 'Do you know the vital signs for this patient?' Now that you need to document 'Do you know, the sugar levels for this patient at admission? That this child has sepsis?' So, these are a lot of responsibility. Amongst our staff, there's also the need to maintain the standard for working within some standards to make sure that they achieve the goals that have been set by the programme. So definitely, one of the biggest changes has beneficiary has been the patient who is the ultimate recipient in terms of improvement of quality of care. That thing also has been to the staff who have been given a better environment to work in terms of equipping in terms of ensuring that supplies are available in terms of also ensuring that they have the requisite knowledge and skills to participate. And also, knowing that they have to continuously improve. I think it's also been of great benefit." (FI 12)*	Refined
8B	When network members' personal identity strongly aligns with a network's identity and culture (context), then this will result in engaged and motivated network members (outcome) because they feel they belong (mechanism)	Confirmed
8C	When network members actively participate in network change practices that align with the professional values they live by (context), this creates engaged and motivated network members (outcome) because it helps them to fulfil their moral obligation or vocational calling (mechanism)	Confirmed
8D	When a network can show its members that it can affect some change (context), members are more likely to continue their engagement with it (outcome) because they can see its value and a sense of satisfaction with the positive changes (mechanism)	Confirmed
8E	If a network can leverage the affective or normative professional commitment of its members to work towards achieving network goals (context), then they can become more engaged with the network (outcome) because of a sense of shared purpose (mechanism)	New
8F	When engaged and motivated network members are provided with the resources and opportunity to act (context), then they will attempt to enact changes in practices (outcome) because they feel empowered to change practice/work towards solving the problem (mechanism)	Confirmed
8G	When network members are committed to the collective vision that is strongly associated with their professional identity and are faced with issues that are beyond their control (context), they will not be deterred from continuing to engage with the network (outcome) because they believe what they are doing is worthwhile and feel accountable to other network members (mechanism)	New
8H	When network members are transferred to facilities out of the network or out of the network unit (context), this leaves a gap in trained, engaged, and motivated network members (outcome) because their skills and knowledge are lost (mechanism)	New
8I	When networks engage with non-network stakeholders in network activities (e.g. quality improvement) and deliberately seek out feedback and advice (context), this can improve network activity implementation (outcome) because the non-network stakeholders provide a broader understanding of relevant issues (mechanism)	New

Table 5.23 CMOCs for Engaged and motivated network members.

Empowered and confident network members

As network members become committed to and engaged with the network, their *confidence* in their skills may improve and they may feel more *empowered* to enact these skills and their role within and beyond the network. A network may acknowledge the capabilities of network members by selecting them to be network trainers and mentors, which makes them feel *confident and empowered* in their skills (CMOC 10A). When network members receive support to help improve and expand their skill set, this can improve their *confidence* in their new and existing skills. This often happens through activities, such as training and mentorship (CMOC 10B). Support can help network members feel *empowered* in their role and proactive in applying their skills beyond the network, for example to other departments within the network hospital that are not formally part of the network (CMOC 10C). When a network brings in previously neglected cadres/positions and enables them in their role, they can feel *empowered* and enact their role in the network (CMOC 10D). When network members feel *empowered* and are given freedom to use their clinical skills and enact their role, they are more likely to independently take action to address problems or provide care without waiting on someone more senior (CMOC 10E). Attitudes towards providing care will also change because network members are *empowered and confident* (CMOC 10F).

In a network, *empowerment* exists at the individual, organisation, and community level[197] (community level see – Identify a problem) (Table 5.5). Engagement in a network can help members believe in their competencies, which can *empower* them. Processes such as decision making, managing resources, and collaborating with others on a shared goal may be *empowering* and are all processes that go on within a well-functioning network. Empowerment Theory links with Bandura's Self-Efficacy theory[158] and Ajzen's Theory of Planned Behaviour[156] (Table 4.2). In a network, if members feel *empowered*, they will have belief in their ability to enact behaviours to influence certain outcomes. Furthermore, in line with Ajzen's theory, when network members think they have the resources and opportunities to enact a behaviour, they will have more perceived control over enacting the behaviour, which will make them feel *empowered*.

Empowerment theory also links with Quinn and Cameron's Culture Typology[198] (Table 5.5). When a network creates opportunities for shared responsibilities, social exchanges, and an enabling environment, all qualities of a clan culture, it is more likely to be *empowering*.

The NEST360 network created *confident and empowered network members* through its relationship building and network activities, such as training and mentoring. NEST360 selected clinicians and biomeds from the network hospitals to act as trainers and mentors. The selection process and training in these roles helped them to feel *confident and empowered* in their clinical and biomedical skills. Training of nurses and clinicians in the NBU and biomeds on clinical skills and devices led them to be more *confident*. The biomeds were able to take the skills they learned as part of the NEST360 network to other departments within the hospital. Prior to the NEST360 network, biomedical engineering was often a neglected hospital department and by bringing biomeds into the network, they have been *empowered* to enact their roles, which has enabled changes in practice in the NBUs. NEST360 also helped the nurses in the NBU to feel *confident and empowered* in their skills and roles, that they were able to address problems and provide care without waiting for their more senior colleagues.

10A	When a network acknowledges the capabilities of network members by selecting them to be network trainers and mentors (context), they become confident and empowered in their skills (outcome) because they develop the capacity to teach them (mechanism)	New
10B	When network members receive support (e.g. training, mentorship) to help them improve and expand their skill set (context), they become more confident in their previously learned and newly acquired skills (outcome) because they develop the capacity to perform them (mechanism)	New
10C	When network members receive support (e.g. training, mentorship) to help them improve and expand their skill set (context), they feel empowered in their role and motivated to proactively apply their skills beyond the network (outcome) because they have greater confidence in their abilities (mechanism)	New
10D	When a network brings in previously neglected cadres/positions into the network and enables them to do their role (context), they feel empowered to enact their role in the network (outcome) because they feel their skills and abilities are valued by the network (mechanism)	New
10E	When network members (e.g. nurses) are given the freedom to use their clinical skills and role (context), they can take action to address problems/provide care without waiting for a more highly trained network member (e.g. doctor) (outcome) because they feel permitted to do so (mechanism) *"And another thing they did was to to embrace teamwork. Yeah, initially it was like mine is nothing come and wait for the doctor to come and do whatever review and I wait to be no follow the instructions on the orders as indicated. The NEST approach was slightly different. All of us are involved. Like in the use of reviews of the babies, so we need to understand the management they*	New

	took us through that knowledge. You know, the the trainings, empower the nurses with the relevant knowledge concerning various conditions. So, when the there's a problem or the condition is worsening, you need to escalate to the next level. But as you do that, there's something we're doing with the use of the machines we are using it to. By the time the doctor is coming to review, there's something already happening." (FI 09)	
10F	When providers in the network are well trained, mentored, or coached (context), this positively changes their attitudes around performing the skills/providing care (outcome) because they feel empowered and confident (mechanism)	New

Table 5.24 CMOCs for Empowered and confident network members.

Purposeful relationships, linkages, and partnerships

This part of the programme theory explains how *purposeful relationships, linkages, and partnerships* form within the network. *Relationships* are an essential part of a network and the intention and strength of these *relationships* set them apart from standard health system connections. There are three main sections to this part of the programme theory: how the network builds *relationships*, the opportunities for building *relationships*, and what the existence of these *relationships* enable. The primary data confirmed three CMOCs (4B, 4C, 4E), refined three (4G, 4J, 4O), added nine (4D, 4F, 4H, 4I, 4K-4N, 4P), and did not provide additional data to assess 4A.

Networks form purposeful and co-operative working *relationship, linkages, and partnerships* within and across facilities and professions in several ways. *Relationships* can form when there is belief in the network's collective vision or when network members are open to and able to invest time in developing *relationships and linkages* through the network (CMOC 4A, 4B). The existence of strong pre-existing *relationships* between network members, a shared a professional identity, and a common baseline understanding between network members and what is expected of them can help to build *relationships* (CMOCs 4C, 4D, 4F). Artefacts that outline the roles and responsibilities of network members are also important in building *relationships* (CMOC 4E). Networks create opportunities for *relationship* building between network members' within and across facilities (CMOC 4G). The provision of resources that supports the network members ways of working provides an opportunity for *relationship* building in the network, as does when network leadership creates a psychological safe space that enables cross-learning between network members (CMOC 4H, 4I). Once purposeful and co-operative *relationships* are

established, communication is improved between network members, ownership of the network may be strengthened, and understanding and trust between network members is built (CMOC 4J – 4M). Network members are better able to provide support to work towards the identified problem and create a psychological safe space (CMOC 4N, 4O). If the network has members of different professions, their attitudes towards each other may change as well (CMOC 4P).

Tuckman's Small Group Development Theory,[154] New Social Movement Theory's Collective Identity Approach,[153] and Organisational Culture Theory[159-161] (Table 4.2) all remain relevant to the revised programme theory. Bartel and Rockmann's work on relational systems and organisational resilience (Table 5.5) finds that when there is positive attention to *relationships* in an organisation, the value of interpersonal *relationships* to the organisation is recognised and resources are allocated to cultivate *relationships*.[200] As explained in my Realist Review (Chapter 4) and above, *relationships* are key throughout a network's evolution and the network provides different opportunities to build these key *relationships*.

The NEST360 network had the benefit of pre-existing *relationships* from the Clinical Information Network. However, despite these pre-existing *relationships* the NEST360 Kenya team and network members still needed to put in effort to strengthen these existing *relationships* and build new ones. For example, when the trainers and mentors made efforts to get to know NBU staff first, this supported mentorship activities. When there were changes within people or network organisations, this undermined network functioning because new *relationships* needed to be formed. MoUs were put in place between the hospitals and the network organisers (NEST360 Kenya). The NEST360 network created different opportunities to develop and strengthen *relationships*, including cross-professional trainings with clinicians, nurses, and biomeds and trainings across levels of facilities (i.e. Level 5 hospitals in the network training Level 4 hospitals that refer to them). Opportunities for cross-learning at inter-hospital network meetings helped to form *relationships* amongst hospital administrators, nurses, and paediatricians at different hospitals in the network. *Relationships* in the NEST360 network have improved communication between NBU nurses and

biomeds, generated a feeling of ownership of the network activities on the part of the hospitals, enabled support in changing and improving clinical and biomedical practices, and created a feeling of psychological safety within and among the NBUs in the network. While trust emerged in the *relationships* between the network organisers (NEST360 Kenya) and network hospitals, changes to the organisations that make up the NEST360 Kenya team weakened this trust.

4A	When network members believe in the network's collective vision (context), then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because they are more willing to work and value working with people whom they identify as being likeminded (mechanism)	No supporting data
4B	When network members are open to and able to invest time in developing relationships and linkages through the network (context), then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because they have a better understanding of each other (mechanism)	Confirmed
4C	If network members have strong pre-existing relationships (context), then this helps ensure that network members have purposeful and co-operative working relationships (outcome) because they are already familiar with each other (mechanism)	Confirmed
4D	When network members share a professional identity (context), this supports forming purposeful and co-operative working relationships (outcome) because they share common socialised perspectives (mechanism)	New
4E	If there are artefacts in place that outline the roles and responsibilities of network members (context), then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because there is a common understanding among network members about what they are expected to do (mechanism)	Confirmed
4F	When a common baseline understanding is created among network members of what is expected of them (context), this helps to develop purposeful relationships (outcome) because the network members have the same level of understanding about each other and their roles and responsibilities (mechanism)	New
4G	When a network creates opportunities for relationship building between network members within and across facilities (context), this may help in the creation of purposeful and co-operative working relationships and improve existing working relationships (outcome) because they get to know each other's personality, skills, ways of working, and motivations better (mechanism) *"Actually feel the major thing that helped create the relationship was ultimately training, one for the nurses to accept and recognise they need the biomeds to support them in terms of equipment functionality. And other hand for the biomeds to recognise and accept for optimal use of this equipment, they need regular checks. Yes. So that alone now builds the confidence. For the two teams for the clinical and the biomed and they realised we need to work together. Yeah, not like, initial whereby we're like, just the equipment is okay, then that's all. But today, you're like, we have to work together. And through that the nurses saw or rather felt, the biomed has been trained specifically on this newborn equipment, then the level of confidence went up. And they realise that now these people are okay now to use or rather to maintain these devices. And with that now followed, now, the assigning of a focal person in the unit, the body is a person that has been trained. And that's now built even more confidence with the clinical team, that now they could now create the rapport and even directly contact this person to come and check on their devices. And with*	Refined

	that, now being on routinely now it has created now that's good relationship between the biomed and the clinical team." (FI 08)	
4H	When the network provides resources that support the network members' ways of working (context), this may help in the creation of purposeful and co-operative working relationships and improve existing working relationships across professions (outcome) because they are better able to collaborate and do their job (mechanism)	New
4I	When network leadership creates a psychological safe space that enables cross-learning between network members (context), this may help in the creation of purposeful and co-operative working relationships and improve existing working relationships (outcome) because network members are able to openly share their experiences (mechanism)	New
4J	When network members have established purposeful relationships within and across network facilities (context), this helps to improve communication between network members (outcome) because they are familiar with each other (mechanism)	Refined
4K	When purposeful linkages and strong working relationships are established between network members (context), this improves network members ownership of the network (outcome) because they feel connected to each other and to the vision (mechanism)	New
4L	When purposeful linkages and strong working relationships are established between network members (context), this helps to build trust among network members (outcome) because network members have confidence in each other (mechanism)	New
4M	When purposeful linkages and strong working relationships are established between network members (context), this supports the creation of a psychological safe space (outcome) because network members feel they can speak freely without fear of negative consequences (mechanism)	New
4N	When purposeful linkages and strong working relationships are established between network members/organisers (context), this enables network members/organisers to provide support in enacting the collective vision (outcome) because they can develop a mutual understanding of the identified problem and potential solutions (mechanism)	New
4O	When purposeful linkages and strong working relationships are established between network members (context), this helps them to be in agreement (outcome) because they can more easily develop a shared conceptualisation of the identified problem and potential solutions (mechanism)	Refined
4P	When different professions within the network (e.g. clinical and technical) develop strong working relationships (context), their attitudes toward the other profession changes (outcome) because they understand each other's value (mechanism)	New

Table 5.25 CMOCs for Purposeful relationships, linkages, and partnerships.

Network cross-cutting strategies

The network cross-cutting factors, *communication, trust,* and *energy, effort, and passion*, (see Cross-cutting arrows in Figure 5.3 and Figure 5.4) are not supported by separate sections of CMOCs and data but they appear across the network processes, activities, and foundations. *Communication* is required for processes, activities, and foundations in network initiation, but it also improves among network members as the network evolves (CMOCs 2I, 3I, 4J, 5B, 5C, 9F). *Trust* emerges from the network activities, foundations, and processes but is also pre-existing to a degree for network initiation to occur (CMOCs 2F, 4L, 9B). The formation of purposeful relationships, linkages, and partnerships can help to build *trust* within

the network. *Trust* is important in the formation and functioning of a network,[139] however it is something that did not emerge strongly in my Realist Review or Evaluation. I will further discuss this in Chapter 6. *Energy, effort, and passion* are needed from a dedicated group of network members for the network to form and function, but as the network evolves they become more distributed across the network (CMOCs 1A, 1C, 2N, 3G, 3H.3, 3J.1-3K, 5S, 5T, 7H, 7G, 11A-11D, 11G, 13B.1, 13B.2, 13E, 15A, 16E).

5.4 Discussion

5.4.1 Summary of findings

The primary data refined and progressed the programme theory on network formation and functioning developed from my Realist Review. This refined theory explains the key processes, activities, foundations, and cross-cutting factors necessary for network Initiation & Formation, Functioning & Performing, and Sustaining Change & Impact achieved by the network. The primary data collected, as well as the literature, is focused on networks that have formed and are functioning. It is likely that the same processes, activities, foundations, and cross-cutting factors remain relevant in different manifestations for sustaining the change and impact enabled by a network, though there are less data on this area. The 143 CMOCs supporting the programme theory are organised according to the specific processes, activities, foundations, and factors for clarity of explanation, however, they are interdependent and interrelated and some CMOCs may operate in more than one part of the programme theory. With the primary data, I added 55 CMOCs in existing parts of the programme theory and 40 CMOCs among the new parts of the programme theory. These new CMOCs bring breadth and depth to the programme theory and exhibit gaps in the literature filled by the primary data collection.

NEST360 has made significant investments in the network including medical device procurement and installation, training, mentoring, and QI. However, they have invested in a way that has created committed, engaged, motivated, empowered, and confident network members who are changing practices around the collective vision. This is necessary because NEST360 will not achieve what they desire with the tangible

investments without the investment in the network. NEST360 has a theory of change describing the programme and its main activities, however, except for leadership and champions, the processes, activities, foundations, and cross-cutting factors of network Initiation & Formation, Functioning & Performing, and Sustaining Change & Impact are not articulated in the theory of change. These complex components are important for the successful implementation of NEST360's programme activities, impact the success of the programme, and may sustain changes in practice that improve quality of care and service delivery for small and sick newborns.

The revised programme theory is supported by 15 substantive theories. Nine of these theories support the Realist Review version of the programme theory, however, their prominence has shifted in the refined version. This is likely because the theory was tested on an externally initiated and supported network. For example, the later stages of Tuckman's Small Group Development Theory, norming and performing, are more prominent than the earlier stages of forming and storming.

5.4.2 Strengths and limitations

This is the first Realist Evaluation, to my knowledge, on networks in LMIC health systems. The evaluation has several strengths. First, I was able to test the programme theory with the primary data collected and evolve the understanding of how networks are initiated, form, function, perform, and sustain change and impact. I had sufficient data to test the programme theory, as I was able to confirm or refine 49 of the 58 CMOCs developed in my Realist Review. The addition of new CMOCs within existing parts of the programme theory from my Realist Review and new parts of the programme theory exhibit that there are gaps in the literature around understanding network initiation, formation, functioning, performance, and sustaining change and impact that I have addressed. I was able to synthesise the results from a large amount of data and 143 CMOCs into a framework that is applicable and practical to those interested in organising, leading, and studying networks.

There are several limitations in my evaluation. In terms of data collection, the majority of the interviewees had positive perspectives of NEST360 and seemed to have strong buy-in to it. On the one hand this may reflect how the NEST360 network has engaged network members and generated commitment to the collective vision and the network; without this level of buy-in from network members, networks may be less successful in forming, functioning and performing, and sustaining change and impact. However, this may have caused interviewees to not disclose negative events, experiences, or perspectives. There are some data that explain what has not worked as well in the network but, in general, these are overshadowed by the positive perspectives. Therefore, there is limited critique on what does not work in the network and is an area for future research, as this is also a gap in the literature.

The NEST360 network is made up of 13 hospitals and I interviewed participants from seven of those hospitals and visited four of them. Ideally, I would have interviewed people from all network hospitals, but the breadth and depth of collected data have partly mitigated this issue. I had initially planned to observe NEST360 meetings but likely due to the timing of my fieldwork, I was only able to informally observe two. By not observing NEST360 meetings, I was not able to observe parts of the programme theory functioning and performing 'in action.' For example, observing network members working together as a team or identifying a problem and taking action to solve the problem. However, at the two meetings I did informally observe, I observed cross-learning and knowledge and skills dissemination across the network.

NEST360 was initially funded for a five-year period; a second five-year period of funding has recently been secured, which will overtime shift resources from existing network hospitals and expand the network. When I collected the data, the network had already formed and was functioning and performing but is now only beginning to work towards sustaining the change and impact the network enabled. Therefore, there is less understanding of how the processes, activities, foundations, and cross-cutting factors play out in the third phase (Sustaining Change & Impact) of the programme theory, as the network is very much still in the functioning and performing phase.

There are 9 CMOCs from my Realist Review that could not be confirmed, refined, or refuted by the primary data. This is likely because these CMOCs are more applicable to networks formed organically or from the bottom-up. The supporting substantive theories have mostly been developed, refined, and applied to Western high-income countries and so need to be applied carefully to other contexts.

5.4.3 Comparison with the existing literature

The revised programme theory progresses the understanding of how and why networks are initiated, form, function, perform, and sustain change and impact. My findings resonate with earlier studies on networks in both HIC and LMIC settings, as well as networks in other disciplines, such as public administration and education. However, while the programme theory touches on some similar concepts as other studies on networks, it provides a deeper explanatory understanding of how and why network initiators, leaders, organisers, and members act to establish a network, which through its functioning and performing can support them to change practices to improve service delivery and quality of care.

Network processes are needed to first initiate the network and remain important throughout the network's evolution as it continues to identify and solve problems to enact the collective vision. The need for networks to have a collective vision or goal is common across different types of networks.[23 28 180 205] This may be articulated in the form of agreements, such as in examples of service delivery networks in the Philippines and Indonesia.[32 61] My programme theory and the underlying CMOCs and data contribute to the idea of a collective vision by explaining how a collective vision is developed, introduced, and communicated in a network; how network members commit to and sustain engagement with the collective vision; and how the network's collective vision may be spread beyond the network.

While the activities that networks undertake to enact the processes throughout its evolution may differ across networks, the activities in the programme theory seem to be most common. Cross-learning and knowledge and skills sharing is done by many networks.[12 180 205] My Scoping Review (Chapter 3) found it to be the most common practical characteristic in networks 'Mode of Functioning'[139] and it is a key activity

in broader types of network arrangements, such a communities of practice.[206] The roles and activities of leaders and champions also resonate across different examples of networks.[46 57 180 205 32] My evaluation brings in important nuances with regards to leaders and champions, particularly how to cultivate and sustain the influence of these important network roles and contributors.

Relationships are the foundation of networks; without taking the time for relationships to form and strengthen, networks would struggle. The importance of relationships in both HIC and LMIC networks has been recognised by other studies.[23 31 57 60 82 180] As the foundation of the programme theory, the purposeful nature of these relationships is what differentiates networks from other health system approaches. Networks offer a potential solution to an important health systems challenge: "health systems are inherently relational and so many of the most critical challenges for health systems are relationship problems."[16 190] My findings reinforce the importance of relationships in health systems and bring further insight into how they are formed, evolve, and adapt over a network's evolution.

My evaluation findings highlight the importance of the energy, effort, and passion network members put into the network that is necessary for its Initiation & Formation, Functioning & Performing, and Sustaining Change & Impact. Energy, effort, and passion from network members and leaders are needed across the network processes, activities, and foundations and without them networks may fail to get off the ground, evolve in the face of challenges or change, or be sustained. This finding is an important aspect that my evaluation brings to the network literature that has not previously been identified.

Fenton et al 2001 raise some important challenges with networks that are reflected in the programme theory. When networks have group norms and a collective identity, which are important for network formation, functioning, and performing, they can "produce a collective blindness through an overconvergence of viewpoints."[207] This may be what I see reflected in my data and the highly positive perspectives from many NEST360 interviewees. Additionally, networks require financial resources, as well as time, and may struggle when certain resources are no longer available;[207] this threat is acknowledged

by the CMOCs and data. However, the CMOCs and data also highlight potential mitigating strategies that networks can take to alleviate these risks.

This chapter provided the background, methods, findings, and a brief discussion of my Realist Evaluation. In the next chapter, Chapter 6, I discuss the implications of the overall findings from the three phases of my DPhil, my approach for dissemination of my findings, directions for future research, the overall strengths and limitations of my DPhil, and personal reflections, including on my positionality.

6. Chapter 6. Discussion & Conclusions

This final chapter of my DPhil begins with a summary of the programme theory and a comparison of it to two types of networks—the Quality of Care Network (QCN) and networks of care (NoCs). I establish my contribution to the fields of health systems and Realist research, discuss the implications of my research for policy and practice, and provide seven recommendations for those interested in forming or supporting networks. Dissemination of my results has already begun, including two journal publications from my Scoping and Realist Reviews; a journal publication and presentation at the Health Systems Global conference on my Realist Evaluation is planned. I have shared the revised programme theory through the stakeholder group and to the Newborn Essential Solutions and Technologies (NEST360) Kenya team. There are several areas for future research from my DPhil, including testing the programme theory in different contexts and on different types of networks, linking the programme theory with measures to better understand network functioning and performing, understanding the experience of users or patients of facilities that are part of networks, and on unsuccessful or failed networks. There are two concepts, trust and power, that were not prominent in the programme theory. I discuss the literature on networks in relation to trust and power and propose why I think these concepts might not have been as prominent as expected. Additionally, I explore a future for networks within a learning health system approach. Specific strengths and limitations of each phase of my DPhil are discussed in Chapters 3, 4, and 5; in this final chapter, I discuss overall and additional strengths and limitations and draw on challenges from the literature of doing Realist work as a non-native researcher. I conclude this final chapter with personal reflections on my DPhil and my positionality and overall conclusions on my DPhil work.

6.1 Summary of the programme theory, including comparison with the existing literature

My thesis contributes a new understanding of what networks are and how and why they are initiated, form, function, perform, and sustain change and impact in complex systems. My Scoping Review, Chapter

3, establishes the components that make up a network, why and for what they are employed as an approach, and who is involved.[139] This laid the groundwork for developing a programme theory through my Realist Review[190] and Realist Evaluation (Chapters 4 and 5, respectively) that explains how and why networks are initiated, form, function, perform, and sustain change and impact.

The literature I selected in my Scoping Review (Chapter 3) to develop a framework of network components and map uses, purposes, and stakeholders helped to create an initial understanding of networks in low- and middle-income country (LMIC) health systems. I used a selection of this literature (with additional searches, including substantive theories) as basis to develop the programme theory in my Realist Review (Chapter 4). This programme theory provided an explanation of how networks are initiated, form, and function in a way that enables network leadership and committed, engaged, and motivated network members to emerge and change practices, which may lead to improved quality of care and service delivery. This change occurs through: identifying a problem; developing a collective vision; taking action to solve the problem; forming purposeful relationships, linkages, and partnerships; building a network identity and culture; and creating a psychological safe space. Once a network is initiated, network members may act with accountability and trust allowing for improved collaboration, teamwork, communication, and coordination in care to change practices.

In my Realist Evaluation, I tested this programme theory on the NEST360 network in Kenya. I used the primary data to confirm, refine, or refute the Context – Mechanism – Outcome Configurations (CMOCs) underlying the programme theory and to evolve the programme theory. With the analysis based on the primary data, I refined the programme theory in terms of the breadth of the evolution of a network—to include network performing and sustaining change and impact. The initial parts of the programme theory, listed above, were reorganised and expanded into:

- Processes: identify a problem; collective vision; taking action to solve a problem; identity and culture

- Activities: knowledge and skills dissemination; cross-learning; resourcing; leadership and champions; adaptability
- Foundations: teamwork; psychological safe space; committed, engaged, motivated, empowered, and confident network members; purposeful relationships, linkages, and partnerships
- Cross-cutting factors: energy, effort, and passion; trust; communication

The depth of the programme theory expanded as my understanding grew of how the different processes, activities, foundations, and cross-cutting factors function across a network's initiation, formation, functioning, performing, and sustaining change and impact. While the programme theory explains a complex phenomenon, I was able to distil it into digestible components, underpinned by primary data, robust analysis, and substantive theory. These components are important for the successful implementation of NEST360's programme activities, impact the success of the programme, and may sustain changes in practice that improve quality of care and service delivery for small and sick newborns. With these components, I have defined guiding principles for managing a complex process in a complex system.

In the discussion sections of Chapters 4 and 5, I compared specific parts of the programme theory with respect to the existing literature in LMICs and high-income countries (HICs). For this section, I discuss the programme theory and examples of LMIC networks from the literature more holistically to illustrate the utility of the programme theory I developed. There are two types of networks in the literature on LMIC health systems that have received significant interest and support from bi- and multilateral organisations, donors, and non-governmental organisations (NGOs): NoCs [31 62 66] and the QCN.[70] Literature on these networks includes studies that explain elements of the networks' formation and functioning, unlike much of the network literature which is focused on the network's clinical outcomes. The revised programme theory provides insights into the initiation, formation, functioning, performing, and sustaining change and

impact of both these networks and helps to demonstrate the potential explanatory value of the programme theory and the transferability of aspects of it to other network examples – as outlined below.

6.1.1 Quality of Care Network

The QCN is a multi-country network aiming to halve health facility maternal and newborn mortality and stillbirths by 2022 and improve the experience of care in health facilities.[208] Started in 11 countries, (Bangladesh, Côte d'Ivoire, Ethiopia, Ghana, India, Kenya, Malawi, Nigeria, Sierra Leone, the United Republic of Tanzania, and Uganda) the governments in collaboration with implementing and technical partners, professional associations, and donors work to improve quality of care through four strategic objectives—leadership, action, learning, and accountability.[208] Researchers evaluated the first five years (2016 - March 2022) of the network at the global level and in four countries (Bangladesh, Ethiopia, Malawi, Uganda) to determine factors shaping network emergence, network legitimacy and ownership, and network effectiveness.[58 70 82 209 210]

Of the four strategic objectives, the evaluation found that countries made the most progress in establishing network leadership, particularly when QCN leadership was integrated in government entities with pre-existing coordination structures, such as technical working groups.[58 70 82] The researchers found that trusting relationships between leadership and key network stakeholders also supported QCN leadership.[58 70 82] These findings are reflected in my programme theory, which uncovered that network *relationships* and *leadership* were facilitated when network members had pre-existing *relationships*, underlining the importance of a pre-existing enabling environment for network initiation. The QCN evaluation found that in countries with stronger national and local network leadership, the QCN was established more quickly.[82] Similarly, my programme theory found that when network leaders enact *leadership* skills and support and actively engage network members, this helps the network form and undertake activities to work towards the *collective vision*. Additionally, the QCN evaluation found that countries had challenges with disseminating and implementing quality of care roadmaps, which may have hindered the coordination of

network activities.[70] My programme theory highlights how the existence of network artefacts, for example memorandums of understanding or operating guides, particularly when they outline the roles and responsibilities of network members, can help to develop *purposeful and co-operative working relationships*, which supports network functioning.

The QCN evaluation found that a government commitment to the goals of the QCN also helped it to emerge.[82] When national and sub-national governments have buy-in or are committed to the network, this can reduce opposition to network emergence and activities. My programme theory confirms the importance of *commitment* in a network. I found that in addition to *commitment* from network members, *commitment* from hospital leadership and sub-national governments facilitated the evolution of a network from initiation to potentially sustaining network activities and addressing the challenges with fostering this *commitment*.

Learning across the QCN was dependent on the global secretariate's online learning platform and country-level capacity building was supported by implementing partners and donors.[70] In externally initiated networks, such as the QCN and NEST360 (as described in my programme theory), formal *learning* opportunities, like training, mentorship, and network meetings, are often initiated by funding from network initiators or organisers.

As an externally initiated multi-country network, the QCN exemplifies what might happen to a network once external support declines, which could have implications for what happens to the NEST360 network once external funding is phased out. The QCN evaluation found that, as initiated, the QCN will not be sustained in current form due to resourcing and capacity issues and insufficient time to integrate and resource the QCN at sub-national level. However, certain activities may be continued by government quality improvement initiatives.[58 209] In terms of *resourcing* and capacity, my programme theory highlights *resourcing* challenges, including how an *under-resourced* health system, a dependency on external *resources*, and insufficient human *resources* can affect a network's ability to sustain the network and its

activities. My programme theory also explains that government, particularly local and sub-national government, can support the sustainability of network activities when they are engaged in the network and the network's *collective vision*, which the QCN seems to have accomplished by integrating activities into government quality improvement activities.

6.1.2 Networks of care

NoCs, defined in Chapter 1, are networks of service delivery sites connected through administrative and clinical management processes that prioritise client-centred, effective, efficient operations, and collaborative learning, which enable providers to work in teams and share responsibility for health outcomes.[31] Prior to my DPhil, I was part of a research team that laid out four domains that compose a NoC: 1) agreement and enabling environment, 2) operational standards, 3) quality, efficiency, and responsibility, and 4) learning and adaptation.[31] Some of these domains within a NoC are composed of more tangible processes and activities, such as referrals and monitoring in the operational standards domain, or policy in the agreement and enabling environment domain,[31] compared to my programme theory which is more relationally focused. The NoC domains do include relationally focused elements similar to parts of my programme theory, such as buy-in and trusting relationships within the agreement and enabling environment domain. My programme theory, particularly the foundations *purposeful relationships, linkages,* and *partnerships and commitment* can help to understand how *relationships* are formed and strengthened between NoC members and how network stakeholders are *engaged*, or what may happen if there is a lack of engagement.

6.1.3 Networks in the World Bank's Hospitals in Health Systems Report

A recent report published by the World Bank, titled Hospitals in Health Systems, highlights networking as an approach to solve fragmentation and move towards integration to advance quality, equity, and efficiency in health systems.[211] The report states that networks need to have a clear purpose or goal to guide their functioning; for example, sharing or maximising resources as in networks of practice in Ghana

and collaborative learning for newborn care in the Clinical Information Network (CIN) in Kenya.[211] This need aligns with my programme theory's processes of *identifying a problem* and developing and evolving a *collective vision*. Second, in addition to tangible inputs, the relational components of a network may be more important for the success of the network, such as a culture of collaboration, and should be incorporated into network strategies for network functioning.[211] These recommendations resonate with my programme theory that found that relationally focused attributes are important across a network's evolution. Third, the financial structure of the network must promote a networked, over a siloed, approach.[211] My programme theory includes *resourcing* as one of the key activities, though broader in scope than just financial resources.

6.2 Contribution of my research to the field

My DPhil has brought to the field of health systems research a greater understanding of what makes up a health system network and how and why networks in health systems are initiated, formed, function, perform, and sustain change and impact, specifically in LMIC health systems. It advances the network literature and is, to my knowledge, the first Realist Evaluation of a network in a LMIC health system. I identified two other Realist Evaluations on networks in HICs, one on a managed care network in Scotland[212] and the other on a network in New Zealand.[213]

Thatcher (1998), looking at policy networks, questioned the explanatory value of network; if networks are a Western centric concept from the United States and United Kingdom (UK); and if networks are useful for LMIC contexts.[27 214] My DPhil, specifically the programme theory, has shown that there is explanatory value in networks and all three phases of my DPhil show that networks are increasingly employed in LMIC health systems, though they are under-documented and researched with many initiated and/or supported externally by global health organisations and donors.

The programme theory explains how networks are initiated and form, which has not previously been explored theoretically, as most theoretical work has been on network effectiveness.[82] Most other research on networks in health systems focuses on clinical outcomes or improvements in quality of care, rather than understanding the organisational nature of networks, as my DPhil has done, progressing the understanding through the three phases of my DPhil. Theory-based work on health system networks has been mostly on networks and health systems in HICs and so my Realist Review and Realist Evaluation are one of the first pieces of theory-based work specifically on networks in LMIC health systems. In the programme theory, I lay out the evolution of a network and have identified what is likely needed to occur for networks to get off the ground, function, perform, and sustain change and impact. My Realist Evaluation looks holistically at NEST360 in Kenya from a network perspective, which is not something other research on NEST360 has done; additionally, there are no other Realist Evaluations on any aspect of NEST360.

The programme theory uncovered aspects of a network that are relational, which might not be planned or budgeted for in networks, but are essential to make them work and support the more tangible activities and tasks that networks set out to do. This was clear from the fact that the programme theory highlighted many important processes and activities that built *relationships*, the foundation of a network, and other specifically relational attributes, such as *commitment, identity,* and *culture*, that NEST360 did not include in its theory of change. NEST360 might not have achieved what it set out to with its tangible investments without the simultaneous investment, through tangible activities and people, in the network. NEST360 made significant investments in the hospitals, such as medical device procurement, training, and quality improvement activities, but has done so in a way that has created *committed, engaged, motivated, empowered, and confident network members*. My DPhil has surfaced these implicit, intangible, and relational processes, activities, foundations, and cross-cutting factors in networks and explained their importance in network initiation, formation, functioning, performing, and sustaining change and impact.

NEST360 and other networks have not been explicit about these things because they may implicitly know that they are important and so do not need to explicitly plan for them. Additionally, they might not be seen as a priority to fund by governments, donors, or implementing partners that support health system strengthening activities. However, articulating these relational attributes brings attention to their importance and reduces the risk of a standard approach that might lose their contextual nature. Explicitly investing in them will not only strengthen networks but also health systems functioning more broadly. These relational aspects may also have relevance beyond networks for other health systems strengthening approaches.

6.3 Implications for policy and practice

My DPhil has several implications for policy and practice. My Scoping Review network framework could be used to guide design and reporting on networks, enabling more standardised and robust information. The framework and mapping of network uses, purposes, and stakeholders provide an approach to thinking about networks that could help further understanding of the essential elements of a network and why it would be pertinent to achieving clinical, public health, and health system goals. This may be particularly useful as networks become a more frequent approach in strengthening health systems, particularly in LMICs.

The refined programme theory and framework from my Realist Review and Evaluation (see Figure 5.3 and Figure 5.4) provide those interested in or working in a network with details on the processes, activities, foundations, and cross-cutting factors to consider for a network throughout its evolution. This can lead to a more considered implementation of networks, thereby improving health system functioning and performance. Forming a network takes work and a level of effort and energy will be required over the evolution of the network. Many parts of the programme theory may be implicit knowledge to those who have started or are part of a network, but they had not yet been put down into evidence and researched as to why these are rational things to do. The following points are recommendations from my Realist

Review and Evaluation and are relevant for those interested in forming, working in, or evaluating a network, such as health system managers, policy makers, implementing organisations, health facility staff, bi- and multilateral organisations, and academia:

1. *Forming a network takes time, effort, and energy; passion helps too.*
2. *The development and buy-in to a collective vision are important and play a key role as the network evolves.*
3. *Purposeful and intentional relationships, linkages, and partnerships are key in network initiation, formation, functioning, and performing, and likely sustaining change and impact, differentiating a network from the health system.*
4. *A psychological safe space may be a key facilitator to network members being able to change practices.*
5. *A network needs to plan for sustainability, focused on the changes and impact it wishes to sustain (without external resources, key people, etc.), from the beginning.*
6. *Networks need to be adaptable throughout their evolution, including around their vision and goals; external forces can limit the formation, functioning, performing, and sustaining change and impact of networks.*
7. *The components in the programme theory, listed below, might not be things that people plan for when forming a network but are important for a network's success:*
    - *Processes:*
        - *Identify a problem*
        - *Collective vision*
        - *Taking action to solve a problem*
        - *Identity and culture*
    - *Activities:*
        - *Knowledge and skills dissemination*
        - *Cross-learning*
        - *Resourcing*
        - *Leadership and champions*
        - *Adaptability*
    - *Foundations:*

        - *Teamwork*
        - *Psychological safe space*
        - *Committed, engaged, motivated, empowered, and confident network members*
        - *Purposeful relationships, linkages, and partnerships*
    - *Cross-cutting factors:*
        - *Energy, effort, and passion*
        - *Trust*
        - *Communication*

Furthermore, my findings, while specific to networks, may have application for other health systems improvement approaches, such as learning health systems, discussed in section 6.5.

6.4 Outputs and dissemination strategy

The outputs (see Appendix 6A) from my DPhil include three publications: my Scoping Review published in January 2023 in PLOS Global Public Health, my Realist Review published in Social Science & Medicine – Health Systems in September 2023, and my Realist Evaluation, which I plan to publish following the submission of my thesis. An abstract of my Realist Review was included in The Global Health Network's 2023 conference proceedings. Versions of the programme theory have been used in master's level teaching. I plan to create a one-page summary of the programme theory that can be shared with different stakeholders interested in a network approach, which will include reflective questions for stakeholders to consider for each part of the programme theory. For example*, Identify a problem* at network Initiation & Formation: "Is the problem the network plans to address clearly articulated and understood by network initiators?"

In terms of disseminating my results, I will give an oral presentation on the findings of my Realist Evaluation at the Health Systems Global conference in November 2024. I held a final meeting with my stakeholder group and NEST360 in Kenya to present the final programme theory. Additionally, I will present the programme theory through the HIGH-Q programme. There may also be opportunities to present to specific types of networks, for example, the NoC steering committee organised by the World Health Organization (WHO) and the QCN.

6.5 Future research

The findings of the different phases of my DPhil suggest several areas for future research on health system networks. In this section, I consider three areas in depth, trust, power, and learning health systems.

Networks are a commonly used term but mean different things to different people, spanning many ideas and conceptualisations (see Table 1.1), which made it difficult to develop a typology as initially planned in my Scoping Review (Chapter 3). Further research clarifying what networks are supposed to be, why, and in what form would help to establish a common understanding.

The revised programme theory can be tested on different types of networks, for example, ones formed organically or from the bottom-up, in different geographies, or focused in different clinical areas. Further research is needed on understanding the third phase of the programme theory, Sustaining Change & Impact, as well as the cross-cutting factors *communication, trust,* and *energy, effort, and passion*. There are nine CMOCs from my Realist Review (Chapter 4) that I was unable to assess with the primary data in my Realist Evaluation (Chapter 5). This is likely because they are more applicable to networks that form organically or from the bottom-up and so are an area for future research. Four (1B, 4D, 4F, 8E) new CMOCs in the revised programme theory lack supporting data but made logical sense in the programme theory and should be tested in future research. Additionally, my research focused on network initiators, organisers, and members; there is a lack of research into how patients, clients, or caregivers experience change (or not) when facilities join a network and what influences their experiences. According to a recent World Bank report, Hospitals in Health Systems, and an analysis on financing NoCs, more research is needed on approaches to financing networks in LMIC health systems.[211 215]

Much of the existing network research is focused on assessing clinical outcomes and quality of care. Beyond clinical outcomes and changes in quality of care, how can we measure network performance, particularly at the relational or health system level? Mandell & Keast (2008) suggest that relational aspects and time to achieve results need to be considered, especially that evaluations should focus on looking at

processes like relationship building, behaviour change, and change in attitude, perceptions, and values, as well as mechanisms in cultivating trust-based relationships, determining the amount of participation and engagement in the network, and assessing interactions between commitment, contribution, and benefit.[60] The programme theory focused on many of these more relational aspects of networks and so a future avenue for the programme theory is to identify performance indicators to understand how networks are effective or successful in certain areas and to make recommendations for practice.

I drew on theories that were mostly developed in North American and European contexts and the implications for this are discussed in section 6.6: Overall strengths & limitations of my DPhil. Future research could draw on theories from African or Asian philosophers, which may have interesting insights for the programme theory as societies in those regions are more collectivist in thinking, which has relevance for networks.[216] An additional area to consider is Social Network Theory, which may be more pertinent for comparing networks or a deep dive into a network functioning and performance.[25 181]

My research, as well as much of the existing literature, is focused on networks and the parts of them that work. Research is needed on understanding what does not work in networks, and how, why, and when they fail in part or whole. The lack of research on failed networks has also been raised by Podolny & Page (2003), who found no studies on failure rates of networks; they suggest this could be because it may be difficult to collect longitudinal data on network performance and that failure may not be the result of one specific event or time period, which makes it challenging to study.[59] Tolson et al (2007) collected data on a palliative care managed care network in rural Scotland as it was forming, which may be one approach, albeit unplanned, to collect data on failed networks.[212] This could also be an approach to further understand network formation, particularly around the identification of a problem, developing a collective vision, and taking action to solve a problem, where I drew more heavily on substantive theories in my Realist Review and on non-externally initiated networks. Almost 20 years following Podolny & Page's

(2003) work, a recent Systematic Review (2022) did not find any studies of networks that had failed or dissembled.[72]

While the programme theory is quite comprehensive, there are two concepts that did not emerge as expected that are important to comment on and are areas for future research: trust and power.

6.5.1 Trust

I expected that trust would play an important role in the programme theory. However, trust was not as prominent in the network literature or in the primary data to the extent that I had anticipated. Intuitively, trust should be part of relationship building, psychological safety, and teamwork. Trust was present however in the following CMOCs: *collective vision; purposeful relationships, linkages, and partnerships; and psychological safe space*. In my Scoping Review, Chapter 3, trust was the sixth most common practical characteristic in the Form and Structure component with 17 unique references.[139] Trust most often appeared in relation to relationships and relationships building,[9 31 32 42 47 48 217-219] as it plays a role in facilitating a shared vision and collective action to reach a common goal.[16 220] If organisations with shared values, as in a network, are trusting, this may facilitate their working together to reach a common goal (i.e. the collective vision).[16 220]

Gilson (2003) argues that trust is key in health systems and the relationships that exist in health systems and may support effective functioning, communication, and information flows.[16] Trust is considered as a resource that helps networks of people do what individual actors cannot.[220] A Systematic Review of clinical network effectiveness in HICs found that a positive trusting culture is a facilitator for network effectiveness.[48] Similarly in a study of global networks, Reinicke et al (2000) found trust among network members to be an intangible outcome of networks.[221] Belrhiti et al's (2024) Scoping Review on network clinical governance found trusting relationships to be an important factor in healthcare networks.[56] When there are pre-existing relationships in networks, trust may already exist between some network members

prior to network formation that can be leveraged.[23] It may be that trust must first be built among network members and then can support network functioning.

Trust, particularly its distribution and reciprocity, appears in network literature beyond the health sector as being essential for network performance and sustainability.[38] However, network performing and sustaining change and impact are two of the phases of network evolution in the programme theory and trust did not clearly emerge as a critical factor.

According to Edmondson (2004), trust and psychological safety differ; psychological safety has more relevance for small groups like a network, and the degree of interpersonal safety they experience. Psychological safety differs from trust on the object of focus (do others give you the benefit of the doubt) and timeframe (very short-term interpersonal effects of an action).[169] Compared to psychological safety, "trust does not accurately capture a particular dimension of interpersonal experience…a sense of how valued and comfortable an employee feels in that work setting."[169] Although both trust and psychological safety include perceived vulnerability, this is narrower for psychological safety than trust.[169]

While trust in networks and how it evolves remains to be better understood,[38] trust may be an emergent property of the network processes, activities, and foundations in the programme theory. Trust may be latent or intangible and not something people explicitly talk about or label, even when present. If trust did not exist in networks, networks logically would be much less likely to achieve what they have for health system functioning, quality of care, and clinical outcomes; therefore, trust may be implicitly fostered through shared aspects of networks. Another reason why trust may not appear in the literature and primary data more prominently and explicitly is that trust in networks may be "a silent background, sustaining the unproblematic, smooth running of cooperative relations."[222] Alternatively, due to the group nature and the creation of psychological safety, trust as a concept may be less prominent in networks because the relationships exist at the organisational or group level and less between individuals, though direct interpersonal relationships exist as well. Trust may also be more relevant for exploring and

understanding the relationship between providers that are part of a network and the patients that receive services in network facilities.[22 37 223]

6.5.2 Power

Another concept the programme theory did not explicitly touch on that is likely relevant for networks is power and power dynamics. Power, like trust, may be latent or intangible and can often be subjective. The role that power plays in networks is under researched,[33] particularly in LMIC networks; power dynamics may be relevant for networks with regards to network leadership, forming relationships, and creating psychological safety. Brown et al's (2016) Systematic Review on clinical network effectiveness found that power imbalances and the limited power of network members were barriers to network success.[48] Non-health care networks highlight that informal power from interpersonal relationships can be more important than formal power, signalling the importance of leadership in networks to manage power dynamics.[23]

In my Scoping Review, Chapter 3, power and power dynamics did not come up in the practical characteristics of the five components.[139] There was one publication from my Scoping Review focused on power and networks—Addicott and Ferlie (2007)—on managed care cancer networks in the UK.[33] This study found that power dynamics were active at two levels – in the development of policy and strategic direction for the network and implementation of its policy and strategy.[33] Policy and strategic direction were set by national entities and network members had little control over this.[33] Regarding the implementation of policy and strategy, the study found there was a group of elite medical professionals from teaching hospitals who dictated decision-making and benefited from resources over smaller district hospitals.[33] In the network, traditional power dynamics held[33] and the network did not facilitate the redistribution of power or flatten traditional hierarchies, but instead reinforced the existing power dynamics. While there was a network management team, they lacked the resources and interpersonal skills to adequately influence the network, and so power and control stayed with the medical

professionals.[33] However, this study was on one type of HIC network and so these power dynamics might not be as relevant for other types of networks or in LMICs.[33]

Ferlie and McGivern (2014) take a different view of power in networks, drawing on Foucault's work on governmentality and pastoral power.[224] [225] Pastoral power explains how people internally incorporate external rules of behaviour, similar to a pastor and their flock of worshipers.[225] In Ferlie and McGivern's case study of a managed sexual health network in the UK undertaking evidence-based organisational change, network leaders employed clinical audit, which made performance visible, to enact pastoral power to get doctors to adopt evidence-based standards to sustain their professional identity.[224]

McGivern et al (2017) again employ the concept of pastoral power in understanding how the CIN in Kenya incorporates quality improvement into practices.[127] In CIN, a collection of hospital leaders enacted pastoral practices to create a form of distributed leadership across the network.[127] This distributed leadership and pastoral power incited others in network hospitals to become network champions, internalising and then advocating for the changed practices.[127]

Although power did not emerge strongly in the primary data and in the programme theory, I can infer that power dynamics are likely at play within different parts of the NEST360 network. Power dynamics exist between the network organisers and the network hospitals, as well as within the network hospitals, potentially between the hospital management and newborn unit (NBU) or the NBU and other departments; for example, because the NBU is seen receiving particular support from NEST360. One of the challenges that the NEST360 network had were changes in the partners that make up the network organisers; some of these changes may have been due to power dynamics. A case study in two Kenyan county hospitals found that power dynamics between senior and midlevel managers negatively influenced the performance and motivation of midlevel managers, and power differences between clinical and hospital management kept out clinical managers from priority setting and resource allocation activities.[226] The different power dynamics might have come out stronger through different data collection methods,

such as observations. My position as a non-native researcher may have made me less sensitive to subtle power dynamics at play.

6.5.3 Learning Health Systems

What eventually happens to networks is not well documented. Networks that are externally supported may fall apart once external resources are no longer available; other networks may have challenges functioning without their initial visionary leaders. If the roles and functions of the network are institutionalised, there may be a better chance of sustaining change and impact created by the network. Networks that are organically initiated or formed from the bottom-up with limited external resources may have a better chance of longevity. They may become absorbed into routine health system functioning. Ultimately, it might not matter if the network continues to exist, as long as the changes and impact it facilitated are institutionalised, sustained, and progressed.

One potential future for networks, and particularly sustaining change and impact, are learning health systems. The concept of learning health systems was introduced by the United States Institute of Medicine/National Academy of Medicine,[227] which first defined it as "one in which science, informatics, incentives, and culture are aligned for continuous improvement and innovation, with best practices seamlessly embedded in the care process, patients and families active participants in all elements, and new knowledge captured as an integral by-product of the care experience."[228] Learning health systems combine quality improvement initiatives and research on service delivery and implementation and may be an approach to overcome previous failures of health systems strengthening initiatives.[229 230] Networks are the basis of some learning health systems in HICs and existing networks in LMICs may be a leverage point for evolving towards a learning health system.[205 229] Networks may have many of the necessary parts for a learning health system, including relationships among motivated stakeholders, a common goal, culture, leadership, adaptability, and cross-learning.[205 229-231] Learning health systems could be a vision towards which networks evolve.

6.6 Overall strengths and limitations of my DPhil

A strength of my DPhil is the way in which each of the three phases feed into each other to iteratively develop the programme theory. My Scoping Review established my understanding of what is a network, their uses, purposes, and stakeholders; my Realist Review took this further to start developing an understanding of how and why networks form and function; and then my Realist Evaluation progressed this understanding further with primary data to explain how and why networks are initiated, form, function, perform, and sustain change and impact.

My DPhil work resonates with people involved in different networks, implying broader applicability of my results and programme theory. In addition to the stakeholder group for my Realist Review and Evaluation, I had opportunities to present my evolving work to WHO, United Nations agencies, academics, and implementing organisations.

A strength, but also a limitation, of my DPhil is the broad number of networks that I included in my Scoping and Realist Reviews. On the one hand, I was able to draw from a range of networks which makes my findings more broadly applicable, but in doing so I might have lost some potential depth. There are many types of networks that I excluded from these two phases, including most networks from HICs, which might have provided additional insights. However, I needed to create some feasible boundaries for my DPhil.

This was my first experience with Realism. CMOC development was a long and iterative process, particularly for my Realist Review, though I became more skilled in the approach to analysis for my Realist Evaluation. One challenge was that I initially made CMOCs too specific to the piece of data and therefore it was difficult to identify semi-occurring outcome patterns (also known as demi-regularities) that support the refinement of the programme theory at a higher level of abstraction.[232] I iteratively revised these CMOCs in a way that allowed them to adequately inform the refinement of the programme theory.

Due to extensive administrative delays to begin my primary data collection in Kenya, I had to condense my data collection into a shorter period than initially planned. This did not provide me with much time to

reflect on the interviews, as I was often doing several in one day. Keeping a fieldnote journal helped to document reflections as well as to reflect on potential biases and positionality. This is particularly important in the Realist approach because unlike with grounded theory or other approaches, the Realist interviewer abandons neutral territory to engage with the interview participants.[194] Ideally, I would have begun to transcribe the interviews, start reviewing them to familiarise myself with the data, and begin preliminary analysis while I was still conducting interviews; the iterative nature of the Realist approach makes this feasible.

My Realist Evaluation is on one specific type of network and there could be a risk that this inhibits the transferability of findings to other types of networks. However, the methodological approach of Realist Evaluation enables the analysis of the behaviour of mechanisms that make NEST360 'work' under different contexts and so any understanding developed could potentially be transferable to other countries, if the same mechanisms are also in operation.[88]

Gilmore (2019) identified four main challenges to undertaking a Realist Evaluation as a non-native researcher. I began to reflect on these while writing the protocol for my Realist Evaluation: 1) power imbalances between researchers and participants during data collection; 2) working through translators to collect data; 3) being 'engaged' with limited contextual familiarity; and 4) bringing in appropriate substantive theories.[172] In my primary data collection, interviews and observed meetings were conducted in English so translation was not relevant.

I aimed to mitigate power imbalances by employing traditional qualitative interview techniques, including building rapport, active listening, and being reflexive about the interviews, including on how power may have or have not influenced the interview.[172] Furthermore, many of the interviewees were senior professionals and experts on NEST360 and in positions of power within the NBU, hospital, or as part of NEST360.

Being a non-native afforded me the opportunity to look at a different health system from the outside, and while there is value in an outsider perspective, there will always be a limitation on the extent of my understanding. However, having worked in sub-Saharan African countries for 10 years prior to my DPhil, I have a deeper understanding of differences in context and the challenges and politics of health systems and the health sector at large. While I had not previously worked in Kenya, I was able to draw on my experience to help me understand where context might matter. Spending five months in Kenya visiting hospitals, interviewing, speaking with people, and engaging with KEMRI Wellcome Trust Research Programme colleagues was invaluable to shaping a more specific understanding of the context. I transcribed most of my interviews using otter.ai and during the editing process, I listened and often relistened to the interviews. This helped me to familiarise myself with the data but also to recall the energy and passion with which many people spoke.

As has been recommended by other Realist researchers, I used substantive theories to help explain my findings and place them within the wider literature.[172] However, I looked at a phenomenon in LMICs with Western generated theories. Yet, one of Realism's assumptions is, to put it crudely, that people are people and that many human behaviours are caused by commonly occurring mechanisms.[84] The goal of Realist research being to try to understand the behaviour of these mechanisms in different contexts.[84] The theories I have used are lenses to help me make sense of the data; it is only possible to know for sure if the theories are relevant and valid for the claims once primary data is collected. In my Realist Evaluation, I assessed if the theories from my Realist Review were applicable and searched for additional theories after I had confirmed, refuted, or refined the CMOCs and programme theory with the primary data. Hence, to an extent, I was able to test the explanatory relevance of Western generated theories in a LMIC setting.

6.7 Personal reflections and positionality

I came to the DPhil having worked for 10 years on global health programmes, mainly focused on collaborating with Ministries of Health (MoHs) to improve the availability of and access to life saving drugs,

diagnostics, and health services in sub-Saharan Africa. These experiences gave me an in-depth understanding of the reality and challenges of working in health systems in LMICs. I decided to shift from the NGO sector because as I was progressing professionally, I started to move more towards the management side with less time to do the programme and technical work with MoHs that I am really interested in and passionate about. While I am grateful for the management experience and skills that I learned, I knew this was not ultimately the direction I wanted my career to go. I started to consider what additional skills I wanted to develop, and research was something that I kept coming back to. I embarked on my DPhil with quite limited research experience, though had broader experience in health programme monitoring and evaluation, and enough healthy naivety to keep me motivated and willing to keep learning and trying.

The last project I worked on before my DPhil was on a specific type of network—networks of care. When I decided to pursue networks as a topic for my DPhil, I had familiarity with the topic and some of the literature, as well as a belief in the approach to improve service delivery, quality of care, and the functioning of health systems. This prior experience has likely influenced my positionality towards the topic as a worthwhile approach to improve health systems functioning, quality of care, and outcomes. While there has been global interest in the idea of networks from WHO, the World Bank, the Gates Foundation, and NGOs, such as the Clinton Health Access Initiative and Jhpiego, over the course of my DPhil I did not always feel confident that anyone outside of my supervisory bubble would find this interesting. Going through Transfer and Confirmation of Status and getting feedback on my work from other academics, plus the stakeholder group, reinforced the confidence I had in the value of my work and its resonance more broadly.

As I discussed in section 6.6, Overall strengths and limitations of my DPhil, I undertook Realist work in Kenya as an American woman and doctoral student. While my professional experience working with MoHs in several sub-Saharan African countries helped me to be sensitive to the importance of different contexts

within the Kenyan health system and NEST360 programme, as a non-native there is a risk that this affected my ability to ask questions in the right way, may have made people less open, and affected my ability to interpretate the data. I posed the interview questions at a level of specificity that was open enough to be able to elicit interviewee reflections, perspectives, and experiences to the greatest degree, but also specific enough to keep the interview focused on NEST360. I kept a fieldnote journal to reflect on the interviews and document my immediate perspectives. My position as a non-native researcher may not make the programme theory perfect, but I did perform the interviews and the analysis in a robust and transparent way to manage the limitations of doing Realist work as an outsider.

I have learned a huge amount over the course of my DPhil. I have become a more precise thinker, writer, and reader, more able to critically reflect on health systems strengthening approaches, and improved my ability to communicate my work in writing and verbally. My DPhil has helped me solve a long-time professional dilemma of whether I am a specialist or a generalist. It has unified my previous work across different health areas with the new knowledge and experience I gained during my DPhil into an expertise in health systems in LMICs. So, where do I go from here? I see myself as a scholar-practitioner and hope to be able to draw on both my academic, strategic, and programme skills to do impactful work.

6.8 Conclusions

In Chapter 1, I provided a definition for what I think a network is. Over the course of my DPhil, as I have developed a greater understanding of the components of a network and how and why networks are initiated, form, function, perform, and sustain change and impact, my initial definition of a network still holds true. I restricted the inclusion criteria for my Scoping and Realist Reviews, Chapters 3 and 4, to networks that operated in health systems that were either of a clinical or programmatic nature, excluding for example, research networks. However, the programme theory is likely to have relevance for the types of excluded networks. The programme theory holds insights for programmes that might not have planned to be or see themselves as networks, but in essence are operating as one, for example, a large international

research consortium. In many health systems, primary health care may be organised on paper or labelled as a network but often does not function as one. The programme theory can provide lessons for how to operationalise a network for primary health care, which may be a useful strategy for ensuring universal health coverage.

Since I began my DPhil in October 2020, networks have continued to be employed as an approach to improve health systems functioning and performance, service delivery, and quality of care in LMIC health systems. A network approach has gained traction and interest from bi- and multilateral organisations, donor agencies, NGOs, and academics. Further research, as I explain in section 6.5, is needed on networks, particularly as the approach becomes more common in different contexts and geographies. My programme theory has the potential to provide insights for many different types of networks as well as having implications for other health systems improvement approaches. Networks are unlikely to go away and their use to address challenges in LMICs will grow; what my DPhil has done is unpacked their complexity and set an agenda for what else we need to know about them.

This final chapter concludes my DPhil. I provided a summary of the programme theory and in comparing my work to the existing literature, I looked at two examples of networks, the QCN and NoCs, and how networks were highlighted in the World Bank's recent Hospitals in Health Systems report. I established the contributions of my research to the fields of health systems and Realist research and provided seven recommendations for policy and practice drawn from the revised programme theory. My existing and planned outputs, dissemination strategy, and areas for future research, including two areas that were somewhat absent in the programme theory—trust and power—were discussed and I reflected on how networks could evolve into learning health systems. This chapter concluded with the overall strengths and limitations of my DPhil and personal reflections on my DPhil.

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Appendices

Appendix 3A. Networks in health systems: a Scoping Review protocol

Abstract

Networks exist across the field of healthcare from the global to community level. There is a large and diverse body of research on health-related networks with many types, focuses, uses, and purposes; however, limited literature looks across more than one type of network. A scoping review would be a useful way to organize, map, and summarize the literature on networks in health systems, particularly in low-and middle-income countries (LMICs). Mapping the literature will identify key characteristics, uses, purposes, and definitions of networks as well as show where there are current knowledge gaps, particularly for networks in LMICs. The main objective of this scoping review is to develop an understanding of different types of networks and the purposes for which they are used in health systems through the development of an operational typology of networks in health systems. Literature related to health system networks will be searched in six databases: Medline, EMBASE, Global Health, the Cochrane Library, Web of Science Core Collection, and Global Index Medicus. A data extraction instrument will compile key information and findings from the selected literature relevant to the review question, specifically: intervention country, network definition, stakeholders, type, characteristics, use, and purpose. The data will be presented to highlight networks by intervention country (high-income vs. LMICs), network definitions, stakeholders, type, characteristics, use, and purposes and their frequencies; any other relevant findings will be group by common theme. Drawing from the analysed and presented data, this scoping review will propose an operational typology of networks in health systems.

Introduction

Networks exist across the field of healthcare from global health advocacy networks to expansive service delivery networks. An initial review of the literature found a diverse array of types and definitions of networks, including global networks, inter-organizational networks, communities of practice, clinical networks, quality of care collaboratives, clinical information networks, managed networks, program networks, and networks of care. Networks are developed and implemented for a range of purposes, such as to address variations in practice and outcomes,[i] improve processes and quality of care,[ii] increase evidence-based practice,[iii] facilitate change,[iv] and achieve joint goals.[v] Despite the diversity of networks, it is possible to identify similar characteristics across them, including having a shared communal goal or vision, strong visionary leadership, communication, and trust.[vi,vii,viii,ix] While networks are a phenomenon across many countries, the majority of the published literature on networks is focused in high-incomes countries and therefore, limited research on networks in low-and-middle income countries (LMICs) has been published.

With a large body of research on health-related networks covering many different types, focuses, and purposes, a scoping review would be a useful way to organize, map, and summarize the literature. Limited studies in the literature look across different types of networks and mapping the literature will identify key characteristics, stakeholders, purposes, uses, and definitions of networks as well as show where there are gaps in knowledge, particularly for networks in LMICs. This will lead to the development of an operational typology of networks in health systems.

An initial review of the published literature and subsequent searches have found few scoping or systematic reviews on health system networks. One network related scoping study (Carmone et al. 2020) was identified. It employed a scoping study methodology to develop a definition, framework, and evidence base for the service delivery concept, Networks of Care.[x] Two systematic reviews on networks were also identified. Brown et al. (2016) determined the effectiveness of clinical networks and how

successful networks improve quality of care and patient outcomes.[xi] Wells et al. (2018) focused on quality improvement collaboratives' improvements on clinical processes and patient outcomes.[xii] A summary of details on these studies, as well as how this study will differ, is provided below. Given the specific nature of these previous studies and the varied literature on networks in health systems identified to be available, a scoping review would be relevant to map and summarize the current literature.

Network	Author	Study	Purpose	Network Definition/Results
Networks of Care	Carmone et al. 2020	Scoping Study Quantitative and qualitative studies of evidence and counterfactual Stakeholder consultations Case studies	• developed a definition and framework and built an evidence base and case studies for the service delivery focused concept, Networks of Care	• "a group of public and/or private health service delivery sites deliberately interconnected through an administrative and clinical management model which promotes a structure and culture that prioritizes client-centered, effective, efficient operation and collaborative learning, enabling providers across all levels of care, not excluding the community, to work in teams and share responsibility for health outcomes" • Development of Networks of Care framework: 1) Agreement and Enabling Environment, 2) Operational Standards, 3) Quality, Efficiency, and Responsibility, 4) Learning and Adaptation • Focused on service delivery networks only, while the evidence base includes network examples, most of the evidence is focused on a specific framework component
Clinical Networks	Brown et al. 2016	Systematic Review Quantitative and qualitative studies	• determined the effectiveness of clinical networks and how successful networks improve quality of care and patient outcomes • identified how clinical networks achieved impacts	• "voluntary clinician groupings that aim to improve clinical care and service delivery using a collegial approach to identify and implement a range of quality improvement strategies" • The review found evidence that clinical networks can improve provision of services but there are limited high quality quantitative studies on clinical network effectiveness • Focused on clinical networks only, considered limited evidence

Quality Improvement Collaborative	Wells et al. 2018	Systematic Review Cluster RCTs, controlled before-after, interrupter time series studies	• evaluated evidence for the impact of quality improvement collaboratives	• "organized, multifaceted approach that includes teams from multiple healthcare sites coming together to learn, apply and share improvement methods, ideas and data on service performance for a given healthcare topic" • Quality improvement collaboratives achieved improvements in targeted clinical processes and patient outcomes, however, less than a third of studies included met set quality and reporting criteria • Focused on quality improvement collaboratives only, considered limited evidence

Table 1: identified scoping study and systematic reviews on types of networks

The main objective of this scoping review is to develop an understanding of different types of networks, when and what they are used for, and the purposes they intend to achieve through the development of an operational typology of health system networks. Specific objectives of the scoping review are as follows: 1) perform a systematic search of published and grey literature on networks in health systems, with a particular focus on LMICs; 2) map and summarize the type of networks, the network definitions, network stakeholders, network characteristics, network uses, network purposes, and other key finding relevant to networks in health systems; 3) identify gaps in the literature related to networks in LMIC health systems; and 4) propose an operational typology of networks in health systems.

Review question

What is a network, when are they used, what are they used for, and what purposes do they intended to achieve in health systems?

Keywords

Networks, health systems, LMICs, Scoping Review

Methods

This scoping review will be conducted in accordance with the original six phase scoping study framework developed by Arksey and O'Malley (2005) and take into consideration additional recommendations on scoping reviews from Levac et al. (2010) and Peters et al. (2015).[xiii,xiv,xv] The scoping review methodology was selected as it will enable the examination of the extent, range, and nature of the activity of interest, networks in health systems in LMICs, and the identification of gaps in the existing evidence, specifically related to networks in LMICs, from a large body of network related literature.[xvi] The literature on networks in health systems is large and diverse and scoping reviews have been found to be particularly useful when the body of literature is of "large, complex, or heterogeneous nature not amenable to a more precise

systematic review."[xvii] Furthermore, the scoping review will help to "clarify a complex concept and refine subsequent research inquiries."[xviii]

Types of sources

This scoping review will consider all types of published and grey literature.

Search strategy

The search strategy has been developed to identify both published and unpublished literature.

1) The first step will consist of searching two databases (PubMed and EMBASE) to identify published literature on networks in health systems in LMICs using an initial list of basic search terms which describe different types of networks (health system network, clinical network, network of care, inter-organization network, quality improvement collaborative, quality of care collaborative, clinical information networks, managed network, managed clinical network, care network, program network, hybrid network, integrated service delivery network). With literature previously collected and reviewed from high-income countries and LMICs, an analysis of the text words in the title and abstract as well as the index terms will be used to develop the full search strategy.
2) A second more in-depth search with all relevant identified key words and index terms will be performed across the six databases listed below (see Appendix I for example search strategy[xix]).
3) To manage the anticipated volume of literature on networks, the search will initially focus on networks in health systems in LMICs. Following the selection of literature to include, a third search will be performed by combing the reference lists of the included literature for additional relevant references not previously identified; this will be an opportunity to gather literature from high-income countries that is most relevant to networks in LMICs.
4) If this process does not lead to saturation of the concepts or there are gaps in the data extraction template, additional searches on networks in health systems will be performed, not limited to LMICs.
5) Throughout the scoping review, grey literature will also be searched for from a variety of sources, including WHO's database, Global Index Medicus, conferences abstracts, and organization and government project reports and strategic and planning documents as well as documents referenced in the published literature from the World Health Organization, World Bank, and major bilateral organizations.

The search process will be open to literature in all languages but those published in English and French will be given priority for inclusion, as there are no additional resources or capacity to translate from other languages. Literature published between 2000 to 2020 will be eligible for inclusion; an initial review of the published literature did not result in sources with relevant information prior to 2002. The following databases will be searched: Medline, EMBASE, Global Health, the Cochrane Library, and Web of Science Core Collection, as well as Global Index Medicus for publications specific to LMICs and grey literature.

Eligibility criteria

Literature eligible for inclusion in the review will relate to health system networks. Networks refer to groups of facilities and/or healthcare stakeholders (including but not limited to all types of providers, technicians, government officials, professional associations, NGO's, and donors) linked formally or informally, horizontally or vertically, through programs, interventions, activities, or initiatives. Literature will be excluded if the discussed program, intervention, activity, or initiative occurs only in one facility or locality among only one group of actors. Health systems networks will be the focus of the search process, including specific types of networks, such as inter-organizational networks, program networks, managed networks, clinical networks, and different types of service delivery networks. Global level advocacy and coordination networks, cross-country learning networks, and communities of practice will be

acknowledged for their roles in global advocacy, policy, and knowledge exchange but will be less of a focus than networks focused on implementation of health programs and clinical services. Research or purely academic networks and networks focused on research capacity building will be excluded as will registry, disaster management, laboratory, diagnostics, social, and home care networks. If other types of networks are identified during the search, they will be included on an ad hoc basis if they align with the outlined eligibility.

As defined by the World Health Organization, a health system "consists of all organizations, people and actions whose primary intent is to promote, restore or maintain health."[xx] Building on this, for the purposes of eligibility inclusion in this scoping review, health systems will refer to the structures, processes, and people responsible for managing health programs and services that provide care for a population. Literature from both high-income countries and LMICs will be eligible for inclusion in the study, as classified by the World Bank for the 2021 fiscal year.[xxi]

Inclusion	Exclusion
• Relate to health system networks • Networks: groups of facilities and/or healthcare stakeholders (including but not limited to all types of providers, technicians, government officials, professional associations, NGO's, and donors) linked formally or informally, horizontally or vertically, through programs, interventions, activities, or initiatives • Health systems: structures, processes, and people responsible for managing health programs and services that provide care for a population • High-income countries and LMICs	• The program, intervention, activity, or initiative occurs only in one facility or locality among only one group of actors • Research or purely academic networks • Networks focused on research capacity building • Disaster management networks • Database/registry networks • Trial/study networks • Social networks • Family/home care networks • Palliative care networks • Laboratory networks • Diagnostics networks • Disease surveillance networks

Table 2: Inclusion – Exclusion Criteria

Study selection

As each database is searched for all search terms, all citations will be collated and imported into EndNote X9.3.3/2020 (Clarivate Analytics, PA, USA) and duplicates removed. The number of results for each search in each database will be recorded. Citations will be imported into the web application Rayyan,[xxii] a second screening of duplicates will be done, and titles and abstracts will be screened against the inclusion and exclusion criteria. A random sample of at least 10% of the titles and abstracts will be reviewed by a peer to check for consistency in selection. Full text of selected titles and abstracts will be retrieved and assessed against the inclusion and exclusion criteria. A random sample of at least 10% of the full text will be reviewed by a peer to check for consistency in selection. The reasons for exclusion at the full text review will be noted to report. Any discrepancies from the peer screening will be discussed to resolve the conflicts. The results will be reported and presented according to the PRISMA Extension for Scoping Reviews (PRISMA_ScR) guidelines.

Data extraction and charting

Relevant data and insights will be extracted from the included literature by the reviewer with the developed data extraction instrument (Appendix II). This tool will compile key information related to the included studies and findings or insights relevant to the review questions. It will contain the following categories: source citation, intervention country, aim/purpose, methodology, intervention, stakeholders, type of network, network definition, network characteristics, network use, network purpose, and other key finding relevant to the review questions. The data extraction instrument will be piloted with a sample of the literature selected from the full text review and the included grey literature to ensure that it captures all necessary categories of data. If any modifications are made during the piloting, the selected literature will be rereviewed with the revised instrument. In case the tool is modified during the data extraction and charting process, the changes will be noted and reported. If the modification of the data extraction instrument consists of the addition or changing of the data collection categories, all literature already reviewed for data extraction will be rereviewed to ensure that relevant data is not missed.

Data analysis and Presentation

The following results will be presented from the data extracted and charted:

- Type of network: The different types of networks identified in the selected literature and their frequency will be represented in a chart to show the diversity of networks in health systems
- Network definition: The various network definitions reported in the literature will be presented in a table and their frequency noted where the same definition is used across studies
- Network characteristics: The different characteristics describing networks in the selected literature will be charted by frequency and network to highlight common characteristics across different types of networks; the characteristics will be defined to ensure a common understanding
- Network stakeholders: Types of partners, actors, and stakeholders engaged in the networks described in the selected literature will be charted by frequency and network to show key stakeholders in different networks
- Network use: When and what are the various uses of networks in the selected literature will be charted by frequency and network to show common uses across different types of networks
- Network purpose: The purposes of networks reported in the literature and their frequency will be mapped with their types to show where common networks have similar or dissimilar purposes
- Intervention country: The intervention countries from the selected literature will be grouped by high-income and LMICs and the frequency represented in a chart to show the geographic distribution of research on networks in health systems
- Other key findings: Additional key findings not included in one of the above categories will be grouped by theme and charted according to frequency; this will provide an opportunity to bring light to any notable themes or concepts around networks not anticipated

Drawing on the results described above, a typology of networks in health systems will be proposed.

Consultation

To round out the literature, a consultation with health system experts, particularly those with an interest/experience in networks will be held. This will provide an opportunity to discuss the results and conclusions from the scoping review with an expert audience. This step will be contingent on identification and availability of experts.

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Conflict of interest

There is no conflict of interest.

Appendices

I. Sample Search Strategy for Medline

(health system network* OR clinical network OR networks of care OR inter-organization network* OR managed network* OR care network* OR hybrid network* OR integrated service delivery network* OR managed clinical network* OR program network* OR quality improvement collaborative* OR quality of care collaborative OR healthcare network* OR network based organization* OR network model OR network* relationship* OR networked governance OR integrated healthcare OR chain of care OR clinical community OR practitioner network* OR networks of health services OR delivery of healthcare OR health system planning OR organization of healthcare OR networks of clinical experts OR referral network* OR clinical governance OR quality improvement program* OR network initiative OR local network* OR district governance OR healthcare delivery OR (healthcare organization and administration) OR integrated delivery of healthcare OR network of safety OR collaborative improvement network* OR provincial network of health services OR health network structures OR quality of care network OR regionalized healthcare OR network of healthcare interventions OR collaborative network OR network for healthcare practice improvement OR integrated system of care OR strategic clinical network* OR regional health network* OR integrated care network* OR network for quality improvement).mp.

AND

(health system* OR LMIC* OR developing countr* OR developing nation* OR developing population* OR developing world OR less developed countr* OR less developed nation* OR less developed population* OR less developed world OR lesser developed countr* OR lesser developed nation* OR lesser developed population* OR lesser developed world OR under developed countr* OR under developed nation* OR under developed population* OR under developed world OR underdeveloped countr* OR underdeveloped nation* OR underdeveloped population* OR underdeveloped world OR middle income countr* OR middle income nation* OR middle income population* OR low income countr* OR low income nation* OR low income population* OR lower income countr* OR lower income nation* OR lower income population* OR underserved countr* OR underserved nation* OR underserved population* OR underserved world OR under served countr* OR under served nation* OR under served population* OR under served world OR deprived countr* OR deprived nation* OR deprived population* OR deprived world OR poor countr* OR poor nation* OR poor population* OR poor world OR poorer countr* OR poorer nation* OR poorer population* OR poorer world OR developing econom* OR less developed econom* OR lesser developed econom* OR under developed econom* OR underdeveloped econom* OR middle income econom* OR low income econom* OR lower income econom* OR low gdp

OR low gnp OR low gross domestic OR low gross national OR lower gdp OR lower gnp OR lower gross domestic OR lower gross national OR lmic OR lmics OR third world OR lami countr* OR transitional countr* OR Africa OR Asia OR Caribbean OR West Indies OR South America OR Latin America OR Central America OR Afghanistan OR Albania OR Algeria OR Angola OR Antigua OR Barbuda OR Argentina OR Armenia OR Armenian OR Aruba OR Azerbaijan OR Bahrain OR Bangladesh OR Barbados OR Benin OR Byelarus OR Byelorussian OR Belarus OR Belorussian OR Belorussia OR Belize OR Bhutan OR Bolivia OR Bosnia OR Herzegovina OR Hercegovina OR Botswana OR Brasil OR Brazil OR Bulgaria OR Burkina Faso OR Burkina Fasso OR Upper Volta OR Burundi OR Urundi OR Cambodia OR Khmer Republic OR Kampuchea OR Cameroon OR Cameroons OR Cameron OR Camerons OR Cape Verde OR Central African Republic OR Chad OR Chile OR China OR Colombia OR Comoros OR Comoro Islands OR Comores OR Mayotte OR Congo OR Zaire OR Costa Rica OR Cote d'Ivoire OR Ivory Coast OR Croatia OR Cuba OR Cyprus OR Czechoslovakia OR Czech Republic OR Slovakia OR Slovak Republic OR Djibouti OR French Somaliland OR Dominica OR Dominican Republic OR East Timor OR East Timur OR Timor Leste OR Ecuador OR Egypt OR United Arab Republic OR El Salvador OR Eritrea OR Estonia OR Ethiopia OR Fiji OR Gabon OR Gabonese Republic OR Gambia OR Gaza OR Georgia Republic OR Georgian Republic OR Ghana OR Gold Coast OR Greece OR Grenada OR Guatemala OR Guinea OR Guam OR Guiana OR Guyana OR Haiti OR Honduras OR Hungary OR India OR Maldives OR Indonesia OR Iran OR Iraq OR Isle of Man OR Jamaica OR Jordan OR Kazakhstan OR Kazakh OR Kenya OR Kiribati OR Korea OR Kosovo OR Kyrgyzstan OR Kirghizia OR Kyrgyz Republic OR Kirghiz OR Kirgizstan OR Lao PDR OR Laos OR Latvia OR Lebanon OR Lesotho OR Basutoland OR Liberia OR Libya OR Lithuania OR Macedonia OR Madagascar OR Malagasy Republic OR Malaysia OR Malaya OR Malay OR Sabah OR Sarawak OR Malawi OR Nyasaland OR Mali OR Malta OR Marshall Islands OR Mauritania OR Mauritius OR Agalega Islands OR Mexico OR Micronesia OR Middle East OR Moldova OR Moldovia OR Moldovian OR Mongolia OR Montenegro OR Morocco OR Ifni OR Mozambique OR Myanmar OR Myanma OR Burma OR Namibia OR Nepal OR Netherlands Antilles OR New Caledonia OR Nicaragua OR Niger OR Nigeria OR Northern Mariana Islands OR Oman OR Muscat OR Pakistan OR Palau OR Palestine OR Panama OR Paraguay OR Peru OR Philippines OR Philipines OR Phillipines OR Phillippines OR Poland OR Portugal OR Puerto Rico OR Romania OR Rumania OR Roumania OR Russia OR Russian OR Rwanda OR Ruanda OR Saint Kitts OR St Kitts OR Nevis OR Saint Lucia OR St Lucia OR Saint Vincent OR St Vincent OR Grenadines OR Samoa OR Samoan Islands OR Navigator Island OR Navigator Islands OR Sao Tome OR Saudi Arabia OR Senegal OR Serbia OR Montenegro OR Seychelles OR Sierra Leone OR Slovenia OR Sri Lanka OR Ceylon OR Solomon Islands OR Somalia OR Sudan OR Suriname OR Surinam OR Swaziland OR Syria OR Tajikistan OR Tadzhikistan OR Tadjikistan OR Tadzhik OR Tanzania OR Thailand OR Togo OR Togolese Republic OR Tonga OR Trinidad OR Tobago OR Tunisia OR Turkey OR Turkmenistan OR Turkmen OR Uganda OR Ukraine OR Uruguay OR USSR OR Soviet Union OR Union of Soviet Socialist Republics OR Uzbekistan OR Uzbek OR Vanuatu OR New Hebrides OR Venezuela OR Vietnam OR Viet Nam OR West Bank OR Yemen OR Yugoslavia OR Zambia OR Zimbabwe OR Rhodesia)

Limit to (humans and yr="2000 – 2021")

II. Data extraction instrument

Study #	Citation	Intervention Country	Aim/ purpose of study	Methodology	Intervention	Network Stakeholders	Type of Network	Network Definition	Network Characteristics	Network Use	Network Purpose	Other key findings
Study 1												
Study 2												
Study….												

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Appendix 3B. Database search strategies

Search Strategy for Medline (Ovid)

(health system network* OR clinical network OR networks of care OR inter-organization network* OR managed network* OR care network* OR hybrid network* OR integrated service delivery network* OR managed clinical network* OR program network* OR quality improvement collaborative* OR quality of care collaborative OR healthcare network* OR network based organization* OR network model OR network* relationship* OR networked governance OR integrated healthcare OR chain of care OR clinical community OR practitioner network* OR networks of health services OR delivery of healthcare OR health system planning OR organization of healthcare OR networks of clinical experts OR referral network* OR clinical governance OR quality improvement program* OR network initiative OR local network* OR district governance OR healthcare delivery OR (healthcare organization and administration) OR integrated delivery of healthcare OR network of safety OR collaborative improvement network* OR provincial network of health services OR health network structures OR quality of care network OR regionalized healthcare OR network of healthcare interventions OR collaborative network OR network for healthcare practice improvement OR integrated system of care OR strategic clinical network* OR regional health network* OR integrated care network* OR network for quality improvement).mp.

AND

(health system* OR LMIC* OR developing countr* OR developing nation* OR developing population* OR developing world OR less developed countr* OR less developed nation* OR less developed population* OR less developed world OR lesser developed countr* OR lesser developed nation* OR lesser developed population* OR lesser developed world OR under developed countr* OR under developed nation* OR under developed population* OR under developed world OR underdeveloped countr* OR underdeveloped nation* OR underdeveloped population* OR underdeveloped world OR middle income countr* OR middle income nation* OR middle income population* OR low income countr* OR low income nation* OR low income population* OR lower income countr* OR lower income nation* OR lower income population* OR underserved countr* OR underserved nation* OR underserved population* OR underserved world OR under served countr* OR under served nation* OR under served population* OR under served world OR deprived countr* OR deprived nation* OR deprived population* OR deprived world OR poor countr* OR poor nation* OR poor population* OR poor world OR poorer countr* OR poorer nation* OR poorer population* OR poorer world OR developing econom* OR less developed econom* OR lesser developed econom* OR under developed econom* OR underdeveloped econom* OR middle income econom* OR low income econom* OR lower income econom* OR low gdp OR low gnp OR low gross domestic OR low gross national OR lower gdp OR lower gnp OR lower gross domestic OR lower gross national OR lmic OR lmics OR third world OR lami countr* OR transitional countr* OR Africa OR Asia OR Caribbean OR West Indies OR South America OR Latin America OR Central America OR Afghanistan OR Albania OR Algeria OR Angola OR Antigua OR Barbuda OR Argentina OR Armenia OR Armenian OR Aruba OR Azerbaijan OR Bahrain OR Bangladesh OR Barbados OR Benin OR Byelarus OR Byelorussian OR Belarus OR Belorussian OR Belorussia OR Belize OR Bhutan OR Bolivia OR Bosnia OR Herzegovina OR Hercegovina OR Botswana OR Brasil OR Brazil OR Bulgaria OR Burkina Faso OR Burkina Fasso OR Upper Volta OR Burundi OR Urundi OR Cambodia OR Khmer Republic OR Kampuchea OR Cameroon OR Cameroons OR Cameron OR Camerons OR Cape Verde OR Central African Republic OR Chad OR Chile OR China OR Colombia OR Comoros OR Comoro Islands OR Comores OR Mayotte OR Congo OR Zaire OR Costa Rica OR

Cote d'Ivoire OR Ivory Coast OR Croatia OR Cuba OR Cyprus OR Czechoslovakia OR Czech Republic OR Slovakia OR Slovak Republic OR Djibouti OR French Somaliland OR Dominica OR Dominican Republic OR East Timor OR East Timur OR Timor Leste OR Ecuador OR Egypt OR United Arab Republic OR El Salvador OR Eritrea OR Estonia OR Ethiopia OR Fiji OR Gabon OR Gabonese Republic OR Gambia OR Gaza OR Georgia Republic OR Georgian Republic OR Ghana OR Gold Coast OR Greece OR Grenada OR Guatemala OR Guinea OR Guam OR Guiana OR Guyana OR Haiti OR Honduras OR Hungary OR India OR Maldives OR Indonesia OR Iran OR Iraq OR Isle of Man OR Jamaica OR Jordan OR Kazakhstan OR Kazakh OR Kenya OR Kiribati OR Korea OR Kosovo OR Kyrgyzstan OR Kirghizia OR Kyrgyz Republic OR Kirghiz OR Kirgizstan OR Lao PDR OR Laos OR Latvia OR Lebanon OR Lesotho OR Basutoland OR Liberia OR Libya OR Lithuania OR Macedonia OR Madagascar OR Malagasy Republic OR Malaysia OR Malaya OR Malay OR Sabah OR Sarawak OR Malawi OR Nyasaland OR Mali OR Malta OR Marshall Islands OR Mauritania OR Mauritius OR Agalega Islands OR Mexico OR Micronesia OR Middle East OR Moldova OR Moldovia OR Moldovian OR Mongolia OR Montenegro OR Morocco OR Ifni OR Mozambique OR Myanmar OR Myanma OR Burma OR Namibia OR Nepal OR Netherlands Antilles OR New Caledonia OR Nicaragua OR Niger OR Nigeria OR Northern Mariana Islands OR Oman OR Muscat OR Pakistan OR Palau OR Palestine OR Panama OR Paraguay OR Peru OR Philippines OR Philipines OR Phillipines OR Phillippines OR Poland OR Portugal OR Puerto Rico OR Romania OR Rumania OR Roumania OR Russia OR Russian OR Rwanda OR Ruanda OR Saint Kitts OR St Kitts OR Nevis OR Saint Lucia OR St Lucia OR Saint Vincent OR St Vincent OR Grenadines OR Samoa OR Samoan Islands OR Navigator Island OR Navigator Islands OR Sao Tome OR Saudi Arabia OR Senegal OR Serbia OR Montenegro OR Seychelles OR Sierra Leone OR Slovenia OR Sri Lanka OR Ceylon OR Solomon Islands OR Somalia OR Sudan OR Suriname OR Surinam OR Swaziland OR Syria OR Tajikistan OR Tadzhikistan OR Tadjikistan OR Tadzhik OR Tanzania OR Thailand OR Togo OR Togolese Republic OR Tonga OR Trinidad OR Tobago OR Tunisia OR Turkey OR Turkmenistan OR Turkmen OR Uganda OR Ukraine OR Uruguay OR USSR OR Soviet Union OR Union of Soviet Socialist Republics OR Uzbekistan OR Uzbek OR Vanuatu OR New Hebrides OR Venezuela OR Vietnam OR Viet Nam OR West Bank OR Yemen OR Yugoslavia OR Zambia OR Zimbabwe OR Rhodesia)

Limit to (humans and yr="2000 – 2021")

Result:
2662 (ran on 03/02/2021)

Search Strategy for Embase (Ovid)

(health system network* OR clinical network OR networks of care OR inter-organization network* OR managed network* OR care network* OR hybrid network* OR integrated service delivery network* OR managed clinical network* OR program network* OR quality improvement collaborative* OR quality of care collaborative OR healthcare network* OR network based organization* OR network model OR network* relationship* OR networked governance OR integrated healthcare OR chain of care OR clinical community OR practitioner network* OR networks of health services OR delivery of healthcare OR health system planning OR organization of healthcare OR networks of clinical experts OR referral network* OR clinical governance OR quality improvement program* OR network initiative OR local network* OR district governance OR healthcare delivery OR (healthcare organization and administration) OR integrated delivery of healthcare OR network of safety OR collaborative improvement network* OR provincial network of health services OR health network structures OR quality of care network OR regionalized healthcare OR network of healthcare interventions OR collaborative network OR network for healthcare practice improvement OR integrated system of care OR strategic clinical network* OR regional health network* OR integrated care network* OR network for quality improvement).mp.

AND

(health system* OR LMIC* OR developing countr* OR developing nation* OR developing population* OR developing world OR less developed countr* OR less developed nation* OR less developed population* OR less developed world OR lesser developed countr* OR lesser developed nation* OR lesser developed population* OR lesser developed world OR under developed countr* OR under developed nation* OR under developed population* OR under developed world OR underdeveloped countr* OR underdeveloped nation* OR underdeveloped population* OR underdeveloped world OR middle income countr* OR middle income nation* OR middle income population* OR low income countr* OR low income nation* OR low income population* OR lower income countr* OR lower income nation* OR lower income population* OR underserved countr* OR underserved nation* OR underserved population* OR underserved world OR under served countr* OR under served nation* OR under served population* OR under served world OR deprived countr* OR deprived nation* OR deprived population* OR deprived world OR poor countr* OR poor nation* OR poor population* OR poor world OR poorer countr* OR poorer nation* OR poorer population* OR poorer world OR developing econom* OR less developed econom* OR lesser developed econom* OR under developed econom* OR underdeveloped econom* OR middle income econom* OR low income econom* OR lower income econom* OR low gdp OR low gnp OR low gross domestic OR low gross national OR lower gdp OR lower gnp OR lower gross domestic OR lower gross national OR lmic OR lmics OR third world OR lami countr* OR transitional countr* OR Africa OR Asia OR Caribbean OR West Indies OR South America OR Latin America OR Central America OR Afghanistan OR Albania OR Algeria OR Angola OR Antigua OR Barbuda OR Argentina OR Armenia OR Armenian OR Aruba OR Azerbaijan OR Bahrain OR Bangladesh OR Barbados OR Benin OR Byelarus OR Byelorussian OR Belarus OR Belorussian OR Belorussia OR Belize OR Bhutan OR Bolivia OR Bosnia OR Herzegovina OR Hercegovina OR Botswana OR Brasil OR Brazil OR Bulgaria OR Burkina Faso OR Burkina Fasso OR Upper Volta OR Burundi OR Urundi OR Cambodia OR Khmer Republic OR Kampuchea OR Cameroon OR Cameroons OR Cameron OR Camerons OR Cape Verde OR Central African Republic OR Chad OR Chile OR China OR Colombia OR Comoros OR Comoro Islands OR Comores OR Mayotte OR Congo OR Zaire OR Costa Rica OR Cote d'Ivoire OR Ivory Coast OR Croatia OR Cuba OR Cyprus OR Czechoslovakia OR Czech Republic OR Slovakia OR Slovak Republic OR Djibouti OR French Somaliland OR Dominica OR Dominican Republic OR East Timor OR East Timur OR Timor Leste OR Ecuador OR Egypt OR United Arab Republic OR El Salvador OR Eritrea OR Estonia OR Ethiopia OR Fiji OR Gabon OR Gabonese Republic OR Gambia OR Gaza OR Georgia Republic OR Georgian Republic OR Ghana OR Gold Coast OR Greece OR Grenada OR Guatemala OR Guinea OR Guam OR Guiana OR Guyana OR Haiti OR Honduras OR Hungary OR India OR Maldives OR Indonesia OR Iran OR Iraq OR Isle of Man OR Jamaica OR Jordan OR Kazakhstan OR Kazakh OR Kenya OR Kiribati OR Korea OR Kosovo OR Kyrgyzstan OR Kirghizia OR Kyrgyz Republic OR Kirghiz OR Kirgizstan OR Lao PDR OR Laos OR Latvia OR Lebanon OR Lesotho OR Basutoland OR Liberia OR Libya OR Lithuania OR Macedonia OR Madagascar OR Malagasy Republic OR Malaysia OR Malaya OR Malay OR Sabah OR Sarawak OR Malawi OR Nyasaland OR Mali OR Malta OR Marshall Islands OR Mauritania OR Mauritius OR Agalega Islands OR Mexico OR Micronesia OR Middle East OR Moldova OR Moldovia OR Moldovian OR Mongolia OR Montenegro OR Morocco OR Ifni OR Mozambique OR Myanmar OR Myanma OR Burma OR Namibia OR Nepal OR Netherlands Antilles OR New Caledonia OR Nicaragua OR Niger OR Nigeria OR Northern Mariana Islands OR Oman OR Muscat OR Pakistan OR Palau OR Palestine OR Panama OR Paraguay OR Peru OR Philippines OR Philipines OR Phillipines OR Phillippines OR Poland OR Portugal OR Puerto Rico OR Romania OR Rumania OR Roumania OR Russia OR Russian OR Rwanda OR Ruanda OR Saint Kitts OR St Kitts OR Nevis OR Saint Lucia OR St Lucia OR Saint Vincent OR St Vincent OR Grenadines OR Samoa OR Samoan Islands OR Navigator Island OR Navigator Islands OR Sao Tome OR Saudi Arabia OR Senegal OR Serbia OR Montenegro OR Seychelles OR Sierra Leone OR Slovenia OR Sri Lanka OR Ceylon OR

Solomon Islands OR Somalia OR Sudan OR Suriname OR Surinam OR Swaziland OR Syria OR Tajikistan OR Tadzhikistan OR Tadjikistan OR Tadzhik OR Tanzania OR Thailand OR Togo OR Togolese Republic OR Tonga OR Trinidad OR Tobago OR Tunisia OR Turkey OR Turkmenistan OR Turkmen OR Uganda OR Ukraine OR Uruguay OR USSR OR Soviet Union OR Union of Soviet Socialist Republics OR Uzbekistan OR Uzbek OR Vanuatu OR New Hebrides OR Venezuela OR Vietnam OR Viet Nam OR West Bank OR Yemen OR Yugoslavia OR Zambia OR Zimbabwe OR Rhodesia)

Limit to (humans and yr="2000 – 2021")

Result: 4325 (ran on 03/02/2021)

Search Strategy for Global Health (Ovid)

(health system network* OR clinical network OR networks of care OR inter-organization network* OR managed network* OR care network* OR hybrid network* OR integrated service delivery network* OR managed clinical network* OR program network* OR quality improvement collaborative* OR quality of care collaborative OR healthcare network* OR network based organization* OR network model OR network* relationship* OR networked governance OR integrated healthcare OR chain of care OR clinical community OR practitioner network* OR networks of health services OR delivery of healthcare OR health system planning OR organization of healthcare OR networks of clinical experts OR referral network* OR clinical governance OR quality improvement program* OR network initiative OR local network* OR district governance OR healthcare delivery OR (healthcare organization and administration) OR integrated delivery of healthcare OR network of safety OR collaborative improvement network* OR provincial network of health services OR health network structures OR quality of care network OR regionalized healthcare OR network of healthcare interventions OR collaborative network OR network for healthcare practice improvement OR integrated system of care OR strategic clinical network* OR regional health network* OR integrated care network* OR network for quality improvement).mp.

AND

(health system* OR LMIC* OR developing countr* OR developing nation* OR developing population* OR developing world OR less developed countr* OR less developed nation* OR less developed population* OR less developed world OR lesser developed countr* OR lesser developed nation* OR lesser developed population* OR lesser developed world OR under developed countr* OR under developed nation* OR under developed population* OR under developed world OR underdeveloped countr* OR underdeveloped nation* OR underdeveloped population* OR underdeveloped world OR middle income countr* OR middle income nation* OR middle income population* OR low income countr* OR low income nation* OR low income population* OR lower income countr* OR lower income nation* OR lower income population* OR underserved countr* OR underserved nation* OR underserved population* OR underserved world OR under served countr* OR under served nation* OR under served population* OR under served world OR deprived countr* OR deprived nation* OR deprived population* OR deprived world OR poor countr* OR poor nation* OR poor population* OR poor world OR poorer countr* OR poorer nation* OR poorer population* OR poorer world OR developing econom* OR less developed econom* OR lesser developed econom* OR under developed econom* OR underdeveloped econom* OR middle income econom* OR low income econom* OR lower income econom* OR low gdp OR low gnp OR low gross domestic OR low gross national OR lower gdp OR lower gnp OR lower gross domestic OR lower gross national OR lmic OR lmics OR third world OR lami countr* OR transitional countr* OR Africa OR Asia OR Caribbean OR West Indies OR South America OR Latin America OR Central America OR Afghanistan OR

Albania OR Algeria OR Angola OR Antigua OR Barbuda OR Argentina OR Armenia OR Armenian OR Aruba OR Azerbaijan OR Bahrain OR Bangladesh OR Barbados OR Benin OR Byelarus OR Byelorussian OR Belarus OR Belorussian OR Belorussia OR Belize OR Bhutan OR Bolivia OR Bosnia OR Herzegovina OR Hercegovina OR Botswana OR Brasil OR Brazil OR Bulgaria OR Burkina Faso OR Burkina Fasso OR Upper Volta OR Burundi OR Urundi OR Cambodia OR Khmer Republic OR Kampuchea OR Cameroon OR Cameroons OR Cameron OR Camerons OR Cape Verde OR Central African Republic OR Chad OR Chile OR China OR Colombia OR Comoros OR Comoro Islands OR Comores OR Mayotte OR Congo OR Zaire OR Costa Rica OR Cote d'Ivoire OR Ivory Coast OR Croatia OR Cuba OR Cyprus OR Czechoslovakia OR Czech Republic OR Slovakia OR Slovak Republic OR Djibouti OR French Somaliland OR Dominica OR Dominican Republic OR East Timor OR East Timur OR Timor Leste OR Ecuador OR Egypt OR United Arab Republic OR El Salvador OR Eritrea OR Estonia OR Ethiopia OR Fiji OR Gabon OR Gabonese Republic OR Gambia OR Gaza OR Georgia Republic OR Georgian Republic OR Ghana OR Gold Coast OR Greece OR Grenada OR Guatemala OR Guinea OR Guam OR Guiana OR Guyana OR Haiti OR Honduras OR Hungary OR India OR Maldives OR Indonesia OR Iran OR Iraq OR Isle of Man OR Jamaica OR Jordan OR Kazakhstan OR Kazakh OR Kenya OR Kiribati OR Korea OR Kosovo OR Kyrgyzstan OR Kirghizia OR Kyrgyz Republic OR Kirghiz OR Kirgizstan OR Lao PDR OR Laos OR Latvia OR Lebanon OR Lesotho OR Basutoland OR Liberia OR Libya OR Lithuania OR Macedonia OR Madagascar OR Malagasy Republic OR Malaysia OR Malaya OR Malay OR Sabah OR Sarawak OR Malawi OR Nyasaland OR Mali OR Malta OR Marshall Islands OR Mauritania OR Mauritius OR Agalega Islands OR Mexico OR Micronesia OR Middle East OR Moldova OR Moldovia OR Moldovian OR Mongolia OR Montenegro OR Morocco OR Ifni OR Mozambique OR Myanmar OR Myanma OR Burma OR Namibia OR Nepal OR Netherlands Antilles OR New Caledonia OR Nicaragua OR Niger OR Nigeria OR Northern Mariana Islands OR Oman OR Muscat OR Pakistan OR Palau OR Palestine OR Panama OR Paraguay OR Peru OR Philippines OR Philipines OR Phillipines OR Phillippines OR Poland OR Portugal OR Puerto Rico OR Romania OR Rumania OR Roumania OR Russia OR Russian OR Rwanda OR Ruanda OR Saint Kitts OR St Kitts OR Nevis OR Saint Lucia OR St Lucia OR Saint Vincent OR St Vincent OR Grenadines OR Samoa OR Samoan Islands OR Navigator Island OR Navigator Islands OR Sao Tome OR Saudi Arabia OR Senegal OR Serbia OR Montenegro OR Seychelles OR Sierra Leone OR Slovenia OR Sri Lanka OR Ceylon OR Solomon Islands OR Somalia OR Sudan OR Suriname OR Surinam OR Swaziland OR Syria OR Tajikistan OR Tadzhikistan OR Tadjikistan OR Tadzhik OR Tanzania OR Thailand OR Togo OR Togolese Republic OR Tonga OR Trinidad OR Tobago OR Tunisia OR Turkey OR Turkmenistan OR Turkmen OR Uganda OR Ukraine OR Uruguay OR USSR OR Soviet Union OR Union of Soviet Socialist Republics OR Uzbekistan OR Uzbek OR Vanuatu OR New Hebrides OR Venezuela OR Vietnam OR Viet Nam OR West Bank OR Yemen OR Yugoslavia OR Zambia OR Zimbabwe OR Rhodesia)

Limit 1 to yr="2000 – 2021"

Result: 1678 (ran on 03/02/2021)

Search Strategy for Web of Science

TS=("health system network"* OR "clinical network" OR "networks of care" OR "inter-organization network"* OR "managed network"* OR "care network"* OR "hybrid network"* OR "integrated service delivery network"* OR "managed clinical network"* OR "program network"* OR "quality improvement collaborative"* OR "quality of care collaborative" OR "healthcare network"* OR "network based organization"* OR "network model" OR "network* relationship*" OR "networked governance" OR "integrated healthcare" OR "chain of care" OR "clinical community" OR "practitioner network*" OR "networks of health services" OR "delivery of healthcare" OR "health system planning" OR "organization

of healthcare” OR “networks of clinical experts” OR “referral network*” OR “clinical governance” OR “quality improvement program*” OR “network initiative” OR “local network*” OR “district governance” OR “healthcare delivery” OR “healthcare organization and administration” OR “integrated delivery of healthcare” OR “network of safety” OR “collaborative improvement network*” OR “provincial network of health services” OR “health network structures” OR “quality of care network” OR “regionalized healthcare” OR “network of healthcare interventions” OR “collaborative network” OR “network for healthcare practice improvement” OR “integrated system of care” OR “strategic clinical network*” OR “regional health network*” OR “integrated care network*” OR “network for quality improvement”)

AND

TS=(LMIC OR "developing countr*" OR "health system*" “developing nation*” OR “developing population*” OR “developing world” OR “less developed countr*” OR “less developed nation*” OR “less developed population*” OR “less developed world” OR “lesser developed countr*” OR “lesser developed nation*” OR “lesser developed population*” OR “lesser developed world” OR “under developed countr*” OR “under developed nation*” OR “under developed population*” OR “under developed world” OR “underdeveloped countr*” OR “underdeveloped nation*” OR “underdeveloped population*” OR “underdeveloped world” OR “middle income countr*” OR “middle income nation*” OR “middle income population*” OR “low income countr*” OR “low income nation*” OR “low income population*” OR “lower income countr*” OR “lower income nation*” OR “lower income population*” OR “underserved countr*” OR “underserved nation*” OR “underserved population*” OR “underserved world” OR “under served countr*” OR “under served nation*” OR “under served population*” OR “under served world” OR “deprived countr*” OR “deprived nation*” OR “deprived population*” OR “deprived world” OR “poor countr*” OR “poor nation*” OR “poor population*” OR “poor world” OR “poorer countr*” OR “poorer nation*” OR “poorer population*” OR “poorer world” OR “developing econom*” OR “less developed econom*” OR “lesser developed econom*” OR “under developed econom*” OR “underdeveloped econom*” OR “middle income econom*” OR “low income econom*” OR “lower income econom*” OR “low gdp” OR “low gnp” OR “low gross domestic” OR “low gross national” OR “lower gdp” OR “lower gnp” OR “lower gross domestic” OR “lower gross national” OR lmic OR lmics OR “third world” OR “lami countr*” OR “transitional countr*” OR Africa OR Asia OR Caribbean OR “West Indies” OR “South America” OR “Latin America” OR “Central America” OR Afghanistan OR Albania OR Algeria OR Angola OR Antigua OR Barbuda OR Argentina OR Armenia OR Armenian OR Aruba OR Azerbaijan OR Bahrain OR Bangladesh OR Barbados OR Benin OR Byelarus OR Byelorussian OR Belarus OR Belorussian OR Belorussia OR Belize OR Bhutan OR Bolivia OR Bosnia OR Herzegovina OR Hercegovina OR Botswana OR Brasil OR Brazil OR Bulgaria OR “Burkina Faso” OR “Burkina Fasso” OR “Upper Volta” OR Burundi OR Urundi OR Cambodia OR “Khmer Republic” OR Kampuchea OR Cameroon OR Cameroons OR Cameron OR Camerons OR “Cape Verde” OR “Central African Republic” OR Chad OR Chile OR China OR Colombia OR Comoros OR “Comoro Islands” OR Comores OR Mayotte OR Congo OR Zaire OR “Costa Rica” OR “Cote d'Ivoire” OR “Ivory Coast” OR Croatia OR Cuba OR Cyprus OR Czechoslovakia OR “Czech Republic” OR Slovakia OR “Slovak Republic” OR Djibouti OR “French Somaliland” OR Dominica OR “Dominican Republic” OR “East Timor” OR “East Timur” OR “Timor Leste” OR Ecuador OR Egypt OR “United Arab Republic” OR “El Salvador” OR Eritrea OR Estonia OR Ethiopia OR Fiji OR Gabon OR “Gabonese Republic” OR Gambia OR Gaza OR “Georgia Republic” OR “Georgian Republic” OR Ghana OR “Gold Coast” OR Greece OR Grenada OR Guatemala OR Guinea OR Guam OR Guiana OR Guyana OR Haiti OR Honduras OR Hungary OR India OR Maldives OR Indonesia OR Iran OR Iraq OR “Isle of Man” OR Jamaica OR Jordan OR Kazakhstan OR Kazakh OR Kenya OR Kiribati OR Korea OR Kosovo OR Kyrgyzstan OR Kirghizia OR “Kyrgyz Republic” OR Kirghiz OR Kirgizstan OR “Lao PDR” OR Laos OR Latvia OR Lebanon OR Lesotho OR Basutoland OR Liberia OR Libya OR Lithuania OR Macedonia OR Madagascar OR “Malagasy Republic” OR Malaysia OR Malaya OR Malay OR Sabah OR Sarawak OR

Malawi OR Nyasaland OR Mali OR Malta OR “Marshall Islands” OR Mauritania OR Mauritius OR “Agalega Islands” OR Mexico OR Micronesia OR “Middle East” OR Moldova OR Moldovia OR Moldovian OR Mongolia OR Montenegro OR Morocco OR Ifni OR Mozambique OR Myanmar OR Myanma OR Burma OR Namibia OR Nepal OR “Netherlands Antilles” OR “New Caledonia” OR Nicaragua OR Niger OR Nigeria OR “Northern Mariana Islands” OR Oman OR Muscat OR Pakistan OR Palau OR Palestine OR Panama OR Paraguay OR Peru OR Philippines OR Philipines OR Phillipines OR Phillippines OR Poland OR Portugal OR “Puerto Rico” OR Romania OR Rumania OR Roumania OR Russia OR Russian OR Rwanda OR Ruanda OR “Saint Kitts” OR “St Kitts” OR Nevis OR “Saint Lucia” OR “St Lucia” OR “Saint Vincent” OR “St Vincent” OR Grenadines OR Samoa OR “Samoan Islands” OR “Navigator Island” OR “Navigator Islands” OR “Sao Tome” OR “Saudi Arabia” OR Senegal OR Serbia OR Montenegro OR Seychelles OR “Sierra Leone” OR Slovenia OR “Sri Lanka” OR Ceylon OR Solomon Islands OR Somalia OR Sudan OR Suriname OR Surinam OR Swaziland OR Syria OR Tajikistan OR Tadzhikistan OR Tadjikistan OR Tadzhik OR Tanzania OR Thailand OR Togo OR “Togolese Republic” OR Tonga OR Trinidad OR Tobago OR Tunisia OR Turkey OR Turkmenistan OR Turkmen OR Uganda OR Ukraine OR Uruguay OR USSR OR “Soviet Union” OR “Union of Soviet Socialist Republics” OR Uzbekistan OR Uzbek OR Vanuatu OR “New Hebrides” OR Venezuela OR Vietnam OR “Viet Nam” OR “West Bank” OR Yemen OR Yugoslavia OR Zambia OR Zimbabwe OR Rhodesia)

IC Timespan=2000-2021

Refined by: WEB OF SCIENCE CATEGORIES: (PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH OR SOCIAL SCIENCES INTERDISCIPLINARY OR HEALTH CARE SCIENCES SERVICES OR MEDICINE GENERAL INTERNAL OR HEALTH POLICY SERVICES OR TROPICAL MEDICINE OR DEVELOPMENT STUDIES OR PEDIATRICS OR INTERNATIONAL RELATIONS OR SOCIAL SCIENCES BIOMEDICAL OR OPERATIONS RESEARCH MANAGEMENT SCIENCE OR NURSING OR PRIMARY HEALTH CARE OR OBSTETRICS GYNECOLOGY)

Results: 1636 (ran on 03/02/2021)

Search Strategy for Cochrane Systematic Review Database

“health system network” OR "clinical network" OR "networks of care" OR "inter-organization network" OR "managed network" OR “care network”* OR “hybrid network”* OR “integrated service delivery network”* OR “managed clinical network”* OR “program network”* OR “quality improvement collaborative”* OR “quality of care collaborative” OR “healthcare network”* OR “network based organization”* OR “network model” OR “network* relationship*” OR “networked governance” OR “integrated healthcare” OR “chain of care” OR “clinical community” OR “practitioner network*” OR “networks of health services” OR “delivery of healthcare” OR “health system planning” OR “organization of healthcare” OR “networks of clinical experts” OR “referral network*” OR “clinical governance” OR “quality improvement program*” OR “network initiative” OR “local network*” OR “district governance” OR “healthcare delivery” OR “healthcare organization and administration” OR “integrated delivery of healthcare” OR “network of safety” OR “collaborative improvement network*” OR “provincial network of health services” OR “health network structures” OR “quality of care network” OR “regionalized healthcare” OR “network of healthcare interventions” OR “collaborative network” OR “network for healthcare practice improvement” OR “integrated system of care” OR “strategic clinical network*” OR “regional health network*” OR “integrated care network*” OR “network for quality improvement” in Title Abstract Keyword

AND

LMIC OR "developing countr*" OR "health system*" OR “developing nation*” OR “developing population*” OR “developing world” OR “less developed countr*” OR “less developed nation*” OR “less developed population*” OR “less developed world” OR “lesser developed countr*” OR “lesser developed nation*” OR “lesser developed population*” OR “lesser developed world” OR “under developed countr*” OR “under developed nation*” OR “under developed population*” OR “under developed world” OR “underdeveloped countr*” OR “underdeveloped nation*” OR “underdeveloped population*” OR “underdeveloped world” OR “middle income countr*” OR “middle income nation*” OR “middle income population*” OR “low income countr*” OR “low income nation*” OR “low income population*” OR “lower income countr*” OR “lower income nation*” OR “lower income population*” OR “underserved countr*” OR “underserved nation*” OR “underserved population*” OR “underserved world” OR “underserved countr*” OR “under served nation*” OR “under served population*” OR “under served world” OR “deprived countr*” OR “deprived nation*” OR “deprived population*” OR “deprived world” OR “poor countr*” OR “poor nation*” OR “poor population*” OR “poor world” OR “poorer countr*” OR “poorer nation*” OR “poorer population*” OR “poorer world” OR “developing econom*” OR “less developed econom*” OR “lesser developed econom*” OR “under developed econom*” OR “underdeveloped econom*” OR “middle income econom*” OR “low income econom*” OR “lower income econom*” OR “low gdp” OR “low gnp” OR “low gross domestic” OR “low gross national” OR “lower gdp” OR “lower gnp” OR “lower gross domestic” OR “lower gross national” OR lmic OR lmics OR “third world” OR “lami countr*” OR “transitional countr*” OR Africa OR Asia OR Caribbean OR “West Indies” OR “South America” OR “Latin America” OR “Central America” OR Afghanistan OR Albania OR Algeria OR Angola OR Antigua OR Barbuda OR Argentina OR Armenia OR Armenian OR Aruba OR Azerbaijan OR Bahrain OR Bangladesh OR Barbados OR Benin OR Byelarus OR Byelorussian OR Belarus OR Belorussian OR Belorussia OR Belize OR Bhutan OR Bolivia OR Bosnia OR Herzegovina OR Hercegovina OR Botswana OR Brasil OR Brazil OR Bulgaria OR “Burkina Faso” OR “Burkina Fasso” OR “Upper Volta” OR Burundi OR Urundi OR Cambodia OR “Khmer Republic” OR Kampuchea OR Cameroon OR Cameroons OR Cameron OR Camerons OR “Cape Verde” OR “Central African Republic” OR Chad OR Chile OR China OR Colombia OR Comoros OR “Comoro Islands” OR Comores OR Mayotte OR Congo OR Zaire OR “Costa Rica” OR “Cote d'Ivoire” OR “Ivory Coast” OR Croatia OR Cuba OR Cyprus OR Czechoslovakia OR “Czech Republic” OR Slovakia OR “Slovak Republic” OR Djibouti OR “French Somaliland” OR Dominica OR “Dominican Republic” OR “East Timor” OR “East Timur” OR “Timor Leste” OR Ecuador OR Egypt OR “United Arab Republic” OR “El Salvador” OR Eritrea OR Estonia OR Ethiopia OR Fiji OR Gabon OR “Gabonese Republic” OR Gambia OR Gaza OR “Georgia Republic” OR “Georgian Republic” OR Ghana OR “Gold Coast” OR Greece OR Grenada OR Guatemala OR Guinea OR Guam OR Guiana OR Guyana OR Haiti OR Honduras OR Hungary OR India OR Maldives OR Indonesia OR Iran OR Iraq OR “Isle of Man” OR Jamaica OR Jordan OR Kazakhstan OR Kazakh OR Kenya OR Kiribati OR Korea OR Kosovo OR Kyrgyzstan OR Kirghizia OR “Kyrgyz Republic” OR Kirghiz OR Kirgizstan OR “Lao PDR” OR Laos OR Latvia OR Lebanon OR Lesotho OR Basutoland OR Liberia OR Libya OR Lithuania OR Macedonia OR Madagascar OR “Malagasy Republic” OR Malaysia OR Malaya OR Malay OR Sabah OR Sarawak OR Malawi OR Nyasaland OR Mali OR Malta OR “Marshall Islands” OR Mauritania OR Mauritius OR “Agalega Islands” OR Mexico OR Micronesia OR “Middle East” OR Moldova OR Moldovia OR Moldovian OR Mongolia OR Montenegro OR Morocco OR Ifni OR Mozambique OR Myanmar OR Myanma OR Burma OR Namibia OR Nepal OR “Netherlands Antilles” OR “New Caledonia” OR Nicaragua OR Niger OR Nigeria OR “Northern Mariana Islands” OR Oman OR Muscat OR Pakistan OR Palau OR Palestine OR Panama OR Paraguay OR Peru OR Philippines OR Philipines OR Phillipines OR Phillippines OR Poland OR Portugal OR “Puerto Rico” OR Romania OR Rumania OR Roumania OR Russia OR Russian OR Rwanda OR Ruanda OR “Saint Kitts” OR “St Kitts” OR Nevis OR “Saint Lucia” OR “St Lucia” OR “Saint Vincent” OR “St Vincent” OR Grenadines OR Samoa OR “Samoan Islands” OR “Navigator Island” OR “Navigator Islands” OR “Sao Tome” OR “Saudi Arabia” OR Senegal OR Serbia OR Montenegro OR Seychelles OR “Sierra Leone” OR Slovenia OR “Sri Lanka” OR Ceylon OR Solomon Islands OR Somalia OR Sudan OR Suriname OR Surinam OR Swaziland

OR Syria OR Tajikistan OR Tadzhikistan OR Tadjikistan OR Tadzhik OR Tanzania OR Thailand OR Togo OR "Togolese Republic" OR Tonga OR Trinidad OR Tobago OR Tunisia OR Turkey OR Turkmenistan OR Turkmen OR Uganda OR Ukraine OR Uruguay OR USSR OR "Soviet Union" OR "Union of Soviet Socialist Republics" OR Uzbekistan OR Uzbek OR Vanuatu OR "New Hebrides" OR Venezuela OR Vietnam OR "Viet Nam" OR "West Bank" OR Yemen OR Yugoslavia OR Zambia OR Zimbabwe OR Rhodesia in All Text

- with Cochrane Library publication date Between Jan 2000 and Jan 2021 (Word variations have been searched)

1/1/2000 – 31/1/2021

Results: 248 (ran on 03/02/2021)
Cochrane reviews: 121
Cochrane protocol: 19
Trials: 108

Search Strategy for Global Index Medicus

((tw:(health system network*)) OR (tw:(clinical network)) OR (tw:(networks of care)) OR (tw:(inter-organization network*)) OR (tw:(managed network*)) OR (tw:(care network*)) OR (tw:(hybrid network*)) OR (tw:(integrated service delivery network*)) OR (tw:(managed clinical network*)) OR (tw:(program network*)) OR (tw:(quality improvement collaborative*)) OR (tw:(quality of care collaborative)) OR (tw:(healthcare network*)) OR (tw:(network based organization*)) OR (tw:(network model)) OR (tw:(network* relationship*)) OR (tw:(networked governance)) OR (tw:(integrated healthcare)) OR (tw:(chain of care)) OR (tw:(clinical community)) OR (tw:(practitioner network*)) OR (tw:(networks of health services)) OR (tw:(delivery of healthcare)) OR (tw:(health system planning)) OR (tw:(organization of healthcare)) OR (tw:(networks of clinical experts)) OR (tw:(referral network*)) OR (tw:(clinical governance)) OR (tw:(quality improvement program*)) OR (tw:(network initiative)) OR (tw:(local network*)) OR (tw:(district governance)) OR (tw:(healthcare delivery)) OR (tw:(healthcare organization and administration)) OR (tw:(integrated delivery of healthcare)) OR (tw:(network of safety)) OR (tw:(collaborative improvement network*)) OR (tw:(provincial network of health services)) OR (tw:(health network structures)) OR (tw:(quality of care network)) OR (tw:(regionalized healthcare)) OR (tw:(network of healthcare interventions)) OR (tw:(collaborative network)) OR (tw:(network for healthcare practice improvement)) OR (tw:(integrated system of care)) OR (tw:(strategic clinical network*)) OR (tw:(regional health network*)) OR (tw:(integrated care network*)) OR (tw:(network for quality improvement)))

Years 2000-2021

Filter Africa: 593

Appendix 3C. Data charting instrument

Study #	Citation	Intervention Country	Aim/ Purpose of Study	Study Methodology	Intervention	Study Outcomes/ Main Findings	Network Stakeholders	Type of Network	Network Definition	Network Characteristics	Network Use	Network Purpose	Other key findings
Study 1													
Study 2													
Study….													

Appendix 3D. Characteristics of sources of evidence

#	Citation	Intervention Country	Aim/purpose of study	Study Methods	Intervention	Outcomes/Main Findings	Type of Network
Peer-review literature							
1	Abdul Kader MAS. Strengthening acute coronary syndrome referral network: Insights from initiatives of Penang General Hospital cardiology centre. Medical Journal of Malaysia. 2019; 74: 4, 355-358.	Malaysia	Commentary on proof of concept to share experiences and give an overview of the initiative	Audit and intervention based on areas needed for improvement	Development and implementation of standardized protocols in all referral hospitals, referral network workshop as medical continuing education for medical officers in referral hospitals	Network resulted in improved quality of PCI referrals	-State PCI-referral network with large tertiary hospital at center -Hub-spoke model
2	Abul-Fadl A, Abu-Zeid A, Besher M, and Sarhan AE. Assessing needs for use of communication networks for continuous improvement of primary health care services. International Proceedings of Chemical, Biological	Egypt	To identify the acceptability, accessibility, affordability, and efficiency for IT for tele-healthcare networks in PHC	-Pilot study assessed by interviews to understand access, skills, and practice use -Assessed needs for teaching primary care medicine using technology and telecommunica	IT solution installed in three large universities in three regions and linked with six remote PHCs	Telecommunications can improve service delivery at PHCs and is a cost-effective way to improve outcomes	Telehealth network: linked university and PHCs centres for teaching, training, and consultation

	and Environmental Engineering. 2012; 41:87-92.			tions by networking universities with PHCs to reinforce teaching in PHC settings			
3	Adams V, Craig S, Samen A, and Bhatta S. It Takes More than a Village: Building a Network of Safety in Nepal's Mountain Communities. Maternal and Child Health Journal. 2016; 20:19, 2424-2430.	Nepal	To show how an NGO established a model for integrated healthcare delivery and support	Report from the field	Implementation of networks of safety in mountainous regions of Nepal, including: -Education for family and community (FCHV, CHWs) -Provider trainings -Collaboration with district-level partners on MCH strategic plans and MoH with national policies -Addresses infrastructure gaps (facility and referral hospitals) and obstacles to safe delivery through investment in	Decrease in maternal deaths	Network of safety - from families to villages up to tertiary care and MoH

					improvement of facilities		
4	Addicott R and Ferlie E. Understanding power relationships in health care networks. Journal of health organization and management. 2007; 21: 4/5, 393-405. DOI 10.1108/14777260710778925	UK (London)	To show that networks are becoming a new, innovative organizational form in the UK public sector and explore and theorize the nature of power relations within a network model of governance	-Comparative case studies -Semi structured interviews, document analysis, meeting observation -Review of evidence of 5 case studies on cancer managed care networks in London	Cancer managed care networks and power relations within the network	"A model of bounded pluralism can be used to understand power relations within London MCNs. However, power over the development of policy and strategic direction is instead exerted in a top-down manner by the government (e.g. Department of Health) and its associated national bodies"	Managed care network
5	Akech S, Ayieko P, Irimu G, Stepniewska K, and English M. Magnitude and pattern of improvement in processes of care for hospitalised children with diarrhoea and dehydration in Kenyan hospitals participating in a clinical network. Tropical Medicine and International	Kenya	To describe the magnitude and patterns of changes in processes of care for children with diarrhea and dehydration in a clinical network	-Observational study -Pediatric Admission Quality of Care scoring	-Implementation of CIN: data on admissions, clinical information, treatment and discharge information entered into an online database by trained clerk after child discharge -Data synched	-"Adherence to guidelines for children admitted with diarrheal disease can be improved through participation in a clinical network but improvement is limited, not uniform for all aspects of care and contexts and occurs early" -Mean PAQC score increased by	Clinical Information Network

	Health. 2019; 24:1, 73-80.				to a central server -Reports produced on processes of care every 2-3 months and shared with the hospitals with a combined report on performance of all hospitals, enabling comparison of hospital performance -Reports are disseminated and discussed by Pediatrician and clinical team to identify action plans -Pediatricians are mentored on how to give feedback and develop action plans -Follow-up from KWTRP after reports to discuss improvement or	13.8% in the first 12 months, average 0.9% increase/month but then plateaued -Changes were similar in the two groups of hospitals joining the network at different times	

					deterioration -Twice yearly CIN meetings to share experiences with key personnel		
6	Alderman EM, Freeman KL, and Lobach KS. Improving adolescent access and services in a large primary care network: report of a 10 year project. International Journal of Adolescent Medicine and Health. 2019; 31:2.	USA	Narrative report: overview of MAPCI initiative in the MMG network	-Baseline survey and provider conference -Subsequent studies on different aspects of the network	-Needs assessment (baseline survey and provider summit) to evaluate current state of adolescent PHC services within the network and develop recommendations -Development an initiative to create a uniform approach to adolescent primary care in the network -Steering committee and working groups to implement initiative	Improvement of adolescent health services in a large PHC network	-Primary care network: community-based practices and school health clinics linked to a large academic medical center -6/22 sites are resident training sites -Some sites are linked to another community health network as well
7	Alkmim MB, Figueira RM, Marcolino MS, Cardoso CS, de	Brazil	Determine user satisfaction and cost-effectiveness of tele-health network	-Project overview -User	-Establish telehealth network linking	"a telehealth service must be part of a	Telehealth network: university

	Abreu MP, Cunha LR, da Cunha DF, Antunes A P, Resende AGD, Resende ES, and Ribeiro ALP. Improving patient access to specialized health care: the Telehealth Network of Minas Gerais, Brazil. Bulletin of the World Health Organization. 2012; 90: 373-378. doi:10.2471/BLT.11.099408.			satisfaction surveys -Cost-effectiveness analyses	university hospitals with remote municipal health departments -Provide support using tele-assistance, conduct tele-electrocardiography and teleconsultations for a variety of issues	collaborative network, meet the real needs of local health professionals, use simple technology and have at least some face-to-face components. If applied to health problems for which care is in high demand, this type of service can be economically viable and can help to improve patient access to specialized health care"	hospitals linked to remote municipal health departments in the state, connects specialists with PHC providers
8	Amiel JM and Pincus HA. The medical home model: new opportunities for psychiatric services in the United States. Current Opinion in Psychiatry. 2011; 24:6, 562-8. doi:10.1097/YCO.0b013e32834baa97.	USA	Overview of PCMH model and how it was adopted for the delivery of psychiatric care	Review	Integration of psychiatric care into PCMH	"PCMH model offers a useful conceptual framework for the management of complex and chronic psychiatric illness. Early pilots of its use in psychiatric settings have demonstrated that people with psychiatric illness who receive their care in a medical home have better	Patient centered medical home

						access to care, improved response to treatment, and higher cost efficiency compared with usual care"	
9	Arrieta J, Orrego C, Macchiavello D, Mora N, Delgado P, Giuffre C, Elorrio EG, Rodriguez V. 'Adios Bacteriemias': a multi-country quality improvement collaborative project to reduce the incidence of CLABSI in Latin American ICUs. International Journal for Quality in Health Care. 2019; 31:9,704-711. doi: 10.1093/intqhc/mzz051.	Five countries in Latin America: Argentina, Chile, Colombia, Mexico, Uruguay	Evaluation	-Explanation of collaborative -Descriptive statistics on an uncontrolled before-after comparison of CLABSI rates	Quality improvement collaborative focused on the implementation of bundles of care for insertion and maintenance of central lines	-Overall reduction in the CLABSI incidence rate of 22% during the intervention period -Quality improvement collaborative effective in reducing the incidence of CLABSI and improving adherence to good practices and maintenance processes in participating ICUs	Multi-country quality improvement collaborative

10	Aspromonte N, Gulizia MM, Di Lenarda A, Mortara A, Battistoni I, De Maria R, Gabriele M, Iacoviello M, Navazio A, Pini D, Di Tano G, Marini M, Ricci RP, Alunni G, Radini D, Metra M, and Romeo F. ANMCO/SIC Consensus Document: Cardiology networks for outpatient heart failure care. European Heart Journal. 2017; 19 Supplement D; D89-D101. doi:10.1093/eurheartj/sux009.	Italy	Guidance document for the organization of national heart failure care network: tasks and requirements of health system points of contact and to define how diagnosis, management, and care processes should be documented and shared	Guidance document	Different levels of heart failure clinics integrated into a dedicated network for management of patients on a regional basis, according to geography	Guidance document with roles and interactions of cardiology specialists	National network for heart failure patients
11	Austin A, Gulema H, Belizean M, Colaci DS, Kendall T, Tebeka M, Hailemariam M, Bekele D, Tadesse L, Berhane Y, and Langer A. Barriers to providing quality emergency obstetric care in Addis Ababa, Ethiopia: Healthcare providers' perspectives on training, referrals and supervision, a	Ethiopia	Assess barriers to provision of emergency obstetric care in Addis according to providers, focusing on implementation of national referral guidelines, staff training, staff supervision	Mixed methods: semi-structured interviews, key informant interviews, quantitative survey	Establishment of obstetric referral network	"lack of transportation and communication infrastructure, overcrowding at the referral hospital, insufficient pre-service and in-service training, and absence of supportive supervision as key barriers to	Urban regional emergency obstetrics referral network

	mixed methods study. BMC Pregnancy and Childbirth. 2015; 15:74. doi: 10.1186/s12884-015-0493-4.					provision of quality emergency obstetric care"	
12	Aveling EL, Martin GP, Armstrong N, Banerjee J, and Dixon-Woods M. Quality improvement through clinical communities: eight lessons for practice. Journal of Health Organization and Management. 2012; 26:2.	Non-specific	Examine role of network forms of organization in QI and to draw out practical lessons to achieve change through this approach	-"author-based" approach review -Used principles of critical interpretive synthesis	Clinical communities for QI	"A number of overlapping but distinct clinical community-based approaches can be identified in the literature, each suitable for different problems. The evidence for the effectiveness of these is mixed, but there is some agreement on the challenges that those adopting such approaches need to address, and how these can be surmounted"	Clinical community for QI
13	Awoonor-Williams, JK, Bailey P, Yeji F, Adongo AE, Baffoe P, Williams A, and Mercer S. Conducting an audit to improve the facilitation of emergency maternal	Ghana	Audit of referral networks to identify areas for improvement and solve issues in a way that could be modelled elsewhere	Clinical/criteria -based audit of obstetric and newborn referrals in five referral networks	Linking communities with sub-district, district, and regional-level health facilities and improving referral	-Increase facilitating referral mechanisms -Decrease in reliance on taxis and increase in use of national/facility ambulance/vehicl	Referral networks

	and newborn referral in northern Ghana. Global Public Health. 2015; 10:9, 1118-1133. doi: 10.1080/17441692.2015.1027247.				practices between facilities through audit which encouraged positive change in facilitation of emergency referrals	e -Increase in healthcare worker accompanying referrals -Increase in use of referral slips -Increase in notification to facility where patient is being referred -Increased feedback	
14	Ayieko P, Irimu G, Ogero M, Mwaniki P, Malla L, Julius T, Chepkirui M, Mbevi G, Oliwa J, Agweyu A, Akech S, Were F, English M, Tuti T, Gathara D, Gachau S, Ngarngar S, Injira I, Kimutai D, Emadau C, Mutiso C, Nzioki C, Mithamo A, Kuria M, Otido S, Wachira G, Njiiri P, Inginia R, Musabi M, Charo S, Ochieng G, Thuranira L, and Clinical Information Network, Authors. Effect of enhancing audit and feedback on uptake of childhood pneumonia	Kenya	To examine if providing enhanced audit and feedback compared to routine feedback could accelerate uptake of new pneumonia guidelines by clinical teams	Parallel group cluster randomized controlled trial	-Standard intervention: training on new guidelines, dissemination of treatment guidelines, support to improve collection and quality of patient data, mentorship, team management training, peer-to-peer networking, feedback reports on guideline uptake -Enhanced: in	-Proportion of children correctly classified and diagnosed in enhanced and standard feedback groups were similar -Difference in adoption of pneumonia policy overtime in the enhanced feedback group vs the standard feedback group	Clinical Information Network

	treatment policy in hospitals that are part of a clinical network: a cluster randomized trial. Implementation Science. 2019; 14:20. doi:10.1186/s13012-019-0868-4.				addition to the standard intervention, monthly hospital-specific feedback sheets on pneumonia indicators linked to performance goals, action plans, and follow-up email from network coordinator		
15	Bailie J, Cunningham FC, Bainbridge RG, Passey ME, Laycock AF, Bailie RS, Larkins SL, Brands JSM, Shanthi Ramanathan, Abimbola S, and Peiris D. Comparing and contrasting 'innovation platforms' with other forms of professional networks for strengthening primary healthcare systems for Indigenous Australians. BMJ	Australia	Compare and contrast concept of innovation platforms with other networks to strengthen PHC	Review	Applying an innovation platform approach to integrated quality improvement in Indigenous PHC	"Policymakers should support further experimentation with innovation platforms as a strategy for engaging with multiple stakeholders in health systems strengthening initiatives"	Innovation platform

	Global Health. 2018; 3:3:e000683. doi:10.1136/bmjgh-2017-000683.						
16	Bansal N. Burstein DS, Lorts A, Smyth L, Rosenthal DN, and Peng DM. Heart failure in children: Priorities and approach of the ACTION collaborative. Progress in Paediatric Cardiology. 2020; 59. doi: 10.1016/j.ppedcard.2020.101313.	International	Describe the ACTION network	Overview of network	Development of the Advanced Cardiac Therapies Improving Outcomes Network	Decrease in stroke rates of children with VADs across the network	Learning health system/learning network
17	Bari S, Mannan I, Rahman MA, Darmstadt GL, Seraji MHR, Baqui AH, El Arifeen S, Rahman SM, Saha SK, Ahmed A, Ahmed, S, Santosham M, Black RE, Winch P J, and Bangladesh Projahnmo II. Trends in use of referral care of sick newborns in hospital services for a community-based intervention in Tangail district, Bangladesh. Journal	Bangladesh	Describe trends in compliance by families with referral when sick newborns were referred by CHWs	Cluster randomized trial	-Families are educated about danger signs -CHWs deliver package of maternal and newborn care interventions at the home, visit home post-partum period to examine newborns and refer if need urgent care	-Increase in proportion of sick newborns for whom care was sought outside the home and from qualified providers -Decrease in the proportion of those who sought care from unqualified providers	CHW linkages to private referral hospital

	of Health Population and Nutrition. 2006; 24:4, 519-529.						
18	Basso MB, Nunes NB, Correa LBC, Vieira CN, Vilarinho Jlpd, and Pucca GA. The construction of the oral health care network in the Federal District, Brazil. Ciencia & Saude Coletiva. 2019; 26:6, 2155-2165. doi: 10.1590/1413-81232018246.08552019.	Brazil	-To explain the process of creation of the oral health care network, through a specific institutional actor – the Dental Management of the SHS-DF -Identify elements, actions, strategies that contributed to effectiveness of process	Qualitative case study	Establishment of oral care network at primary level and dental specialty centers at regional hospitals	"change in the paradigm of the work process, characterized by the connection with community and multi-professional performance"	Oral healthcare network
19	Batson, J. Guiding community-based public health planning in rural New Mexico. Journal of Public Health Management & Practice. 2002; 8:1, 47-52.	USA	Description of program	Program overview	-Community care network groups 25 agencies and 100 individuals on a monthly basis to provide the action framework for community initiated programs -Organization of the Turning Point Initiative through this network	"Through this collaboration, information is shared regarding the focus of agencies, funding for programming is sought through the most appropriate agency, and much of the competitive energy has been channeled into sharing of resources to write the best funding proposal and implement the	Community care network

						best program when funding is obtained"	
20	Beyeler N, de la Cruz AY, and Montagu D. The impact of clinical social franchising on health services in low- and middle-income countries: a systematic review. PLoS ONE. 2013; 8:4, e60669.	Studies included from Nepal, Myanmar, Kenya, Pakistan, Philippines, Madagascar, Viet Nam, Ethiopia, India	Evaluate the effect of clinical social franchising clients, communities, and private providers, and on healthcare quality, equity, cost-effectiveness, and health outcomes	Systematic review	Social franchises - reproductive health	-Social franchising positively associated with increased client volume and client satisfaction -Findings regarding health care utilization and health impact were mixed -Poorer outcomes on cost-effectiveness and equity	Social franchise
21	Bhatta S, Rajbhandari S, Kalaris K, and Carmone AE. The Logarithmic Spiral of Networks of Care for Expectant Families in Rural Nepal: A Descriptive Case Study. Health Systems and Reform. 2020; 6:2. doi:10.1080/23288604.2020.1824520.	Nepal	-Describe to what extent the processes followed to establish, operate, and refine the network of safety model addresses the four domains of NOC; -Explain the network of safety approach through the network of care framework	Descriptive case study	Network of safety approach: model to improve maternal and neonatal survival, investments in workforce, infrastructure, essential equipment, technical support, training, mentoring, supervision, community engagement,	-Contributed to reductions in preventable maternal and neonatal deaths -End-line surveys in two districts service utilization surpassed the 30% target -Reduction of maternal and newborn deaths by 80%, surpassing the 50% target	Network of Care/network of safety

					systematic behavior change, program planning and budget management support to local government - which facilitates continuation of activities after OHW support transitions		
22	Bowen JR, Callander I, Richards R, and Lindrea KB. Decreasing infection in neonatal intensive care units through quality improvement. Archives of Disease in Childhood. Fetal and Neonatal Edition. 2017; 102:1. F51–F57. doi:10.1136/archdischild-2015-310165.	Australia	-To decrease the incidence of neonate bloodstream infection through a quality improvement program -Describe QI activities in the program -Describe process of almost real time data to audit infections	Statistical analyses of network data on blood stream infections	Sepsis Prevention in NICUs Group Project - multihospital quality improvement initiative	State-wide QI initiative was effective	Quality improvement network
23	Bowker SL, Stelfox HT and Bagshaw SM. Critical care strategic clinical network: Information infrastructure ensures a learning	Canada	Overview of Alberta's Critical Care Strategic Clinical Network	Commentary: description of network	Foster a learning health system using provincial informatics infrastructure to drive	Example: sustained improvements in screening and a measurable reduction in delirium-days	Critical Care Strategic Clinical Network made up of 20

	health system. CMAJ. 2019; 191(Suppl 1):S22-3. doi: 10.1503/cmaj.190578.				innovation, implement evidence-informed practice, and evaluate outcomes		provincial ICUs
24	Britto M, Fuller SC, Kaplan HC, Kotagal U, lannon C, Margolis PA, Muething SE, Schoettker PJ, and Seid M. Using a network organisational architecture to support the development of Learning Healthcare Systems. BMJ Qual Saf. 2018; 27; 937-946. doi:10.1136/bmjqs-2017-007219.	USA	Describe the common framework and methods of Learning Networks and how the network model supports transformation of the health system to a Learning Health System	Framework paper	Design, development, and implementation of network-based Learning Healthcare Systems called Learning Networks	Examples from different networks: -Improvements in care processes and outcomes, which have been sustained, 80% of population in clinical remission -Reduction in interstage mortality by 40% and 95% survival across the network -Reduction in hospital-acquired conditions by 5% to 79% -Improved neonatal outcomes, reduction by 40% of medically unnecessary early delivery	Learning Network: a network-based Learning Health System

25	Broughton E, Hermida J, Hill K, Sloan N, Chavez M, Gonzalez D, Freire JM, and Ximena Gudino. Evaluation of an intervention to improve essential obstetric and newborn care access and quality in Cotopaxi, Ecuador. Frontiers in Public Health. 2016; 4:247. doi: 10.3389/fpubh.2016.00247.	Ecuador	To evaluate changes in facilities participating in the EONC network with respect to access and quality of EONC and compare to non-participating facilities	Evaluation: household survey at baseline and endline of intervention and control groups, facility chart reviews, simulation care by TBAs to assess knowledge and skills	Network created among health services to improve service provision and provide culturally sensitive, quality EONC services, including transport of obstetric and newborn emergencies	-Percentage of women receiving a postnatal visit within first 2 days of delivery increased -Postpartum/counselling on newborn care increased -Increased community and facility quality of care and improved mothers' health knowledge -Continual decline in newborn mortality in project intervention years	Provincial to community level MNH QI network
26	Brown BB, Haines M, Middleton S, Paul C, D'Este C, Klineberg E, and Elliott E. Development and validation of a survey to measure features of clinical networks. BMC Health Services Research. 2016; 16:531. doi:10.1186/s12913-016-1800-0.	Australia	"to outline the development, validation and descriptive results of an Internet survey designed to assess the effectiveness of clinical networks in order to guide future strategic and operational management and leadership in the wider context in which they operate"	-Development of survey instrument -Psychometric assessment of survey instrument -Survey of sample of network members	Survey of effectiveness of clinical networks	"network members there was strong reported commitment and belief in network-led quality improvement initiatives, which were perceived to have improved quality of care (72.8 %) and patient outcomes (63.2 %). Network managers were	Clinical networks

						perceived to be effective leaders and clinical co-chairs were perceived as champions for change"	
27	Brown BB, Patel C, McInnes E, Mays N, Young J, and Haines M. The effectiveness of clinical networks in improving quality of care and patient outcomes: a systematic review of quantitative and qualitative studies. BMC Health Services Research. 2016; 16:360. doi: 10.1186/s12913-016-1615-z.	USA, UK, Canada, Australia	"to ascertain the effectiveness of clinical networks and identify how successful networks improve quality of care and patient outcomes"	Systematic review - quantitative and qualitative studies included	The review focused on managed and non-managed clinical networks	-"clinical networks can be effective vehicles for quality improvement in service delivery and patient outcomes across a range of clinical disciplines" -"variability in the networks' ability to make meaningful network- or system-wide change in more complex processes" -"networks that had a positive impact on quality of care and patients outcomes were those that had adequate resources, credible leadership and efficient management	Clinical networks

						coupled with effective communication strategies and collaborative trusting relationships"	
28	Burns E, Collington M, Eden T, Freccero P, Renner L; Paintsil V, Dolendo M, Islam A, Khaing AA and Rosser J. Development of paediatric oncology shared-care networks in low-middle income countries. Journal of Cancer Policy. 2018; 16:26-32. doi: 10.1016/j.jcpo.2018.03.003.	Ghana, Bangladesh	To write up findings from the project as a resource guide, share lessons learned, and make available	Stakeholder workshop: discussions, agreement, defining criteria, exploration, reflection	Establishment of shared-care networks for child cancer are in LMICs	Successes of a shared-care network: Hub (referral center), shared-care center hospitals, good communication, ability to train staff within the network, and supportive hospitals and government	Shared-care network
29	Carmone AE, Kalaris K, Leydon N, Sirivansanti N, Smith JM, Storey A, and Malata A. Developing a Common Understanding of Networks of Care through a Scoping Study. Health Systems & Reform. 2020; 6:2, e1810921.	Global	"delineating the concept of NOC and looking at the comprehensive context of interventions, in order to create a common understanding of the term, justify why the approach is necessary, and begin to explore how its use within health systems could be encouraged"	Scoping study: triangulated data from three methods: 1) a scoping literature review; 2) stakeholder perspectives; and 3) descriptive case studies of anecdotally successful operational	Definition and framework for networks of care	NOC definition and framework	Network of Care

	doi:10.1080/23288604.2020.1810921.			programs that fit the working definition of NOC			
30	Cassinelli A, Pauselli N, Piola A, Martinelli C, de Azevedo JLA, Bidondo MP, Groisman B, Barbero P, Liascovich R, and Sala A. National Health Care Network for children with oral clefts: organization, functioning, and preliminary outcomes. Archivos Argentinos De Pediatria. 2018; 116;1, E26-E33. doi: 10.5546/aap.2018.eng.e26.	Argentina	Describe network and preliminary outcomes	Descriptive, observational, and cross-sectional study	Development of a care network for newborn infants with oral clefs	70% of children were assessed by a certified treating institution and were treated	Treatment and referral network for oral clefs
31	Chan BTB, Rauscher C, Issina AM, Kozhageldiyeva LH, Kuzembaeva DD, Davis CL, Kravchenko H, Hindmarsh M, McGowan J, and Kulkaeva G. A programme to improve quality of care for patients with chronic diseases, Kazakhstan. Bulletin	Kazakhstan	Describe the results of a disease management program and the effect of the initial design and pilot of the program	Quasi-experimental before/after	"supportive, team based, multifaceted approach to quality improvement that aimed to help clinic teams address the root causes of poor care in an environment that	Improvements in care quality process measures	Quality improvement program

	of the World Health Organization. 2020; 98:3, 161-169. doi:10.2471/BLT.18.227447.				emphasized learning, analysis and improving work processes"		
32	Cordier LF, Kalaris K, Rakotonanahary RJL, Rakotonirina L, Haruna J, Mayfield A, Marovavy L, McCarty MG, Aina AT, Ratsimbazafy B, Razafinjato B, Loyd T, Ihantamalala F, Garchitorena A, Bonds MH, and Finnegan KE. Networks of Care in Rural Madagascar for Achieving Universal Health Coverage in Ifanadiana District. Health Systems & Reform. 2020; 6:2, e1841437. doi: 10.1080/23288604.2020.1841437.	Madagascar	Using the NOC framework, describe the innovations and best practices for a NOC in a rural district with limited financial resources	Descriptive case study	Partnership between PIVOT (NGO) and MoH to build a district level model health system based on "integrating clinical care, system readiness, and scientific innovation at all levels of the health system"	-Under-five mortality declined 19% and neonatal mortality by 36% -Care-seeking for childhood illness increased by 51% in PIVOT-supported areas and fell slightly in the rest of the district -Attendance at four or more ANC visits increased for all areas of the district	Network of Care
33	Cunningham F, Morris A, and Braithwaite J. Experimenting with clinical networks: the Australasian experience. Journal of Health Organization and	Australia	To "draw on the recent extensive development of Australasian clinical networks to identify themes and discuss recurring challenges"	Viewpoint/review	Clinical networks	Various	Clinical networks

	Management. 2012; 26:6, 685-696. doi: 10.1108/14777261211276961.						
34	Datta V, Srivastava S, and Singh M. Formation of Quality of Care Network in India: Challenges and Way Forward. Indian Paediatrics. 2018; 55:9, 824-827.	India	To provide an overview of the network, its relevance, and impact	Overview of network	"self-sustaining network of facilities implementing Quality Improvement methods for improvement of care"	Self-sustaining network of quality improvement teams, leading the spread and adoption of simple quality improvement strategies across the Indian subcontinent	Nationwide Quality of Care Network
35	de Almeida PF, de Oliveira SC, and Giovanella L. Network integration and care coordination: the case of Chile's health system. Ciencia & Saude Coletiva. 2018; 23:7, 2213-2227. doi: 10.1590/1413-81232018237.09622018.	Chile	To analyze the implementation of integrated networks and strategies and tools for coordination of PHC care	Exploratory, descriptive-interpretative, and qualitative study	Implementation of integrated networks and tools for coordination of care in Chilean health system through reform and strengthening PHC	Documentation of transition from fragmented to integrated care	Integrated healthcare network
36	Devarakonda, S. Hub and spoke model: making rural healthcare in India affordable, available and accessible. Rural and Remote Health. 2016; 16:1.	India	To determine if a hub and spoke model can expand market reach and increase profits while reducing costs of operations for organizations and to customers	Exploratory review and interviews	Implementation of hub-spoke model with ICT component	Hub-spoke model with an ICT component is an effective mechanism allowing for greater distribution while minimizing costs	Hub-spoke model

37	Diallo MM, Diallo AM, Balde NM, Camara A, Balde MC, Kake A, Bah A, Barry TO, Diallo IP, and Lokrou A. Access to diabetes care in sub-Saharan Africa: Results of a diabetes health network in Guinea. Medecine des Maladies Metaboliques. 2013; 7:3, 272-276.	Guinea	Provide an overview of activities of the network and describe its specificities	Program overview	Establishment of diabetes network	-Increase in number of annual consultation (30-fold) -Reduction in hospital death rate (by 80%)	Regional diabetes management network
38	Diniz PRB, Sales FJR, and Novaes MD. Providing Telehealth Services to a Public Primary Care Network: The Experience of RedeNUTES in Pernambuco, Brazil. Telemedicine and E-Health. 2016; 22:8, 694-698. doi: 10.1089/tmj.2015.0209.	Brazil	Report on the PHC telehealth experience and discuss factors associated with telehealth service utilization	Descriptive study	Implementation of telecare services: teleconsultation, telediagnosis, tele-education, remote screening	-Increase in usage of services, particularly for tele-education, telediagnosis, and tele-consult -Over two-thirds of providers said they changed their referral plans after the consult	PHC-university specialist teleconsultation network
39	Dixon-Woods M, Bosk CL, Aveling EL, Goeschel CA, and Pronovost PJ. Explaining Michigan: developing an ex post theory of a quality improvement	USA	-"outline an approach, located within the broad family of theory-oriented evaluation methods, for developing ex post theory by using program leaders' experience and social scientists' input...describe an application of this approach to the Michigan Keystone Project" -Why was the program successful	Development of ex post program theory	Quality improvement collaborative: interventions specifically on practices related to CVC care and through	-Sustained effects of QI program and showed that there was an associated reduced mortality median reported infection rate dropped and stayed at the	Quality improvement collaborative

	program. The Milbank Quarterly. 2011; 89:2, 167-205.		explain how the program worked on average across participating units		promoting cultural and organizational changes regarding safety more generally	reduced level through the end of the study -The mean rate of infections decreased which was sustained for 18 months after the study	
40	D'Mello BS, Bwile P, Carmone AE, Kalaris K, Magembe G, Masweko M, Mtumbuka E, Mushi T, Sellah Z, and Gichanga B. Averting Maternal Death and Disability in an Urban Network of Care in Dar es Salaam, Tanzania: A Descriptive Case Study. Health Systems & Reform. 2020; 6:2. e1834303. doi: 10.1080/23288604. 2020.1834303.	Tanzania	To detail the efforts made to build and maintain the CCBRT network of care using the network of care framework	Descriptive case study	-Development of a network of care between 22 government hospitals and catchment facilities -With investments in infrastructure from partners and local government funding -Increased capacity to provide MNH services	-Benefit-cost ratio 6:1 -Redistribution of deliveries from three tertiary facilities (66.1% to 51.6%) to secondary hospitals (34.1%), health centers, and dispensaries (14.4%) -Reduction in hospital delivery volumes with none more that 15,000 deliveries a year (from a high of 16,000 to 22,000/year) -Results of standards-based performance assessments increased from 9% in 2010 to over 75% in 2019 -Reduction in maternal death	Network of Care

						rate by almost 40%, from 153.8 deaths/100,000 live births in 2012 to 79 deaths/100,000 live births in 2019 -Reduction in fistula cases from over 40/year in 2010 to less than 10/year in 2019 -More variable outcomes in stillbirths and neonatal deaths (stillbirths 29 to 20.5/1000 deliveries from 2013-2019, neonatal deaths 14.48 to 12/1000 live births from 2014-2019)	
41	Dougherty G, Panya M, Madevu-Matson C, Anyalechi GE, Clarke K, Fayorsey R, Kamonga M, Kimambo S, Lutkam D, Mugisha V, Mtiro H, Msuke S, Ramadhani A, Sipemba J, Urasa P, and Rabkin M. Reaching the First 90: Improving Inpatient Pediatric	Tanzania	The "purpose of our project was to build QI capacity and improve pediatric PITC coverage by designing and supporting a QI Collaborative (QIC) to catalyze swift improvement in PITC performance for pediatric inpatients"	Program overview	Implementation of a quality improvement collaborative for PITC, including interventions on facility-driven change ideas: improvements in staff and client education,	-All participating facilities met or surpassed the 80% coverage target for aim 1 at least once and for a median of 5 months -Increase in number of children tested from 38% to 76% -Proportion of children testing	Quality improvement collaborative

	Provider-Initiated HIV Testing and Counseling Using a Quality Improvement Collaborative Strategy in Tanzania. Journal of the Association of Nurses in AIDS Care. 2019; 30:6,682-690. doi:10.1097/JNC.0000000000000066.				staffing patterns, workflow, commodity management, documentation, HIV test kit management, and referrals	positive remained stable -Linkages (aim 2) remained high throughout from 96% to 100% of children linked to care -Overall a 96% increase in number of children living with HIV linked to care -HIV rapid test kits supply improved as stockouts fell from 8.8 days/month to 1.5 days/month -"QICs were used to address a critical need in the pediatric HIV cascade and improve the identification of children living with HIV who had been previously undiagnosed"	

42	Duvalko KM, Sherar M, and Sawka C. Creating a system for performance improvement in cancer care: Cancer Care Ontario's clinical governance framework. Cancer Control. 2009; 16:4, 293-302.	Canada	"describes the benefits and results reported by Cancer Care Ontario (CCO) in transforming from a direct provider of cancer services to an organization whose responsibilities include improving the quality of care across the province's cancer system"	Program overview and case examples	The creation of a clinical governance framework integrating clinical accountability with administrative accountability in an ongoing performance improvement cycle	Examples include: -Increase of specialized surgeries at designated centers -Reduction in 90th percentile surgical waitlist time by 36% and regional variability in waitlist times has decreased -Guideline adherence rates increased from 60% to 77% between 2004-2007 and all regions reporting 100% compliance	Clinical governance and performance improvement system
43	Elrod JK and Fortenberry JL The hub-and-spoke organization design revisited: a lifeline for rural hospitals. BMC Health Services Research. 2017; 17(Suppl 4):795.	USA	"overview of the hub-and-spoke network and discusses Willis-Knighton Health System's use of it to establish productive partnerships with rural hospitals"	Program overview	-Development of hub-spoke model and extension to rural hospitals -Hub provided management leadership and infrastructure support to rural hospitals to act as linked satellite	-The rural hospitals were able to provide more comprehensive services and had greater patient volume than before integration in the network -Benefits to the hub as it opened up a new geography of referred patients that would not have otherwise	Hub-spoke model

						been in their catchment	
44	English M, Ayieko P, Nyamai R, Were F, Githanga D, and Irimu G. What do we think we are doing? How might a clinical information network be promoting implementation of recommended paediatric care practices in Kenyan hospitals? Health Research Policy and Systems. 2017; 15:4. doi: 10.1186/s12961-017-0172-1.	Kenya	To provide an overview of implementation of CIN strategy, explain how components of the strategy might align with implementation activity typology, explain how the components could cause change using the Behavior Change Wheel, and a proposition of the strategy in realist terms	-Analysis of CIN activities and identify core active components based on typology of implementation components -Use of the Behavior Change Wheel to show to network activities and intervention strategies may lead to change in providers behavior	-Systems oriented intervention focused on the leaders of units -Addressing context and norms influencing practice	Examples: -Increase in clear documentation of HIV status -Improved uptake of MUAC	Clinical Information Network
45	Fandre M, McKenna C, Beauvais B, Kim F, and Mangelsdorff AD. Patient-centered medical home implementation effects on emergency room utilization: a case study. Hospital Topics. 2014; 92:3, 59-65. doi: 10.1080/00185868.2014.937967.	USA	"to evaluate the implementation of a PCMH within a high-volume patient utilization area and determine whether those individuals enrolled into a PCMH had a significantly lower likelihood of visiting the ER than those not enrolled"	-Cross-sectional, post-test-only comparison group study -Quasi-experimental -Explanatory	Implementation of PCMH model for PHC in the military health system	-PCMH enrollees are less likely to visit ER than those registered with a standard PHC clinic -67% reduction in likelihood of utilizing the ER for those registered with a PCMH	Patient centered medical home

46	Fasawe O, Adekeye O, Carmone AE, Dahunsi O, Kalaris K, Storey A, Osy U, and Wiwa O. Applying a Client-centered Approach to Maternal and Neonatal Networks of Care: Case Studies from Urban and Rural Nigeria. Health Systems & Reform. 2020; 6:2, e1841450. doi: 10.1080/23288604.2020.1841450.	Nigeria	To apply the "NOC framework, the case studies elucidate key elements that made the NOC successful in improving the quality of MNH care and outcomes for women delivering in three states of Northern Nigeria and Lagos Mainland"	Descriptive case study	-Northern Nigeria: MNH program focused on averting preventable deaths in the 24-48 hour window around birth through early identification of potential complications, simple interventions to quickly stabilize and ensure survival, timely and proper referrals to high level care -Lagos State: urban MCH network coordinated from the public sector with public facilities, private sector hospitals, TBA clinics; TBAs linked to formal health sector as a strategy to reduce	-Northern Nigeria: reductions in maternal mortality (37%), neonatal mortality (43%), stillbirth (15%), and perinatal mortality (27%) -Lagos: linking TBAs into the formal health system decreased the fragmentation of care for pregnant women and improved referrals; it also increased use of primary care services in Lagos Mainland LGA by an estimated 7%	Network of Care

					preventable maternal and neonatal deaths		
47	Fleury MJ and Mercier C. Integrated local networks as a model for organizing mental health services. Administration & Policy in Mental Health. 2002; 30:1, 55-73.	Canada	To describe how integrated service networks came to serve as a model for transforming the mental health system in Québec and to propose a frame of reference	Overview of network	Development of integrated networks for mental health	Outcomes of network not included	Integrated service networks
48	Foreman S. Montefiore Medical Center in the Bronx, New York: Improving health in an urban community. Academic Medicine. 2004; 79:12, 1154-1161.	USA	To describe Montefiore Medical Centre's experience in building a community-based care system for a large urban population	Case study	Built an integrated system of community-based care	Example: -Implementation of clinical information system led to an improvement in quality and efficiency and reduction in medication errors	Community based case system
49	Gachau S, Ayieko P, Gathara D, Mwaniki P, Ogero M, Akech S, Maina M, Agweyu A, Oliwa J, Julius T, Malla L, Wafula J, Mbevi G, Irimu G, and English M. Does audit and feedback improve the adoption of recommended practices? Evidence	Kenya	"to describe and explore responses to repeated rounds of A&F delivered to 14 facilities in Kenya of performance assessed using indicators representing adoption of or adherence to recommended practices articulated in Kenyan guidelines"	Descriptive and exploratory analyses	-Within the context of the CIN, describe responses to audit and feedback across multiple indicators with different tasks and types of feedback -Examine variations in	-Improvements in adoption and adherence to clinical practice recommendations among 70% of analyzed indicators -No indicators had overall deterioration of average performance,	Clinical Information Network

	from a longitudinal observational study of an emerging clinical network in Kenya. BMJ Global Health. 2017; 2:e000468. doi:10.1136/bmjgh-2017-000468.				responses across facilities in the CIN -Examine influence of standard PAR	though there were site specific declines -Many indicators showed average positive change with time -A PAR linked to audit and feedback showed improved documentation of clinical signs (simple and difficult documentation indicators)	
50	Garcia PJ, Carcamo CP, Garnett GP, Campos PE, and Holmes KK. Improved STD syndrome management by a network of clinicians and pharmacy workers in Peru: the PREVEN Network. PLOS One. 2012; 7:10, e47750. doi: 10.1371/journal.pone.0047750.	Peru	To develop and evaluate an integrated network of physicians, midwives, and pharmacy staff trained in STD syndromic management	Part of a randomized trial	Training of pharmacy workers linked to a referral network of clinicians to manage STD care	-Pharmacies reported more STD cases than clinicians -Improvements in management of STD syndromes at intervention pharmacies	Clinician - pharmacy network
51	Giessler K, Seefeld A, Montagu D, Phillips B, Mwangi J, Munson M, Green C, Opot J, and Golub G. Perspectives on	Kenya	To understand perspectives and experiences related to participation in a QIC to improve person-centered care for maternal health and FP	Semi-structured qualitative interviews	Quality improvement collaborative focused on improving person-	"that sensitization to PCC principles resulted in multiple perceived benefits for staff and	Quality improvement collaborative

	implementing a quality improvement collaborative to improve person-centered care for maternal and reproductive health in Kenya. International Journal for Quality in Health Care. 2020; 30:10, 671-676. doi:10.1093/intqhc/mzaa130.				centered care experiences for women using maternal health and FP services	patients alike, including improved interactions with patients and clients, deeper awareness of patient and client preferences, and improved interpersonal skills and greater job satisfaction"	
52	Gould LJ, Wachter PA, Aboumatar H, Blanding RJ, Brotman DJ, Bullard J, Gilmore MM, Golden SH, Howell E, Ishii L, Lee KH, Paul MG, Rotello LC, Satin AJ, Wick EC, Winner L, Zenilman ME, and Pronovost PJ. Clinical Communities at Johns Hopkins Medicine: An Emerging Approach to Quality Improvement. Joint Commission Journal on Quality & Patient Safety. 2015; 2015; 41:9, 387-95. doi:	USA	Overview of clinical communities	Program overview	Establishment of clinical communities across a health network for different health needs	No specific outcomes mentioned	Clinical community for QI

	10.1016/S1553-7250(15)41050-5.						
53	Greene A, Pagliari C, Cunningham S, Donnan P, Evans J, Emslie-Smith A, Morris A, and Guthrie B. Do managed clinical networks improve quality of diabetes care? Evidence from a retrospective mixed methods evaluation. Qual Saf Health Care. 2009; 18, 456-461. doi:10.1136/qshc.2007.023119.	Scotland	To describes the form and impact of quality improvement work in a managed care network for diabetes	Retrospective mixed-methods evaluation	Progressive implementation of quality improvement strategies targeted at individual and clinical teams	-Simple process measures improved quickly -Complex measures improved more slowly and dependent on care pathway redesign	Managed clinical network
54	Grover TR, Pallotto EK, Brozanski B, Piazza AJ, Chuo J, Moran S, McClead R, Mingrone T, Morelli L, and Smith JR. Interdisciplinary teamwork and the power of a quality improvement collaborative in tertiary neonatal intensive care units. The Journal of Perinatal & Neonatal Nursing. 2015; 29:2, 179-86. doi: 10.1097/JPN.0000000000000102.	USA	"describe the structure and components of the CHND's new, multi-institutional neonatal QIC, and highlight our inaugural study in which we effectively reduced central line-associated bloodstream infections (CLABSIs) across participating institutions"	Program overview	-Development of a quality improvement collaborative for neonates referred to tertiary NICUs -First QI projected focused on reducing central line-associated bloodstream infections	-CLABSI rates decreased by 20% -71% of sites in the collaborative participated in the project -Data reporting compliance over 80%	Quality improvement collaborative

55	Gudlavalleti VSM, Shukla R, Batchu T, Malladi BVS, and Gilbert C. Public health system integration of avoidable blindness screening and management, India. Bulletin of the World Health Organization. 2018; 96:10, 705-715. doi: 10.2471/BLT.18.212167.	India	To provide an overview of two pilot projects on diabetic retinopathy and retinopathy of prematurity and show how elements of the pilots have expanded to other geographies	Program overview	Integrate strategies for control of diabetic retinopathy and retinopathy of prematurity into existing health systems through two pilot programs	Establishment of sustainable and scalable systems for controlling the two conditions that are integrated into the public system and are expanded geographically	Hub-spoke model
56	Haines MM, Brown B, D'Este CA, Yano EM, Craig JC, Middleton S, Castaldi PA, Pollock CA, Needham K, Watt WH, Elliott EJ, Scott A, Dominello A, Klineberg E, Atkinson JA, Paul C, and Redman S. Improving the quality of healthcare: a cross-sectional study of the features of successful clinical networks. Public Health Research & Practice. 2018; 8:4. doi: 10.17061/phrp2801803.	Australia	To examine factors that make clinical networks effective in improving quality of care and enabling system-wide changes	Retrospective cross-sectional study	-Quantitative assessment of features of clinical networks that influence networks' ability to drive improvements in quality of care and facilitate system-wide change in state-funded clinical networks with a system-wide focus across various disciplines in a large geographic	-Three networks had high impact on quality of care -Seven networks had high impact on system-wide change -Better perceived strategic and operational network management led to high ratings on impact of quality of care -Better perceived leadership of network manager and strategic and operational network management associated with	Clinical networks

					region -Clinicians identify and push for models of service delivery and QI activities	higher ratings of impact on system-wide change	
57	Hansudewechakul R, Naiwatanakul T, Katana A, Faikratok W, Lolekha R, Thainuea V, and McConnell MS. Successful clinical outcomes following decentralization of tertiary paediatric HIV care to a community-based paediatric antiretroviral treatment network, Chiangrai, Thailand, 2002 to 2008. Journal of the International AIDS Society. 2012; 15:17358. doi: 10.7448/IAS.15.2.17358.	Thailand	To assess "factors associated with death and clinical outcomes of HIV-infected children who received care at CRH and CHs after implementation of a community-based pediatric HIV care network"	Quantitative	Tertiary - community hospital provincial level HIC care network of pediatric HIV	Entire cohort -Increase in WAZ score -Proportion of children moderately and severely underweight decreased from 27% to 1.8% -96-100% reported 95% adherence -CD4 improved from 6% to 26% -Decrease in proportion of children with severe immune suppression from 80% to 4.8% Subgroup analysis -Children at tertiary or community hospitals in the network had similar adherence levels and numbers of	Counter-referral network between tertiary hospital and community hospitals

						children with VL>400 copies/ml -No difference in rate of weight gain but children from community hospitals had lower WAZ at baseline and throughout the study -No difference in CD4 gain	
58	Harrison, L. and Montenegro, G. and Malvares, S. and Astudillo, M. and Behn, V. and Bertolozzi, M. R. and Chiesa, A. M. and Espinoza, M. and Fujimori, E. and Harper, D. and Orellana, A. and Saenz, K. and Sigaud, C. H. and Verissimo Mde, L. The Network for Nursing in Child Health. Pediatric Nursing. 2008; 34:2, 113-6, 138.	South America: Brazil, Chile, Colombia, Argentina	To describe the history and objectives of the Network for Nursing in Child Health	Program overview	Development of a multi-country network for child health nursing, with an initial focus on inclusion of ICMI into nursing curricula	-Augmentation of communication on improving child health among experts -Promotion of use of IMCI guidelines in nursing interventions -Translation of evidence-based protocols for designing interventions in child health -Promotion of student and faculty exchanges -Dissemination of work of the network via publication and presentations -Expansion of knowledge work	Specialty nursing network

						of nursing, e.g. standardized curriculum and interventions -Development of model for web-based communications	
59	Hilliard LM, Maddox MH, Tang SH, and Howard TH. Development of a regionalized, comprehensive care network for pediatric sickle cell disease to improve access to care in a rural state. Disease Management & Health Outcomes. 2004; 12:6, 393-398. doi: 1173-8790/04/0006-0393.	USA	To evaluate the impact of a rural comprehensive clinical care network	Retrospective analysis	Development of a sickle cell care network	-Percent of newborns identified to have sickle cell enrolled in a clinics increased from 50% to 90% -Average age at first clinic visit declined from 21 to 5.3 months -Average age of penicillin prescription declined from 4 to 1.1 months -Distance to comprehensive sickle cell care decreased from an average of 90 to 45 miles, increase in percent of patients living within 30 miles of a clinics from 41% to 84%, with 96% living within 60 miles	Clinical networks

						-Death rate due to sepsis decreased from 5.71 to 1.94 deaths/100 patient years	
60	Hyre A, Caiola N, Amelia D, Gandawidjaja T, Markus S, and Baharuddin M. Expanding Maternal and Neonatal Survival in Indonesia: A program overview. International Journal of Gynecology & Obstetrics. 2019; 144. doi: 10.1002/ijgo.12730.	Indonesia	Provide an overview of the EMAS program	Program overview	To address challenges (high case fatality, unclear referral processes, lack of accountability and reliable data): -Improve clinical governance -Strengthen referral process	Described in other articles in the supplement	Referral networks
61	Iedema R, Verma R, Wutzke S, Lyons N, and McCaughan B. A network of networks. Journal of Health Organization & Management. 2017; 31:2. doi:10.1108/JHOM-07-2016-0146.	Australia	"to investigate how one agency, the NSW Agency for Clinical Innovation (ACI), and the multiple networks and enabling resources that it encompasses, govern, manage and extend the potential of networks for healthcare practice improvement"	Ethnographic descriptive case study	"government-funded agency that houses a mix of self-steering, government-resourced and government-steered networks which are co-located with “enabler teams” assisting those networks with programme	No specific outcomes mentioned	Network of networks made up of taskforces, institutes, and clinical networks

					implementation across the State's health system, with health professional training and programme evaluation"		
62	Irimu G, Ogero M, Mbevi G, Agweyu A, Akech S, Julius T, Nyamai R, Githang'a D, Ayieko P, and English M. Approaching quality improvement at scale: a learning health system approach in Kenya. Arch Dis Child. 2018. doi: 10.1136/archdischild-2017-314348.	Kenya	-To "outline the rationale for and philosophy of the CIN" -"illustrate how the CIN is a mechanism promoting continued improvement of basic hospital services, implementation of new effective practices and technologies, and conduct of locally relevant research to optimise interventions"	Program overview	Development of clinical information network	Examples: -Increase in proportion of children with PAR from 54.05% to 99.47% -71.5% of children had MUAC recorded measurement	Clinical Information Network
63	Joseph JP, Jerome G, Lambert W, Almazor P, Cupidon CE, and Hirschhorn LR. Going beyond the vertical: leveraging a national HIV quality improvement programme to address other health priorities in Haiti. AIDS. 2015; 29 (Suppl 2):S165-S173.	Haiti	To describe the "successful leveraging of expertise and framework of a national HIV quality improvement programme to spread capacity and improve quality across a network of clinics in HIV and other targeted areas of healthcare delivery in rural Haiti"	Program overview and descriptive statistics	Network of facilities supported with infrastructure, HR, training, M&E, EMR for HIV, clinical care, QI	-Facility QI capacity increase with expansion from HIC to other health areas -Significant increase in capacity of Quality Management Program, performance measurement, quality improvement	Quality improvement network

	doi:10.1097/QAD.0000000000000715.					projects, and patient engagement -Average performance across all HIV indicators increased from 39 to 72%	
64	Lannon CM and Peterson LE. Pediatric collaborative networks for quality improvement and research. Academic pediatrics. 2013; 13:6, S69-74.	USA	to "describe the network model, provide examples of these networks in paediatrics, and discuss how paediatric collaborative networks can serve to close the quality gap and accelerate the translation of evidence into practice, resulting in improved care and outcomes for children"	Descriptive review	Pediatric collaborative networks	Examples: -Quality Transformation Network: Average aggregate CLABSI rate decreased by 56%, saved 355 child lives, over $100m in cost savings -Solutions for Patient Safety: 60% reduction in surgical site infections, 34.5% reduction in adverse drug events, 3576 children avoid adverse events, over $5m in cost savings -CPQCC: reduced central line-associated bloodstream infections, increased breast-feeding rates,	Collaborative improvement network

						achieved normothermia -PPQC: 20% sustained decrease in bloodstream infections and 60% decrease in near-term deliveries without medical indicators - ImproveCareNow: increase proportion of Crohn's (55% to 68%) and ulcerative colitis (86% to 90%) patients with inactive disease	
65	Lee SK, Shah PS, Singhal N, Aziz K, Synnes A, McMillan D, and Seshia MM. Association of a quality improvement program with neonatal outcomes in extremely preterm infants: a prospective cohort study. CMAJ. 2014; 186: 13. doi:10.1503/cmaj.140399.	Canada	"to assess the generalizability of EPIQ to other neonatal units in Canada and to determine any association with improvements in mortality and morbidity among preterm neonates born at less than 29 weeks gestational age"	Prospective cohort study	Evidence-based Practice for Improving Quality (EPIQ): quality improvement approach using the best evidence with institution data to identify institution needs	-Severe retinopathy, necrotizing enterocolitis, and nosocomial infections were significantly reduced -No statistically significant difference in mortality -Most improvement in infants born at 26 to 28 weeks	Quality improvement program

66	Lee SJC, Higashi RT, Inrig SJ, Sanders JM, Zhu H, Argenbright KE, and Tiro JA. County-level outcomes of a rural breast cancer screening outreach strategy: a decentralized hub-and-spoke model (BSPAN2). Translational Behavioral Medicine. 2017; 7:2. doi: 10.1007/s13142-016-0427-3.	USA	To evaluate the hub-spoke model by quantifying women receiving services at county level and assessing spokes ability to conduct outreach	Mixed methods	Expansion of a hub-and-spoke model for mammography services with local organization outreach	-Average number of women served/month in hub-led and spoke-led counties did not vary -Similar uptake for screening services among rural, uninsured women despite heterogeneous catchment area -"program expansion was highly successful: the number of women interested in receiving services greatly exceeded program expectations"	Regional hub-spoke model
67	Lee HC, Bennett MV, Crockett M, Crowe R, Gwiazdowski SG, Keller H, Kurtin P, Kuzniewicz M, Mazzeo AM, Schulman J, Nisbet CC, and Sharek PJ. Comparison of Collaborative Versus Single-Site Quality Improvement to Reduce NICU Length of Stay. Pediatrics. 2018; 142:1,	USA	"to assess the effectiveness of a collaborative QI project designed to optimize LOS for preterm NICU patients"	Evaluation	Collaborative QI model and single-site QI models both implementing evidence-based practice bundle for optimizing length of stay	-Hospitals in the QI collaborative decreased PMA at discharge from 37.8 to 37.5 weeks, decreased in adjusted length of stay from 52.9 days to 50 days, and early PMA at discharge increased from 31.6% of eligible patients to 41.9% -Single NICU QI	Quality improvement collaborative

	e20171395. doi:10.1542/ peds.2017- 1395.					facilities did not have significant changes in any of the outcome measures -Non-participant facilities had no significant trend towards overall improvement -Did not see increase in readmission in collaborative QI group	
68	Leslie M, Khayatzadeh-Mahani A, Birdsell J, Forest P, G, Henderson R, Gray RP, Schraeder K, Seidel J, Zwicker J, and Green LA. An implementation history of primary health care transformation: Alberta's primary care networks and the people, time and culture of change. BMC Family Practice. 2020; 21:258. doi: 10.1186/s12875-020-01330-7.	Canada	"better understand the PCNs' implementation history, and so generate a rich, contextualized account of these particular PHC transformation efforts"	Interpretative qualitative study	Implementation of PHC networks	-PCNs shifted from a focus on local solutions to local problems with few rules to a framework of accountability with central demands for standardized measures, governance, and co-planning -A core group of people, time to develop long term QI vision, and understanding and aligning each other's cultures have been central to PCN survival and success	Primary Care Networks

69	Lin Y. Integration in primary community care networks (PCCNs): examination of governance, clinical, marketing, financial, and information infrastructures in a national demonstration project in Taiwan. BMC Health Services Research. 2007; 7:90. doi:10.1186/1472-6963-7-90.	Taiwan	"to understand the nature and extent of integration to which they and their associated PCCN members (clinics and hospitals) had in governance, clinical, marketing, financial, and information infrastructures"	Descriptive analyses	Demonstration project of Primary Community Care Networks	-"wide variance in the kind and degree of integration among them and a lot of room for better integration" -"PCCNs' members had higher involvement in the governance infrastructure, which was usually viewed as the most important for establishment of core values in PCCNs' organization design and management" -"higher extent of integration of clinical, marketing, and information infrastructures among the hospital-clinic member relationship than those among clinic members within individual PCCNs" -"financial infrastructure was	Primary Community Care Network

						shown the least integrated relative to other functional infrastructures at the early stage of PCCN formation"	
70	Magill MK, Lloyd RL, Palmer D, and Terry SA. Successful turnaround of a university-owned, community-based, multidisciplinary practice network. Annals of Family Medicine. 2006; 4(Suppl 1):S12-18. doi: 10.1370/afm.54.	USA	To describe the "financial turnaround of a university-owned, community-based, multidisciplinary practice network"	Report	To save a financially failing community-based multidisciplinary practice network	Financial performance improved	Primary Care Networks
71	Manns BJ, Strilchuk A, Mork M, and Wasylak T. Alberta's Strategic Clinical Networks: A roadmap for the future. Healthcare Management Forum. 2019; 32:6, 313-322. doi: 10.1177/0840470419867344.	Canada	"This article describes the SCNs, their impact to date, and the objectives, areas of focus, and processes Alberta's SCNs will use to improve health outcomes and health system performance over the next 5 years"	Qualitative	Development and evolution of strategic clinical networks and development of strategic plan building on networks' accomplishments and identifying collaborative areas of focus	No specific outcomes mentioned	Strategic clinical network

72	Manns BJ and Wasylak T. Clinical networks: enables of health system change. CMAJ. 2019; 25:191, E1299-1305. doi: 10.1503/cmaj.190313.	Canada, England, Scotland, Australia	to "consider evidence of the effect of clinical networks, and discuss potential barriers and enablers of such networks to inform strengthening of health systems in Canada"	Analytical review	Development of clinical networks	Examples: -Increase in proportion of preterm babies born at hospitals providing highest volume of specialist care (18% to 49%) -Statistically significant improvements in process indicators -Reduction in antipsychotic use from 26.8% to 17.4% -Reduction in length of stay by 1.5 days, complication risk lowered by 11.7%, and increased cost savings -Improved door-to-needle times from 70 to 36 minutes -143,800 hospital bed days avoided with $62.5m net savings -Reduction in time interval from referral to initial assessment by the service from 19.5 to 10 days	Clinical networks

						- 37% of networks had moderate impact and 16% high impact 37% of networks had moderate impact and 37% had high impact on facilitating system-wide change	
73	Martinez B, Ixen EC, Hall-Clifford R, Juarez M, Miller AC, Francis A, Valderrama CE, Stroux L, Clifford GD, and Rohloff P. mHealth intervention to improve the continuum of maternal and perinatal care in rural Guatemala: a pragmatic, randomized controlled feasibility trial. Reproductive Health. 2018; 15:120. doi: 10.1186/s12978-018-0554-z.	Guatemala	To evaluate the impact of an mhealth application on the use of referral by TBAs for higher-level maternal and perinatal medical care for rural patients in Guatemala	RCT	A perinatal monitoring mHealth platform was introduced in the daily practice of participating TBAs in a unidirectional cross-over study design	-Referral rates for pregnancy and childbirth complications were higher among TBAs that had access to mhealth application	TBA referral network
74	Mate KS, Ngubane G, and Barker PMA quality improvement model for the rapid scale-	South Africa	To describe how NGOs and the National Department of Health jointly developed the Accelerated Plan to improve PMTCT services at facilities in South Africa	Program overview	-Demand-side intervention to increase the number of pregnant	-Expansion from 5 to 9 subdistricts due to demand -Main achievement of	Quality improveme nt network

	up of a program to prevent mother-to-child HIV transmission in South Africa. International Journal for Quality in Health Care. 2013; 25:4, 373-380. doi:10.1093/intqhc/mzt039.				women attending ANC and accessing PMTCT interventions -Supply-side intervention to strengthen delivery of PMTCT services at facilities	the project: "demonstrate how a systems improvement design could coordinate available resources and speed up implementation of guideline-based PMTCT care. Two notable achievements - rapid buy-in and project leadership by district managers, and collaboration of multiple supporting NGO partners—were responsible for early success of the intervention and provide a potential model for implementation of other large-scale programs in similar resource-constrained settings"	

75	McGivern G, Nzinga J, and English M. 'Pastoral practices' for quality improvement in a Kenyan clinical network. Social Science & Medicine. 2017; 195:115-122. doi:/10.1016/j.socscimed.2017.11.031.	Kenya	"to develop a formative explanation and theory of change for the organisational processes underlying network activities, developed through interdisciplinary, insider-outsider dialogue"	Qualitative case study	"promotes and supports development and use of evidence-based guidelines, measurement of clinical activities and outcomes, leadership and a form of QI involving meeting and discussing the practical challenges of delivering QI and locally solving problems highlighted by audit"	"lateral accountability and governance mechanisms, associated with pastoral practices influencing professional status, may provide a means for motivating health care improvement in LMICs"	Clinical Information Network
76	McInnes E, Middleton S, Gardner G, Haines M, Maertsch M, Paul CL, and Castaldi P. A qualitative study of stakeholder views of the conditions for and outcomes of successful clinical networks. BMC Health Services Research. 2012; 12:49.	Australia	"aims of this study were to identify key stakeholders' views on the conditions required to establish successful and effective clinical networks and also their views on desirable outcomes of successful networks"	Qualitative	Stakeholders' perspectives on clinical networks	Did not specify, main findings in characteristics and other section	Clinical networks

	doi:10.1186/1472-6963-12-49.						
77	McInnes E, Haines M, Dominello A, Kalucy D, Jammali-Blasi A, Middleton S, and Klienberg E. What are the reasons for clinical network success? A qualitative study. BMC Health Services Research. 2015; 15: 479. doi: 10.1186/s12913-015-1096-5.	Australia	"to identify the views of stakeholders internal and external to clinical networks regarding influential factors in NSW clinical networks, in terms of achieving impacts on quality of care and system-wide change during the period 2006–2008"	Qualitative	Stakeholders' perspectives on clinical networks regarding impacts on quality of care and system-wide change	Did not specify, main findings in characteristics and other section	Clinical networks
78	McIntosh N, Grabowski A, Jack B, Nkabane-Nkholongo EL, and Vian T. A Public-Private Partnership Improves Clinical Performance In A Hospital Network In Lesotho. Health Affairs. 2015; 34:6, 954-962.	Lesotho	"purpose of this study was to compare measures of capacity, utilization, clinical quality, and patient outcomes before and after the implementation of a health care public-private partnership"	Mixed methods	Private entity partially financed and designed, built, equipped, and operated a new referral hospital and clinic and upgraded three network clinics	-PPP network higher staffing levels -PPP network had increased utilization, while average length of inpatient stay and casualty visits were lower -Improved quality in the PPP network -Decreased rate of mortality and stillbirths and increased rate of c-section in PPP network	Public-Private-Partnership Integrated Healthcare Network

79	Mullany LC, Lee CI, Paw P, Od EKS, Maung C, Kuiper H, Mansenior N, Beyrer C, and Lee TJ. The MOM Project: Delivering maternal health services among internally displaced populations in eastern Burma. Reproductive Health Matters. 2008;16:31, 44-56. doi: 10.1016/S0968-8080(08)31341-X.	Burma	"describes the rationale for this innovative model of delivering maternal health and family planning services, provides an overview of the programme structure, training and roles of the health care providers in the project, and outlines the planned monitoring and evaluation activities"	Program overview	Pilot a model of integrated package of MNH and FP interventions through a network of tiered mobile health workers	Reported separately	Three-tiered collaborative network of community-based maternal health workers
80	Murki S, Kiran S, Kumar P, Chawla D, and Thukral A. Quality Improvement Collaborative for Preterm Infants in Healthcare Facilities. Indian Pediatrics. 2018; 55:9, 818-823.	India	To "describe the concept of Collaborative quality improvement, and the success stories of the best-known Collaborative quality improvement initiatives across the world...highlight the process and progress of creating Collaborative quality improvement in our country"	Review and program overview	Neonatal quality improvement collaborative to decrease care associated infections	"the hospital with the highest incidence of healthcare associated infections showed the maximum improvement with more than 50% reduction from baseline in both microbiological and clinical blood stream infections per 1000 patient days"	Quality improvement collaborative

81	Nahimana E, McBain R, Manzi A, Iyer H, Uwingabiye A, Gupta N, Muzungu G, Drobac P, and Hirschhorn LR. Race to the Top: evaluation of a novel performance-based financing initiative to promote healthcare delivery in rural Rwanda. Global Health Action. 2016; 9:1, 32943, doi: 10.3402/gha.v9.32943.	Rwanda	To evaluate outcomes associated with a PBF capacity-building model throughout one district	Program overview and mixed-effects linear regression	"district-wide PBF scheme to reward health centres upon reaching district-identified targets that reflect district-level health priorities, supported with technical support in quality improvement (QI) and peer-to-peer learning"	-Increase in community-based health insurance from 68% to 93% -Mean number of acute malnutrition cases declined from 24 to 5 per facility -CPR increased from 42% to 59%	PBF linked quality improvement collaborative program
82	Ortiz-Barrios M and Alfaro-Saiz JJ. An integrated approach for designing in-time and economically sustainable emergency care networks: A case study in the public sector. PLoS ONE. 2020; 15:6, e0234984. doi: 10.1371/journal.pone.0234984.	South America	"to develop an integrated framework based on Discrete-event simulation, lean manufacturing and six sigma techniques for designing in-time ECNs…the creation of a scheme that guarantees the efficient distribution of payments among the ECN participants"	Methodological overview and case study	Development of emergency care network	Average waiting time in an emergency care network can be reduced with the optimized coordination between emergency departments	Emergency Care Network

83	Payan DD, Sloane DC, Illum J, Vargas RB, Lee D, Galloway-Gilliam L, and Lewis LB. Catalyzing Implementation of Evidence-Based Interventions in Safety Net Settings: A Clinical-Community Partnership in South Los Angeles. Health Promotion Practice. 2017; 18:4, 586-597. doi: 10.1177/1524839917705418.	USA	"demonstrates how a CBO acted as an external facilitator and employed a collaborative partnership model to catalyse implementation of evidence based interventions in safety net settings"	Qualitative process evaluation	Hypertension evidence-based interventions in a clinical safety net setting: "(1) increasing early follow-up of patients, (2) encouraging intensification of therapies, and/or (3) increasing engagement in lifestyle interventions"	Participants said the collaborative improved the quality of patient care and preventive medicine, increased resource awareness, provided a structured plan for sustained improvements	Clinical community
84	Rabkin M, Achwoka D, Akoth S, Boccanera R, Kimani M, Leting I, Madevu-Matson C, Mutei R, Nyaga L, Onyango C, Ouma C, Rondinelli I, Rumunyu P, Tsiouris F, Wakoli A, Walker L, and Dougherty G. Improving Utilization of HIV Viral Load Test Results Using a Quality Improvement Collaborative in Western Kenya. The Journal of the Association of Nurses in AIDS Care :	Kenya	"to design and implement an QI collaborative (QIC), using well-established QI methods to empower frontline HCW to explore and address the root causes of suboptimal VLT utilization"	Program overview	Quality improvement collaborative focused on improving viral load testing utilization	-All facilities increased the proportion of patients with unsuppressed viral load completing three adherence sessions within 4 months to over 90% (from 40% to 93%) -Switching patients to second line ART with persistent unsuppressed viral load within 2 months from 58% to 84%	Quality improvement collaborative

	JANAC. 2020; 31:5, 566-573. doi: 10.1097/JNC.0000000000000158.					-Zero reports of stocked out second line	
85	Ramos Junior AN, Correia D, Almeida EA, and Shikanai-Yasuda MA. History, current issues and future of the brazilian network for attending and studying Trypanosoma cruzi/HIV coinfection. Journal of Infection in Developing Countries. 2010; 4:11.	Brazil	"to describe the Brazilian response to the challenges of Chagas disease: the history, current issues, and future of the Brazilian Network for attending and studying *T.cruzi*/HIV coinfection"	Descriptive study	Development of a care, research, and coordination network to manage *T/cruzi/*HIV coinfection	-Structure of national technical guidelines and standards, health care and research protocols and resource priorities -Mobilization and advocacy towards HIV/AIDS reference centers on coinfection occurrences	Care network
86	Rask K, Naylor D, and Schuessler L. Voluntary Hospitals Coalitions to Promote Patient Safety. Advances in Patient Safety. 2005; 3: 493-505.	USA	"describes a unique patient safety initiative developed by the Georgia Hospital Association (GHA), working closely with State regulatory agencies and health care professional groups"	Program overview	Patient safety program	-"engaging health care organizations in an iterative change process, while focusing on an ultimate goal, can yield promising results" -"Most hospitals report significant improvement following implementation of their improvement plans, but not all do"	Partnership for Health and Accountability

87	Rossiter M, Verma J, Denis JL, Samis S, Wedge R, and Power C. Governing Collaborative Healthcare Improvement: Lessons From an Atlantic Canadian Case. International Journal of Health Policy & Management. 2017; 6:12, 691-694. doi:10.15171/ijhpm.2017.60.	Canada	Examines an approach to governing collaborative health system improvement focused on governance structure, governance capacity, and sustaining improvement	Program overview	Quality improvement collaborative focused on chronic diseases	-Spread of PEER model -Symposium to share and disseminate success in intervention implementation -Development of diabetes registry, enhance skills, and education of clinicians in diabetes self-management support	Quality improvement collaborative
88	Salamanca O, Geary A, Suarez N, Benavent S, and Gonzalez M. Implementation of a diabetic retinopathy referral network, Peru. Bulletin of the World Health Organization. 2018; 96: 674-681. doi: 10.2471/BLT.18.212613.	Peru	"To describe the implementation of a diabetic retinopathy referral network incorporating all levels of health care"	Program overview	Establishment of referral network of primary, secondary, and tertiary facilities for diabetic retinopathy screening and treatment	-138.1% increase in diabetic retinopathy screenings -Screening at secondary facilities increased and reduced at tertiary level	Referral networks
89	Schneider H, George A, Mukinda F, and Tabana H. District Governance and Improved Maternal, Neonatal and Child Health in South Africa: Pathways of Change. 2020; 6:1,	South Africa	"this paper seeks to shed light on the value and potential of a governance lens on district health system strengthening for improved health outcomes"	Independent retrospective evaluation, qualitative case study	Introduction of a new district and sub-district governance mechanism - Monitoring and Response Unit	-Improvement in cause-specific under 5 deaths, particularly for severe acute malnutrition -Reduction in number of maternal deaths -	Monitoring and Response Unit

	e1669943, doi: 10.1080/23288604.2019.1669943.					by half in one district -However difficult to attribute these changes directly to the intervention -Changes in scope, quality, and organization of MNCH services attributed to introduction of the MRU with the support of DCST and program managers -Enhanced community and PHC screening, improve referral systems across levels of care and between clinicians, improvement in clinical practices in hospitals, better continuity of care	
90	Sheaff R, Benson L, Farbus L, Schofield J, Mannion R, and Reeves D. Network resilience in the face of health system reform. Social Science & Medicine.	UK	"To examine how quasimarket reforms impact upon health networks' macroculture"	Narrative case studies	Four networks: child mental health network, self-care network, sub-regional cardiac heart disease	-"reforms stimulated production of managerial artefacts, changed the function of two networks into commissioning	Clinical networks and professional networks

	2010; 70:779-86. doi: 10.1016/j.socscimed.2009.11.011.				network, small local cardiac heart disease network	support and in three networks brought the networks' espoused values closer to national policy, especially for evidence-based practice" -"quasi-market reforms did therefore alter the existing macroculture in three of the networks, but did not radically conflict with it" -"network macrocultures adapted through a sequence of changes" -"core artefact production as the activity driving the development of the other aspects of network macroculture"	
91	Shortell SM and Gillies R. United States innovations in health care delivery. Public Health Reviews. 2010; 32:1, 190-212.	USA	Discussion of three new organizational forms of care - PCMH, ACO, and PHMS - that may be able to respond to new payment incentives	Review	Implementation of PCMH, ACO, and PMHS	-PCMH: improvements in quality of care, patient satisfaction, care coordination, and access to care leading to	PCMH linked to ACO linked to PMHS

						reduction in ER visits and hospitalizations at same or lower cost (various specific examples cited) -ACO: more integrated forms provide better care at same or lower cost per capita (various specific examples cited)	
92	Sibbald S, Schouten K, Sedig K, Maskell R, and Licskai C. Key characteristics and critical junctures for successful Interprofessional networks in healthcare - a case study. BMC Health Services Research. 2020; 20:700. doi: 10.1186/s12913-020-05565-z.	Canada	-"describes lessons learned from the successful implementation of a small localized primary care network to support the development and successful implementation of similar networks in other geographical locations" -Explore network complexity	Exploratory case study	Development of Primary Care Innovation Collective and implementation of their Lung Health Program	-Improving quality of life of over 2500 patients by 90% -Provided better patient outcomes at a lower cost	small local network: Primary Care Innovation Collective
93	Sloan NL, Storey A, Fasawe O, Yakubu J, McCrystal K, Wiwa O, Lothe LJ, and Grepstad M. Advancing Survival in Nigeria: A Pre-post Evaluation of an Integrated	Nigeria	"to evaluate the MNH program impact on reducing women's, neonatal and perinatal mortality and stillbirth"	Pre-post design	Holistic integrated approach to improving MNH by addressing critical gaps in care through linking the	-MMR declined 37%, NMR declined 43%, stillbirth rates declined 15%, PMR declined 27%	Integrated maternal and neonatal health program/Network of Care

	Maternal and Neonatal Health Program. Maternal and Child Health Journal. 2018; 22:986-997. doi: 10.1007/s10995-018-2476-3.				health system from household to hospital		
94	Spence K and Henderson-Smart D. Closing the evidence-practice gap for newborn pain using clinical networks. Journal of Paediatrics and Child Health. 2011; 47:92-98. doi:10.1111/j.1440-1754.2010.01895.x.	Australia	"aim of the project was to identify gaps between evidence and practice and to introduce strategies within a model to close the gaps"	Evaluation	Implementation model of research utilization: "examining the available evidence, baseline surveys of current practices, providing educational workshops on critical appraisal, examining the specific contexts in relation to organisational support and team involvement in decision making"	-21% overall improvement in number of infants receiving breastfeeding or sucrose for procedural pain -Use of pain assessment tool increased from 14% to 22% -56% of units introduced use of the tool -Improvement in proportion of families aware of infant pain and strategies to manage from 19% to 57%	Clinical networks

95	Srivastava S, Datta V, Garde R, Singh M, Sooden A, Pemde H, Jain M, Shivkumar P, Bang A, Kumari P, Makhija S, Ravi T, Mehta S, Garg BS, and Mehta R. Development of a hub and spoke model for quality improvement in rural and urban healthcare settings in India: a pilot study. BMJ Open Quality. 2020; 9:e000908. doi: 10.1136/bmjoq-2019-000908.	India	To evaluate the feasibility of employing a hub-and-spoke model for QI in rural and urban settings in India with support from a QI network	Evaluation	Implementation of QI initiatives through a hub-and-spoke model with mentor component	-10 QI projects completed by teams -34 mentoring visits completed by network mentors (14 planned) -Rural hub-mentors completed 4 visits (18 planned)	Quality improvement network
96	Syengo M and Suchman L. Private Providers' Experiences Implementing a Package of Interventions to Improve Quality of Care in Kenya: Findings From a Qualitative Evaluation. Global Health-Science and Practice. 2020; 8:3, 478-487. doi: 10.9745/GHSP-D-20-00034.	Kenya	-"examines private providers' experiences with a package of interventions intended to improve the quality of small and medium-sized private health facilities in Kenya" -"seek to better understand private providers' experiences in this context to determine whether providers felt their clinical quality improved through participation in a comprehensive package of quality improvement interventions, the challenges they faced, and what other opportunities might exist for improving health care quality in Kenya"	Qualitative Evaluation	Increase access to high-quality primary care for low-income clients through a comprehensive package of QI interventions	-"engaging private providers in efforts to improve quality of care in private clinics through a package of interventions that extend beyond the typical social franchising model is achievable" -"costs of implementing a comprehensive quality improvement program	Social franchise

						remained a critical concern for private providers"	
97	Tayler-Smith K, Zachariah R, Manzi M, Van den Boogaard W, Nyandwi G, Reid T, De Plecker E, Lambert V, Nicolai M, Goetghebuer S, Christiaens B, Ndelema B, Kabangu A, Manirampa J, and Harries AD. An ambulance referral network improves access to emergency obstetric and neonatal care in a district of rural Burundi with high maternal mortality. Tropical Medicine & International Health. 2013; 18:8,993-1001. doi:10.1111/tmi.12121.	Burundi	" (i) describe the communication and ambulance service together with the cost; (ii) examine the association between referral times and maternal and early neonatal deaths; and (iii) assess the impact of the referral service on coverage of complicated obstetric cases and caesarean sections"	Cross-sectional study, retrospective analysis	EmONC referral facility linked to ambulance and communication referral system	-Median time from call to ambulance dispatch 30 min -Median referral time from call to ambulance arriving at referral facility with patient 78 min -Yearly costs 61 Euro/obstetric case; 0.43 Euro/capita/year based on area population -1 maternal death and 104 early neonatal deaths (10%) -Referral times of > 3h associated with higher risk of neonatal death (15% vs. 9%)	Referral networks
98	Vazquez ML, Vargas I, Unger JP, Mogollon A, Silva MR, and Paepe PD. Integrated health care networks in Latin America: toward a conceptual framework for	Latin America	"This paper describes different types of IHN that are found in the international context, discusses their risks and benefits, and develops a conceptual framework for their analysis"	Literature review	Introduction of integrated healthcare networks in health system reform in Latin America	-Development of a conceptual framework: analyzing network performance, taking into account internal processes developed by the	Integrated healthcare network

	analysis. Pan American Journal of Public Health. 2009; 26:4, 360-7.					networks to achieve their objectives, and context of the network -Intermediate outcomes: coordination, continuity of care, access -Final outcomes: equity of access and efficiency	
99	Vergara MTM, de Vera EA and Carmone AE. Building Trust to Save Lives in a Metro Manila Public-Private Network of Care: A Descriptive Case Study of Quirino Recognized Partners in Quezon City, Philippines. Health Systems & Reform. 2020; 6:2, e1815473, doi: 10.1080/23288604. 2020.1815473.	Philippines	To describe the Quirino Respect Partners program using the Network of Care framework	Descriptive case study	Quirino Recognized Partners: linking tertiary public hospital with private and public midwifery clinics to better manage low and high-risk deliveries by decongesting the maternity ward at the tertiary hospital	-Increase in early inward referrals for higher risk cases -Impact on reduction of maternal mortality: in 2014 QRP MMR 49% lower than the city (35/100,000) -Improvement in neonatal mortality but not statistically significant (44.25/1000 to 32/1000) -Observed decline in incidence of perinatal asphyxia -"Midwives in the lying-in clinics in the QRP network have expressed	Network of Care

						deep satisfaction with being in QRP and increased confidence in their practice; they also report higher (sometimes doubled) income as a recognized partner"	
100	Waiswa P, Manzi F, Mbaruku G, Rowe AK, Marx M, Tomson G, Marchant T, Willey BA, Schellenberg J, Peterson S and Hanson C. Effects of the EQUIP quasi-experimental study testing a collaborative quality improvement approach for maternal and newborn health care in Tanzania and Uganda. Implementation Science. 2017; 12:89. doi: 10.1186/s13012-017-0604-x.	Tanzania, Uganda	"report the effect of the EQUIP intervention on the coverage and quality of essential maternal and newborn health care interventions and knowledge of danger signs after 15 and 26 months of full implementation in Uganda and Tanzania"	Quasi-experimental, plausibility design	QI approach using collaborative model of improvement in two districts at district, facility, and community level, compared to two non-intervention districts using continuous household and facility surveys	-In Tanzania increase in proportion of women with a live birth receiving uterotonics by 26 percentage points -In Uganda increase was 8% -No evidence of association between intervention and immediate breastfeeding or knowledge of maternal and newborn danger signs -In Tanzania some evidence of association between intervention and birth preparedness via clean birth kits for	Quality improvement collaborative

						home delivery -In Tanzania some association between the intervention and improvement in supervision visits by district managers to PHC	
101	Wang X, Sun XZ, Gong FF, Huang YX, Chen LJ, Zhang Y, and Birch S. The Luohu Model: A Template for Integrated Urban Healthcare Systems in China. International Journal of Integrated Care. 2018; 18:4, 3, 1-10. doi: 10.5334/ijic.395.	China	-This paper studies "the integration process, analyse the core mechanisms, and conduct preliminary evaluations of integrated policy development in the Luohu model" -"aims of this study are to introduce the Luohu model, to evaluate its effects and to explore lessons learned"	Policy paper	"tiered health care delivery system in accordance with a People-Centred Integrated Care model"	-Increase in asset value -Number of GPs doubled, increase in public health physicians -Increase in proportion of hospitalizations going to group hospitals, reducing the cost of health insurance in the group -Increase in proportion of outpatient visits in community health stations from 29.49% to 42.60% -Increase in patients with chronic disease and mental health issues enrolled in case management -Decrease in pneumonia cases	Integrated healthcare network

						-High resident satisfaction of community health stations -Cost of healthcare per resident increase from $675.3 to $844.2 -42.6% of residents saw community health stations as first contact for health services -Demands of residents drive reforms	
102	White DE, Virk N, Jackson M, Stelfox HT, Wasylak T, and Ghali W. Experimenting with Governance: Alberta's Strategic Clinical Networks. Healthcare Quarterly. 2019; 21:4, 37-42.	Canada	"examine the rational and potential of this governance intervention, while also considering some of the fundamental questions around their potential impact and the ultimate need for multidimensional assessment"	Review	Implementation of strategic clinical networks	Various, for example: -Additional 1,100 people received stroke care not previously available, saving 3,377 acute care bed days, 88% of patients received early stroke rehabilitation assessments within 48h, 29% decrease in long-term care admissions, satisfaction levels of 92% patients and 97% providers	Strategic clinical network

103	Willis CD, Riley BL, Herbert CP, and Best A. Networks to strengthen health systems for chronic disease prevention. American Journal of Public Health. 2013; 103:11, e39-48.	Canada	"We use examples from the Canadian Heart Health Initiative and Alberta's Primary Care Networks to illustrate characteristics of networks, describe the limitations of existing frameworks for assessing the performance of prevention-oriented networks, and propose a research agenda for guiding future efforts to improve the performance of these initiatives"	Review	Service delivery and public health networks	Various outcomes at community, organizations, and network level	Service delivery and comprehen sive multilevel public health network
104	Wood SJ, Albertson EM, and Conrad DA. Accountable Care Program Implementation and Effects on Participating Health Care Systems in Washington State: A Conceptual Model. Journal of Ambulatory Care Management. 2019; 42:4, 321-336. doi: 10.1097/JAC.0000000000000302.	USA	"The purpose of this study was to assess the suitability of an evidence based conceptual model to explain the perceived effects of ACP implementation on participating health care systems in Washington State"	Qualitative comparative case studies	Five different ACO networks and relevant theory	No specific outcomes mentioned	Accountabl e Care Networks
105	Yiu V, Belanger F, and Todd K. Alberta's Strategic Clinical Networks: Enabling health system innovation and improvement. CMAJ. 2019; 4:191(Suppl 1):S1-3.	Canada	Brief overview of SCNs and introduce articles in the supplement	Introduction to special edition	Establishment of strategic clinical networks	-Provided a return on investment -Improvements resulted in 143,800 hospital bed days avoided -Contributed to patient care, safety, and	Strategic clinical network

	doi: 10.1503/cmaj.191232.					experience, improved health outcomes, developed clinical pathways, collaborator in clinical research	
106	Patel S, Awoonor-Williams JK, Asuru R, Boyer C, Yepakeh Tiah JA, Sheff MC, Schmitt ML, Alirigia R, Jackson EF and Phillips JF. Benefits and Limitations of a Community-Engaged Emergency Referral System in a Remote, Impoverished Setting of Northern Ghana. Global Health: Science and Practice. 2016; 4:4, 552-567. doi: 10.9745/GHSP-D-16-00253.	Ghana	"article provides a summary of the initiative components and evaluates the effectiveness of the program using results from mixed-methods implementation research"	Mixed methods	Establishment of a community and subdistrict level low-cost emergency referral transport-communication system with community education interventions (named SERC (Sustainable Emergency Referral Care))	-"community exposure to SERC was associated with an increased volume of emergency referrals, diminished reliance on primary care facilities not staffed or equipped to provide surgical care, and increased caseloads at facilities capable of providing appropriate acute care" -"referring facilities often failed to alert receiving facilities of incoming patients, not all patients transported were accompanied by a health worker,	Emergency Referral Care Network

						and receiving facilities commonly failed to provide patient outcome feedback to the referring facility"	

Grey literature

107	USAID/Engender Health. A collaborative network to improve access to fistula treatment in Nigeria. (Fistula Care). 2010.	Nigeria	Program activities overview	Brief	Development of a clinical peer-support network for fistula with periodic pooled repair and quarterly professional retreats to discuss clinical issues	958 repair surgeries through pooled events	Clinical peer-support network
108	Save the Children. The Regional Learning Network: A Model for Improving Maternal and Newborn Health Care Outcomes in Uganda.	Uganda	Program activities overview	Report	Development of a regional learning network based on QI and referral systems	-RLN improved facility readiness to support obstetric and newborn services -Increase in availability of basic newborn care units -Reduced drug and supply stockouts -Increased provide knowledge and confidence in key competencies -Improved	Regional Learning Network

						documentation of care, including 74% increase in recording of management of premature deliveries -Increase in quality and coverage of newborn care practices, including early initiation of breastfeeding from 12% to 81%, KMC initiative from 7% to 65%, weighing at birth from 25% to 100%, provision of Vitamin K increased by 80% -Skills labs and learning session found as more beneficial -Improved facility communication -Average early institutional NMR decreased from 1% to 0.5% and stillbirths from 3% to 1.4% -Increase in provider knowledge of	

						indications for newborn referral from 43% to 80%	
109	USAID/Save the Children. USAID's MaMoni Maternal and Newborn Care Strengthening Project: Project Brief. 2019.	Bangladesh	"to advance learning, expand and scale up effective Maternal and Newborn Care (MNC) interventions to substantially improve outcomes for mothers and newborns in Bangladesh"	Brief	-Improve responsiveness of district to deliver patient-centered MNC -Improve quality of service and governance of quality of care -Sustain improvements in access and demand for services and household practices -Improve national capacity to deliver quality MNC services at scale	No specific outcomes mentioned	District Learning Network for Quality of Care
110	USAID. Establishing Model Referral Networks in Haiti: MCSP Case Study. 2018.	Haiti	Program activities overview	Brief	Creation of model referral networks	-4406 referrals -1104 counter-referrals -70% of providers followed guidelines on referral registration -87% of patients satisfied with care -53% of providers followed all	Referral network

						communication protocols -51% followed all transport protocols -Only 8% of providers often and only 3% always received counter-referral slips -65% of referrals to hospitals within network -Ambulance only transported 26% of referrals	
111	Corbett E, Guenther T, and Sitrin D. Facilitated Referral for Newborns with Danger Signs: The role of community health workers. 2013.	Malawi, Nepal, Bangladesh, Uganda	To examine the role of CHWs in identification and referral of newborns with danger signs	Report	Implementation of CHW referral network for newborn care	-Women received home visit during pregnancy: 90% Bangladesh, 97% Nepal, 68% Uganda, 37% Malawi -Women and newborn received home visit within first week of life: 64% Bangladesh, 62% Nepal, 63% Uganda, 17% Malawi -Good knowledge of newborn danger signs and care for newborn complications in Malawi and Nepal	CHW referral network

112	Federal Ministry of Health Ethiopia. Catchment Based RMNCAH Mentoring: Participant Manual. Version 1.02.	Ethiopia	Implementation of catchment based RMNCAH mentoring	Manual	Catchment-based mentoring	Intervention manual, no outcomes included	Catchment-based mentoring
113	Ferlie E, Fitzgerald L, McGivern G, Dopson S, Exworthy M, Addicott R, Bennett C, Ceppi M, and Griffin R. Networks in healthcare: a comparative study of their management, impact and performance. Report for the National Institute for Health Research Service Delivery and Organisation Programme. 2010.	UK	To assess the "nature and impact of network forms in the English National Health Service (NHS) and provide evidence to inform future policy choices"	Report	Public policy networks	-"networks often worked on cross cutting objectives across agencies only realistically achievable over the long term" -"increasing co production and influence from users and citizens" -tackled challenging behavior change objectives -"continuing obstacles to the transfer of	Various academic/research, managed, clinical

114	Ferlie E, Fitzgerald L, McGivern, Dopson S, and Bennett C. Public Policy Networks and 'Wicked Problems': A Nascent Solution. 2011.		to "explore the nature and functioning of eight different public policy networks"	Paper		information electronically across agency boundaries and only incremental moves to shared ICTs or data bases" -ICTs not a major driver of organizational transformation towards a network and lack of clear network wide knowledge management strategies -Limited inter-organizational learning across the network examples; poorly developed cross boundary processes; power inequalities, organizational cliques -"widespread shift from a line managerial bureaucratic style of management to a more value driven form of lateral leadership. The absence of	

						middle level general management is striking. It has been supplanted by various local leadership configurations, supplemented by framework setting from the centre" -Important role of clinical managerial hybrids who link management and clinical worlds	
115	IHI. Breakthrough Series White Paper. 2003.	USA	"to share with readers the problems IHI is working to address; the ideas, changes, and methods we are developing and testing to help organizations make breakthrough improvements; and early results where they exist"	Paper	Development of breakthrough series collaborative	Example for the first collaborative: -15% of facilities reduced c-section rate by at least 25% -50% of facilities had reductions of 10% to 25%	Breakthrough Series Collaborative
116	Kirunda R, Rakhmanova N, Wynne L, Mubiru F, Nabaliisa J, Kim C, and Nampewo E. Strengthening Community-based Family Planning Systems through Collaborative Improvement in	Uganda	Program activities overview	Brief	Learning site for Community-based FP (CBFP)	-VHTs reported following all steps on in FP counselling checklist with 90% of clients in pilot sites and 60% to 80% in scale-up sites -VHTs increased time counselling	Service delivery network

	Busia District, Uganda. Issue 2. 2017.					clients -Less than 14% of women counselled with partners -Increase in the number of men reached with FP information and counselling from 50 to 300/month -VHTs counselled an average of 149 men/month -Client return rate in all sites 60% to 70%	
117	Kirunda R, Mubiru F, Akumu E, Wynne L, Rakhmanova N, and Kim C. Applying a Quality Improvement Model to Strengthen Community-based Family Planning Services in Busia District, Uganda. Issue 1. 2016.			Brief			
118	Manga L and Bagayoko M. Piloting a new approach for capacity building in entomology and vector control at the level of national malaria control programmes. African Health Monitor, Issue 18: Health Systems and Disaster Preparedness and Response, WHO AFRO. 2013.	Cameroon, Kenya, Madagascar, Mali, Mozambique, Senegal, Tanzania	"outline the impressive results of the project and its wider implications for adopting similar approaches across the region"	Report	Development of a professional expert network on vector control	-Set up or strengthened basic capacities in malaria entomology and vector control -Trained 300 national entomologists (basic and advanced) -Increase in the number of field entomology staff	African Network on Vector Resistance to Insecticides

119	Montagu D, Prata N, Campbell MM, Walsh J, and Orero S Kenya: reaching the poor through the private sector - a network model for expanding access to reproductive health services. Health, Nutrition and Population Discussion Paper, World Bank. 2005.	Kenya	To determine if it is possible to offer RH services through a network of private sector for profit providers without exacerbating inequity in service access	Paper, survey	Provision of reproductive health services through a private sector network	-The network does not exacerbate inequities in access to health services in rural communities -Clients more likely to be rural and less educated	Private provider network (Kisumu Medical and Educational Trust (KMET))
120	Roy T, Marcil L, Chowdhury RH, Afsana K, and Perry H. The BRAC Manoshi Approach to initiating a maternal, neonatal and child health project in urban slums with social mapping, census taking, and community engagement.	Bangladesh	A guide for program leaders to implement effective maternal, neonatal, and child health program in urban slums and to advocate to policy makers the efficacy of these techniques to be widely adopted	Manual	Community-based MNCH program with social mapping, census taking, and community engagement as key strategies	Increase in percentage of deliveries occurring in facilities and declines in MNM in the service areas	CHW referral network
121	Brun M, Monet JP, Moreira I, Agbigbi Y, Lysias J, Schaaf M, and Ray N. Implementation manual for developing a national network of maternity units - Improving	Global	"This manual aims to share an innovative approach implemented in several countries with a high burden of maternal and newborn mortality and morbidity, each with widely differing contexts, to develop their national network of referral maternity facilities"	Manual	Development, implementation, and monitoring of a national EmONC network	Examples from pilot countries: -Burundi: decrease in number of designated EmONC health facilities (152 to 112) only slight decrease in	National network for EmONC facilities

	Emergency Obstetric and Newborn Care (EmONC), United Nations Population Fund (UNFPA), 2020.					population coverage from 72% to 68% within 2 hours travel time -Senegal: decrease in number of designated EmONC health facilities (173 to 142) increase in population coverage from 91% to 92% within 2 hours travel time, increase in number of functioning EmONC facilities from 15 to 29, increase in availability of Magnesium Sulphate and IUDs, increase in number performing vacuum extraction -Togo: decrease in number of designated EmONC health facilities (109 to 67) with population coverage static at	

						81% within 1 hour travel time	
122	WHO QoC Network Brief. 2018.	Global	-Documents detail how the network was conceived and its implementation approach to quality of care for MNCH -Outlines strategic objectives and M&E framework -Reports on progress towards the network strategic objectives and insights into successes and challenges in an effort to inform implementation at scale within the network and beyond	Brief	Implementation of a quality of care network	-"Network has been successful in keeping quality of care at the top of countries' national health agendas" -Network countries have made efforts to adopt and adapt the WHO MNH quality of care standards to their context and priorities -Active engagement from MoH and partners towards preparing districts and facilities for quality of care implementation, measurement, monitoring, and learning	Network for improving quality of care for maternal, newborn, and child health
123	WHO QoC Network Brief. 2019.			Brief			
124	WHO QoC Network M&E Framework. 2019.			Manual			
125	Quality, equity, dignity: the network to improve quality of care for maternal, newborn and child health – strategic objectives. Geneva: World Health Organization; 2018.			Report			
126	The network for improving quality of care for maternal, newborn and child health: evolution, implementation and progress. 2017-2020 report. Geneva: World Health Organization; 2021.			Report			
127	Yang R, Poon MC, Luke KH, Zhao Y, Sun J, Wang X, Wu R, Chen L, Zhang X, and Wu J. Building a network for hemophilia care in China: 15 years of achievement for the	China	Program activities overview	Report	Creation of a treatment center collaborative network for Hemophilia	"great achievements in developing infrastructure, improving health coverage, creating in formation registries, providing	Hemophilia Treatment Centre Collaborative Network of China

	Hemophilia Treatment Center Collaborative Network of China. Blood Advances. 2019; 3, Suppl 1, Global Capacity-Building Showcase.					professional education, and ensuring cooperation among various organizations"	
Update searches							
128	Pittalis C, Brugha R, Bijlmakers L, Cunningham F, Mwapasa G, Clarke M, Broekhuizen H, Ifeanyichi M, Borgstein E, Gajewski J. Using Network and Complexity Theories to Understand the Functionality of Referral Systems for Surgical Patients in Resource-Limited Settings, the Case of Malawi. International Journal of Health Policy and Management. 2021; 1-12. doi: 10.34172/ijhpm.2021.175.	Malawi	-To explore the referral system for surgical patients -Unpack how the different aspects of the system and behavior of providers contribute to its functioning	Mixed Methods – surveys, interviews, referral database	Surgical referral network	-Obstacles to referral system functioning – weaknesses in formal coordination structures -Deficiencies in informal relationships -Poor systems functioning impacted quality, efficiency, and safety of patient referral-related care	Surgical referral network

129	Lopez-Vazquez J, Perez-Martinez DE, Vargas I, Vazquez ML. Interventions to Improve Clinical Coordination between Levels: Participatory Experience in a Public Healthcare Network in Xalapa, Mexico. International Journal of Integrated Care. 2021;21 (4): 12,1-17. doi: 10.5334/ijic.5892.	Mexico	"To analyse the factors that influence the implementation of participatively designed interventions and their effects on clinical coordination between levels of care in a public health network"	Qualitative, descriptive-interpretative study	-Two participatory action research cycles to design and implement the intervention -Offline virtual consultations between primary and secondary care physicians -Joint training meetings between levels of care	Clinical coordination between levels of care was improved by involvement in designing the interventions, institutional support, and reflexive methods for training	Public healthcare network

Appendix 3E. Reported network components and characteristics

Table 1: The component form and structure with the corresponding component characteristics and the reference numbers of the selected literature for each characteristic. Number of different published, grey, and total literature sources is included for each characteristic.

Form and Structure -Creation of the network: top-down/mandated vs. bottom-up/organic -Linkages between entities -Existence of a network coordinating entity	**Publication Number (published + grey literature)**	**# Published**	**# Grey**	**Total #**
connecting across levels of the health system and entities	27, 59, 1, 36, 43, 66, 4, 3, 21, 32, 46, 93, 99, 91, 2, 7, 38, 89, 22, 95, 11, 13, 30, 57, 60, 97, 28, 6, 17, 35, 47, 48, 68, 69, 79, 101, 10, 82, 109, 112, 127, 128	39	3	42
established vision, mission, shared values, targets, rules, roles, responsibilities, culture	62, 27, 33, 71, 72, 90, 102, 105, 42, 61, 15, 24, 53, 21, 32, 40, 99, 19, 91, 96, 89, 104, 12, 41, 52, 80, 84, 87, 60, 48, 70, 92, 101, 82, 85	35		35
network agreements / network mapping	61, 55, 32, 40, 46, 99, 21, 29, 96, 104, 39, 87, 60, 18, 35, 47, 48, 68, 78, 92, 98, 101, 103, 50, 10, 82, 42, 110, 121, 128	28	2	30
partnerships / links to external stakeholders	44, 56, 71, 72, 76, 77, 90, 105, 61, 85, 16, 15, 32, 46, 104, 64, 74, 83, 87, 37, 47, 48, 101, 103, 122 - 126	24	5	29
linkages / engagement / alignment with government	27, 71, 76, 77, 90, 105, 61, 16, 32, 40, 46, 99, 89, 104, 25, 74, 30, 28, 68, 103	20		20
trust	27, 72, 90, 15, 40, 99, 29, 86, 51, 52, 54, 87, 83, 47, 92, 101, 24	17		17
multidisciplinary	75, 26, 76, 77, 105, 42, 71, 94, 61, 53, 9, 41, 52, 54, 64, 92	16		16
horizontal / lateral network	5, 3, 29, 20, 12, 34, 39, 6, 18, 69, 92, 98, 113 – 114, 128	13	2	15
relationships / links between teams / internal	62, 27, 76, 16, 46, 99, 89, 52, 54, 84, 18, 37, 48, 103, 128	15		15
link community to network	56, 59, 55, 46, 25, 52, 13, 6, 79, 109, 111	9	2	11
bottom-up / local / organic / informal	27, 77, 42, 46, 99, 92, 98	7		7
standard / formalized organizational structure	26, 76, 90, 42, 20, 96, 104	7		7
patient / family / consumer engagement	33, 71, 72, 90, 64, 101	6		6
vertical structures	12, 39, 63, 35, 69, 98	6		6

created on existing relationships	44, 90, 102, 74, 18, 107	5	1	6
voluntary clinician / hospital involvement	56, 76, 77, 66, 39, 68	6		6
combination of top-down and bottom-up	56, 72, 61, 39, 113 - 114	4	2	6
mandated / top down on policy and strategic direction	90, 4, 87, 70	4		4
coordination body	90, 61	2		2
peer to peer network	14, 44, 55	3		3
multi-organizational	75, 61	2		2
open membership	58, 61	2		2
supra-network	61	1		1

Table 2: The component governance and leadership with the corresponding component characteristics and the reference numbers of the selected literature for each characteristic. Number of different published, grey, and total literature sources is included for each characteristic.

Governance and Leadership -Leadership level -Leadership form -Management of network -Governance/decision-making processes	**Publication Number (published + grey literature)**	**# Published**	**# Grey**	**Total #**
network meetings	5, 14, 44, 49, 62, 75, 56, 61, 55, 21, 32, 40, 46, 19, 7, 89, 25, 39, 41, 51, 54, 74, 80, 81, 87, 83, 60, 6, 18, 108, 110, 122 – 126, 129	30	7	37
network leadership / management	27, 56, 71, 72, 76, 77, 42, 85, 43, 24, 15, 53, 40, 99, 104, 9, 25, 52, 54, 63, 74, 81, 87, 95, 35, 48, 78, 79, 92, 98, 50	31		31
working /sub-groups / task forces	33, 71, 76, 90, 102, 61, 55, 19, 86, 89, 104, 52, 54, 60, 18, 48, 110, 127, 122 - 126	16	7	23
government leadership / oversight	71, 90, 94, 102, 105, 42, 55, 4, 53, 46, 86, 104, 95, 60, 48, 108, 122 - 126	15	6	21
network manager / coordinator / facilitator	26, 33, 56, 76, 77, 90, 94, 105, 61, 4, 89, 31, 51, 83, 6, 35, 82, 108	17	1	18
local / clinical champions	27, 33, 94, 66, 34, 52, 54, 63, 83, 116 - 117, 122 - 126	9	7	16

steering / coordinating committees / groups	33, 90, 94, 43, 25, 31, 54, 30, 60, 6, 35, 48, 78, 79, 82	15		15
core leadership committee / team	23, 71, 102, 61, 4, 39, 54, 87, 60, 35, 48, 101, 103	13		13
clinical leader - network coordinator / voluntary co-chairs	44, 49, 26, 27, 71, 76, 77, 102, 105, 61, 52, 70	12		12
decision-making	90, 24, 4, 19, 89, 41, 48, 78, 92, 103, 82, 121	11	1	12
interdisciplinary / effective / open / multi governance	33, 76, 77, 61, 29, 89, 82, 122 - 126	7	5	12
hybrid leadership - clinical (general - specialisms), program/operational, executive	33, 71, 102, 61, 53, 87, 83, 70, 92, 103	10		10
community / local leadership / ownership in activities	23, 94, 32, 46, 19, 91, 86, 25, 81	9		9
focal point mid-level managers - clinical leaders	62, 75, 90, 89, 31, 80, 57, 108	7	1	8
executive support / strategic and technical assistance	26, 33, 61, 39, 54, 60, 70	7		7
governance structure	33, 102, 4, 89, 60, 68	6		6
stakeholder management	44, 33, 71, 4, 41, 82	6		6
administrative core / support	15, 52, 92	3		3

Table 3: The component functioning with the corresponding component characteristics and the reference numbers of the selected literature for each characteristic. Number of different published, grey, and total literature sources is included for each characteristic.

Functioning -Management: monitoring compliance, accountability -Clinical: policy/program operationalization, care coordination	**Publication Number (published + grey literature)**	**# Published**	**# Grey**	**Total #**
knowledge / information sharing / education / learning	44, 62, 75, 23, 26, 27, 33, 90, 59, 58, 85, 1, 36, 16, 15, 24, 53, 19, 2, 86, 60, 28, 9, 12, 22, 31, 34, 39, 41, 51, 52, 54, 63, 64, 65, 67, 74, 80, 81, 84, 95, 100, 83, 37, 47, 79, 92, 50, 82, 108, 109, 112, 113 - 114, 115, 116 - 117, 118, 119, 127, 122 – 126, 128, 129	51	16	67
guideline / standards / protocols uptake / adherence	5, 14, 44, 49, 75, 23, 33, 94, 102, 42, 58, 85, 1, 36, 16, 24, 53, 91, 20, 96, 7, 89, 104, 21, 29, 32, 40, 46, 93, 99, 30, 60, 88, 28, 9, 22, 25, 31, 52, 74, 83, 6, 18, 35, 70, 78, 79, 92, 10, 82, 108, 110, 116 - 117, 119, 127, 129	51	6	57

data collection, analysis, use, quality	5, 14, 49, 62, 75, 23, 33, 42, 55, 16, 24, 91, 86, 89, 21, 32, 40, 46, 93, 99, 60, 97, 9, 22, 39, 41, 51, 52, 54, 63, 64, 65, 67, 74, 80, 84, 95, 100, 48, 78, 79, 92, 50, 108, 109, 110, 111, 116 - 117, 120, 121, 122 - 126	43	13	56
quality improvement	75, 23, 26, 56, 77, 42, 55, 16, 24, 91, 96, 86, 21, 32, 40, 99, 9, 22, 25, 31, 34, 41, 51, 52, 54, 63, 64, 65, 74, 81, 84, 95, 100, 48, 68, 70, 92, 82, 108, 109, 112, 115, 116 - 117, 121, 122 – 126, 129	39	12	51
care pathways / models of service delivery promotion / implementation	23, 26, 33, 71, 77, 90, 102, 59, 43, 66, 8, 45, 91, 20, 86, 89, 32, 46, 99, 60, 73, 97, 31, 52, 74, 87, 17, 18, 35, 37, 69, 70, 79, 98, 101, 10, 50, 107, 108, 111, 120, 122 – 126, 128	38	9	47
training and/or supervision	55, 24, 20, 96, 2, 21, 29, 32, 40, 46, 93, 30, 57, 60, 88, 22, 25, 34, 41, 63, 65, 74, 81, 84, 83, 17, 18, 35, 37, 47, 48, 78, 79, 103, 10, 50, 107, 108, 109, 110, 111, 116 - 117, 119, 127	36	9	45
feedback - performance / performance management / care processes	5, 14, 44, 49, 62, 75, 94, 102, 42, 4, 8, 91, 21, 29, 13, 60, 9, 63, 65, 100, 17, 68, 70, 78, 79, 92, 82, 116 - 117, 120, 122 - 126	27	8	35
work plans / strategic planning / project development	27, 33, 56, 72, 76, 77, 91, 32, 40, 30, 60, 28, 64, 87, 100, 83, 47, 68, 103, 121, 122 - 126	19	6	25
revise / standardize patient forms / records systems / tools	5, 14, 44, 49, 75, 90, 24, 91, 86, 40, 46, 99, 13, 9, 39, 6, 17, 37, 48, 70, 92, 10, 110, 111	22	2	24
mentoring / coaching	75, 55, 96, 21, 40, 46, 93, 57, 60, 31, 34, 39, 41, 63, 64, 74, 81, 95, 100, 107, 108, 112, 116 - 117	19	5	24
coordination	27, 90, 94, 1, 36, 8, 45, 91, 29, 30, 73, 47, 48, 69, 92, 98, 107, 122 – 126, 129	17	6	23
changes in practice or service delivery	76, 94, 102, 15, 53, 104, 99, 13, 60, 9, 25, 41, 65, 67, 47, 48, 108, 116 - 117	16	3	19
monitoring	14, 16, 96, 86, 21, 29, 99, 30, 17, 18, 35, 121, 122 - 126	11	6	17
reporting	14, 44, 42, 24, 86, 89, 104, 40, 30, 9, 22, 64, 70, 92, 115, 120	14	2	16
assessment / evaluation	5, 71, 76, 90, 58, 16, 24, 8, 86, 32, 99, 81, 87, 103	14		14

collaboration	77, 90, 61, 16, 24, 53, 13, 52, 64, 65, 74, 98, 101, 107	13	1	14
accountability	72, 42, 91, 89, 60, 52, 65, 47, 68, 78	10		10
performance comparison / benchmarking	62, 75, 94, 86, 29, 22, 39, 41, 63, 65	10		10
quality of care	44, 43, 8, 20, 96, 29, 48, 101, 10	9		9
role clarification / orientation of new providers on preferred practices	62, 72, 46, 51, 87, 92, 98, 111	7	1	8
MPDSR	21, 32, 40, 46, 60, 108, 120	5	2	7
audit and feedback - data	44, 49, 27, 53, 84	5		5
leadership training / enhance skills / relationship building	44, 19, 40, 63	4		4
clinical audit	75, 7, 40, 82	4		4
teamwork	105, 54, 92, 98	4		4
shared responsibility	55, 65	2		2
mentorship and training - management	14	1		1

Table 4: The component resources with the corresponding component characteristics and the reference numbers of the selected literature for each characteristic. Number of different published, grey, and total literature sources is included for each characteristic.

Resources -Human resources -Financial	**Publication Number (published + grey literature)**	**# Published**	**# Grey**	**Total #**
human resources	14, 62, 27, 33, 76, 90, 94, 105, 61, 36, 15, 53, 29, 32, 46, 93, 99, 12, 39, 100, 83, 57, 73, 28, 48, 70, 79, 92, 101, 10, 50, 20, 89, 40 / 111, 116 - 117, 119, 122 - 126	34	9	43
IT	14, 27, 33, 76, 58, 55, 66, 16, 53, 21, 32, 40, 46, 8, 31, 54, 64, 73, 18, 35, 69, 70, 98, 101, 38, 104, 92, 36, 81, 48 / 113 - 14, 120, 122 - 126	30	8	38
commodities/equipment	21, 29, 32, 40, 46, 93, 60, 88, 97, 20, 96, 108, 119	12	2	14
funding	27, 33, 90, 105, 53, 3, 19, 18, 48, 101, 103, 96, 119	12	1	13
government funding	26, 71, 59, 61, 21, 60, 35, 48, 68, 78, 103, 38	12		12
supportive policies	27, 43, 24, 3, 46, 99, 60, 73, 18, 98, 101, 104	12		12
transport	3, 21, 46, 93, 99, 97, 17, 32, 13, 110, 128	10	1	11

infrastructure	90, 3, 21, 29, 32, 40, 79, 86, 104	9		9
cost reduction / savings	43, 66, 45, 91, 67, 48, 70, 101, 47	9		9
financial incentives	42, 21, 40, 91, 31, 70, 101, 103	8		8
administrative / operational support	27, 76, 53, 99, 52, 54, 81, 68	8		8
financial subsidies / free services	36, 21, 32, 17, 37	5		5
UHC / insurance	21, 99, 31, 60	4		4
pay-for-performance / results	91, 81, 35, 78	4		4
financial management support	21, 99, 68, 96	4		4
resource sharing	19, 69, 82	3		3
service payments	91, 20	2		2
non-financial incentives	44, 40	2		2

Table 5: The component communication with the corresponding component characteristics and the reference numbers of the selected literature for each characteristic. Number of different published, grey, and total literature sources is included for each characteristic.

Communication	Publication Number (published + grey literature)	# Published	# Grey	Total #
between network members	56, 105, 36, 3, 8, 51, 100, 57, 60, 28, 18, 69, 92, 86, 44, 77, 102, 4, 82, 27, 24, 99, 128, 129	24		24
communication infrastructure	32, 40, 46, 99, 97, 73, 60, 10, 113 - 114, 120, 129	9	3	12
strengthening communication	13, 70, 112, 118, 108	2	3	5
effective strategies	33, 72, 79, 107	3	1	4

Appendix 3F. Reported uses, purposes, and stakeholders

Table 1: Reported network uses with corresponding reference numbers of the selected literature for each reported network use. Number of different published, grey, and total literature sources is included for each reported network use.

Use	Publication Number (published + grey literature)	# Published	# Grey	Total #
provide / improve / expand care / services	11, 14, 15, 18, 20, 21, 23, 25, 27, 28, 29, 33, 34, 36, 42, 43, 46, 47, 54, 57, 63, 70, 72, 73, 77, 85, 93, 100, 116-117, 128	29	2	31
improve / provide quality and efficiency of care	8, 21, 22, 25, 29, 32, 33, 42, 46, 60, 67, 93, 98, 102, 107, 108	14	2	16
uptake of standard guidelines / change clinical practice	5, 6, 9, 31, 34, 39, 44, 53, 54, 61, 62, 64, 67, 75, 94, 118	15	1	16
to change aspects of the health system / service delivery	19, 23, 27, 69, 72, 76, 77, 84, 87, 101, 102, 103, 109, 112	12	2	14
increase access to care and use	20, 28, 30, 36, 59, 66, 97, 98, 106, 107, 119, 128	10	2	12
overcome obstacles / gaps to provision of basic services / interventions	3, 29, 46, 71, 72, 75, 83, 84, 102	9		9
to build capacity / skills	23, 27, 38, 44, 58, 63, 81, 87, 118	8	1	9
respond to specific health problems	16, 29, 37, 48, 68, 76, 81, 90, 103	9		9
promote standard / evidence-based approaches to care	5, 26, 30, 53, 56, 72, 92, 107	7	1	8
foster flow of knowledge and share best practices among providers and organizations and care givers	4, 38, 58, 59, 71, 74, 115, 118	6	2	8
implementation of QI initiatives	26, 31, 40, 41, 52, 54, 65, 95	8		8
foster partnerships / teamwork / linkages	15, 23, 27, 30, 32, 55, 73	7		7
facilitate / improve referral	17, 38, 50, 60, 88, 106, 128	7		7
to meet people's needs	36, 47, 48, 90, 98, 102	6		6
manage patients / care	1, 10, 27, 37, 50, 88	6		6
collaboration	26, 27, 40, 58, 74, 82	6		6
platform for problem solving	13, 15, 24, 29, 68, 128	6		6
to facilitate coordination and cooperation	8, 24, 37, 55, 104, 129	6		6
studies / research / generate evidence	54, 85, 94, 109, 118	3	2	5
develop / implement / improve models of care / UHC	29, 51, 55, 61, 103	5		5

coordinate complex care / continuum of care	29, 32, 42, 47, 93	5		5
introduce new technologies / innovations	29, 61, 71, 87, 109	4	1	5
shift culture of the network	6, 39, 44	3		3
use data and evidence to guide decision making	30, 71, 99	3		3
improve governance	60, 89, 98	3		3
decentralization of care / distribution of cases	40, 99	2		2
generate consumer demand	20, 93	2		2
streamline patient pathways	4	1		1
consultation	2	1		1
shift staff attitudes	6	1		1
deliver care benefits	7	1		1
improve documentation	62	1		1

Table 2: Reported network purposes with corresponding reference numbers of the selected literature for each reported network purpose. Number of different published, grey, and total literature sources is included for each reported network use.

Purpose	Publication Number (published + grey)	# Published	# Grey	Total #
provide optimal / high / improve quality care	1, 3, 6, 13, 14, 15, 17, 18, 20, 23, 25, 26, 29, 30, 32, 33, 34, 37, 38, 48, 50, 52, 54, 56, 59, 63, 64, 68, 69, 71, 73, 75, 77, 81, 82, 84, 86, 88, 90, 92, 95, 96, 99, 103, 104, 107, 115, 122-126	45	7	52
improve outcomes	10, 11, 16, 21, 22, 24, 26, 29, 31, 39, 40, 46, 48, 51, 52, 55, 57, 58, 60, 61, 64, 65, 66, 71, 74, 86, 89, 91, 92, 93, 97, 99, 100, 101, 102, 103, 104, 105, 106, 108, 119, 122-126	39	7	46
to transform / improve delivery of services / system	29, 33, 36, 40, 42, 43, 47, 53, 55, 56, 61, 69, 76, 85, 101, 105, 118	16	1	17
address access to care	11, 19, 25, 28, 32, 33, 37, 43, 79, 81, 90, 96, 102, 105, 109, 116, 117	14	3	17
to foster practice change / uptake evidence-based practices	5, 9, 26, 33, 49, 76, 90, 94, 102, 107	9	1	10
improve participation / information / experience to patients / clients	33, 69, 71, 90, 105, 122-126	5	5	10

address challenges to providing care	3, 7, 15, 19, 28, 44, 80, 83	8		8
reduce / improve referral	7, 30, 41, 69, 90, 110	5	1	6
contain / reduce healthcare costs	10, 28, 96, 101, 104, 115	5	1	6
linking of stakeholders / network entities	2, 34, 43, 52, 69, 71	6		6
coordinate care	28, 33, 45, 90	4		4
provide integrated patient / family centered care	8, 32, 69, 87	4		4
provide information / teaching resources to providers	7, 33, 85	3		3
reduce hospital admissions / stays	10, 67, 101	3		3
improve coverage of services	18, 41, 96	3		3
increase uptake/use of services	104, 116, 117	1	2	3
reduce incidence of complication	9, 80	2		2
improve generation and use of health data	44, 49	2		2
provider feedback	44	1		1

Table 3: Reported network stakeholders with corresponding reference numbers of the selected literature for each reported network stakeholder. Number of different published, grey, and total literature sources is included for each reported network use.

Stakeholder	Publication Number (published + grey literature)	# Published	# Grey	Total #
clinicians	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 16, 18, 20, 21, 22, 23, 24, 26, 28, 29, 30, 31, 32, 34, 36, 37, 38, 39, 40, 41, 42, 43, 44, 48, 49, 50, 51, 52, 53, 54, 56, 57, 59, 62, 63, 64, 65, 66, 67, 69, 70, 71, 72, 74, 76, 77, 79, 82, 83, 85, 86, 89, 90, 92, 93, 94, 95, 99, 100, 101, 102, 103, 104, 105, 107, 115, 116 - 117, 119, 128, 129	79	5	84
PTFs	3, 9, 21, 23, 25, 31, 37, 40, 41, 46, 55, 58, 60, 61, 63, 71, 72, 74, 77, 79, 80, 81, 84, 86, 87, 88, 90, 93, 96, 97, 108, 109, 110, 118, 119, 122 - 126	30	10	40
MoH	5, 25, 32, 35, 37, 44, 47, 49, 62, 63, 68, 75, 81, 82, 84, 93, 102, 106, / 108, 110, 112, 122 - 126	18	8	26
community / local organizations	15, 19, 25, 56, 59, 60, 63, 66, 71, 72, 73, 79, 81, 83, 87, 88, 101, 105, 106, 107, 113 - 114	19	3	22

patients / clients	16, 20, 23, 29, 31, 53, 57, 61, 64, 71, 72, 73, 76, 77, 82, 90, 92, 100, 102, 105, 116 - 117	20	2	22
professional associations	5, 14, 23, 24, 34, 37, 44, 49, 53, 60, 62, 75, 77, 79, 86, 99, 101, 122 - 126	17	5	22
research partners	5, 14, 15, 16, 23, 24, 30, 34, 39, 44, 49, 61, 64, 71, 72, 75, 77, 85, 92, 102, 105	21		21
CHWs/FCHV / allied health staff	3, 17, 19, 21, 25, 26, 32, 46, 76, 79, 93, 94, 100, 111, 116 - 117, 120	13	4	17
regional / provincial / state health officials / managers	13, 15, 18, 31, 40, 41, 42, 46, 47, 56, 60, 71, 86, 93, 95, 106, 107, 129	17	1	18
district health officials	3, 13, 21, 41, 56, 60, 74, 77, 81, 84, 89, 95, 100, 101, 106, 116 - 117	15	2	17
government	3, 28, 46, 61, 78, 102, 103, 105, 109, 122 - 126	8	6	14
families / care givers	3, 16, 17, 21, 23, 28, 29, 64, 71, 72, 92 94, 102	13		13
health authorities / PHC boards / councils	4, 18, 42, 45, 46, 53, 68, 79, 82, 86, 101, 105, 112	12	1	13
national managers / directorates government	30, 31, 41, 55, 60, 74, 82, 90, 110, 118	8	2	10
community	3, 19, 20, 21, 81, 84, 93, 106	8		8
data clerks	44, 49, 51, 53, 54, 62, 89, 107	7	1	8
network coordinator / manager / chairs	4, 14, 26, 35, 53, 56, 76, 102	8		8
network management team / committee	4, 30, 35, 48, 54, 55, 79, 102	8		8
facility administrative staff	1, 4, 6, 51, 62, 63, 64	7		7
health system leaders / executives / champions	24, 26, 42, 56, 61, 94, 115	6	1	7
industry / private sector agencies	16, 60, 78, 96, 105, 113 - 114,	5	2	7
hospital service team leader	14, 39, 65, 76, 89, 99	6		6
policy makers / advisor	3, 15, 71, 72, 76, 105	6		6
ambulance staff / transport drivers	1, 46, 82, 93, 106	5		5
local government	21, 46, 107, 113 - 114	2	3	5
operations leaders / partners	23, 71, 72, 82, 105	5		5
supervisors / facilitators / mentors	11, 81, 89, 94, 95	5		5
TBAs	25, 46, 73, 79, 93	5		5
facility management staff	39, 43, 81, 89	4		4

health management professionals	36, 42, 55, 61	4		4
pharmacy workers	49, 57, 86, 101	4		4
QI personnel	3, 51, 65, 83	4		4
social workers	6, 10, 30, 59	4		4
university staff	2, 7, 14, 70	4		4
counsellors	41, 57, 59	3		3
hospital associations	39, 59, 86	3		3
network executive	76, 102, 104	3		3
other ministries (MoF / MoWCA)	45, 101, 107	2	1	3
project managers / teams	54, 83, 94	3		3
social security	25, 82, 101	3		3
university medical students	2, 34, 59	3		3
activists / advocacy groups	55, 59	2		2
health insurers	82, 99	2		2
IT support	53, 83	2		2
laboratory staff	41, 63	2		2
network administrators	53, 70	2		2
patient associations	72, 82	2		2
regulatory bodies	16, 86	2		2
case managers	19	1		1
decision makers	23	1		1
elected officials	19	1		1
facility management committee	21	1		1
hospital CEO	39	1		1
legal experts	72	1		1
school health teams	6	1		1
service commissioners	4	1		1
Levels of System				**Total #**

PHC	1, 8, 18, 25, 32, 35, 37, 38, 46, 50, 57, 79, 83, 84, 88, 89, 96, 97, 129	19		19
district / county / regional hospital	4, 5, 25, 32, 49, 59, 60, 62, 75, 88, 89, 94, 128	13		13
private sector	20, 46, 50, 60, 80, 119, 122 - 126	5	6	11
tertiary / university hospitals	4, 7, 38, 57, 60, 66, 70, 88, 89, 94, 128	10		10
university	49, 62, 113 - 114, 122 - 126	2	7	9
hospitals	63, 80, 84, 87, 108	4	1	5
referral hospital	11, 17, 37, 84, 97	5		5
medical center	24	1		1
military health system	45	1		1
TBA clinics	46	1		1

Appendix 4A. Understanding how and why networks improve and provide high-quality healthcare and services in LMIC health systems: a Realist Review protocol

Abstract

Health system stakeholders look to approaches to improve poor service delivery, quality of care, and clinical outcomes that are within their capabilities and available resources. Networks are an increasingly employed intervention by which to do so. This realist review builds on a scoping review that performed a systematic search of the literature on networks in health systems, with a focus on low-and-middle income countries (LMICs), to map network uses, purposes, and stakeholders, identify gaps in the literature, and propose a framework of key network components. The realist review will develop an initial programme theory outlining the underlying mechanisms and interactions of contexts that explain how networks improve and provide high-quality care and services and why they work in these ways, thereby improving clinical outcomes in LMIC health systems. It will follow the five steps of realist reviews outlined by Pawson in The Science of Evaluation, drawing on peer-reviewed published and grey literature. The findings from this realist review will enable a greater understanding of how networks work and why they work in these ways to improve and provide high-quality care and services. Putting these findings into practice can lead to better implementation of networks, thereby improving care and service delivery and subsequently clinical and health system outcomes. The main output of this realist review will be a refined programme theory to be tested in a realist evaluation. Organisations and governments implementing or interested in implementing a network in their health system may find these findings particularly relevant and useful.

Introduction and Background

Health systems are complex systems that may not function optimally due to increased demands, limited resources, and structural inertia.[i] This can lead to sub-standard service delivery and poor quality of care and clinical outcomes. Clinicians and health systems leaders, among other stakeholders, look to approaches to improve poor service delivery, quality of care, and clinical outcomes that are within their capabilities and available resources. Networks are an oft employed approach to solve these problems.[ii]

Many different networks exist in the field of healthcare, ranging from global advocacy networks to service delivery networks to community-based networks. There are various definitions, typologies, and frameworks in the literature describing networks but there is "no single, consensually agreed definition of what constitutes a 'network.'"[iii] Networks of a mainly clinical or programmatic nature are developed and implemented in health systems to achieve a range of purposes, including to address variations in practice and outcomes,[iv] improve processes and quality of care,[v] increase evidence-based practice,[vi] facilitate change,[vii] share knowledge and innovation,[viii] and achieve joint goals.[ix] Despite this apparent diversity across networks, it is possible to identify similar characteristics among them, such as, having a shared common goal or vision, strong visionary leadership, communication, and trust.[x,xi,xii,xiii] While networks are an intervention that have been implemented in health systems in many countries, the majority of the published literature on networks is focused on examples from high-incomes countries (HIC) and therefore, limited research on networks in low-and-middle income countries (LMICs) has been published.

This realist review builds on a scoping review that performed a systematic search of peer-reviewed published and grey literature on networks in health systems, with a particular focus on LMICs. The scoping review used the relevant literature to map network uses, purposes, and stakeholders, identify gaps in the literature, and propose a framework of the key components of networks, supported by examples of the components operationalised in practice. This proposed network framework characterises a network by five key components: form and structure, governance and leadership, functioning, resources, and communication (Figure 1). The framework is unique because it was developed based on a broad range of clinical and programmatic health system networks, therefore generating broad applicability, and is supported with a literature base focused on networks in LMIC health systems.

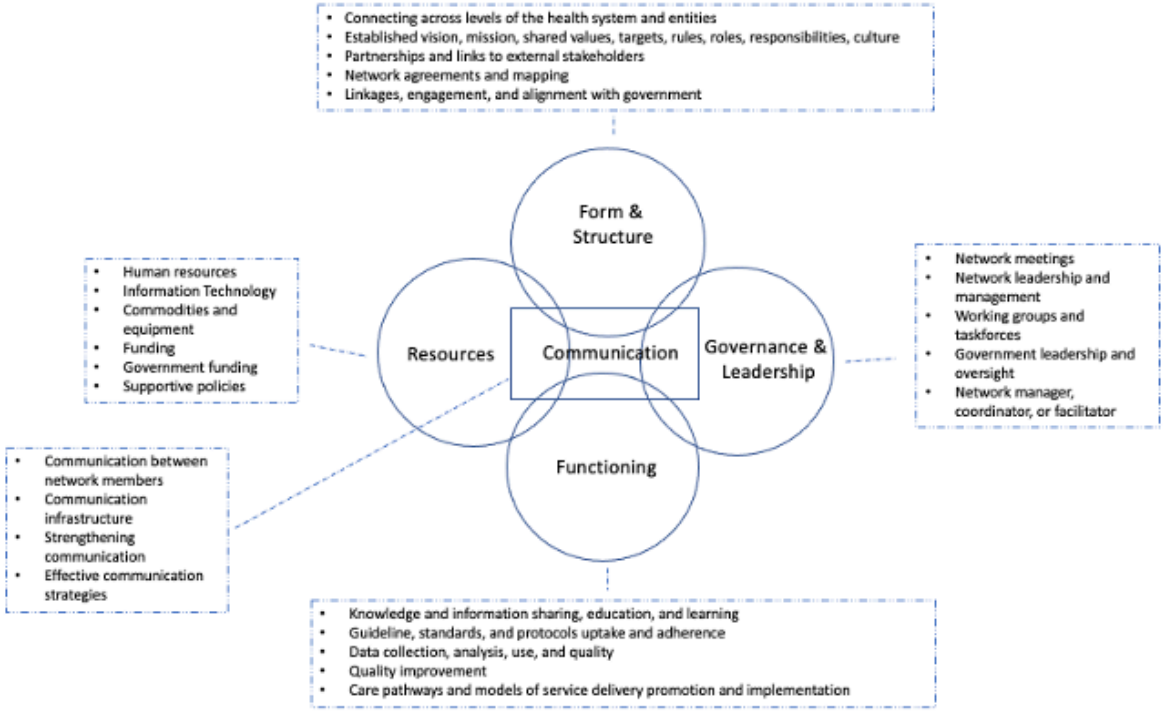

Figure 1: Scoping review results: proposed network framework with key practical characteristics

The scoping review mapped reported network uses and purposes to help begin the process of understanding why networks are implemented in health systems. It found a significant overlap between reported uses and purposes of networks, making it challenging to differentiate between them. This may be due to the way in which networks are reported or because networks are often established to solve a pre-identified problem and the network is therefore used for this pre-established purpose. Based on the literature, the most common use and purpose of networks is to improve and provide high-quality services and care. The research questions for this realist review are drawn from the mapped network uses and purposes.

Literature from the scoping review and other relevant literature can be employed to further investigate networks to generate an understanding into and a programme theory explaining how they work, why they work in these ways, and in what contexts they provide and improve high-quality services and care. While there is a large body of network-related literature, gaps in understanding remain. Much of the health system network literature focuses on the clinical outcomes produced by the network and less so on how

the network was formed or functions to produce these outcomes. Understanding how a network was established and functions can enable health system stakeholders to identify the key elements necessary to better employ networks to improve and provide high-quality care and services. The ability to generate an understanding of how an intervention can work more effectively is a core aim of undertaking a realist review.[xiv] This realist review, by generating a programme theory based on the health systems network literature, will fill an important gap in understanding how, why, and in what context these networks improve and provide high-quality care and services.

Existing Reviews

This realist review will draw on findings and the literature base from a scoping review on networks in LMIC health systems. The scoping review's search process identified one scoping study on networks of care and five systematic reviews on clinical networks (1), clinical social franchise networks (1), and quality improvement collaboratives (3). One of the systematic reviews on quality improvement collaboratives took inspiration from the realist review approach to look at how and when quality improvement collaboratives lead to improved outcomes.[xv] There were no realist reviews identified through the search process related to networks. Two realist evaluations were identified on quality management in health systems and on a maternal and child health programme, though both were excluded from the scoping review based on relevance.[xvi,xvii] Overall, there are limited realist reviews focused on literature from LMIC health systems and as found in the scoping review, most network literature is focused on one type of network. This realist review will therefore contribute to the knowledge base in two ways, methodologically in terms of employing the realist review approach to LMIC literature and context-wise by focusing on different types of networks across LMICs.

Realist Review

Health systems are complex systems which are "composed of many interdependent, heterogeneous parts that self-organize and co-evolve."[xviii] Networks are complex interventions, as they are made up of many interacting components,[xix] that are implemented within these complex systems. Pawson, in The Science of Evaluation (2013), explains complexity in realist terms using seven concepts: volition, implementation, context, time, outcome, rivalry, and emergence (i.e. VICTORE).[xx] Table 1 applies these concepts to networks in health systems and exemplifies how networks in health systems meet Pawson's criteria of complex interventions. Networks in health systems are therefore a suitable candidate for the realist approach to research, which works well with complex social programmes or interventions.[xxi]

Concept	Explanation	Application to networks in health systems
Volition	People make choices	Networks are composed of stakeholders who make decisions on what, how, and when to implement activities to set-up and run a network. Stakeholders can be an individual, institution, or organisation. In a network a stakeholder may be represented individually as well as with an institution or organisation.

Implementation	Programmes have long implementation chains	There may be many different activities, relationships, and steps involved to implement and run a network, and they may occur over time.
Context	Pre-existing from micro to macro levels, influences outcomes	Networks involve all levels and sectors of the health system, and these have different contexts which can affect the network in different ways.
Time	Programmes and interventions come from somewhere	Networks are not a new intervention in health systems and there is relevant existing research that can be drawn on to understand them. Networks are often developed from or linked to prior relationships or existing structures.
Outcome	Desired, undesired, predictable, unpredictable, intermediate	Networks can support the production of clinical outcomes, health system outcomes, and network specific outcomes. These outcomes may be intended or an unintentional biproduct of the network.
Rivalry	Interactions with other programmes or interventions	A multitude of interventions and programmes occur in health systems; networks are not implemented in isolation.
Emergence	Things change	Health systems and networks are dynamic and subject to change.

Table 1: Explanation of networks in health systems as complex interventions, using Pawson's VICTORE framework

Realist research tries to understand causation in social programmes, initiatives, or interventions based on a generative view of causality.[xxii,xxiii] According to the realist philosophy of science, patterns of observed outcomes are the result of an underlying 'generative' mechanism, that may or may not function in certain contexts.[xxiv] The realist approach helps to understand how and why things work and in what context, which can have broader applications for identifying lessons learned and best practices. It is useful to know if something works but it is equally important, if not more, to know how, why, when, and in what contexts.

Realist reviews use data from the literature to identify what mechanisms are triggered in what contexts to produce certain observable outcomes. Mechanisms are the key to understanding how programmes and interventions produce outcomes.[xxv] A mechanism is the interaction between the resources that a programme or intervention provides and how participants interpret and act upon these resources.[xxvi] While a programme or intervention mechanism is always present, whether or not it operates is dependent on the context.[xxvii] There are different types of contexts which may or may not trigger a given mechanism. Realist consider context to be aspects of the environment in which programmes and interventions are introduced that affect the triggering of a mechanism.[xxviii] The identification and linking of which mechanisms are triggered in which contexts to produce certain outcomes can be described by developing

Context – Mechanism – Outcome Configurations (CMOCs). CMOCs are used to explain causation in a programme theory of the programme or intervention of interest.

All programmes and interventions have underlying theories that explain how and why they lead to certain outcomes, whether or not they are explicit.[xxix] A realist review applies the realist philosophy of science to a systematic review and synthesis of the literature to develop a programme theory.[xxx] Realist programme theories explain what works, for whom, under what circumstances, and how.[xxxi] They are supported, refined, or refuted by data from the literature through the development and analysis of CMOCs, which explain the cause of outcomes within the programme theory. Realist programme theories are considered 'middle range' theories because they are specific enough to be tested but general enough to be transferable to other cases.[xxxii]

This realist review will develop and refine a programme theory which will be subsequently tested and further refined in a realist evaluation. The findings from the scoping review on networks in LMIC health systems will be taken a step further to not just understand what a network is, but how and why it works and in what contexts it does to improve and provide high-quality care and services in LMIC health systems. There are limited realist reviews that have focused on LMIC health systems, and this review is an opportunity to generate new insights that could inform areas of research beyond this scope of work.

Review Objectives and Study Design

This realist review follows the five steps outlined by Pawson in The Science of Evaluation (2013).[xxxiii]

Review objectives

Develop an initial programme theory outlining the underlying mechanisms and interactions of contexts that explain how networks improve and provide high-quality care and services and why they work in these ways, thereby improving clinical outcomes in LMIC health systems.

Review questions

How do networks improve and provide high-quality care and services in LMIC health systems?

Why do networks work in these ways to improve and provide high-quality care and services in LMIC health systems?

What are the mechanisms in a network that enable the improvement and provision of high-quality care and services in LMIC health systems?

What contexts trigger the mechanisms within a network that lead to improvements and the provision of high-quality care and services in LMIC health systems?

Stakeholder involvement

A stakeholder group will be formed to support multiple aspects of the realist review. The scoping review, from which this realist review is an extension, looked across different types of networks in health systems,

and this realist review aims to engage stakeholders with an expertise in a range of types of networks in LMICs. Stakeholders will be convened in a group or on an individual basis to provide insight at different stages throughout the review process. This engagement includes validating the focus of the review, helping to interpret data, supporting sense-making of the emerging programme theory and associated CMOCs, reviewing and helping finalise the revised programme theory, and providing guidance on dissemination and messaging. The stakeholders may be able to alert the researchers to areas that are absent from the literature but are relevant and important to consider. Engaging the stakeholder group throughout the review process should support the review to move forward in one direction and result in a useful programme theory. The following stakeholders listed in Table 2 will be targeted; additional stakeholders recommended by the initial group of stakeholders may be engaged with as well.

Network	Stakeholder Organisation	Number of Stakeholders
Clinical Information Network	CIN/KWTRP	1-2
Perinatal Network of Yaoundé	Network lead, Ministry of Health	1-2
Networks of Care	CHAI, WHO, Case study networks	1-3
Quality Improvement Collaborative	IHI	1

Table 2: Planned stakeholder group
CIN: Clinical Information Network, KWTRP: Kenya Medical Research Institute/Wellcome Trust Research Programme, CHAI: Clinton Health Access Initiative, WHO: World Health Organisation, IHI: Institute for Healthcare Improvement

Patient and public involvement

While patients are the ultimate beneficiaries of a network, they are not necessarily involved in its development and functioning. Clinicians, health system managers and administrators, partner organisations, and other health system stakeholders are the focus of a network. Some networks may have a steering committee or task force that could include opinion leaders or community representatives. If feasible, interested community steering committee or task force members will be invited to provide feedback and advice on the emerging programme theory. Their input may provide insights into what they see as effective or working within networks. These individuals could possibly be reengaged with for the realist evaluation.

Step 1: develop an initial programme theory

The first step of a realist review is to develop an initial programme theory that is a first attempt to understand the intervention of interest. Interventions are "theories incarnate" meaning that every programme is made up of a set of theories that explain why certain aspects of the intervention are needed.[xxxiv] For this realist review, the initial programme theory will aim to explain how and when networks improve and provide high-quality care and services in LMIC health systems and for whom and why, and when and why they do not improve and provide high-quality care and services.

The identification of initial contributing theories will first draw on the scoping review evidence base, identifying potentially relevant theories from the selected literature or literature excluded at the full text review stage and flagged for rereview in the realist review as well as theories from other sources preliminary identified to be of potential interest. This process has started and preliminary contributing theories to further investigate include organisational learning theory, structuration theory, organisation theory, and Foucauldian theory of governmentality. If necessary, the authors will search for theories

through informal literature searches, such as forward and backward snowballing from the scoping review literature, and potentially look beyond the domain of healthcare to other disciplines where networks are implemented. The stakeholder group may be consulted for potentially relevant theories that might explain how networks work to improve and provide high-quality care and services and why they work in this way.

A long list of theories that could plausibly contribute to an initial programme theory on networks in health systems will be cultivated from those identified in the searches. Theories that seem to be most relevant to the intervention will be prioritised to investigate. The contributing theories that provide the most plausible realist explanation of the intervention will be synthesized into an initial programme theory to be tested and refined in the review. Development of this initial programme theory will be an iterative process through discussion with the authors, revisiting the literature, drawing on insights from the scoping review, and experience. Once a plausible initial programme theory has been developed, it will be presented to the stakeholder group for review and input.

Step 2: search strategy

The search process aims to identify literature which can further develop and refine the programme theory developed in Step 1. Realist reviews often draw on different types of literature, this includes quantitative and qualitative studies, reviews, programme overviews, and grey literature.

This realist review builds on a scoping review on networks in LMIC health systems and will draw on this reviews' peer-review published and grey literature body. The scoping review systematically searched six databases (Medline, Embase, Global Health, Web of Science, Cochrane Library, and Global Index Medicus (Africa database)) for relevant literature on networks in LMIC health systems and selected 127 pieces of peer-reviewed published and grey literature for inclusion in the review. Database search strategies are provided in Appendix A and eligibility criteria is detailed in Table 3.

The realist review search process will start by purposively combing through this set of evidence. Literature will be reviewed in waves, starting with those pieces of literature focused on LMIC networks that are most likely to contain relevant data of contexts, mechanisms, and outcomes for building CMOCs and work through the literature base to continuously fill gaps in context, mechanisms, or outcomes. HIC focused literature will be drawn on to further support mechanisms, contexts, or outcomes already identified in the LMIC literature, which will help to establish mechanisms, contexts, or outcomes with common or global applicability. It is likely that some of the literature selected for the scoping review might not include the type of information needed for the realist review. This is because it may not contain sufficient information on how the network was established and functions to be included in the realist review. Literature that was excluded in the scoping review at full text review stage but was potentially relevant for the realist review will also be reviewed for relevant data.

If the scoping review literature is insufficient and gaps remain in the data for the context, mechanisms, and outcomes and to refine the initial programme theory, then additional literature searches will be undertaken. This includes forward and backwards snowballing from the scoping review literature. If there are specific gaps that need additional evidence, targeted searches may be undertaken, and stakeholders may also be asked for insights into literature resources. The subsequent searches may search specifically for literature from HICs relevant to the emerging CMOCs and that may have been missed in the scoping review LMIC-focused searches.

The review process will move iteratively between Steps 2 through 4 until theoretical saturation has been reached and no new information is retrieved from the literature. Sufficient information on contexts, mechanisms, and outcomes will have been identified from the literature to move to Step 5 to build CMOCs and refine the initial programme theory, though with the flexibility to return to earlier steps as needed. Following the development of the CMOCs, a final search will be undertaken to identify any additional literature or formal theories to support the CMOCs.

Inclusion and exclusion criteria

The eligibility criteria from the scoping review will be applied to the realist review. In addition, the literature will need to be relevant to contribute to building CMOCs and rigorous.

Inclusion	Exclusion
• Related to health system networks • Networks: groups of facilities and/or healthcare stakeholders (including but not limited to all types of providers, technicians, government officials, professional associations, NGOs, and donors) linked formally or informally, horizontally or vertically, through programs, interventions, activities, or initiatives • Health systems: structures, processes, and people responsible for managing health programmes and services that provide care for a population • HICs and LMICs	• The programme, intervention, activity, or initiative occurs only in one facility or locality among only one group of actors • Research or purely academic networks • Networks focused on research capacity building • Communities of practice • Advocacy networks • Disaster management networks • Database/registry networks • Trial/study networks • Social networks • Family/home care networks • Palliative care networks • Laboratory networks • Diagnostics networks • Disease surveillance networks • Telemedicine/e-health/m-health interventions • Accreditation interventions • Integrated community case management interventions • Integrated management of childhood illnesses interventions • Mobile unit outreach • Faith based organisation sector • General studies on Universal Health Care (UHC) • Primary Health Care networks that were limited to the peripheral level of the health system

Table 3: Eligibility criteria

Step 3: selection and appraisal

Literature selected for inclusion in the realist review, in addition to meeting the eligibility criteria must relevantly contribute data to CMOCs and theory building and be considered rigorous. In the scoping review, the literature was initially selected based on the eligibility criteria outlined in Table 3 and if there was information on the network definition, characteristics, uses, purposes, or stakeholders. At both screening and full text review, a sample of 15% was reviewed by a second reviewer to check for selection bias. The realist review is therefore starting with the selection of the most relevant literature on the intervention of interest and a second reviewer will not be necessary. Literature selection will be an iterative process through the existing literature base with additional searches as needed. The literature that most likely contains relevant pieces of data for building CMOCs will be prioritised.

In realist reviews, rigour of the selected literature is based on if the methodology to produce the relevant data are credible and trustworthy.[xxxv] Where it is clear the piece of data was empirically generated it will be assumed that the data is most likely trustworthy, however, if it is unclear how the data was obtained, then the trustworthiness of the data will be considered uncertain, though the data may still be able to contribute plausibly to the programme theory.[xxxvi] To the extent possible, as much data as is available (at least two different sources of data as a minimum) will be sought to support each aspect of the programme theory.[xxxvii] A description of the methods from which the data is drawn will be documented for each CMOC. If necessary and where possible, if a CMOC has limited data, a rigour assessment of the data for that CMOC will be documented.

Overall, the judgement of quality will extend to the coherence of the programme theory. This will be based on three criteria: consilience – the capability of the theory to explain the data, the simplicity of the theory, and the ability of the theory to fit in to the current knowledge and theories to explain the phenomena of interest.[xxxviii]

Step 4: extracting and organising data

The data extraction process will identify relevant pieces of data from the selected literature to refine the initial programme theory. Literature characteristics, intervention overview, and intervention outcomes were collated for the scoping review literature. This same information will be collected from any additional pieces of literature included in this realist review and compiled for all pieces of selected literature for this realist review in a literature characteristics document in Excel.

The initial programme theory will be used to guide data extraction and organisation. As the literature body is iteratively reviewed, full text of the selected pieces of literature will be imported into NVivo QRS International, a qualitative analysis software tool. Starting with the literature base from the scoping review, relevant data from the literature will be sorted according to the different pieces of the programme theory and guided by data extracted for the scoping review. Data that does not clearly have a place but may be relevant will be noted to be re-reviewed later. Trustworthiness of the data will be assessed as mentioned in Step 3. Relevant data will then be coded as context, mechanism, or outcome based for specific parts of the initial programme theory or additional information that would be helpful for theory building or creating CMOC linkages. Coding will be a combination of deductive coding, based on pre-developed codes from the initial programme theory, and inductive coding, codes that become apparent during the review and coding of the literature. Each piece of data will then be linked to the appropriate CMOC or developed into one which does not yet exist for the specific part of the programme theory. As data elements are identified they will be used to refine the initial programme theory and as the theory is revised literature will be re-reviewed to search for relevant information for the new iteration of the theory. This process will continue until theoretical saturation has been reached in the CMOCs.

Step 5: analysis and synthesis

The realist review approach, moving from search process to data extraction, to analysis, and to synthesis is an iterative process and so the authors will move between Steps 2 to 5 until theoretical saturation is reached and the initial programme theory is judged to be sufficiently refined explanation-wise. To guide the sense making of the data, the following approaches will be used, as suggested by Pawson: 1) juxtaposition of the literature – evidence in one piece enables insight into evidence about outcomes in another; 2) reconciliation of the literature – results are different in similar circumstances, additional investigation is needed to understand why these different results occurred; 3) adjudication of the literature – based on methodological strengths or weaknesses; 4) consolidation of literature – explanation of how and why different outcomes occur; and 5) situation of the evidence.[xxxix] The programme theory will be iteratively revised through the building and evolution of CMOCs using retroductive reasoning and based on the aforementioned approaches for sense-making. Retroductive reasoning, which lies between inductive and deductive reasoning, enables the linking of causal mechanisms with the observed outcomes and is done by moving between the data and theory building.[xl]

The stakeholder group will be involved at this stage to provide guidance on the emerging revised programme theory and the programme theory will continue to be refined as needed. This final revised programme theory will be tested in a subsequent realist evaluation. Figure 2 provides an overview of the entire review process.

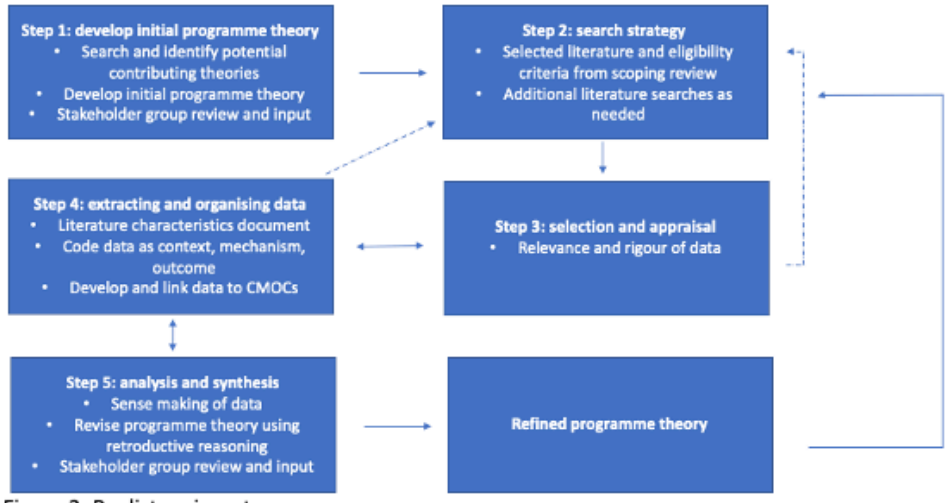

Figure 2: Realist review steps

Discussion

Importance of the research

Networks are increasingly employed as an approach to solve problems of poor service delivery and inadequate quality of care, particularly in LMIC health systems. The findings from this realist review will

enable a greater understanding of how networks work and why they work in this way to improve and provide high-quality care and services. This can lead to better implementation of networks, thereby improving care and service delivery and subsequently clinical and health system outcomes.

This review will add to the growing literature on networks in LMIC health systems and is the first realist review, to our knowledge, that looks across networks in LMIC health systems. The development and refinement of a programme theory will not only lead into subsequent research for the authors but will also provide an opportunity for additional research to test and refine the programme theory in other contexts.

Limitations and risks

Several potential limitations and risks of this review have been anticipated and mitigation strategies considered. First, there is limited literature on networks in LMIC health systems and the scoping review literature base draws on the literature from HIC as well. This could lead to a programme theory that is more applicable to networks in HIC health systems than LMICs. To manage this risk, the LMIC published and grey literature will be prioritised in the analysis and CMOC building, and data extracted from HIC literature will only be to support identified mechanisms, contexts, and outcomes present in the LMIC literature.

The published and grey literature consists of a range of different types of networks. There is a potential challenge in identifying stakeholders to participate in the stakeholder group with expertise in different networks. This should be mitigated by using the authors' various professional contacts to source a stakeholder group representing a variety of networks.

One theoretical risk considered is that networks might be too diverse to develop a 'testable' programme theory. As shown in the scoping review findings, while networks are diverse, there are core components (see Figure 1) that are essential to their makeup and that are represented across different networks. The ability to find a common ground across health system networks to describe what a network is, suggests that it will also be feasible to look across networks to develop and refine a programme theory explaining how they work to improve and provide high-quality care and services and why they work in this way. One additional way to mitigate this would be to concentrate on one specific type of network that would then be the focus of the realist evaluation.

Outputs and Dissemination

The main output of this realist review will be a refined programme theory to be tested in a realist evaluation. These findings may be able to influence the design of networks in the future or how they are reported on and researched. Findings from this realist review will be written-up according to the Realist and Meta-narrative Evidence Syntheses (RAMESES) publication standards and submitted for publication in a peer-reviewed journal. Initial dissemination of the findings will be through the stakeholder group. The stakeholders may be able to advise on additional dissemination paths, including presentations to potentially interested groups. Organisations and governments implementing or interested in implementing a network in their health system may find these findings particularly relevant and useful.

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Appendix 4B. Realist Review updated database search strategies

Search Strategy for Medline (Ovid)

(health system network* OR clinical network OR networks of care OR inter-organization network* OR managed network* OR care network* OR hybrid network* OR integrated service delivery network* OR managed clinical network* OR program network* OR quality of care collaborative OR healthcare network* OR network based organization* OR network model OR network* relationship* OR networked governance OR integrated healthcare OR chain of care OR clinical community OR practitioner network* OR networks of health services OR delivery of healthcare OR health system planning OR organization of healthcare OR networks of clinical experts OR referral network* OR network initiative OR local network* OR district governance OR healthcare delivery OR (healthcare organization and administration) OR integrated delivery of healthcare OR network of safety OR provincial network of health services OR health network structures OR quality of care network OR regionalized healthcare OR network of healthcare interventions OR collaborative network OR network for healthcare practice improvement OR integrated system of care OR strategic clinical network* OR regional health network* OR integrated care network* OR network for quality improvement).mp.

AND

(health system* OR LMIC* OR developing countr* OR developing nation* OR developing population* OR developing world OR less developed countr* OR less developed nation* OR less developed population* OR less developed world OR lesser developed countr* OR lesser developed nation* OR lesser developed population* OR lesser developed world OR under developed countr* OR under developed nation* OR under developed population* OR under developed world OR underdeveloped countr* OR underdeveloped nation* OR underdeveloped population* OR underdeveloped world OR middle income countr* OR middle income nation* OR middle income population* OR low income countr* OR low income nation* OR low income population* OR lower income countr* OR lower income nation* OR lower income population* OR underserved countr* OR underserved nation* OR underserved population* OR underserved world OR under served countr* OR under served nation* OR under served population* OR under served world OR deprived countr* OR deprived nation* OR deprived population* OR deprived world OR poor countr* OR poor nation* OR poor population* OR poor world OR poorer countr* OR poorer nation* OR poorer population* OR poorer world OR developing econom* OR less developed econom* OR lesser developed econom* OR under developed econom* OR underdeveloped econom* OR middle income econom* OR low income econom* OR lower income econom* OR low gdp OR low gnp OR low gross domestic OR low gross national OR lower gdp OR lower gnp OR lower gross domestic OR lower gross national OR lmic OR lmics OR third world OR lami countr* OR transitional countr* OR Africa OR Asia OR Caribbean OR West Indies OR South America OR Latin America OR Central America OR Afghanistan OR Albania OR Algeria OR Angola OR Antigua OR Barbuda OR Argentina OR Armenia OR Armenian OR Aruba OR Azerbaijan OR Bahrain OR Bangladesh OR Barbados OR Benin OR Byelarus OR Byelorussian OR Belarus OR Belorussian OR Belorussia OR Belize OR Bhutan OR Bolivia OR Bosnia OR Herzegovina OR Hercegovina OR Botswana OR Brasil OR Brazil OR Bulgaria OR Burkina Faso OR Burkina Fasso OR Upper Volta OR Burundi OR Urundi OR Cambodia OR Khmer Republic OR Kampuchea OR Cameroon OR Cameroons OR Cameron OR Camerons OR Cape Verde OR Central African Republic OR Chad OR Chile OR China OR Colombia OR Comoros OR Comoro Islands OR Comores OR Mayotte OR Congo OR Zaire OR Costa Rica OR Cote d'Ivoire OR Ivory Coast OR Croatia OR Cuba OR Cyprus OR Czechoslovakia OR Czech Republic OR Slovakia OR Slovak Republic OR Djibouti OR French Somaliland OR Dominica OR Dominican Republic OR East Timor OR East Timur OR Timor Leste OR

Ecuador OR Egypt OR United Arab Republic OR El Salvador OR Eritrea OR Estonia OR Ethiopia OR Fiji OR Gabon OR Gabonese Republic OR Gambia OR Gaza OR Georgia Republic OR Georgian Republic OR Ghana OR Gold Coast OR Greece OR Grenada OR Guatemala OR Guinea OR Guam OR Guiana OR Guyana OR Haiti OR Honduras OR Hungary OR India OR Maldives OR Indonesia OR Iran OR Iraq OR Isle of Man OR Jamaica OR Jordan OR Kazakhstan OR Kazakh OR Kenya OR Kiribati OR Korea OR Kosovo OR Kyrgyzstan OR Kirghizia OR Kyrgyz Republic OR Kirghiz OR Kirgizstan OR Lao PDR OR Laos OR Latvia OR Lebanon OR Lesotho OR Basutoland OR Liberia OR Libya OR Lithuania OR Macedonia OR Madagascar OR Malagasy Republic OR Malaysia OR Malaya OR Malay OR Sabah OR Sarawak OR Malawi OR Nyasaland OR Mali OR Malta OR Marshall Islands OR Mauritania OR Mauritius OR Agalega Islands OR Mexico OR Micronesia OR Middle East OR Moldova OR Moldovia OR Moldovian OR Mongolia OR Montenegro OR Morocco OR Ifni OR Mozambique OR Myanmar OR Myanma OR Burma OR Namibia OR Nepal OR Netherlands Antilles OR New Caledonia OR Nicaragua OR Niger OR Nigeria OR Northern Mariana Islands OR Oman OR Muscat OR Pakistan OR Palau OR Palestine OR Panama OR Paraguay OR Peru OR Philippines OR Philipines OR Phillipines OR Phillippines OR Poland OR Portugal OR Puerto Rico OR Romania OR Rumania OR Roumania OR Russia OR Russian OR Rwanda OR Ruanda OR Saint Kitts OR St Kitts OR Nevis OR Saint Lucia OR St Lucia OR Saint Vincent OR St Vincent OR Grenadines OR Samoa OR Samoan Islands OR Navigator Island OR Navigator Islands OR Sao Tome OR Saudi Arabia OR Senegal OR Serbia OR Montenegro OR Seychelles OR Sierra Leone OR Slovenia OR Sri Lanka OR Ceylon OR Solomon Islands OR Somalia OR Sudan OR Suriname OR Surinam OR Swaziland OR Syria OR Tajikistan OR Tadzhikistan OR Tadjikistan OR Tadzhik OR Tanzania OR Thailand OR Togo OR Togolese Republic OR Tonga OR Trinidad OR Tobago OR Tunisia OR Turkey OR Turkmenistan OR Turkmen OR Uganda OR Ukraine OR Uruguay OR USSR OR Soviet Union OR Union of Soviet Socialist Republics OR Uzbekistan OR Uzbek OR Vanuatu OR New Hebrides OR Venezuela OR Vietnam OR Viet Nam OR West Bank OR Yemen OR Yugoslavia OR Zambia OR Zimbabwe OR Rhodesia)

Limit to (english language and humans and yr="2021 – current")

Result: 556

Search Strategy for Embase (Ovid)

(health system network* OR clinical network OR networks of care OR inter-organization network* OR managed network* OR care network* OR hybrid network* OR integrated service delivery network* OR managed clinical network* OR program network* OR quality of care collaborative OR healthcare network* OR network based organization* OR network model OR network* relationship* OR networked governance OR integrated healthcare OR chain of care OR clinical community OR practitioner network* OR networks of health services OR delivery of healthcare OR health system planning OR organization of healthcare OR networks of clinical experts OR referral network* OR network initiative OR local network* OR district governance OR healthcare delivery OR (healthcare organization and administration) OR integrated delivery of healthcare OR network of safety OR provincial network of health services OR health network structures OR quality of care network OR regionalized healthcare OR network of healthcare interventions OR collaborative network OR network for healthcare practice improvement OR integrated system of care OR strategic clinical network* OR regional health network* OR integrated care network* OR network for quality improvement).mp.

AND

(health system* OR LMIC* OR developing countr* OR developing nation* OR developing population* OR developing world OR less developed countr* OR less developed nation* OR less developed population* OR less developed world OR lesser developed countr* OR lesser developed nation* OR lesser developed population* OR lesser developed world OR under developed countr* OR under developed nation* OR under developed population* OR under developed world OR underdeveloped countr* OR underdeveloped nation* OR underdeveloped population* OR underdeveloped world OR middle income countr* OR middle income nation* OR middle income population* OR low income countr* OR low income nation* OR low income population* OR lower income countr* OR lower income nation* OR lower income population* OR underserved countr* OR underserved nation* OR underserved population* OR underserved world OR under served countr* OR under served nation* OR under served population* OR under served world OR deprived countr* OR deprived nation* OR deprived population* OR deprived world OR poor countr* OR poor nation* OR poor population* OR poor world OR poorer countr* OR poorer nation* OR poorer population* OR poorer world OR developing econom* OR less developed econom* OR lesser developed econom* OR under developed econom* OR underdeveloped econom* OR middle income econom* OR low income econom* OR lower income econom* OR low gdp OR low gnp OR low gross domestic OR low gross national OR lower gdp OR lower gnp OR lower gross domestic OR lower gross national OR lmic OR lmics OR third world OR lami countr* OR transitional countr* OR Africa OR Asia OR Caribbean OR West Indies OR South America OR Latin America OR Central America OR Afghanistan OR Albania OR Algeria OR Angola OR Antigua OR Barbuda OR Argentina OR Armenia OR Armenian OR Aruba OR Azerbaijan OR Bahrain OR Bangladesh OR Barbados OR Benin OR Byelarus OR Byelorussian OR Belarus OR Belorussian OR Belorussia OR Belize OR Bhutan OR Bolivia OR Bosnia OR Herzegovina OR Hercegovina OR Botswana OR Brasil OR Brazil OR Bulgaria OR Burkina Faso OR Burkina Fasso OR Upper Volta OR Burundi OR Urundi OR Cambodia OR Khmer Republic OR Kampuchea OR Cameroon OR Cameroons OR Cameron OR Camerons OR Cape Verde OR Central African Republic OR Chad OR Chile OR China OR Colombia OR Comoros OR Comoro Islands OR Comores OR Mayotte OR Congo OR Zaire OR Costa Rica OR Cote d'Ivoire OR Ivory Coast OR Croatia OR Cuba OR Cyprus OR Czechoslovakia OR Czech Republic OR Slovakia OR Slovak Republic OR Djibouti OR French Somaliland OR Dominica OR Dominican Republic OR East Timor OR East Timur OR Timor Leste OR Ecuador OR Egypt OR United Arab Republic OR El Salvador OR Eritrea OR Estonia OR Ethiopia OR Fiji OR Gabon OR Gabonese Republic OR Gambia OR Gaza OR Georgia Republic OR Georgian Republic OR Ghana OR Gold Coast OR Greece OR Grenada OR Guatemala OR Guinea OR Guam OR Guiana OR Guyana OR Haiti OR Honduras OR Hungary OR India OR Maldives OR Indonesia OR Iran OR Iraq OR Isle of Man OR Jamaica OR Jordan OR Kazakhstan OR Kazakh OR Kenya OR Kiribati OR Korea OR Kosovo OR Kyrgyzstan OR Kirghizia OR Kyrgyz Republic OR Kirghiz OR Kirgizstan OR Lao PDR OR Laos OR Latvia OR Lebanon OR Lesotho OR Basutoland OR Liberia OR Libya OR Lithuania OR Macedonia OR Madagascar OR Malagasy Republic OR Malaysia OR Malaya OR Malay OR Sabah OR Sarawak OR Malawi OR Nyasaland OR Mali OR Malta OR Marshall Islands OR Mauritania OR Mauritius OR Agalega Islands OR Mexico OR Micronesia OR Middle East OR Moldova OR Moldovia OR Moldovian OR Mongolia OR Montenegro OR Morocco OR Ifni OR Mozambique OR Myanmar OR Myanma OR Burma OR Namibia OR Nepal OR Netherlands Antilles OR New Caledonia OR Nicaragua OR Niger OR Nigeria OR Northern Mariana Islands OR Oman OR Muscat OR Pakistan OR Palau OR Palestine OR Panama OR Paraguay OR Peru OR Philippines OR Philipines OR Phillipines OR Phillippines OR Poland OR Portugal OR Puerto Rico OR Romania OR Rumania OR Roumania OR Russia OR Russian OR Rwanda OR Ruanda OR Saint Kitts OR St Kitts OR Nevis OR Saint Lucia OR St Lucia OR Saint Vincent OR St Vincent OR Grenadines OR Samoa OR Samoan Islands OR Navigator Island OR Navigator Islands OR Sao Tome OR Saudi Arabia OR Senegal OR Serbia OR Montenegro OR Seychelles OR Sierra Leone OR Slovenia OR Sri Lanka OR Ceylon OR Solomon Islands OR Somalia OR Sudan OR Suriname OR Surinam OR Swaziland OR Syria OR Tajikistan OR Tadzhikistan OR Tadjikistan OR Tadzhik OR Tanzania OR Thailand OR Togo OR Togolese Republic OR Tonga OR Trinidad

OR Tobago OR Tunisia OR Turkey OR Turkmenistan OR Turkmen OR Uganda OR Ukraine OR Uruguay OR USSR OR Soviet Union OR Union of Soviet Socialist Republics OR Uzbekistan OR Uzbek OR Vanuatu OR New Hebrides OR Venezuela OR Vietnam OR Viet Nam OR West Bank OR Yemen OR Yugoslavia OR Zambia OR Zimbabwe OR Rhodesia)

Limit to (english language and humans and yr="2021 – current")

Result: 872

Search Strategy for Global Health (Ovid)

(health system network* OR clinical network OR networks of care OR inter-organization network* OR managed network* OR care network* OR hybrid network* OR integrated service delivery network* OR managed clinical network* OR program network* OR quality of care collaborative OR healthcare network* OR network based organization* OR network model OR network* relationship* OR networked governance OR integrated healthcare OR chain of care OR clinical community OR practitioner network* OR networks of health services OR delivery of healthcare OR health system planning OR organization of healthcare OR networks of clinical experts OR referral network* OR network initiative OR local network* OR district governance OR healthcare delivery OR (healthcare organization and administration) OR integrated delivery of healthcare OR network of safety OR provincial network of health services OR health network structures OR quality of care network OR regionalized healthcare OR network of healthcare interventions OR collaborative network OR network for healthcare practice improvement OR integrated system of care OR strategic clinical network* OR regional health network* OR integrated care network* OR network for quality improvement).mp.

AND

(health system* OR LMIC* OR developing countr* OR developing nation* OR developing population* OR developing world OR less developed countr* OR less developed nation* OR less developed population* OR less developed world OR lesser developed countr* OR lesser developed nation* OR lesser developed population* OR lesser developed world OR under developed countr* OR under developed nation* OR under developed population* OR under developed world OR underdeveloped countr* OR underdeveloped nation* OR underdeveloped population* OR underdeveloped world OR middle income countr* OR middle income nation* OR middle income population* OR low income countr* OR low income nation* OR low income population* OR lower income countr* OR lower income nation* OR lower income population* OR underserved countr* OR underserved nation* OR underserved population* OR underserved world OR under served countr* OR under served nation* OR under served population* OR under served world OR deprived countr* OR deprived nation* OR deprived population* OR deprived world OR poor countr* OR poor nation* OR poor population* OR poor world OR poorer countr* OR poorer nation* OR poorer population* OR poorer world OR developing econom* OR less developed econom* OR lesser developed econom* OR under developed econom* OR underdeveloped econom* OR middle income econom* OR low income econom* OR lower income econom* OR low gdp OR low gnp OR low gross domestic OR low gross national OR lower gdp OR lower gnp OR lower gross domestic OR lower gross national OR lmic OR lmics OR third world OR lami countr* OR transitional countr* OR Africa OR Asia OR Caribbean OR West Indies OR South America OR Latin America OR Central America OR Afghanistan OR Albania OR Algeria OR Angola OR Antigua OR Barbuda OR Argentina OR Armenia OR Armenian OR Aruba OR Azerbaijan OR Bahrain OR Bangladesh OR Barbados OR Benin OR Byelarus OR Byelorussian OR Belarus OR Belorussian OR Belorussia OR Belize OR Bhutan OR Bolivia OR

Bosnia OR Herzegovina OR Hercegovina OR Botswana OR Brasil OR Brazil OR Bulgaria OR Burkina Faso OR Burkina Fasso OR Upper Volta OR Burundi OR Urundi OR Cambodia OR Khmer Republic OR Kampuchea OR Cameroon OR Cameroons OR Cameron OR Camerons OR Cape Verde OR Central African Republic OR Chad OR Chile OR China OR Colombia OR Comoros OR Comoro Islands OR Comores OR Mayotte OR Congo OR Zaire OR Costa Rica OR Cote d'Ivoire OR Ivory Coast OR Croatia OR Cuba OR Cyprus OR Czechoslovakia OR Czech Republic OR Slovakia OR Slovak Republic OR Djibouti OR French Somaliland OR Dominica OR Dominican Republic OR East Timor OR East Timur OR Timor Leste OR Ecuador OR Egypt OR United Arab Republic OR El Salvador OR Eritrea OR Estonia OR Ethiopia OR Fiji OR Gabon OR Gabonese Republic OR Gambia OR Gaza OR Georgia Republic OR Georgian Republic OR Ghana OR Gold Coast OR Greece OR Grenada OR Guatemala OR Guinea OR Guam OR Guiana OR Guyana OR Haiti OR Honduras OR Hungary OR India OR Maldives OR Indonesia OR Iran OR Iraq OR Isle of Man OR Jamaica OR Jordan OR Kazakhstan OR Kazakh OR Kenya OR Kiribati OR Korea OR Kosovo OR Kyrgyzstan OR Kirghizia OR Kyrgyz Republic OR Kirghiz OR Kirgizstan OR Lao PDR OR Laos OR Latvia OR Lebanon OR Lesotho OR Basutoland OR Liberia OR Libya OR Lithuania OR Macedonia OR Madagascar OR Malagasy Republic OR Malaysia OR Malaya OR Malay OR Sabah OR Sarawak OR Malawi OR Nyasaland OR Mali OR Malta OR Marshall Islands OR Mauritania OR Mauritius OR Agalega Islands OR Mexico OR Micronesia OR Middle East OR Moldova OR Moldovia OR Moldovian OR Mongolia OR Montenegro OR Morocco OR Ifni OR Mozambique OR Myanmar OR Myanma OR Burma OR Namibia OR Nepal OR Netherlands Antilles OR New Caledonia OR Nicaragua OR Niger OR Nigeria OR Northern Mariana Islands OR Oman OR Muscat OR Pakistan OR Palau OR Palestine OR Panama OR Paraguay OR Peru OR Philippines OR Philipines OR Phillipines OR Phillippines OR Poland OR Portugal OR Puerto Rico OR Romania OR Rumania OR Roumania OR Russia OR Russian OR Rwanda OR Ruanda OR Saint Kitts OR St Kitts OR Nevis OR Saint Lucia OR St Lucia OR Saint Vincent OR St Vincent OR Grenadines OR Samoa OR Samoan Islands OR Navigator Island OR Navigator Islands OR Sao Tome OR Saudi Arabia OR Senegal OR Serbia OR Montenegro OR Seychelles OR Sierra Leone OR Slovenia OR Sri Lanka OR Ceylon OR Solomon Islands OR Somalia OR Sudan OR Suriname OR Surinam OR Swaziland OR Syria OR Tajikistan OR Tadzhikistan OR Tadjikistan OR Tadzhik OR Tanzania OR Thailand OR Togo OR Togolese Republic OR Tonga OR Trinidad OR Tobago OR Tunisia OR Turkey OR Turkmenistan OR Turkmen OR Uganda OR Ukraine OR Uruguay OR USSR OR Soviet Union OR Union of Soviet Socialist Republics OR Uzbekistan OR Uzbek OR Vanuatu OR New Hebrides OR Venezuela OR Vietnam OR Viet Nam OR West Bank OR Yemen OR Yugoslavia OR Zambia OR Zimbabwe OR Rhodesia)

Limit 1 to (english language and yr="2021 – current"

Result: 275

Search for Web of Science

TS=("health system network"* OR "clinical network" OR "networks of care" OR "inter-organization network"* OR "managed network"* OR "care network"* OR "hybrid network"* OR "integrated service delivery network"* OR "managed clinical network"* OR "program network"* OR "quality of care collaborative" OR "healthcare network"* OR "network based organization"* OR "network model" OR "network* relationship*" OR "networked governance" OR "integrated healthcare" OR "chain of care" OR "clinical community" OR "practitioner network*" OR "networks of health services" OR "delivery of healthcare" OR "health system planning" OR "organization of healthcare" OR "networks of clinical experts" OR "referral network*" OR "network initiative" OR "local network*" OR "district governance"

OR “healthcare delivery” OR “healthcare organization and administration” OR “integrated delivery of healthcare” OR “network of safety” OR “provincial network of health services” OR “health network structures” OR “quality of care network” OR “regionalized healthcare” OR “network of healthcare interventions” OR “collaborative network” OR “network for healthcare practice improvement” OR “integrated system of care” OR “strategic clinical network*” OR “regional health network*” OR “integrated care network*” OR “network for quality improvement”)

AND

TS=(LMIC OR "developing countr*" OR "health system*" “developing nation*” OR “developing population*” OR “developing world” OR “less developed countr*” OR “less developed nation*” OR “less developed population*” OR “less developed world” OR “lesser developed countr*” OR “lesser developed nation*” OR “lesser developed population*” OR “lesser developed world” OR “under developed countr*” OR “under developed nation*” OR “under developed population*” OR “under developed world” OR “underdeveloped countr*” OR “underdeveloped nation*” OR “underdeveloped population*” OR “underdeveloped world” OR “middle income countr*” OR “middle income nation*” OR “middle income population*” OR “low income countr*” OR “low income nation*” OR “low income population*” OR “lower income countr*” OR “lower income nation*” OR “lower income population*” OR “underserved countr*” OR “underserved nation*” OR “underserved population*” OR “underserved world” OR “under served countr*” OR “under served nation*” OR “under served population*” OR “under served world” OR “deprived countr*” OR “deprived nation*” OR “deprived population*” OR “deprived world” OR “poor countr*” OR “poor nation*” OR “poor population*” OR “poor world” OR “poorer countr*” OR “poorer nation*” OR “poorer population*” OR “poorer world” OR “developing econom*” OR “less developed econom*” OR “lesser developed econom*” OR “under developed econom*” OR “underdeveloped econom*” OR “middle income econom*” OR “low income econom*” OR “lower income econom*” OR “low gdp” OR “low gnp” OR “low gross domestic” OR “low gross national” OR “lower gdp” OR “lower gnp” OR “lower gross domestic” OR “lower gross national” OR lmic OR lmics OR “third world” OR “lami countr*” OR “transitional countr*” OR Africa OR Asia OR Caribbean OR “West Indies” OR “South America” OR “Latin America” OR “Central America” OR Afghanistan OR Albania OR Algeria OR Angola OR Antigua OR Barbuda OR Argentina OR Armenia OR Armenian OR Aruba OR Azerbaijan OR Bahrain OR Bangladesh OR Barbados OR Benin OR Byelarus OR Byelorussian OR Belarus OR Belorussian OR Belorussia OR Belize OR Bhutan OR Bolivia OR Bosnia OR Herzegovina OR Hercegovina OR Botswana OR Brasil OR Brazil OR Bulgaria OR “Burkina Faso” OR “Burkina Fasso” OR “Upper Volta” OR Burundi OR Urundi OR Cambodia OR “Khmer Republic” OR Kampuchea OR Cameroon OR Cameroons OR Cameron OR Camerons OR “Cape Verde” OR “Central African Republic” OR Chad OR Chile OR China OR Colombia OR Comoros OR “Comoro Islands” OR Comores OR Mayotte OR Congo OR Zaire OR “Costa Rica” OR “Cote d'Ivoire” OR “Ivory Coast” OR Croatia OR Cuba OR Cyprus OR Czechoslovakia OR “Czech Republic” OR Slovakia OR “Slovak Republic” OR Djibouti OR “French Somaliland” OR Dominica OR “Dominican Republic” OR “East Timor” OR “East Timur” OR “Timor Leste” OR Ecuador OR Egypt OR “United Arab Republic” OR “El Salvador” OR Eritrea OR Estonia OR Ethiopia OR Fiji OR Gabon OR “Gabonese Republic” OR Gambia OR Gaza OR “Georgia Republic” OR “Georgian Republic” OR Ghana OR “Gold Coast” OR Greece OR Grenada OR Guatemala OR Guinea OR Guam OR Guiana OR Guyana OR Haiti OR Honduras OR Hungary OR India OR Maldives OR Indonesia OR Iran OR Iraq OR “Isle of Man” OR Jamaica OR Jordan OR Kazakhstan OR Kazakh OR Kenya OR Kiribati OR Korea OR Kosovo OR Kyrgyzstan OR Kirghizia OR “Kyrgyz Republic” OR Kirghiz OR Kirgizstan OR “Lao PDR” OR Laos OR Latvia OR Lebanon OR Lesotho OR Basutoland OR Liberia OR Libya OR Lithuania OR Macedonia OR Madagascar OR “Malagasy Republic” OR Malaysia OR Malaya OR Malay OR Sabah OR Sarawak OR Malawi OR Nyasaland OR Mali OR Malta OR “Marshall Islands” OR Mauritania OR Mauritius OR “Agalega

Islands” OR Mexico OR Micronesia OR “Middle East” OR Moldova OR Moldovia OR Moldovian OR Mongolia OR Montenegro OR Morocco OR Ifni OR Mozambique OR Myanmar OR Myanma OR Burma OR Namibia OR Nepal OR “Netherlands Antilles” OR “New Caledonia” OR Nicaragua OR Niger OR Nigeria OR “Northern Mariana Islands” OR Oman OR Muscat OR Pakistan OR Palau OR Palestine OR Panama OR Paraguay OR Peru OR Philippines OR Philipines OR Phillipines OR Phillippines OR Poland OR Portugal OR “Puerto Rico” OR Romania OR Rumania OR Roumania OR Russia OR Russian OR Rwanda OR Ruanda OR “Saint Kitts” OR “St Kitts” OR Nevis OR “Saint Lucia” OR “St Lucia” OR “Saint Vincent” OR “St Vincent” OR Grenadines OR Samoa OR “Samoan Islands” OR “Navigator Island” OR “Navigator Islands” OR “Sao Tome” OR “Saudi Arabia” OR Senegal OR Serbia OR Montenegro OR Seychelles OR “Sierra Leone” OR Slovenia OR “Sri Lanka” OR Ceylon OR Solomon Islands OR Somalia OR Sudan OR Suriname OR Surinam OR Swaziland OR Syria OR Tajikistan OR Tadzhikistan OR Tadjikistan OR Tadzhik OR Tanzania OR Thailand OR Togo OR “Togolese Republic” OR Tonga OR Trinidad OR Tobago OR Tunisia OR Turkey OR Turkmenistan OR Turkmen OR Uganda OR Ukraine OR Uruguay OR USSR OR “Soviet Union” OR “Union of Soviet Socialist Republics” OR Uzbekistan OR Uzbek OR Vanuatu OR “New Hebrides” OR Venezuela OR Vietnam OR “Viet Nam” OR “West Bank” OR Yemen OR Yugoslavia OR Zambia OR Zimbabwe OR Rhodesia)

IC Timespan=2021-2022

Refined by: WEB OF SCIENCE CATEGORIES: (PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH OR SOCIAL SCIENCES INTERDISCIPLINARY OR HEALTH CARE SCIENCES SERVICES OR MEDICINE GENERAL INTERNAL OR HEALTH POLICY SERVICES OR TROPICAL MEDICINE OR DEVELOPMENT STUDIES OR PEDIATRICS OR INTERNATIONAL RELATIONS OR SOCIAL SCIENCES BIOMEDICAL OR OPERATIONS RESEARCH MANAGEMENT SCIENCE OR NURSING OR PRIMARY HEALTH CARE OR OBSTETRICS GYNECOLOGY)

Not Document types: meeting abstracts or letters or proceedings papers

Results: 377

Appendix 4C. Realist Review rigour assessment table

Summary

Author	Type of study	Assessment Tool	CMOCs
McGivern et al 2017	qualitative case study	Stake's checklist	1A
Vargas et al 2020 (2)	qualitative, descriptive-interpretative study	CASP	1B, 5F, 8B
Leslie et al 2020	Interpretative qualitative study	CASP	1C
Schneider et al 2020	descriptive qualitative case study	Stake's checklist	4A
Pittalis et al 2021	mixed methods	Mixed methods appraisal tool	4B, 8C, 9F
Irimu et al 2018	report/reflective piece	No tool available	6C
Vergara et al 2020	descriptive case study	Stake's checklist	8E
Sibbald et al 2020	exploratory case study	Stake's checklist	2A, 9E
Lopez-Vazquez et al 2021	qualitative, descriptive-interpretative study	CASP	4E*
McInnes et al 2015	qualitative study	CASP	5M
*Two pieces of data but from the same source			

Assessments

Stake's checklist for assessing the quality of a case study report		
CMOCs: 1A, 5I*		
McGivern G, Nzinga J, English M. 'Pastoral practices' for quality improvement in a Kenyan clinical network. Social Science & Medicine. 2017; 195:115-122. doi:/10.1016/j.socscimed.2017.11.031.		
Questions	**Response**	**Comments**
1. Is this report easy to read?	yes	A bit complicated in section 2 - Governmentality, pastoral power, and their application in healthcare
2. Does it fit together, each sentence contributing to the whole?	yes	
3. Does this report have a conceptual structure (i.e. themes or issues)?	yes	Foucault's concept of pastoral practices
4. Are its issues developed in a series and scholarly way?	yes	
5. Is the case adequately defined?	yes	CIN and pastoral practices within CIN
6. Is there a sense of story to the presentation?	yes	
7. Is the reader provided some vicarious experience?	yes	Illustrative quotes
8. Have quotations been used effectively?	yes	Within the text and in a summary table
9. Are headings, figures, artefacts, appendices, indexes effectively used?	yes	Heading help to organise the findings; summary table useful to provide clear overview of findings
10. Was it edited well, then again with a last minute polish?	yes	Overall, well written

11. Has the writer made sound assertions, neither over- or under-interpreting?	yes	
12. Has adequate attention been paid to various contexts?	yes	LMICs, Kenya
13. Were sufficient raw data presented?	yes	use of quotes to support the findings and summary table of findings
14. Were data sources well chosen and in sufficient number?	yes	Interviews (34), ethnographic observation (3 meetings), documentary analysis
15. Do observations and interpretations appear to have been triangulated?	yes	use of abductive approach to data analysis and theorising
16. Is the role and point of view of the researcher nicely apparent?	yes	"This paper is written by an interdisciplinary team containing CIN insiders and outsiders. A social scientist from outside CIN, funded by the network to research and explain how it functioned, and a social scientist based at KWTRP, collected and analysed data. A clinician involved in CIN, who commissioned the research, helped interpret findings but was not involved in data collection or analysis. Accordingly, rather than providing an objective external evaluation of CIN, the research aimed to develop a formative explanation and theory of change for the organisational processes underlying network activities, developed through interdisciplinary, insider-outsider dialogue."
17. Is the nature of the intended audience apparent?	yes	Researchers, those interested in clinical networks in healthcare, application of Foucauldian theories
18. Is empathy shown for all sides?		Neutral?
19. Are personal intentions examined?	yes	"Accordingly, rather than providing an objective external evaluation of CIN, the research aimed to develop a formative explanation and theory of change for the organisational processes underlying network activities, developed through interdisciplinary, insider-outsider dialogue."
20. Does it appear individuals were put at risk?	no	"We received ethical approval for our empirical research from the KEMRI Scientific and Ethical Review Unit in Kenya."

Critical appraisal skills programme qualitative studies checklist		
CMOCs: 1B, 5F, 8B		
Vargas I, Eguiguren P, Mogollon-Pérez AS, et al. Understanding the factors influencing the implementation of participatory interventions to improve care coordination. An analytical framework based on an evaluation in Latin America. Health Policy and Planning. 2020;35: 962-972. doi: 10.1093/heapol/czaa066.		
Questions	**Response**	**Comments**
1. Was there a clear statement of the aims of the research?	Yes	"This study, which forms part of a wider research project (Equity-LA II; www.equity-la.eu; Vazquez et al., 2015), aims to analyse, from the actors' perspective, the factors that influenced the implementation of interventions in the public health networks of five Latin American countries—Brazil, Chile, Colombia, Mexico and Uruguay."

2. Is a qualitative methodology appropriate?	Yes	"A qualitative, descriptive-interpretative study was conducted to analyse the process of implementation of care coordination interventions through PAR to determine the influencing factors from the actors' perspective."
3. Was the research design appropriate to address the aims of the research?	Can't tell	Authors did not justify the research design or how they decided to use the method
4. Was the recruitment strategy appropriate to the aims of the research?	Yes	"A criterion sample was designed to include all the discursive variants on the implementation of interventions. Actors were selected who had participated at some point in the process: LSC, PP and working groups, other professionals who took part and managers who provided institutional support. The research team was excluded from the sample. Final sample size was between 14 and 41 informants per country, depending on when information saturation was reached"
5. Was the data collected in a way that addressed the research issue?	Yes	"Data were collected by means of focus groups segmented by the type of informant, and individual semi-structured interviews were conducted to investigate certain topics in greater depth, or when groups could not be created due to professionals' lack of time. Topic guides were drawn up, which included, among other aspects, opinions on the process and factors that influenced the implementation of the interventions, related to the health system and its policies, networks or professionals. Informants were contacted and invited to participate according to the established criteria, using attendance registers taken at different stages in the process." "The interviews generally took place in healthcare facilities and the focus groups in university facilities. They lasted between 45 and 120 min and were audio-recorded and fully transcribed."
6. Has the relationship between researcher and participants been adequately considered?	Yes	"These analysts had different backgrounds and in-depth knowledge of qualitative methods, the evaluation framework, the research topic and the context. The researchers gained awareness of their assumptions and preconceptions through reviewing the literature, seeking critique from experts and international researchers in the subject and discussing their assumptions throughout the research process."
7. Have ethical issues been taken into consideration?	Yes	"Ethical approval. Ethical approval was obtained from the ethical committees in the participating countries. All interviewees participated on a voluntary basis, after signing an informed consent. The right to refuse to participate or withdraw from the study, anonymity and protection of data were all guaranteed. The recordings and transcripts were coded in such a way that the individual origin could not be identified, and appropriately stored."

8. Was the data analysis sufficiently rigorous?	Yes	"Thematic analysis was carried out using the Atlas-ti or MAXQDA software. In the first stage, the process of implementation of the interventions in each country was analysed on a stand-alone basis and, in the second stage, a comparative analysis was conducted. Data were segmented by country and themes. Categories of analysis were generated through a process of mixing those from the topic guide with those emerging from the data. Themes were identified, coded, re-coded and classified to identify common patterns by looking at regularities, convergences and divergences in data in a process of constant comparison, going back and forth between the data and the conceptual framework."
9. Is there a clear statement of findings?	Yes	"Results reveal that contextual factors, the PAR process and the intervention's content influenced their implementation, interacting across time. First, institutional support providing necessary resources, and professionals' and managers' willingness to participate, emerge as contextual pivotal factors, influenced by other factors related to: the system (alignment with policy and political cycle), networks (lack of time due to work overload and inadequate working conditions) and individuals (not knowing each other and mutual mistrust). Second, different characteristics of the PAR process have a bearing, in turn, on institutional support and professionals' motivation: participation, flexibility, consensual decision-making, the LSC's leadership and the facilitating role of researchers. Evidence is provided that implementation through an adequate PAR process can become a factor of motivation and cohesion that is crucial to the adoption of care coordination interventions, leading to better results when certain contextual factors converge."
10. How valuable is the research?		"The results of this study, based on the analysis of experiences in five different Latin American contexts from the actors' perspective, show that the PAR approach, correctly carried out in terms of time, method and levels of participation, can be successfully used to define priorities locally, as well as to remove contextual obstacles and facilitate the implementation of interventions in health services. Participation in the selection, design and implementation of the interventions gradually increased the motivation of the professionals to adopt the interventions and empowered them by enhancing professional control over the care coordination problems faced in their daily practice. Lessons can be drawn for the implementation of care coordination interventions in general and also for implementation research." "Several recommendations can be drawn from the results for the implementation of interventions through a PAR process in other contexts."

Critical appraisal skills programme qualitative studies checklist		
CMOCs: 1C		
Leslie M, Khayatzadeh-Mahani A, Birdsell J, et al. An implementation history of primary health care transformation: Alberta's primary care networks and the people, time and culture of change. BMC Family Practice. 2020; 21:258. doi: 10.1186/s12875-020-01330-7.		
Questions	**Response**	**Comments**

1. Was there a clear statement of the aims of the research?	Yes	"Drawing on policy analysis and key stakeholder interviews we present an implementation history that describes the interactions between people, time, and culture that have supported the bottom up emergence and evolution of Alberta's PHC-focused Primary Care Networks (PCNs)."
2. Is a qualitative methodology appropriate?	Yes	"We conducted an interpretive qualitative study to better understand the PCNs' implementation history, and so generate a rich, contextualized account of these particular PHC transformation efforts."
3. Was the research design appropriate to address the aims of the research?	Yes	"We approach the ecology of the PCNs as being a recursive interaction between policy documents, human experiences, and institutional history [25]. In taking this approach we developed a recursive two phase method aimed at highlighting the factors – what would become in our findings the people, time, and culture – which have interacted to see the PCNs not just survive, but incrementally evolve from the bottom up in a FFS environment. In the initial documentary phase, we conducted a background policy analysis and in the subsequent interview phase, we focused on stakeholder perspectives on and experiences of those policies."
4. Was the recruitment strategy appropriate to the aims of the research?	Yes	"We employed purposeful and "chain referral" [45] sampling strategies to identify our research participants and policy documents. We developed an initial list of organizations and actors engaged with primary care transformation in Alberta through policy document analysis and a pilot interview."
5. Was the data collected in a way that addressed the research issue?	Yes	"We continued interviews until we reached saturation and no new observations on the nature and form of the PCNs' implementation history emerged." "All interviews were recorded digitally and transcribed verbatim."
6. Has the relationship between researcher and participants been adequately considered?	Can't tell	Unclear from manuscript if researchers critically examined their own role, potential bias, and influence; or how responded to events during study
7. Have ethical issues been taken into consideration?	Yes	"Ethics approval and consent to participate. This research was reviewed and approved by the University of Calgary's Research Ethics Board. The research was conducted under certificate REB18– 1709. In accordance with this approval, written consent to participate in the study generally, and specifically for each interview to be audio recorded for later analysis, was obtained from all participants." "Our research was approved by the Conjoint Faculties Research Ethics Board at the University of Calgary. We obtained, in advance of the interviews, written informed consent both to participate, and to allow recording from all participants. Transcripts were stored and analyzed securely with the assistance of NVIVO analytic software."
8. Was the data analysis	Yes	"We used an inductive approach [46] to analyzing both the documentary and interview data, drawing them into themes using content analysis methods"

sufficiently rigorous?		
9. Is there a clear statement of findings?	Yes	"Over time, the PCNs have shifted from an initial Frontier Era that emphasized local solutions to local problems and featured few rules, to a present Era of Accountability that features central demands for standardized measures, governance, and co-planning with other elements of the health system. Across both eras, the PCNs have been first and foremost instruments and supporters of family physician authority and autonomy. A core group of people emerged to create the PCNs and, over time, to develop a long-term Quality Improvement (QI) vision and governance plan for them as organizations. The continuing willingness of both these groups to work at understanding and aligning one another's cultures to achieve the transformation towards PHC has been central to the PCNs' survival and success."
10. How valuable is the research?		"The broader lessons for those seeking to support PHC transformation in similar FFS environments are: Begin from a broad commitment to improving quality, but be prepared to proceed flexibly; Provide time for individuals and organizations to learn about quality improvement, one another, and how best to support the transformation of a system while delivering care locally; Create physical and policy spaces where cultural contact can occur as these are central to achieving 'buy in' and to easing mistrust."

Stake's checklist for assessing the quality of a case study report		
CMOCs: 4A, 2B		
Schneider H, George A, Mukinda F, Tabana H. District Governance and Improved Maternal, Neonatal and Child Health in South Africa: Pathways of Change. 2020; 6:1, e1669943, doi: 10.1080/23288604.2019.1669943.		
Questions	**Response**	**Comments**
1. Is this report easy to read?	yes	overall clear and well written
2. Does it fit together, each sentence contributing to the whole?	yes	
3. Does this report have a conceptual structure (i.e. themes or issues)?	yes	governance lens on district health system strengthening
4. Are its issues developed in a series and scholarly way?	yes	
5. Is the case adequately defined?	yes	Monitoring and Response Unit, in two districts in Mpumalanga and Limpopo provinces, four sub-districts with total of six hospitals with PHC and community-based services
6. Is there a sense of story to the presentation?	yes	
7. Is the reader provided some vicarious experience?	yes	supporting illustrative examples
8. Have quotations been used effectively?	yes	supporting the findings
9. Are headings, figures, artefacts, appendices, indexes effectively used?	yes	Heading help to organise and present the findings, tables - information on sites, interviewees, figures - analytical framework, structures, alliances, tables to provide examples to support findings
10. Was it edited well, then again with a last minute polish?	yes	

11. Has the writer made sound assertions, neither over- or under-interpreting?	yes	
12. Has adequate attention been paid to various contexts?	yes	two districts in Mpumalanga and Limpopo provinces with details provided in a table
13. Were sufficient raw data presented?	yes	quotes in text and in summary tables to provide examples to support findings
14. Were data sources well chosen and in sufficient number?	yes	89 interviews, review of documentation, meetings, and interviews, observation of district and sub-district meetings (9)
15. Do observations and interpretations appear to have been triangulated?	yes	"Following the case study methodology,22 the six subunits and two districts were each analyzed as a unit, triangulating findings from the observations (recorded in detailed notes) and interviews. The approach to analysis was an abductive one,23 developing lines of explanation that built on the initial themes in an iterative and interactive process within the research team."
16. Is the role and point of view of the researcher nicely apparent?	yes	
17. Is the nature of the intended audience apparent?	yes	Health systems researchers, those interested in health system governance
18. Is empathy shown for all sides?		Neutral?
19. Are personal intentions examined?	no	
20. Does it appear individuals were put at risk?	no	"The research received ethical approval from the University of the Western Cape's Biomedical Research Ethics Committee and from the respective Provincial Research Committees. All interviews were conducted following signed, informed consent. In attributing quotes from interviews, we have sought to be sufficiently specific to contextualize the quote, while preserving the anonymity of respondents."

Mixed Methods Appraisal Tool		
CMOCs: 4B, 8C, 9F		
Pittalis C, Brugha R, Bijlmakers L, et al. Using Network and Complexity Theories to Understand the Functionality of Referral Systems for Surgical Patients in Resource-Limited Settings, the Case of Malawi. International Journal of Health Policy and Management. 2021; 1-12. doi: 10.34172/ijhpm.2021.175.		
Questions	**Response**	**Comments**
The focus was more on the analytical framework used, so difficult to respond to these questions		
S1. Are there clear research questions?	Yes - there are clear study aims	"The aim of this study is to undertake a deeper exploration of the referral system for surgical patients (hereinafter referred to as the "surgical referral system") and unpack how the different aspects of the system, and the interacting behaviour of care providers within it, jointly contribute to its functionality. By taking a whole-system approach,15 it also seeks to unveil how the shortcomings described in the earlier work came about. Lessons from this research aim to inform the debate on the role of the referral system in expanding

		the delivery of safe, timely and affordable surgical care to underserved populations in SSA"
S2. Do the collected data allow to address the research questions?	Yes	Surveys, interviews, referral database analysis
5.1 Is there an adequate rationale for using a mixed methods design to address the research question?	Maybe?	"employed mixedmethods and iterative data collection, reflecting the nature of inquiry in CAS research" "This initial evidence informed the subsequent data collection."
5.2 Are the different components of the study effectively integrated to answer the research question?	Yes	"Where appropriate quantitative data sources were triangulated with each other and with qualitative data." "The qualitative data analysis aimed to gather further details about the context in which the network operates and to provide insights into network dynamics from the perspective of its members and potential areas of improvement."
5.3 Are the outputs of the integration of qualitative and quantitative components adequately interpreted?	Yes	"the presentation of results starts with a description of the Malawi surgical referral network structure (ie, the links between hospitals), followed by an assessment of how hospitals interact and determine what the network does, according to the model"
5.4 Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	No	
5.5 Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?	See below	
Qualitative methods		
1.1 Is the qualitative approach appropriate to answer the research question?	Yes	"The aim of this study is to undertake a deeper exploration of the referral system for surgical patients (hereinafter referred to as the “surgical referral system”) and unpack how the different aspects of the system, and the interacting behaviour of care providers within it, jointly contribute to its functionality. By taking a whole-system approach,15 it also seeks to unveil how the shortcomings described in the earlier work came about. Lessons from this research aim to inform the debate on the role of the referral system in expanding the delivery of safe, timely and affordable surgical care to underserved populations in SSA"
1.2 Are the qualitative data collection methods adequate to address the research question?	Yes	semi-structured interviews "The qualitative data analysis aimed to gather further details about the context in which the network operates and to provide insights into network dynamics from the perspective of its members and potential areas of improvement."

1.3 Are the findings adequately derived from the data?	Yes	"A thematic analysis of the interview data was conducted in NVivo v12, following a mixed top-down and bottom-up approach,33 guided by the framework in Figure 1. A first coding framework and structure of the analysis were drafted by the lead author and discussed with the wider team of researchers. These were then revised and finalised in a collaborative manner."
1.4 Is the interpretation of results sufficiently substantiated by data?	Yes	"Our analysis identified a number of obstacles to the functionality of the surgical referral system in Malawi (eg, resource shortages, weak integration and inadequate coordination between sending and receiving hospitals) that have been previously reported across LMICs.9 The added value of this paper, we contend, is that the application of principles from network21 and complexity19 sciences in interpreting our findings has helped to reframe the conceptualisation of referral system functionality to reveal new insights into known problems. In addition, the picture of the surgical referral system emerging from our findings exhibits many characteristics of a CAS."
1.5 Is there coherence between qualitative data sources, collection, analysis and interpretation?	Yes	
Quantitative Descriptive		
4.1 Is the sampling strategy relevant to address the research question?	Yes	"Data were collected to map the surgical referral network, and to conduct an initial assessment of referral practices and resource availability at DLHs. Information on the mandate, resources and governance of the referral network, as well as the intended role of its members, was gathered through a review of national health policies and other background documentation. A survey was administered in 22 of the 24 surgically active public DLHs country-wide" "Information collected concerned patient demographics and clinical information, referral documentation, details of referral and hospital of origin" "we repeated the survey of DLHs to gather further information on referral communication practices, including sharing of feedback"
4.2 Is the sample representative of the target population?	Yes	
4.3 Are the measurements appropriate?	Yes	
4.4 Is the risk of nonresponse bias low?	Can't tell	
4.5 Is the statistical analysis appropriate to answer the research question?	Yes	

Stake's checklist for assessing the quality of a case study report		
CMOCs: 8E		
Vergara MTM, de Vera EA, Carmone AE. Building Trust to Save Lives in a Metro Manila Public-Private Network of Care: A Descriptive Case Study of Quirino Recognized Partners in Quezon City, Philippines. Health Systems & Reform. 2020; 6:2, e1815473, doi: 10.1080/23288604.2020.1815473.		
Questions	**Response**	**Comments**
1. Is this report easy to read?	yes	Clearly written and organised
2. Does it fit together, each sentence contributing to the whole?	yes	
3. Does this report have a conceptual structure (i.e. themes or issues)?	yes	Networks of Care
4. Are its issues developed in a series and scholarly way?	yes	Follows the four domains of a network of care
5. Is the case adequately defined?	yes	QRP network
6. Is there a sense of story to the presentation?	yes	
7. Is the reader provided some vicarious experience?	yes	Examples highlight the different domains
8. Have quotations been used effectively?	no	only one quotation
9. Are headings, figures, artefacts, appendices, indexes effectively used?	yes	Organised by domains and sub-domains, figure to show layout of network and artefact from the network
10. Was it edited well, then again with a last minute polish?	yes	
11. Has the writer made sound assertions, neither over- or under-interpreting?	yes	applying the Networks of Care model to this example
12. Has adequate attention been paid to various contexts?	yes	Metro-Manila, public sector hospital, private midwifery clinics, public facilities
13. Were sufficient raw data presented?	no	only one quotation, presented existing quantitative findings
14. Were data sources well chosen and in sufficient number?	unclear	Objectively unclear, but I know as part of the research team that a wide range of facilities, providers, and stakeholders were spoken to/visited
15. Do observations and interpretations appear to have been triangulated?	unclear	Objectively unclear, but as part of the research team - all information were compiled and applied to the Networks of Care framework
16. Is the role and point of view of the researcher nicely apparent?	yes	
17. Is the nature of the intended audience apparent?	yes	MNH experts, those interested in a network approach to service delivery
18. Is empathy shown for all sides?		Neutral?
19. Are personal intentions examined?	no	
20. Does it appear individuals were put at risk?	no	

Stake's checklist for assessing the quality of a case study report
CMOCs: 2A, 9E

Sibbald S, Schouten K, Sedig K, Maskell R, Licskai C. Key characteristics and critical junctures for successful Interprofessional networks in healthcare - a case study. BMC Health Services Research. 2020; 20:700. doi: 10.1186/s12913-020-05565-z.		
Citation	**Response**	**Comments**
1. Is this report easy to read?	yes	Clear and well-organised
2. Does it fit together, each sentence contributing to the whole?	yes	
3. Does this report have a conceptual structure (i.e. themes or issues)?	yes	Network complexity, Consolidated Framework for Implementation Research
4. Are its issues developed in a series and scholarly way?	yes	
5. Is the case adequately defined?	yes	"Site selection was made using Yins 'extreme case' rationale [21]: the team chosen for the study demonstrated successful patient outcomes [18], used an innovative chronic disease management model, and expressed a desire to learn more about their team function [22]."
6. Is there a sense of story to the presentation?	yes	
7. Is the reader provided some vicarious experience?	yes	
8. Have quotations been used effectively?	yes	Used throughout the findings
9. Are headings, figures, artefacts, appendices, indexes effectively used?	yes	Findings well-organised through use of headings, tables for details of study participants and overview of results additional file for focus group/interview guides
10. Was it edited well, then again with a last minute polish?	yes	
11. Has the writer made sound assertions, neither over- or under-interpreting?	yes	
12. Has adequate attention been paid to various contexts?	yes	Primary Care Innovation Collective (network) in Southwester Ontario
13. Were sufficient raw data presented?	yes	Use of quotes to support findings
14. Were data sources well chosen and in sufficient number?	yes	Focus groups (33), observations of team meetings (3), document analysis (over 25 documents), semi-structured phone interviews (7)
15. Do observations and interpretations appear to have been triangulated?	yes	"The data was analyzed iteratively using a modified thematic approach [25]. First, data sources were analyzed by researchers independently to identify concepts and ideas. In this first stage, the analysis process was open and inclusive to create a comprehensive coding list. Next, data sources were analyzed in aggregate to explore emerging themes. These themes were then defined and grouped (coded) into broad categories. Lastly, researchers discussed themes and patterns to create a common coding framework and consistent definitions [26]. Document analysis was incorporated at this stage both to support and validate our findings as well

		as to ensure congruence of themes. Member checking was done with the PCIC participants (group 1) and the ARGI participants (group 2) by creating an interim report with draft findings and meeting with teams to discuss results. Feedback was incorporated into our findings. Analysis was organized and supported using qualitative analysis software (NVivo11)."
16. Is the role and point of view of the researcher nicely apparent?	yes	
17. Is the nature of the intended audience apparent?	yes	those interested in a network approach to service delivery and respiratory health
18. Is empathy shown for all sides?		Neutral?
19. Are personal intentions examined?	no	
20. Does it appear individuals were put at risk?	no	"Each participant provided written consent prior to participating. REB approval was obtained through Western University's Research Ethics Board (#108415)."

Critical appraisal skills programme qualitative studies checklist		
CMOCs: 4E		
Lopez-Vazquez J, Perez-Martinez DE, Vargas I, Vazquez ML. Interventions to Improve Clinical Coordination between Levels: Participatory Experience in a Public Healthcare Network in Xalapa, Mexico. International Journal of Integrated Care. 2021; 21(4):12, 1-17. doi: 10.5334/ijic.5892.		
Question	**Response**	**Comments**
1. Was there a clear statement of the aims of the research?	Yes	"The objective of this article is to analyse the factors that influenced the implementation of participatively designed interventions and their effects on clinical coordination between levels of care in a public network of health services in Xalapa, Veracruz, Mexico."
2. Is a qualitative methodology appropriate?	Yes	"A qualitative descriptive-interpretive study was carried out to analyse the factors that influence the implementation of the participatively designed interventions and their effects on clinical coordination between levels of care, from the perspective of the participants."
3. Was the research design appropriate to address the aims of the research?	Yes	"The study is part of a broader investigation [30] (Equity-LA II; www.equity-la.eu/en/), which combines quantitative methods to analyse the effectiveness of interventions in improving care coordination [32] and continuity [33], with qualitative methods to evaluate the design and implementation process and the perceived contributions of interventions to improving coordination between levels of care from the perspective of the participants [34]. This article focuses on the experience in Mexico, delving into the similarities and differences between interventions, and complements previous local

		publications on care coordination [3, 6, 35] and continuity"
4. Was the recruitment strategy appropriate to the aims of the research?	Yes	"A sample was designed by criterion of key actors who had participated in any of the different stages of the process of selection, design and implementation of the interventions, in order to have all the possible discursive variants (members of the Local Steering Committee and members of the Professional Platform), with maximum variation according to their role in the intervention. The sample consisted of 15 informants: nine members of the Local Steering Committee (four managers and five middle managers) and six of the Professional Platform (three primary care and three secondary care physicians) who were interviewed individually, in a discussion group or in both"
5. Was the data collected in a way that addressed the research issue?	Yes	"Data collection was carried out through discussion groups and individual semi-structured interviews, to delve into some issues. Topic guides were developed for each cycle and intervention" "According to the established criteria, informants were identified and then asked to join by considering their attendance at meetings held by the Local Steering Committee and Professional Platform as well as at joint training meetings."
6. Has the relationship between researcher and participants been adequately considered?	Can't tell	Unclear from manuscript if researchers critically examined their own role, potential bias, and influence; or how responded to events during study
7. Have ethical issues been taken into consideration?	Yes	"A confidentiality agreement was signed with the institution. Involvement of each informant was free and voluntary expressed in written form by signing a an informed consent. The recordings and transcriptions were coded to guarantee the anonymity of informants." "The research conditions were approved by the Research Ethics Committee of the State Health Services of Veracruz (Number SEI/2013/06/26)."
8. Was the data analysis sufficiently rigorous?	Yes	"Thematic analysis was carried out using ATLAS.ti® software. Data were segmented by intervention and topics. Analysis categories were generated in a mixed way (from the topic guide and emerging from the discourses). Topics were identified, coded, re-coded and classified, in order to find out similarities and differences among informants. To ensure good quality of results, the information was triangulated using several techniques and various analysts who had a good understanding of the context were involved. The preliminary results were presented, and feedback was given over two meetings (with seven informants), allowing us to confirm the

		findings by taking into account the participants opinions in the analysis."
9. Is there a clear statement of findings?	Yes	"Respondents perceived a differentiated impact on clinical coordination according to intervention: greater in the case of joint maternal health trainings and limited for the chronic diseases meetings, as they were the offline virtual consultation was rarely used."
10. How valuable is the research?		"This study contributes to the knowledge on the implementation of participatory interventions to improve care coordination in health services by analysing the factors that influenced their implementation from the perspective of the participants and their effects on improving care coordination, which has been little explored internationally [21, 22] and is non-existent in Mexico." "The results show the importance of the involvement of professionals in the design of interventions, institutional support and methods reflexive training, as determinants to improve clinical coordination between levels."

Critical appraisal skills programme qualitative studies checklist		
CMOCs: 5M		
McInnes E, Haines M, Dominello A, et al. What are the reasons for clinical network success? A qualitative study. *BMC Health Serv Res* 2015;15:497. doi: 10.1186/s12913-015-1096-5.		
Question	**Response**	**Comments**
1. Was there a clear statement of the aims of the research?	Yes	"The aim of the qualitative study reported here was to identify the views of stakeholders internal and external to clinical networks regarding influential factors in NSW clinical networks, in terms of achieving impacts on quality of care and system-wide change during the period 2006–2008. The study was conducted to assist with interpretation of the explanatory quantitative results arising from the main study [1]."
2. Is a qualitative methodology appropriate?	Yes	"The study reported here, using a different sample, was conducted to investigate what participants believed were critical factors in helping to achieving actual network impacts."
3. Was the research design appropriate to address the aims of the research?	Yes	"The study was conducted to assist with interpretation of the explanatory quantitative results arising from the main study [1]. In addition, understanding the critical ingredients that have enabled networks to achieve significant impacts is important."
4. Was the recruitment strategy appropriate to the aims of the research?	Yes	"Six networks that had been in operation during the period 2006–2008 were sampled on the basis of their rating by an Expert Panel as high-impact (n = 2); moderate-impact (n = 2); and low-impact (n = 2)." "When sampling the high and moderate-impact networks, we selected a range of networks that had

		different types and number(s) of impacts and combinations of impacts (for example, development of models of care; educational programmes; clinical protocols)." "A purposive maximum variation sampling approach was used to recruit participants from two groups (internal and external stakeholders). Eligible participants were 18 years of age or over and able to give informed consent. Internal stakeholders from each of six networks were either a current or past chair who had held that post during the 2006–2008 study period. The sample interviewed from this group was six, that is one from each network. External stakeholders were recognised experts in the clinical field of the network or who were connected to the network, through network membership or through their connections with the local health services in which the clinical network operated."
5. Was the data collected in a way that addressed the research issue?	Yes	"After obtaining informed consent, individual, semistructured, audio-recorded, face-to-face interviews using a topic guide were conducted at a place convenient to the interviewee. The interviews were of approximately 20–30 minutes duration. For all interviewees, the main focus of the interviews was to identify views on the critical factors they believed were needed for clinical networks to enable impact on quality of care and system-wide change."
6. Has the relationship between researcher and participants been adequately considered?	Can't tell	Unclear from manuscript if researchers critically examined their own role, potential bias, and influence; or how responded to events during study
7. Have ethical issues been taken into consideration?	Yes	"Ethics approval was granted by the Human Research Ethics Committee of the University of Sydney and ratified by the Australian Catholic University Ethics Committee. All participants were informed of the study objective and were free to participate or withdraw from the study at any point. Participants gave written consent to be interviewed and for the interviews to be audiorecorded. Recordings and transcripts were coded so that the origin of each one could not be identified."

8. Was the data analysis sufficiently rigorous?	Yes	"The coding frame was developed iteratively as two researchers read the transcripts and developed codes relating to factors that were believed to influence network ability to achieve impacts. Recurrent themes were noted including those covered by the topic guide and others which emerged from participant feedback. Excerpts from the transcripts were allocated to these codes. The coding frame and themes were further refined by examining differences and convergences in the data. Participant quotes were used to illustrate meaning in the themes and accompanying narrative summaries. Analysis was conducted alongside the interview process, facilitating reflection on the emerging themes to be probed further in later interviews. The final sample size was determined by saturation of themes, that is, when no new insights were identified in the data. Thematic saturation was reached after interviewing 10 participants associated with or connected to the six networks sampled (six network chairs and four external stakeholders)."
9. Is there a clear statement of findings?	Yes	"Critical factors required for networks to achieve impacts that were nominated by key informants comprised both intrinsic (for example, leadership) and external factors (for example, external relationships). Participants believed the most influential factors for overall network success were (in no particular order of priority): being faithful to network model principles; leadership – both network chairs and network managers; formal organisational structures and processes; nature of network projects; external relationships; profile and credibility of the network."
10. How valuable is the research?		"This study provides clinical networks with guidance on essential factors for maximising optimal network outcomes and that may assist networks to move from being a 'low-impact' to 'high-impact' network."

Appendix 4D. Characteristics of sources of included evidence

#	Citation	Country	Study Methods	Type of Network	Contributes to CMOCs
Peer-reviewed literature					
1	Adams V, Craig S, Samen A, Bhatta S. It Takes More than a Village: Building a Network of Safety in Nepal's Mountain Communities. Maternal and Child Health Journal. 2016; 20:19, 2424-2430.	Nepal	Report	Network of safety	3C
2	Bhatta S, Rajbhandari S, Kalaris K, Carmone AE. The Logarithmic Spiral of Networks of Care for Expectant Families in Rural Nepal: A Descriptive Case Study. Health Systems and Reform. 2020; 6:2. doi:10.1080/23288604.2020.1824520.	Nepal	Descriptive case study	Network of Care/network of safety	1D, 7D, 7E
3	Broughton E, Hermida J, Hill K, Sloan N, Chavez M, Gonzalez D, Freire JM, Ximena Gudino. Evaluation of an intervention to improve essential obstetric and newborn care access and quality in Cotopaxi, Ecuador. Frontiers in Public Health. 2016; 4:247. doi: 10.3389/fpubh.2016.00247.	Ecuador	Programme overview and evaluation	Provincial to community level MNH QI network	4G, 7D
4	Burns E, Collington M, Eden T, Freccero P, Renner L; Paintsil V, Dolendo M, Islam A, Khaing	Ghana, Bangladesh	Report	Shared-care network	2F, 4D

	AA, Rosser J. Development of paediatric oncology shared-care networks in low-middle income countries. Journal of Cancer Policy. 2018; 16:26-32. doi: 10.1016/j.jcpo.2018.03.003.				
5	Chan BTB, Rauscher C, Issina AM, Kozhageldiyeva LH, Kuzembaeva DD, Davis CL, Kravchenko H, Hindmarsh M, McGowan J, Kulkaeva G. A programme to improve quality of care for patients with chronic diseases, Kazakhstan. Bulletin of the World Health Organization. 2020; 98:3, 161-169. doi:10.2471/BLT.18.227447.	Kazakhstan	Quasi-experimental evaluation	Disease management network	1D
6	Cordier LF, Kalaris K, Rakotonanahary RJL, Rakotonirina L, Haruna J, Mayfield A, Marovavy L, McCarty MG, Aina AT, Ratsimbazafy B, Razafinjato B, Loyd T, Ihantamalala F, Garchitorena A, Bonds MH, Finnegan KE. Networks of Care in Rural Madagascar for Achieving Universal Health Coverage in Ifanadiana District. Health Systems & Reform. 2020; 6:2, e1841437. doi: 10.1080/23288604.2020.1841437.	Madagascar	Descriptive case study	Network of Care	2F, 4D

7	D'Mello BS, Bwile P, Carmone AE, Kalaris K, Magembe G, Masweko M, Mtumbuka E, Mushi T, Sellah Z, Gichanga B. Averting Maternal Death and Disability in an Urban Network of Care in Dar es Salaam, Tanzania: A Descriptive Case Study. Health Systems & Reform. 2020; 6:2. e1834303. doi: 10.1080/23288604.2020.1834303.	Tanzania	Descriptive case study	Network of Care	4G, 5J, 7C, 8A
8	English M, Ayieko P, Nyamai R, Were F, Githanga D, Irimu G. What do we think we are doing? How might a clinical information network be promoting implementation of recommended paediatric care practices in Kenyan hospitals? Health Research Policy and Systems. 2017; 15:4. doi: 10.1186/s12961-017-0172-1.	Kenya	Realist informed programme overview	Clinical Information Network	2E, 5B, 5C, 5D, 6E, 8D
9	Fasawe O, Adekeye O, Carmone AE, Dahunsi O, Kalaris K, Storey A, Osy U, Wiwa O. Applying a Clientcentered Approach to Maternal and Neonatal Networks of Care: Case Studies from Urban and Rural Nigeria. Health Systems & Reform. 2020; 6:2, e1841450. doi: 10.1080/23288604.2020.1841450.	Nigeria	Descriptive case study	Network of Care	7E
10	Gachau S, Ayieko P, Gathara D, Mwaniki P, Ogero M, Akech S,	Kenya	Longitudinal observational study	Clinical Information Network	5H, 5J

	Maina M, Agweyu A, Oliwa J, Julius T, Malla L, Wafula J, Mbevi G, Irimu G, English M. Does audit and feedback improve the adoption of recommended practices? Evidence from a longitudinal observational study of an emerging clinical network in Kenya. BMJ Global Health. 2017; 2:e000468. doi:10.1136/bmjgh-2017-000468.				
11	Hyre A, Caiola N, Amelia D, Gandawidjaja T, Markus S, Baharuddin M. Expanding Maternal and Neonatal Survival in Indonesia: A program overview. International Journal of Gynecology & Obstetrics. 2019; 144. doi: 10.1002/ijgo.12730.	Indonesia	Programme overview	Referral networks	2F, 7D, 8A
12	Iedema R, Verma R, Wutzke S, Lyons N, McCaughan B. A network of networks. Journal of Health Organization & Management. 2017; 31:2. doi:10.1108/JHOM-07-2016-0146.	Australia	Ethnographic descriptive case study	Network of networks made up of taskforces, institutes, and clinical networks	2B, 3B, 5C
13	Irimu G, Ogero M, Mbevi G, Agweyu A, Akech S, Julius T, Nyamai R, Githang'a D, Ayieko P, English M. Approaching quality improvement at scale: a learning health system approach in Kenya. Arch Dis Child. 2018. doi:	Kenya	Programme overview	Clinical Information Network	5K, 6B, 6C, 6D, 6E, 7D, 8A, 8D, 8F

	10.1136/archdischild-2017-314348.				
14	Leslie M, Khayatzadeh-Mahani A, Birdsell J, Forest P, G, Henderson R, Gray RP, Schraeder K, Seidel J, Zwicker J, Green LA. An implementation history of primary health care transformation: Alberta's primary care networks and the people, time and culture of change. BMC Family Practice. 2020; 21:258. doi: 10.1186/s12875-020-01330-7.	Canada	Interpretative qualitative study	Primary Care Networks	1C, 2B, 2C, 6B, 6E
15	Lopez-Vazquez J, Perez-Martinez DE, Vargas I, Vazquez ML. Interventions to Improve Clinical Coordination between Levels: Participatory Experience in a Public Healthcare Network in Xalapa, Mexico. International Journal of Integrated Care. 2021; 21(4):12, 1-17. doi: 10.5334/ijic.5892.	Mexico	Qualitative, descriptive-interpretative study	Public Healthcare Network	4E, 7B, 7D, 9B
16	McGivern G, Nzinga J, English M. 'Pastoral practices' for quality improvement in a Kenyan clinical network. Social Science & Medicine. 2017; 195:115-122. doi:/10.1016/j.socscimed.2017.11.031.	Kenya	Qualitative case study	Clinical Information Network	1A, 2H, 3D, 5D, 5G, 5H, 5I, 5J, 6A, 6D, 7C, 8D, 9B, 9D
17	McInnes E, Middleton S, Gardner G, Haines M, Maertsch M, Paul CL, Castaldi	Australia	Qualitative study	Clinical networks	2H, 4D, 4G, 5C, 5E, 5G,

	P. A qualitative study of stakeholder views of the conditions for and outcomes of successful clinical networks. BMC Health Services Research. 2012; 12:49. doi:10.1186/1472-6963-12-49.				5I, 5K, 7B, 8A, 8D, 9B
18	McInnes E, Haines M, Dominello A, Kalucy D, Jammali-Blasi A, Middleton S, Klienberg E. What are the reasons for clinical network success? A qualitative study. BMC Health Services Research. 2015; 15: 479. doi: 10.1186/s12913-015-1096-5.	Australia	Qualitative study	Clinical networks	2C, 2G, 4G, 5A, 5B, 5E, 5G, 5L, 5M, 8D, 8F
19	Mullany LC, Lee CI, Paw P, Od EKS, Maung C, Kuiper H, Mansenior N, Beyrer C, Lee TJ. The MOM Project: Delivering maternal health services among internally displaced populations in eastern Burma. Reproductive Health Matters. 2008;16:31, 44-56. doi: 10.1016/S0968-8080(08)31341-X.	Burma	Programme overview	Three-tiered collaborative network of community-based maternal health workers	7D
20	Nahimana E, McBain R, Manzi A, Iyer H, Uwingabiye A, Gupta N, Muzungu G, Drobac P, Hirschhorn LR. Race to the Top: evaluation of a novel performance-based financing initiative to promote healthcare delivery in rural Rwanda. Global Health Action. 2016; 9:1, 32943, doi: 10.3402/gha.v9.32943.	Rwanda	Programme overview and evaluation	PBF linked quality improvement collaborative program	7D

21	Pittalis C, Brugha R, Bijlmakers L, Cunningham F, Mwapasa G, Clarke M, Broekhuizen H, Ifeanyichi M, Borgstein E, Gajewski J. Using Network and Complexity Theories to Understand the Functionality of Referral Systems for Surgical Patients in Resource-Limited Settings, the Case of Malawi. International Journal of Health Policy and Management. 2021; 1-12. doi: 10.34172/ijhpm.2021.175.	Malawi	Mixed methods study	Referral network	2B, 2G, 2H, 3C, 4B, 8C, 9D, 9F
22	Rycroft-Malone J, Burton CR, Wilkinson J, Harvey G, McCormack B, Baker R, Dopson S, Graham ID, Staniszewska S, Thompson C. Collective action for implementation: a realist evaluation of organisational collaboration in healthcare. Implement Sci. 2016;11:17.	UK	Longitudinal realist evaluation	Collaborations for Leadership in Applied Health Research in Care	2B, 4C, 8A
23	Schneider H, George A, Mukinda F, Tabana H. District Governance and Improved Maternal, Neonatal and Child Health in South Africa: Pathways of Change. 2020; 6:1, e1669943, doi: 10.1080/23288604.2019.1669943.	South Africa	Qualitative case study	Monitoring and Response Unit	2A, 2G, 3B, 4A, 4F, 5A, 5K, 6E, 8D, 9D

24	Sibbald S, Schouten K, Sedig K, Maskell R, Licskai C. Key characteristics and critical junctures for successful Interprofessional networks in healthcare - a case study. BMC Health Services Research. 2020; 20:700. doi: 10.1186/s12913-020-05565-z.	Canada	Exploratory case study	Primary Care Innovation Collective	2D, 2B, 2C, 2E, 3A, 5B, 7A, 9A, 9B, 9C, 9E
25	Srivastava S, Datta V, Garde R, Singh M, Sooden A, Pemde H, Jain M, Shivkumar P, Bang A, Kumari P, Makhija S, Ravi T, Mehta S, Garg BS, Mehta R. Development of a hub and spoke model for quality improvement in rural and urban healthcare settings in India: a pilot study. BMJ Open Quality. 2020; 9:e000908. doi: 10.1136/bmjoq-2019-000908.	India	Programme overview and evaluation	Quality improvement network	6D, 7D, 8A, 9A
26	Tuti T, Bitok M, Malla L, Paton C, Muinga N, Gathara D, Gachau S, Mbevi G, Nyachiro W, Ogero M, et al. Improving documentation of clinical care within a clinical information network: an essential initial step in efforts to understand and improve care in Kenyan hospitals. BMJ Global Health. 2016; 1(1):e000028. doi:10.1136/bmjgh-2016-000028.	Kenya	Programme overview and assessment	Clinical Information Network	5H, 6D
27	Vargas I, Eguiguren P, Mogollón-Pérez AS, Samico I, Bertolotto F, López-Vázquez J, Vázquez ML. Can care	Brazil Chile Colombia Mexico	Qualitative descriptive-interpretative study	Public Healthcare Networks	1D, 2B, 4D, 4F, 6A, 6D

	coordination across levels be improved through the implementation of participatory action research interventions? Outcomes and conditions for sustaining changes in five Latin American countries. BMC Health Services Research. 2020; 20:941. doi: 10.1186/s12913-020-05781-7.	Uruguay			
28	Vargas I, Eguiguren P, Mogollon-Pérez AS, Bertolotto F, Samico I, Lopez J, De Paepe P, Vazquez ML. Understanding the factors influencing the implementation of participatory interventions to improve care coordination. An analytical framework based on an evaluation in Latin America. Health Policy and Planning. 2020;35: 962-972. doi: doi: 10.1093/heapol/czaa066.	Brazil Chile Colombia Mexico Uruguay	Qualitative descriptive-interpretative study	Public Healthcare Networks	1B, 4C, 5F, 7A, 7B, 8A, 8B,
29	Vergara MTM, de Vera EA, Carmone AE. Building Trust to Save Lives in a Metro Manila Public-Private Network of Care: A Descriptive Case Study of Quirino Recognized Partners in Quezon City, Philippines. Health Systems & Reform. 2020; 6:2, e1815473, doi: 10.1080/23288604.2020.1815473.	Philippines	Descriptive case study	Network of Care	2E, 3C, 5L, 6E, 7C, 7D, 8E, 9A

Grey literature

30	Kirunda R, Mubiru F, Akumu E, Wynne L, Rakhmanova N, Kim C. Applying a Quality Improvement Model to Strengthen Community-based Family Planning Services in Busia District, Uganda. Issue 1. 2016.	Uganda	Brief	Service delivery network	1D
31	USAID/Engender Health. A collaborative network to improve access to fistula treatment in Nigeria. (Fistula Care). 2010.	Nigeria	Brief	Clinical peer-support network	4D, 8A
32	USAID. Establishing Model Referral Networks in Haiti: MCSP Case Study. 2018.	Haiti	Brief	Referral network	4G

Appendix 4E. Context-Mechanism-Outcome Configurations and supporting data

Identify a problem	
1A. When potential network members feel a sense of dissatisfaction (misaligned with expectations or values) with an issue (e.g. in clinical care, service delivery organisation, or health system management) (context), they will have the energy, excitement, and motivation to do something about it (outcome) because of their frustration (mechanism)	*"Yet good intentions were frustrated by the Kenyan health system. Paediatrician 3 noted: "Frustration is actually top on the list… I wish I had this [equipment/drug], I would be able to save this baby … your potential is being utilized 20–30%, you get bored … your hands are tied." This undermined motivation to improve care. Paediatrician 21 noted: "Motivation … is gone. You go to work at eight and you leave at four. It's just work now, it's not how can I make [health care] better."" (McGivern et al 2017)*
1B. When a network is in the initial stages and potential network members reflect together on problems (context), they will recruit others to the cause (outcome) because there is a realisation that they can be part of the solution to some degree (mechanism)	*"So when it's an idea, a strategy that comes from the group, it's already born with everybody willing and able, committed to the implementation process, which we knew was going to involve a set of challenges (LSC, Chile)" (Vargas et al 2 2020)*
1C. When potential network members share and discuss their collective experiences, emotions, understanding, or perspectives for a commonly felt problem (context), they are better able to understand what needs to be done and find solutions (outcome) because they have more knowledge to draw on (mechanism)	*"At a time of significant upheaval for the RHAs – they were in the throes of amalgamating into AHS – a small group of independent, lone, long-term generalists working in a field technically and culturally peripheral to what was seen as core healthcare operations, began talking to one another and directly to politicians. Out of these LPCI conversations came a vision, and the technical details of the PCNs. As one policy-maker noted, the vision coalesced around local solutions for local problems." (Leslie et al 2020)*
1D. When members in an established network feel it is safe to critically examine and reflect on existing practices (context), they are able to identify new problems and potential solutions (outcome) because they feel enabled to challenge the status quo or feel in a psychological safe space to be able to challenge the status quo (mechanism)	*"During learning sessions and coaching visits, implementation problems were observed, such as the incomplete use of flowsheets, data entry errors, incorrect techniques in patient self-management discussions and confusion about interpreting guidelines, algorithms or indicators. The traditional learning model of attending a single lecture would probably not have resulted in similar improvements" (Chan et al 2020)* *"In February 2015 APC, implemented by FHI 360 in Uganda, conducted a collaborative site assessment for CBFP programs with the MOH in the three pilot sites, Bulumbi, Buhehe and Buteba. The assessment identified areas for service delivery improvement, which were quantified by the QI monitoring that started in June 2015: • Inadequate counseling of clients by VHTs, especially on the possible side effects of long acting and reversible contraceptives (LARCs). On average, only 30% of clients were receiving counseling that included all the steps listed in the MOH FP counseling flipchart. • Low FP continuation: Only about 25% of clients on average return to the VHTs on time for resupply or reinjection of a method. Through a root cause analysis, stakeholders identified common reasons why women are not using family planning methods that*

	are available and accessible through the VHTs. The reasons cited include opposition from male partners, side effects experienced by clients, and myths and misconceptions about family planning among men and women; these reasons are also supported by the literature.6,7 VHTs identified addressing side effects and misconceptions, as well as male involvement, as key to uptake and continued use of FP methods." (Kirunda et al 2016) *"OHW conducted a landscape analysis that resulted in a long list of improvements required and then carried out across 35 facilities in order to facilitate treatment. Subsequent monitoring, however, found no impact; although equipment to treat jaundice was now available, it was not being used. Realizing that there was a piece missing, and because the Network of Safety model is committed to the process of expanding access to good quality care, additional attention was dedicated to evaluating why the expected outcomes were not achieved. Upon reexamination of the cascade of care, consequential details became clear. Most babies were being discharged home with their mothers within 24 hours after birth, which is too early to see signs of jaundice on physical examination. Providers had no way to identify babies with hyperbilirubinemia at the earlier stage, before days 3–5 when jaundice typically becomes physically apparent. Because the neonates with jaundice were not being identified, treatment was not being given. Initial indications suggest that the addition of one simple diagnostic tool, a transcutaneous bilirubin meter, may make a difference in identifying neonates with jaundice early so that treatment can be initiated through the referral hospitals newly capacitated with Special Newborn Care Units (SNCU) equipped with phototherapy devices." (Bhatta et al 2020)* *"Helped to get to know professionals of the other level and their work context and fostered personal connections "I've got the impression, as I also participate in the consultations and videoconferences, that ties have been made between primary care and the specialists (…). We often have that frank conversation of: look, this is what's going on, or this is the real case scenario, as seen from primary care and also as seen from the hospital perspective (…) so that leads to this kind of 'Ohhh, right! Well let's see how we can put our heads together and solve this then'" (Healthcare Manager, Chile). (Vargas et al 2020)* *"According to the majority of informants in Chile, the cross-level bidirectional visits between PC and SC improved administrative coordination between levels because they permited direct communication between professionals to facilitate access to specialist care and monitor the patient's transition between levels, joint problem solving in administrative matters, and a better knowledge of the administrative pathways and access requirements of the other care level (Table 2.4): "(…) we started to get to know the secondary level problems over there and they got to know the problems we face here. We started to realise that we had nearly the same problems and that there were lots of things we could solve. That also facilitated almost direct communication, one*

	on one, the person in charge of one thing here liaising with the person in charge of the same thing there (...) so it flowed better, shall we say, the care of the patient" (Healthcare Manager, Chile). Informants reported that the improved administrative coordination helped to reduce waiting times and administratively deficient referrals (incomplete information, etc.) and to provide the patient with more adequate information on the procedure." (Vargas et al 2020)
Developing a collective vision	
2A. When potential network members engage in an open process of collective sense-making around a problem (context), they can identify what they share in common (outcome) because they learn about each other's experiences, emotions, understandings, or perspectives (mechanism)	*"An initial formative event was a consensus meeting to establish the CIN's vision and mission. It was attended by partner representatives and a focal team from each hospital, comprising a paediatrician, a nurse heading the paediatric ward and the officer in charge of health records and information. This meeting helped align participants' goals drawing on shared values and resources as part of collective meaning-making and resulted in vision and mission statements." (Irimu et al 2018)* *"During the course of the visits to the districts, sub- districts and facilities, the facilitator was also actively engaged in a process of communication and collective sense-making, building consensus on firstly, the problem to be prioritized (high MNC mortality) and secondly, a set of appropriate responses to the identified problem. The latter entailed presenting the evidence base on interventions for MNCH, drawing attention to existing guidelines, and packaging formal information in ways that promoted system thinking and enabled individual players to locate their place in the whole." (Schneider et al 2020)*
2B. If potential network members identify and articulate commonalities among each other (context), then this enables the development of a collective network vision (outcome) because they understand each other's perspectives (mechanism)	*"The PAR process improved interactional factors between managers of the network "(…) Hospital: "There's nothing more I can do because primary care is doing such a terrible job". Primary care centre: "There's nothing more I can do because the hospital is doing such a bad job" (…) And with that we don't get anywhere constructive (…) I would say that this in some way....means we basically see ourselves as one and the same. So we've really managed to lower our defensive barriers (…) and start to understand that what we really need to do is help each other out" (LSC, Chile). "it's like a sign that a shared vision of the network is appearing, which was the problem we had in the first place (…) Of course, and people perceive it and everyone can feel it now. If I've got a problem I know who to speak to and I know they're going to help, you know? And the certainty that they'll help me, that they'll collaborate with me for the sake of the patient"" (LSC, Chile) (Vargas et al 2020)* *"Our findings demonstrate that when beliefs, values and priorities among members of the referral network converge, this fosters cooperative behaviours which are beneficial for individuals and the network as a whole. When values, beliefs and priorities diverge, self-interest prevails to the benefit of individual clinicians but impacting negatively on other clinicians and potentially on patients." (Pittalis et al 2021)*

	"The paper concluded by labelling ACI as a "network of networks". This phrase served to describe ACI as leveraging not merely the collaborative enthusiasm of stakeholders with specific clinical or scientific agendas, but also the energy that emerges from the co-location of and dynamic interaction among healthcare networks, enabling them to explore and capitalise on commonalities and shared concerns. Here, the uniqueness of ACI's arrangement became fully apparent: through centralising the processes involved with decentralising control over the healthcare reform agenda, the agency articulates individual stakeholders' and networks' goals with those of other stakeholders and networks, as well as with State-wide system-level and science-driven reform agendas in the interest of nurturing alternative perspectives on care innovation and better outcomes and experiences for patients." (Iedema et al 2017) **"***sharing lessons was a key feature of all team meetings. Learning from one another was a priority, alongside taking time to work together to solve problems. Program improvements were determined collectively by the network through regular reporting on network-wide program use and continuous quality improvement efforts" (Sibbald et al 2020)* **"***At a time of significant upheaval for the RHAs – they were in the throes of amalgamating into AHS – a small group of independent, lone, long-term generalists working in a field technically and culturally peripheral to what was seen as core healthcare operations, began talking to one another and directly to politicians. Out of these LPCI conversations came a vision, and the technical details of the PCNs. As one policy-maker noted, the vision coalesced around local solutions for local problems. The local PCN basically got the dollars … in order to meet the needs of the local community." (Leslie et al 2020)* **"***PCIC was developed on the acknowledged need to share resources and garner support for quality improvement in primary care. PCIC participants all agreed that the need to work together was very strong and was the driving force behind their performance and success: "we figured out we could do more than what we were just doing. You know, we were brought around for something and it was just so exciting that it was like everybody came, the conversation never stopped, it just kind of, and it was like wow! We should make this bigger" (Provider FG#1). There was also an internal drive to share best practices coupled with an external pressure to provide better care in different ways. The creation of the PCIC Network played a critical role solidifying a shared vision for the respiratory health and gave the Lung Health Program overall legitimacy." (Sibbald et al 2020)* *"The different perspectives individuals and groups brought to the issue perpetuated professional and epistemic boundaries and these resulted in semantic boundaries. The geographic delineation of the CLAHRC and network of CLAHRCs resulted in physical and spatial boundaries…These*

	conditions reduced the opportunity for interaction, communication and working together in general, and specifically, in implementation-related activity. Despite the call for collaboration embodied in the CLAHRC concept, in practice, participants' reflections often represented different points along a co-operation to collaboration continuum." (Rycroft-Malone et al 2017)
2C. When network members have common professional or vocational identities or calling (context), this facilitates the development of a collective network vision (outcome) because they are more likely to have common professional ideals or identities (mechanism)	**"***PCIC was developed on the acknowledged need to share resources and garner support for quality improvement in primary care. PCIC participants all agreed that the need to work together was very strong and was the driving force behind their performance and success: "we figured out we could do more than what we were just doing. You know, we were brought around for something and it was just so exciting that it was like everybody came, the conversation never stopped, it just kind of, and it was like wow! We should make this bigger" (Provider FG#1). There was also an internal drive to share best practices coupled with an external pressure to provide better care in different ways. The creation of the PCIC Network played a critical role solidifying a shared vision for the respiratory health and gave the Lung Health Program overall legitimacy." (Sibbald et al 2020)* *"The formation of clinician-led networks in NSW in 2002, was predicated on the principles of multidisciplinary membership, collaboration, and engagement in health system innovation [13]. Participants remarked that these principles had underpinned the development of strategic network project objectives focused on addressing local and statewide health system needs that, prior to the establishment of clinical networks, had not been satisfactorily addressed because of lack of multidisciplinary input: 'What gets things up is the whole network package'. What this 'package' added to the pre-existing status quo, was a mechanism by which multi-disciplinary groups of clinicians could initiate and drive collaborative projects focused on quality improvement and improving patient outcomes related to their clinical specialty, using a 'bottom-up' push." (McInnes et al 2015)* *"Another participant from AHS repeated the mantra and emphasized, there has to be flexibility, because PCNs were created [to deliver] local solutions for local problems. (P7) In this way the independent professional and vocational identities of family physicians guided the initial vision for the PCNs. The technical details were also worked out in a culturally concordant manner." (Leslie et al 2020)*
2D. If the collective vision of a network is based on shared experiences, emotions, perspective, and understanding among the network members (a similar specific way in which reality is perceived) (context), then this will lead to commitment to the collective vision (outcome) because network members feel represented (mechanism)	

2E. If the collective vision of a network is communicated and explained by network leadership in a way that appeals to professional ideals and values shared by network members (context), then this will lead to commitment to the collective vision (outcome) because network members feel engaged (mechanism)	*"Getting hospital management to buy-in to the NOC structure was difficult at first because they feared losing income through outward referrals to lying-in clinics and had doubts about the quality of care possible at those sites. Persistent advocacy by QRP leadership eventually assured hospital administration buy-in by contending that rational distribution of cases would improve quality of services delivered and not result in income losses, demonstrating early signs of this success through presentation of QRP data and less formal anecdotal evidence." (Vergara et al 2020)* *"The network was initiated with a meeting of a paediatrician, a senior nurse and the health records information officer from each participating hospital and the research institute and university partners. At this meeting and at subsequent hospital-specific introductory visits the network was explained and its purpose to promote better generation and use of health information to support better care." (English et al 2017)* "*The network's vision provided a common foundation and a shared approach, allowing each member to work towards a collective goal. PCIC and ARGI participants described how the network leaders communicated the vision clearly and helped set goals collectively while continuously supporting individual network members and RTs: "… it's a very goal-oriented group that looks for solutions and that I find, quite uplifting. Wednesday I'm feeling kind of low and scattered, but Friday (after our team meeting) a little more feeling good, I'll feel energized, like we've got a direction." (Provider FG#1). (Sibbald et al 2020)*
2F. When formal agreements have been negotiated and agreed between network members (context), then the network members will be more likely to follow a collective vision (outcome) because this helps network members to understand their roles and responsibilities (mechanism)	*"There should be an MOU between hub and shared-care centres, to strengthen the understanding of the teams and of hospital management. It should define responsibilities and timeframes. It is also much easier to achieve conformity and guidelines if hospital management are involved from the start of the programme." (Burns et al 2018)* *"As a central part of the collaboration, PIVOT developed strong relationships with the Government of Madagascar and with local communities in Ifanadiana. The foundation of the MoPH/PIVOT partnership is based on purposeful agreements that clarify common objectives and specify each party's responsibilities; this clarity fosters an enabling environment for the NOC." (Cordier et al 2020)* *"Representatives of all public and private health facilities worked collaboratively with district health officials and civil society representatives to map the most efficient referral pathways between puskesmas and hospitals. Roles and responsibilities of each entity in the referral system were outlined. Memoranda of understanding (MOU) formalized the referral networks by defining the governance of the network, ensuring that all entities within a referral network, including private sector providers, had clearly defined and agreed- upon roles and responsibilities. The MOU*

	also served as a mechanism for holding all entities within the network accountable for upholding their roles and responsibilities. The MOUs were modified periodically as roles and responsibilities evolved within the network, such as facilities developing more capacity over time to manage complications." (Hyre et al 2019)
2G. When potential network members establish and agree to a collective vision (context), this purposefully links them into a network (outcome) because they have common understanding and perspectives on what the goals of the network are (mechanism)	*"The formation of clinician-led networks in NSW in 2002, was predicated on the principles of multidisciplinary membership, collaboration, and engagement in health system innovation [13]. Participants remarked that these principles had underpinned the development of strategic network project objectives focused on addressing local and statewide health system needs that, prior to the establishment of clinical networks, had not been satisfactorily addressed because of lack of multidisciplinary input: 'What gets things up is the whole network package'. What this 'package' added to the pre-existing status quo, was a mechanism by which multi-disciplinary groups of clinicians could initiate and drive collaborative projects focused on quality improvement and improving patient outcomes related to their clinical specialty, using a 'bottom-up' push." (McInnes et al 2015)* *"Collaborative relationships between DLHs and RHs around a shared objective of providing optimal patient care are of great importance in determining the referral network's overall performance, as the components of the system are mutually reliant on each other and share reciprocal relationships." (Pittalis et al 2021)* *"Coordinated action was driven by shared goals, recognition of inter-dependence, and greater shared responsibility: We all share the same goal and it's kind of motivating. (Dietitian) It is like a link, everyone is linking with the other so everyone is playing his or her role, that's what I can say … We are working like this because the one can't survive without the other. (Hospital manager)" (Schneider et al 2020)* *"The structures and processes of the MRU were specifically designed to enable coordinated action across key interfaces. These interfaces were between the PHC system players and district hospitals at the sub-district level, between district and sub-district managers, between units within hospitals, and between clinicians (experts) and managers (drivers). The new relationships and common collective visions for MNCH forged across these interfaces were generally regarded as the most important organizational impacts of the MRU.* *…what I've found the system able to do was to break down those silos and to cross-pollinate across the whole district, and I find that extremely helpful. (DCST member)* *Before, it was like two entities, the hospital and the clinics. But I don't know what forces or whatever it has combined us now, we are not two entities anymore. (PHC manager)" (Schneider et al 2020)*

2H. If there is no collective vision or if network members do not follow the network's collective vision (context), then they will be less successful in implementing network activities (outcome) because network members do not feel committed to the network (mechanism)	*"Less successful and effective networks were seen by all stakeholders as being less well organised and structured and as being run by 'turfdom and fiefdoms' focused on objectives of individual interest rather than of broader relevance to the health system: "Trying to protect their particular practice and fear that they're going to lose something. Rather than seeing the gains for everybody else in the state." (McInnes et al 2012)* *"Our findings demonstrate that when beliefs, values and priorities among members of the referral network converge, this fosters cooperative behaviours which are beneficial for individuals and the network as a whole. When values, beliefs and priorities diverge, self-interest prevails to the benefit of individual clinicians but impacting negatively on other clinicians and potentially on patients." (Pittalis et al 2021)* *"However, we did note resistance among nurses to collecting data for CIN. Paediatrician 12 noted: "Some [nurses] … tick information and … I feel like probably they didn't do it." Nurses explained that they were often too busy focusing on clinical care to document data: "The workload is just too much … [Nurses] don't have time … observations are not well documented … [nurses] concentrate on giving treatment or attending emergencies" (Nurse-in-Charge 14). Some CIN members believed such resistance required further pastoral intervention. For example, HRIO 26 noted that CIN's "biggest challenge" was clinical staff who "don't understand the purpose or the benefits of data" and so provided "data which is inaccurate" or "incomplete". The HRIO added that these clinical staff needed to understand that this was not "good for decision-making and that's why the country is not moving ahead." (McGivern et al 2017)*
Taking action to solve a problem	
3A. In a bottom-up network when potential network members realise they alone are unlikely to be able to solve a problem (context), they will recruit likeminded colleagues for their cause (outcome) because they believe collective action is needed (mechanism)	*"PCIC was developed on the acknowledged need to share resources and garner support for quality improvement in primary care. PCIC participants all agreed that the need to work together was very strong and was the driving force behind their performance and success: "we figured out we could do more than what we were just doing. You know, we were brought around for something and it was just so exciting that it was like everybody came, the conversation never stopped, it just kind of, and it was like wow! We should make this bigger" (Provider FG#1). There was also an internal drive to share best practices coupled with an external pressure to provide better care in different ways. The creation of the PCIC Network played a critical role solidifying a shared vision for the respiratory health and gave the Lung Health Program overall legitimacy." (Sibbald et al 2020)*
3B. While in a top-down/more directed network when health system administrators or managers realise that they need diverse health system actors to be able to solve the problem/meet the target (context), they will recruit/mandate/encourage colleagues they perceive	*"During the course of the visits to the districts, sub- districts and facilities, the facilitator was also actively engaged in a process of communication and collective sense-making, building consensus on firstly, the problem to be prioritized (high MNC mortality) and secondly, a set of appropriate responses to the identified problem. The latter entailed presenting the evidence base on interventions for MNCH, drawing attention to existing guidelines, and packaging formal*

to be capable to their cause (outcome) because they believe that collective effort/action is needed (mechanism)	*information in ways that promoted system thinking and enabled individual players to locate their place in the whole." (Schneider et al 2020)* *"The general point that can be made about this is that the HIPS initiative acted as a forum for the articulation of top-down direction and local opinion. On the one hand, the taskforce was charged with a policy reform agenda that aimed to reduce clinical practice variation. On the other hand, its decision to target hip fracture care arose through open deliberation among taskforce members. Seen through the lens of network governance, the taskforce facilitated deliberations among clinicians, academics, bureaucrats and service users about where to direct its energies, and how to tackle the issue identified as needing attention, resulting in a reform agreement (the minimum standards) as the basis for a state-wide ortho-geriatric improvement initiative." (Iedema et al 2017)*
3C. When potential network stakeholders think collective action is needed to solve the identified problem (context), they will seek out other individuals with common experience or perspectives (outcome), because they believe such people may be willing to help them (mechanism)	*"In 2013, in the face of the ongoing challenge to reduce maternal death, the head of the Obstetrics and Gynecology (Ob/Gyn) Department at QMMC decided to take a proactive approach by designing a program to decongest the maternity ward with the aim of improving quality of care and outcomes. The Quirino Recognized Partners (QRP), as a Network of Care, identified public and private lying-in clinics within first a seven, then a ten-kilometer, radius around the hospital. These were identified as potential "spokes" in a hub-and-spoke model. Identifying clinical sites to partner with was the first step in the process of creating a group of intentionally interconnected maternity care touch points within a defined catchment area. This group, the nascent Network of Care, defined common goals while distributing maternity cases rationally among the facilities and to achieve better outcomes for the women and newborns in their care. QRP is a public–private partnership, uniting the public hospital, some public health centers, and a host of private birth centers run by entrepreneurial midwives. Together, the partners distribute maternity cases by risk profile and location, communicate fluidly, and share monitoring information to track performance of the Network of Care." (Vergara et al 2020)* *"Individual DLHs also use the referral network to exchange resources and cope with challenging situations. For example, respondents reported that Mulanje DLH refers patients to the nearby Mulanje mission hospital in case of (frequent) shortage of essential resources, but occasionally also "borrows" the mission hospital's more experienced clinicians to manage particularly difficult cases locally and avoid referral. A number of other DLHs reported having informal local arrangements with each other allowing them to move their whole surgical team to perform urgent operations at nearby facilities when there are major failures in equipment or interruptions to electricity or water supply. Others share supplies and other surgical essentials, such as instrument sets or gowns." (Pittalis et al 2021)*

	‘‘On our last visit to Baglung District, we had to drive 6 h from Kathmandu over a bumpy, winding dirt road, across rivers … you know, remote. When we finally got up to one particular village in the mountains, the senior auxiliary health worker came out to meet us. He began to tell us about how our program was working. He knew all the statistics about who delivered and how many delivered, and all the progress they had made. He said that as a leader in the community he established a no-home births policy. ‘No women should deliver at home, and no one should deliver alone,’ he said. He went around to every household in the community and collected money and with that money he built a birthing center. This was probably also related to the fact that our organization had promised to supply the equipment for the center. Another man in the village donated his land for the building site. He was not wealthy. Together the community built this space. It was one of the best I have ever seen: well constructed, clean, organized, attached bathroom, a separate room for intake and prenatal care, a room for labor and delivery, and a room for postpartum care. All of the decisions and effort that created this facility were initiated by the men in this community. Not just the raising of the money and setting the policy, but the community outreach as well. The district health officer was a man. The head of the hospital was a man. Most health post supervisors were men. The person who donated the land was a man. In many ways it is always men who are decision-makers about health care for women. So, of course, men will be the driving force for change.’’ (Adams et al 2016)
3D. When members in an established network have access to resources that will help them solve the problem they have identified (context), they may be more prepared/more likely to intend to take action (outcome), because they believe they have a more realistic chance of success (mechanism)	*"In Kenya, health professionals often work in remote district hospitals, overseeing clinical departments with little support or training. Many find this difficult, particularly without resources to provide high standards of care. Consequently, loss of motivation and burnout are common (Brown, 2016; Mbindyo et al., 2009). CIN leaders attempted to create a supportive network community to addressed this problem, by providing physical and online spaces in which to meet and share as a professional community. CIN encourages network participants to think about new approaches to problem-solving, and then implement, test and measure solutions, and facilitates sharing of learning across participating organizations, thus functioning as an improvement collaborative (English, 2013)." (McGivern 2017)* *"To help develop ‘engaged and motivated’ members of CIN at local levels and build a collective identity and community of practice, we hold twice yearly face-to-face meetings with paediatricians inviting the other CIN focal persons to one annual meeting.9 These meetings allow participants to discuss their audit reports (including offering suggestions for improving data collection) and to identify underlying problems and potential solutions with peers. They also provide a forum for short, specific skills building sessions focused on the ‘soft skills’ needed as a manager (eg, how to run a team) and on building their understanding of research. Crosstalk among the scientific, clinical and policy communities in an arena promoting collegial relationships helps interpret results based on an understanding of practice in the real world. This enables all*

	sides to understand how contexts interact with improvement approaches to bring about observed outcomes26" (Irimu et al 2018) "*The network's vision provided a common foundation and a shared approach, allowing each member to work towards a collective goal. PCIC and ARGI participants described how the network leaders communicated the vision clearly and helped set goals collectively while continuously supporting individual network members and RTs: "… it's a very goal-oriented group that looks for solutions and that I find, quite uplifting. Wednesday I'm feeling kind of low and scattered, but Friday (after our team meeting) a little more feeling good, I'll feel energized, like we've got a direction." (Provider FG#1). (Sibbald et al 2020)*
Forming purposeful relationships, linkages, and partnerships	
4A. When network members believe in the network's collective vision (context), then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because they are more willing to work with and value working with people whom they identify as being likeminded (mechanism)	*"The structures and processes of the MRU were specifically designed to enable coordinated action across key interfaces. These interfaces were between the PHC system players and district hospitals at the sub-district level, between district and sub-district managers, between units within hospitals, and between clinicians (experts) and managers (drivers). The new relationships and common collective visions for MNCH forged across these interfaces were generally regarded as the most important organizational impacts of the MRU.* *…what I've found the system able to do was to break down those silos and to cross-pollinate across the whole district, and I find that extremely helpful. (DCST member)* *Before, it was like two entities, the hospital and the clinics. But I don't know what forces or whatever it has combined us now, we are not two entities anymore. (PHC manager)" (Schneider et al 2020)*
4B. When network members are open to and able to invest time in developing relationships and linkages through the network (context), then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because they have a better understanding of each other (mechanism)	"*Interview respondents highlighted that particular DLHs have established positive working relationships with RHs over the years to the benefit of both parties. This is often driven by the spirit of initiative of individual district clinicians, who have invested time and efforts in cultivating collaborative relationships with RH specialists, and persistence to maintain them. As explained by a RH respondent when describing one such clinician: "he is very collegial. All the time, if [name of district clinician] sends something [a case] you know for sure that's something which he really needed help with.[...] If [he] was behaving like all the other ones he would have been a tough guy, giving us all the problems, but he is very professional and he communicates very well" (27RMW)." (Pittalis et al 2021)*
4C. If network members have strong pre-existing relationships (context), then this helps ensure that network members have purposeful and co-operative working relationships (outcome) because they are already familiar with each other (mechanism)	*"However, a lack of interest in participating also emerged in all five countries, with greater intensity in Uruguay and Brazil in general; and with regard to offline virtual consultations in Mexico, and replica meetings (meetings with other network doctors not in the PP) in Colombia. Contributing factors, according to interviewees, were: the 'limited adherence to the primary care-based model' of some SC doctors in Brazil, Chile and Uruguay and 'not knowing the doctors of the other care level', 'mutual mistrust' and PC doctors' 'shyness and fear to express their doubts' in Chile, Colombia and Mexico. However, these obstacles diminished as they participated: Yes, yes,*

	at the start I found it really difficult to participate (.. .) at first it was like: 'um...what am I going to do there? They're all going to be looking at me, I've got to give a reply, it's scary, I don't want to do this' (.. .). But it's all got a lot better, (...) they want to participate, because they're enjoying it. (Administrative personnel, Chile)" (Vargas et al 2 2020) *"In contexts where there was an absence of a history of established relationships and collaboration, where there has been less activity around the joint setting of priorities either at bid development stage, the need to sell the benefits of CLAHRC to encourage or incentivise engagement of mutual benefit was evident: I think that getting people engaged in it is about them seeing there's some mutual benefit and where there wasn't seen as any mutual benefit it doesn't happen…I know other CLAHRC Directors feel a bit the same, that you feel like you're a salesperson going round trying to sell things. (Leader, Hazeldean)" (Rycroft-Malone et al 2017)*
4D. If there are artefacts in place that outline the roles and responsibilities of network members (context), then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because there is a common understanding among network members about what they are expected to do (mechanism)	*"Ensuring that a true partnership exists among project staff, service providers, the government, donors, and other key state stakeholders is crucial to a successful pooled effort. Clearly outlining what each organization is expected to provide or do and ensuring that contributions come from the state and local governments and other local stakeholders has resulted in continued successes." (Fistula Care 2010)* *"As a central part of the collaboration, PIVOT developed strong relationships with the Government of Madagascar and with local communities in Ifanadiana. The foundation of the MoPH/PIVOT partnership is based on purposeful agreements that clarify common objectives and specify each party's responsibilities; this clarity fosters an enabling environment for the NOC." (Cordier et al 2020)* *"There should be an MOU between hub and shared-care centres, to strengthen the understanding of the teams and of hospital management. It should define responsibilities and timeframes. It is also much easier to achieve conformity and guidelines if hospital management are involved from the start of the programme." (Burns et al 2018)* *"Some from the senior health service manager and policy-maker groups, expressed that there were some tensions in the evolution of this relationship and this was said to be a barrier to network development. It was felt that not all network personnel effectively liaised with the state health department. This was largely attributed to a lack of understanding of the correct procedures and processes for consulting and communicating with government. Developing strong positive relationships between networks and senior administrators and executives from local health services were regarded as essential by all stakeholder groups. However, the development of this relationship was seen as a 'work in progress'. From the perspective of those in the network group, this was partially attributable to local health services reluctance for network initiatives to*

	extend across health service boundaries: "This is part of the local health service culture - they see all health needs being able to be met within their boundaries and by the health service employee."" (McInnes et al 2012) *"Fostered clinical agreement on treatments, diagnostic tests and referral criteria "on going over the meeting topics and all that, well let's just say that we get a space in which to air our differences or opinions, which us general doctors also have on the management of cases (…). So there are discussions, there's a space for discussion and so somehow more agreements are reached" (PP, Colombia). "(…) I think the most positive aspect [of the videoconferences] is about coming to an agreement on the type of pathology we're working on, you know? Through a protocol, so that each one of us understands what they have to do and what their responsibilities are" (Healthcare professional, Chile)" (Vargas et al 2020)*
4E. When a network creates opportunities for relationship building between network members (context), this may help in the creation of purposeful and co-operative working relationships and improve existing working relationships (outcome) because they get to know each other's personality, skills, ways of working, and motivations better (mechanism)	*"The informants perceived that joint training meetings had an impact on interactional factors, since personal knowledge between physicians was allowed; thus, collaboration was favoured: "This close relationship among people working here is fostered, because we no longer perceive them so distant…we perceive them as members of the same team…attitude towards the patient changes when you know that he is received by someone you know" (Professional Platform/Primary Care)." (Lopez-Vazquez et al 2021)* *"Regarding the training method, informants considered that the open attitude and absence of hierarchies shown by facilitators of the joint training meetings on maternal health, as well as including practical activities and resolution of clinical cases, enhanced dialogue, interest and involvement in the sessions. Thus, the initial defensiveness of primary care physicians was eliminated, a climate of equality (Table 4d) was fostered, and the resolution of doubts via direct communication between peers was promoted: "Now, I was able to stay in touch with a gynaecologist, and any particular doubt I could not solve by reading (regarding CPG), so I could trust them, I was able to detect a greater close relationship" (Professional Platform/Primary Care)." (Lopez-Vazquez et al 2021)*
4F. When network members have established purposeful relationships (context), this helps to improve communication between network members (outcome) because they are familiar with each other (mechanism)	*"These new relationships facilitated more open day-today communication: There is a lot more open communication. If there is an ANC that you must refer now it is high risk, you can phone up to the maternity ward. (PHC manager). It is easy to pick up a phone and phone them and ask the sister to tell me about this patient. Most likely they will be able to tell you about the patient because they draw files. So we have a very good working relationship with the guys outside especially the PHCs. (Pediatric ward manager)." (Schneider et al 2020)* *"Allowed clinical cases on the waiting list or complex cases to be resolved in primary care "(..) it was shown to be useful [joint virtual clinical conferences],it's very useful, for example when the general doctor who has a grandma with dementia that wakes everyone up at 3 in the morning, so*

	he doesn't just have one patient now but 5, which is the whole family that hasn't slept… and we [SC doctors] can say to him: 'well let's have a look at this, or that, we'll treat it with this medicine, we'll do these tests, and it's not necessary for her to come over here'" (Healthcare professional, Chile) (Vargas et al 2020) *"Most informants in Chile pointed out that as a consequence of the virtual joint meetings, agreement was reached on how to manage or resolve clinical cases that were complex or on the waiting list, thus avoiding referrals to specialist care. In Colombia and Mexico, they also highlighted solving queries and reaching general clinical agreements on disease management, not only for specific cases: "(...) so the fact that, for example, I can now talk to the dermatologist and say "Look, I've got this case..." Before the videoconference that just didn't exist and was unthinkable. So, now I've resolved a couple of cases that were really complicated, and there was a waiting list of I don't know how many years (…) so in that sense it's been really favourable (…)" (PC doctor, Chile)." (Vargas et al 2020)* *"Impact limited to the specialities that participated, or little impact on coordination "Well yes I think so, in the areas we had contact with. Of course the hospital is huge, there's a lot of different specialities that also need the chance to get to know each other and that's the main reservation I have, that one person can only do so much (…) So that's why I think it may be important to repeat it [cross-level visits] to cover more specialities" (Administrative professional, Chile) "The relationship between general doctor and the specialist that was directing, leading the progress of the meeting (…) was great because they talked to each other, communicated, they got to ask each other questions and they used tools like WhatsApp text messages." (Vargas et al 2020)*
4G. When purposeful linkages and strong working relationships are established between network members or between network members and external stakeholders (context), this bridges gaps between network members or network members and stakeholders (outcome) because of mutual understanding (mechanism)	*"To help develop 'engaged and motivated' members of CIN at local levels and build a collective identity and community of practice, we hold twice yearly face-to-face meetings with paediatricians inviting the other CIN focal persons to one annual meeting.9 These meetings allow participants to discuss their audit reports (including offering suggestions for improving data collection) and to identify underlying problems and potential solutions with peers. They also provide a forum for short, specific skills building sessions focused on the 'soft skills' needed as a manager (eg, how to run a team) and on building their understanding of research. Crosstalk among the scientific, clinical and policy communities in an arena promoting collegial relationships helps interpret results based on an understanding of practice in the real world. This enables all sides to understand how contexts interact with improvement approaches to bring about observed outcomes26" (Irimu et al 2018)* *"Our data support the value of formally recognizing and integrating TBAs into EONC services, consistent with observations that when integrated into a healthcare system, TBAs can play an integral role in improving EONC services and maternal and newborn health (13–15). Moreover,*

	through the creation of an EONC network, the project bridged profound gaps among fractured and isolated public and non-governmental institutions aligning formal and informal health systems and linking science-based health care with traditional and culturally responsive procedures. EONC was tailored to be implemented in a three-level network of services – parish health centers, district, and provincial hospitals – each one with its specific responsibilities and an effective referral system. QI methods were implemented at each level in the EONC network. Application of these principles resulted in an increase of access to and quality of EONC services. It greatly contributed to improving postpartum and neonatal care within the first 2 days of delivery, an outcome that likely contributed to neonatal survival improvement" (Broughton et al 2016) *"Networks that had not formed strategic external relationships were thought by some participants to have limited reach and to experience difficulties in facilitating projects that could deliver significant impacts: They [the network] do have a strong voice with local hospitals, but not really beyond. It is the relationships with external bodies (professional, academic and health departments) that helps to facilitate and implement projects that will make the bigger impact. Ability to effectively engage with external bodies relevant to the network such as government; professional organisations and colleges, was therefore seen as important for maximising network potential to achieve significant long-term impacts." (McInnes et al 2015)* *"Partnerships with external stakeholders, such as the state government health department and the local health services, were regarded as an important and desirable outcome by all stakeholder groups, not least because it was seen as giving networks credibility and legitimacy in the broader health arena. Participants stated that since the formation of clinical networks, overall the relationship between clinicians and government agencies had improved and had led to greater mutual understanding of perspectives: "I think the successful outcomes have been the partnerships and how those partnerships have worked in an open and transparent way and that's how we need to do it. At a hospital level, at a local health service level, at a state level and at a national level."" (McInnes et al 2012)* *"Generating buy-in from, and establishing trusting relationships with, these public sector partners was the first step in developing the network. The process began with the initial needs assessment and continued throughout proposal writing, facility selection and implementation." (D'Mello et al 2020)* *"Referral protocols should include alternatives outside the referral network sites. Of all referrals, 65% were sent to the referral hospital inside the MRN, while 30% were sent to an out-of-MRN hospital. For the out-of-MRN sites, often private or NGO hospitals, providers reported that they believed patients with particularly complicated cases would receive better care. The study found*

	that establishing relationships with hospitals that are commonly used but are not formally part of the referral system is important to strengthening the network plan. These relationships are especially important during hospital strikes, when services may be lacking or nonexistent at certain public hospitals." (MCSP Haiti 2018)
Network leadership	
5A. When networks have a member(s) that clearly takes on a leadership role, focuses on building linkages between potential network members and stakeholders, and creates communication channels (context), this helps the network to form (outcome) because it brings people together (mechanism)	*"Participants were unanimous about the critical importance of the role of the network manager in contributing to network success. Participants from the high- and moderate- impact networks frequently attributed the success of their network to the work and skills of the network manager. As well as project management, communication, organisational, coordination and leadership skills network managers also needed high credibility, be able 'to talk the language of networks', that is to communicate the vision and principles of networks to a range of clinical and policy stakeholders, and to have good interpersonal skills. To lay the groundwork for later success the network manager had to 'hit the ground running' in the early stages of a network's development. One participant attributed the success of their network to the activities of their network manager in the early stages of the network's history: They built links; met with all key players and created formal and informal communication channels between diverse bodies. Effective network managers also: Provided a hub around the network's clinical specialty and engaged with key stakeholders and the broader clinical base formally and informally." (McInnes et al 2015)* *"For network chairs (and network managers) skills in negotiation and relationship building were regarded as essential by all participants. These skills were thought to bring the 'outliers into the fold' ('outliers' referring to those not involved in networks) and to enable connection with key partners in academic, professional and policy spheres, thus 'building a broad base of support from which to facilitate achievements and significant impacts'." (McInnes et al 2015)* *"The essence of effective network leadership appeared to hinge on the ability of the network chairs and network managers to span both discipline and sector boundaries and to champion network agendas and associated projects, linking networks to key stakeholder organisations such as professional colleges and policy agencies to ensure buy-in and the spread of network innovations." (McInnes et al 2015)* *"In our study, charismatic and visionary network chairs who could negotiate with the Ministry of Health, particularly in the early stages of a network's history, were perceived as kick-starting the network on the road to success. These individuals had attributes indicative of a transformational style of leadership [17]. These attributes included possessing knowledge of complex systems, ability to influence peers and to bring together diverse groups of people across disciplinary and organisational boundaries to form positive and productive alliances. These types of clinical leaders have been termed 'strategic clinicians' [15] and represent clinicians who 'think more managerially*

	and strategically' [15]. However it was also noted that those networks who mainly depended on a network chair to be the primary driving force, risk having limited impacts." (McInnes et al 2015) *"In the sub-units where the MRU did not convene (except when visited by the external facilitator), this was usually due to a gap in leadership and support from either the hospital or PHC services, preventing the establishment of the informal coalition of actors" (Schneider et al 2020)*
5B. When networks have a member(s) that clearly takes on a leadership role, communicates the network's vision, and helps to set collective goals (context), this helps to bring network members around the collective vision and to move forward in the same direction (outcome) because they have the same understanding (mechanism)	"*The network's vision provided a common foundation and a shared approach, allowing each member to work towards a collective goal. PCIC and ARGI participants described how the network leaders communicated the vision clearly and helped set goals collectively while continuously supporting individual network members and RTs: "… it's a very goal-oriented group that looks for solutions and that I find, quite uplifting. Wednesday I'm feeling kind of low and scattered, but Friday (after our team meeting) a little more feeling good, I'll feel energized, like we've got a direction." (Provider FG#1). For network members, this translated back to their primary goal of delivering high quality patient care." (Sibbald et al 2020)* *"There were two unique aspects of this role that were believed by participants to lay the groundwork for success. One was the ability to 'clear a path through the maze of issues'. This referred to the ability to anticipate and manage operational and project complexities and to negotiate with and involve the right stakeholders at the right time in relation to critical project stages. The other unique aspect was the ability to effectively translate information and ideas to different audiences, namely to clinicians, funders and policy makers. In effect, acting as a knowledge-broker able to 'deliver high content knowledge' to a wide audience and to: Sell the project – make internal and external stakeholders feel as though the network initiative is an important, achievable target." (McInnes et al 2015)* *"Participants were unanimous about the critical importance of the role of the network manager in contributing to network success. Participants from the high- and moderate- impact networks frequently attributed the success of their network to the work and skills of the network manager. As well as project management, communication, organisational, coordination and leadership skills network managers also needed high credibility, be able 'to talk the language of networks', that is to communicate the vision and principles of networks to a range of clinical and policy stakeholders, and to have good interpersonal skills. To lay the groundwork for later success the network manager had to 'hit the ground running' in the early stages of a network's development. One participant attributed the success of their network to the activities of their network manager in the early stages of the network's history: They built links; met with all key players and created formal and informal communication channels between diverse bodies. Effective network managers also: Provided a hub around the network's clinical specialty and engaged with key stakeholders and the broader clinical base formally and informally." (McInnes et al 2015)*

	"The network was initiated with a meeting of a paediatrician, a senior nurse and the health records information officer from each participating hospital and the research institute and university partners. At this meeting and at subsequent hospital-specific introductory visits the network was explained and its purpose to promote better generation and use of health information to support better care. Collaboration is supported from the network centre by a clinical coordinator who coordinates network meetings and offers the feedback, discusses it and provides advice as required while also promoting peer-to-peer support. During the 4–6 monthly meetings predominantly with paediatricians specific short sessions (< half a day) were provided that explained leadership of teams, how to give group feedback, on understanding complex systems and on the principles of quality indicators and their use. The training typically used discussion, reflection and individuals' experiences as well as presentations. Relationships and the educational approach were complemented by visits to hospitals by the clinical coordinator in the first year to explain and discuss the hospital-specific indicators provided in an overall report National guidelines for care were distributed to network and non-network hospitals as part of a national distribution and some network paediatricians took part in updating these guidelines in 2015" (English et al 2017)
5C. When networks have a member(s) that clearly takes on a leadership role and actively coordinates network members (context), this helps the network to form (outcome) because there is a central figure bringing people together (mechanism)	*"Collaboration is supported from the network centre by a clinical coordinator who coordinates network meetings and offers the feedback, discusses it and provides advice as required while also promoting peer-to-peer support. During the 4–6 monthly meetings predominantly with paediatricians specific short sessions (< half a day) were provided that explained leadership of teams, how to give group feedback, on understanding complex systems and on the principles of quality indicators and their use. The training typically used discussion, reflection and individuals' experiences as well as presentations. Relationships and the educational approach were complemented by visits to hospitals by the clinical coordinator in the first year to explain and discuss the hospital-specific indicators provided in an overall report National guidelines for care were distributed to network and non-network hospitals as part of a national distribution and some network paediatricians took part in updating these guidelines in 2015." (English et al 2017)* *"Another diversifying factor was that network members were drawn from the various clinical, patient, academic and non-government organisation391 communities across metropolitan, regional and rural areas. Members were regularly invited to attend network meetings and events in person or through video-conferencing. ACI-based network managers were central to building and maintaining their network's dynamics and activities, and to achieving and coordinating network output and impact. At the same time, ACI had not made it a priority to standardise391 networks' memberships, their deliberative dynamics, or their output. This attests of ACI's tolerance towards variability and acknowledgement of the influence exerted by individual*

	members' personalities, contextual pressures and constraints, and unexpected opportunities and unpredictable challenges." (Iedema et al 2017) *"All stakeholder groups saw leadership across three different levels as an essential building block for effective structure, organisation392 and governance, and as a major facilitator of network effectiveness and success. Having 'a strong network manager who can direct a lot of the stuff' with ability to effectively liaise with clinicians, consumers, and external stakeholders; implement workplans; and effectively run network operations was one level of leadership which was seen as important, particularly for setting up organisational392 and governance processes. A participant from the network driver group summed up the importance of the network manager's role as follows: "It's a big jigsaw puzzle and you have to have one person, I think, who knows all the pieces of the puzzle."" (McInnes et al 2012)*
5D. When networks have a member(s) that clearly takes on a leadership role and provides support and feedback to network members (context), this can help the network function and take more appropriate action towards the identified problem (outcome) because network members are engaged and see what they need to do to help achieve the vision (mechanism)	*"Normalizing data collection and clinical audit involved pastoral inscription practices too. CIN provided on-going training for data clerks, HRIOs and clinical teams about how to collect data and understand CIN quality care reports (English et al., 2017). CIN leaders provided performance feedback to participating hospitals in person for the first 18 months, to ensure that participants could interpret data and use it to address problems, improve practices and clinical outcomes (English, 2013; English et al., 2011, 2017). Nurse-in-charge 30 commented that CIN's leaders: "keep on giving feedback … they come in [to district hospital] physically … to instill more confidence and more value to the program. I think it is very useful."" (McGivern et al 2017)* *"Collaboration is supported from the network centre by a clinical coordinator who coordinates network meetings and offers the feedback, discusses it and provides advice as required while also promoting peer-to-peer support. During the 4–6 monthly meetings predominantly with paediatricians specific short sessions (< half a day) were provided that explained leadership of teams, how to give group feedback, on understanding complex systems and on the principles of quality indicators and their use. The training typically used discussion, reflection and individuals' experiences as well as presentations. Relationships and the educational approach were complemented by visits to hospitals by the clinical coordinator in the first year to explain and discuss the hospital-specific indicators provided in an overall report National guidelines for care were distributed to network and non-network hospitals as part of a national distribution and some network paediatricians took part in updating these guidelines in 2015."" (English et al 2017)*
5E. When networks have a member(s) that takes on a leadership role and gets things done (context), network members develop greater commitment, engagement, and/or motivation (outcome) because they believe belonging to the network is worthwhile (mechanism)	*"There were two unique aspects of this role that were believed by participants to lay the groundwork for success. One was the ability to 'clear a path through the maze of issues'. This referred to the ability to anticipate and manage operational and project complexities and to negotiate with and involve the right stakeholders at the right time in relation to critical project stages. The other unique aspect was the ability to effectively translate information and ideas to different audiences, namely to clinicians, funders and policy makers. In effect, acting as a*

	knowledge-broker able to 'deliver high content knowledge' to a wide audience and to: Sell the project – make internal and external stakeholders feel as though the network initiative is an important, achievable target." (McInnes et al 2015) *"All stakeholder groups saw leadership across three different levels as an essential building block for effective structure, organisation and governance, and as a major facilitator of network effectiveness and success. Having 'a strong network manager who can direct a lot of the stuff' with ability to effectively liaise with clinicians, consumers, and external stakeholders; implement workplans; and effectively run network operations was one level of leadership which was seen as important, particularly for setting up organisational and governance processes. A participant from the network driver group summed up the importance of the network manager's role as follows: "It's a big jigsaw puzzle and you have to have one person, I think, who knows all the pieces of the puzzle."" (McInnes et al 2012)* *"the Clinical Network Executive. This body was seen by all groups as having the authority and credibility to 'take management issues up the chain' to state government and as having a direct line to both the Minister of Health and the Director-General of NSW Health. From the perspective of those in the network driver group, maintenance of that direct line was seen as critical to the ongoing sustainability of networks. Some from this group commented that having a co-ordinating body such as the Clinical Network Executive helped to 'keep [networks] going and on track': "The support from the Executive is very, very important and executive understanding of the issues is even more important. I don't think that we could undertake our projects without [the Executive Officer] who really is on top of all the issues and knows the ways to address them."" (McInnes et al 2012)* *"The ability of the network chair to engage the multidisciplinary clinical workforce in network initiatives, collaborate with external stakeholders, and to drive the implementation of network objectives was seen as critical for providing the foundation for the delivery of high-impact projects and creating a momentum towards successful network outcomes." (McInnes et al 2015)*
5F. When networks have a member(s) that takes on a leadership role and dedicates time to setting up and the functioning of the network (context), network members develop greater commitment, engagement, and/or motivation (outcome) because they believe belonging to the network is worthwhile (mechanism)	*"The 'institutional support' of network managers emerged in all five countries as the main organizational factor that influenced implementation of the interventions (Supplementary Box S2). In Chile, and in Brazil with the occasional interruption, it was identified as a facilitator that remained stable throughout the process. In Mexico, it was strengthened following political change; in Colombia, it was weakened; and in Uruguay, it remained frail. It was considered key in terms of whether the resources needed (professionals' time and materials) were available to implement the interventions (and in Brazil and Mexico also to solve operational problems—see Supplementary Box S2): '...there was support from the managers to protect these (allocated*

	project) schedules, that normally doesn't happen with this kind of more low-scale project' (Professionals' inter-level working group, Chile)" (Vargas et al 2 2020)
5G. When networks have a member(s) that clearly takes on a leadership role and actively engages network members (context), network members develop greater commitment, engagement, and/or motivation (outcome) because network members feel part of the network (mechanism)	*"Developing Kenyan national guidelines involved extensive engagement with key stakeholders, including the Kenyan Ministry of Health, Kenyan Medical Schools and the Kenyan Paediatric Association. CIN Director 25 noted: "That process of developing the national guide … introduced me to … stakeholders … that needed to be engaged … [who] began to know me and what I was up to." Thus, involvement in constructive practices indirectly established CIN leaders' expert and legitimate pastoral status. Yet this pastoral status was also grounded in experience of the challenges Kenyan clinicians faced. Both CIN leaders had practised in the Kenyan health systems for over 20 years and taught Paediatrics and Child Health at a leading Kenyan university, so knew many Kenyan paediatricians personally. Thus, CIN leaders had expert, professional and personal credibility." (McGivern et al 2017)* *"The ability of the network chair to engage the multidisciplinary clinical workforce in network initiatives, collaborate with external stakeholders, and to drive the implementation of network objectives was seen as critical for providing the foundation for the delivery of high-impact projects and creating a momentum towards successful network outcomes." (McInnes et al 2015)* *"Influential and passionate clinical leaders (who lead or chair a network) were also regarded as necessary to build effective networks. Characteristics of a good clinical leader included being well respected by the clinical community and as having 'a bit of fire in their belly' and 'a fair bit of ambition'. The ability to keep people engaged and to influence a wide range of consumers and clinical stakeholders was identified by all groups as an essential part of developing an effective network: "You need to keep people's passion; if you lose that you lose sight of everything.""" (McInnes et al 2012)*
5H. When network leadership consistently and regularly supports and provides resources to network members (context), this helps network members act to achieve the network's collective vision (outcome) because the network members feel empowered (mechanism)	*"A third inscription practice was mentoring and supporting use of audit for QI as a form of professional development (English et al., 2017). Nurse-in-Charge 5 commented: "Support is very important … people to guide and giving the feedback … to help improve data … quality of care … mentoring… I find it very helpful." Likewise, Paediatrician 4 noted: "[CIN leaders] will give you an answer that actually opens up a whole road of possibilities … they're really good mentors." Mentoring and support was also apparent during CIN meetings: "The mentoring and supervision is useful, especially from the network coordinator … you see a lot of engagement… during [the CIN] forum … between the members of the network, the clinicians and their mentors."" (McGivern et al 2017)* *"Moreover, senior paediatricians and nurses 'in-charge' locally mentored colleagues to adopt the practices CIN advocated. Paediatrician 4 commented: "I mentor a lot of doctors … I love paediatrics … I'm passionate about what I do, including even quality improvement… it's kind of*

	catching." Consequently, QI practices spread via a constellation of CIN members through the inscription practices we describe" (McGivern et al 2017) *"Such feedback reports and participation in the network have prompted greater adoption and use of the standard paediatric admission record form and, consequently, overall improvements in documentation of clinical characteristics." (Tuti et al 2016)* *"A senior paediatrician (the CIN clinical coordinator) also followed up the provision of reports with specific emails and phone calls (after 1–2 weeks) to the paediatricians highlighting specific areas of success and areas requiring continued improvement. These calls aimed to provide encouragement and support as part of building a sense of being within the network." (Gachau et al 2017)*
5I. When network leadership consistently and regularly promotes, encourages, or champions practices or influences network members to take up certain practices (context), this helps network members to adopt these practices (outcome) because it allows network members to fulfil a latent desire to practice better (mechanism)	*"championing in CIN involved 'influencing' rather than imposing change. CIN Director 25 noted: "We … promote and encourage rather than say you have got to do it this way … put yourself in the shoes of the person you're trying to support or influence, so that you can appreciate their realities." Similarly, Epidemiologist 23 noted: "within CIN, where you have paediatricians who are authorities in their field, the type of leadership that they need is one of influencing, not teaching or directing what they should do … you can achieve significant changes in care through influencing" (McGivern et al 2017)* *"From data analysis, we noted three pastoral inscription practices in CIN inscribing paediatric guidelines into routine care. The first involved CIN's leaders evangelically championing CIN's purpose as benefitting network participants and patients. CIN Director 1 described: "Challenging mind-sets … becoming a champion, going out speaking." CIN Director 25 was described as "the force behind what we are doing" and "our champion" (CIN Director 1). Thus, by championing CIN's activities, its leaders motivated doctors and nurses involved in the network to use guidelines, clinical audit and data collection for QI purposes." (McGivern et al 2017)* *"Another network participant from a well-established network, regarded the role modelling by senior clinicians of these new ways of collegial working as important an outcome as achieving improvements in patient outcomes: "Above all else, role modelling, so that younger clinicians can see that all disciplines are conversing, working together and can see that everyone has a place and a voice at the table. This is the most important, most desirable network outcome in my view." (McInnes et al 2012)*
5J. When network leadership creates a welcoming and inclusive environment within the network (context), members feel more able to critically discuss issues and suggest possible solutions (outcome) because network	*"Improving the quality of patient-level practice often requires support for an enabling professional culture. Providers at one of the CCBRT NOC referral hospitals noted that improvements in teamwork in labor and delivery resulted in a decline in their facility's maternal and perinatal death rates. Further, they described how their team's motivation was inspired largely by improved*

members feel that they are in a psychologically safe environment (mechanism)	*hospital management. When the medical officer in-charge and the hospital Matron walked around facilities to check-in with health workers, inquiring about maternity care and identifying how they could assist, it fostered a positive environment with improved teamwork. The clarification of a sense of purpose and confidence in leadership promoted by the NOC formation nurtured these and other better management practices." (D'Mello et al 2020)* *"A senior paediatrician (the CIN clinical coordinator) also followed up the provision of reports with specific emails and phone calls (after 1–2 weeks) to the paediatricians highlighting specific areas of success and areas requiring continued improvement. These calls aimed to provide encouragement and support as part of building a sense of being within the network." (Gachau et al 2017)* *"CIN leaders attempted to link recognition of senior colleagues and peers to affirming professional values, challenging a traditional, authoritarian medical culture in Kenya, which was seen to perpetuate outdated clinical practice. CIN Director 25 noted that CIN "benefitted from trying to present… a new way of doing business", which junior health professionals were "receptive to" due to a "dissatisfaction with the sort of old professor stands in the corner and tells you … [CIN] fitted into that generational issue, of the expanded internet … seeing that there is more than just doing what you were told fifteen years ago." This new approach appealed to younger health professionals." (McGivern et al 2017)*
5K. When networks have processes in place to identify and enable those with the necessary skills, motivations, or attitudes to take on leadership roles (context), this may support network functioning and may lead to changes happening (outcome) because the network can draw on a wider pool of engaged resources (mechanism)	*"The initiative relied heavily on mobilizing the District Clinical Specialist Teams and program managers to steer and implement collectively agreed-upon strategies for improving MNCH services. Also, key were nursing managers in the districts, hospital and PHC services and the dietitians who formed a core of stable professional cadres, in the face of a high turnover of doctors and political appointees at more senior management levels. The MRU offered new spaces of decision-making, participation and recognition for these players. Dietitians, for example, emerged as the key leaders of the response to malnutrition, authorized through the MRU to engage and lead the team response. Similarly, as related by a Ward Based Outreach Team (WBOT) coordinator: "…through this, now suddenly they recognize WBOTs. They see what they are really used, [for] what they can really be used for."* *At a formal level, the MRU exemplified a hierarchical mode of governance: Starting at the district level, the driver is the district manager, and then the rest of us follow. At the subdistrict level at the hospital the CEO is the driver, and all other units will follow. And then from PHC level, the PHC manager of that particular sub-district is their driver, and then the navigators will follow. (District Dietitian) However, at an informal level, the "real" drivers were often the middle managers at district and sub-district levels (Figure 2), functioning in a more networked mode of governance." (Schneider et al 2020)*

	“Rotating chairs between clinical disciplines was regarded as a strength by those in the network groups and as an effective strategy for building local support, because it ‘gets away from the doctor-boss type thing’ and signals that the network values the contribution of all disciplines. The need for appropriate representation in working groups and on governing committees was also seen as important for the same reason: “If people saw it as being just the teaching hospitals driving this then our district hospital and our GP services wouldn’t want to be a part of it. So you’ve got to have an appropriate level of representation.”” (McInnes et al 2012) *"The CIN focal persons in each hospital are ‘mid-level’ managers who lead departments and teams. In these clinical hybrid roles, they are responsible for improving documentation in medical records that facilitates data collection and ongoing improvement work. The focal persons bring local authority and a distributed form of leadership that promotes CIN legitimacy and credibility. They also understand the local context of hospital systems and power relationships, and play key boundary spanning roles in changing the behaviours of frontline workers that are critical to achieving improvements in care and outcomes. Engaging such personnel in improvement work does demand, however, that they have the capability, that the environment offers them the opportunity and that they remain motivated in what can be challenging low-resource settings." (Irimu et al 2018)* *"However, even where the CEOs and medical managers were not active players, the MRU was able to meet regularly and make a positive contribution if a stable core of middle managers in both hospital and PHC services saw its value. In the presence of formal authorization of the MRU from above, locally specific, informal coalitions, led in large part by senior nursing managers, were able to anchor and sustain implementation of the MRU." (Schneider et al 2020)* *"In District 1, there had been three acting District Directors since the inception of the MRU, and at the time of the interviews, the district management team had not met formally for 6 months. Although the MRU was written into job descriptions of hospital CEOs and PHC managers, there was limited active oversight of sub-district MRUs by district managers. However, active support from one senior member within the district management team, and from the DCST and program managers, ensured a sufficient degree of cooperation for the district MRU to meet regularly and be considered effective....In sum, there was more evidence of cooperation with the MRU as a strategy in District 2 than in District 1, even if in the latter the MRU had enthusiastic proponents who ensured its ongoing functioning." (Schneider et al 2020)*

5L. If a network is highly dependent on a few people to implement network activities (context), then it is at risk of being unsustainable (outcome) because of burnout and/or loss in those tasked with implementation (mechanism)	*"despite seven years of QRP implementation and agreements, the management of the QRP is not yet formalized in the job description of the head of the Ob/Gyn Department. This oversight has the potential to create a vacuum once dedicated personalities step away from daily work for QRP. Recognizing this risk, a roster was formed of Ob/Gyn residents who are tasked with management of QRP on a rotating basis." (Vergara et al 2020)* *"It was remarked that beyond the establishment phase, with a good network manager in place, the network should become less dependent on the network chair. Some participants from both groups interviewed, believed that those networks that were highly dependent on the activities of the network chair were less likely to have impacts because the network became a 'one-person show', with 'limited reach' as well as burning-out the network chair." (McInnes et al 2015)*
5M. When network leadership is not able to get the network to develop and agree on a shared vision (context), then it is at risk of not performing well and becoming unsustainable (outcome) because members are unclear as to what the network is for (mechanism)	*"It was remarked that beyond the establishment phase, with a good network manager in place, the network should become less dependent on the network chair. Some participants from both groups interviewed, believed that those networks that were highly dependent on the activities of the network chair were less likely to have impacts because the network became a 'one-person show', with 'limited reach' as well as burning-out the network chair." (McInnes et al 2015)*
Network identity and culture	
6A. When network members with a collective identity come together to solve a shared problem (context), this makes them feel fulfilled (outcome) because of a sense of shared purpose (mechanism)	*"The PAR process improved interactional factors between managers of the network "(…) Hospital: "There's nothing more I can do because primary care is doing such a terrible job". Primary care centre: "There's nothing more I can do because the hospital is doing such a bad job" (…) And with that we don't get anywhere constructive (…) I would say that this in some way....means we basically see ourselves as one and the same. So we've really managed to lower our defensive barriers (…) and start to understand that what we really need to do is help each other out" (LSC, Chile). "it's like a sign that a shared vision of the network is appearing, which was the problem we had in the first place (…) Of course, and people perceive it and everyone can feel it now. If I've got a problem I know who to speak to and I know they're going to help, you know? And the certainty that they'll help me, that they'll collaborate with me for the sake of the patient"" (LSC, Chile) (Vargas et al 2020)* *"Bi-annual network meetings helped to develop paediatrics as a professional community in Kenya. CIN Director 25 described one of the network's aims as: "Truly being able to engage with one's peers … for the profession to begin to take more of a view … a stand on what is happening and begin to own that agenda." CIN meetings enabled participants to share experiences, learn from colleagues facing similar challenges and develop as part of a multi-professional and multi-organisational paediatric community. Nurse-in-charge 30 noted: "CIN has been great. It has made me meet so many other people from different organizations and different work backgrounds but we are all pushing towards the same goal." Similarly, Paediatrician 10 described how by "coming*

	together" and being able to "share challenges and successes and learn from others" CIN members "move together to improve the quality of care for our children [patients], individually and then collectively." (McGivern et al 2017)
6B. When network members feel fulfilled from working with likeminded people in a network (context), they want to belong to the network (outcome) because they feel it is worthwhile (mechanism)	*"The implementation history of the PCNs suggests an evolving and nuanced role for cultural adaptation as a strategy for achieving longevity, popularity, and transformation towards a physician-focused interpretation of PHC. Our findings suggest a super structure of cultural transformation has emerged from and been made possible by a base layer of requisite, legally as identified elsewhere, acknowledging and adapting interventions to these closely held cultural values is clearly a key element in making PHC transformation not just possible [68] but seen as legitimate by family physicians [73]. In Alberta's case that legitimacy, generated out of cultural concordance and a sense of local ownership of self-made solutions has held [61, 74, 75]. Indeed, it has thrived, with over 80% of the province's physicians making the decision to sign contracts and remain members of their PCNs even as the Era of Accountability with its opposing cultural values arrived. The PCNs have survived and grown in popularity in part because they offer a cultural redoubt where independence and local action are protected and respected." (Leslie et al 2020)* *"Face-to-face meetings remain important to create and sustain individuals' and institution's identification with the Clinical Information Network (CIN) and consequently help overcome turnover of specific individuals." (Irimu et al 2018)*
6C. When network members identify with other network members and the network's vision (context), they develop a network identity (outcome) because it gives them a sense of purpose (mechanism)	*"To help develop 'engaged and motivated' members of CIN at local levels and build a collective identity and community of practice, we hold twice yearly face-to-face meetings with paediatricians inviting the other CIN focal persons to one annual meeting.9 These meetings allow participants to discuss their audit reports (including offering suggestions for improving data collection) and to identify underlying problems and potential solutions with peers. They also provide a forum for short, specific skills building sessions focused on the 'soft skills' needed as a manager (eg, how to run a team) and on building their understanding of research. Crosstalk among the scientific, clinical and policy communities in an arena promoting collegial relationships helps interpret results based on an understanding of practice in the real world. This enables all sides to understand how contexts interact with improvement approaches to bring about observed outcomes26" (Irimu et al 2018)*
6D. When a network creates opportunities for members to connect, share experiences, and learn from each other in an open and safe environment, (context), this creates a positive network culture and a feeling of belonging to the network (outcome) because they feel respected and valued (mechanism)	*"Bi-annual network meetings helped to develop paediatrics as a professional community in Kenya. CIN Director 25 described one of the network's aims as: "Truly being able to engage with one's peers … for the profession to begin to take more of a view … a stand on what is happening and begin to own that agenda." CIN meetings enabled participants to share experiences, learn from colleagues facing similar challenges and develop as part of a multi-professional and multi-organisational paediatric community. Nurse-in-charge 30 noted: "CIN has been great. It has made me meet so many other people from different organizations and different work backgrounds but we are all pushing towards the same goal." Similarly, Paediatrician 10 described how by "coming*

	together" and being able to "share challenges and successes and learn from others" CIN members "move together to improve the quality of care for our children [patients], individually and then collectively." (McGivern et al 2017) *"Knowing each other in person, according to informants, helped to improve their opinions and understanding of the other care level, increased their willingness to collaborate and find joint care strategies, facilitated direct communication for patient follow-up, and in Chile, moreover, bolstered their feeling of belonging to the network: "… barriers are now being broken down between the specialist [and the general doctor], 'because I'm the one who knows the most and the general doctor has no idea'. So now the specialist is starting to see the reality of a general doctor's work with all its limitations (…) That's when they open up their world view and say, ah right!, well my suggestion would be this, or whatever other path that allows the patient to improve their condition and their quality of life" (Healthcare Manager, Colombia); "I think there's certainly been a great contribution to coordination. For a start, this situation of acknowledgment…, this situation of acknowledgement of the different parts (...) And I think that this respect that has kind of been generated between one and the other paves the way, it creates the chance to build something together" (Healthcare Manager, Chile). In Chile, this improvement in interactional factors – personal relationships, trust – also occurred among administrators and middle managers that participated in creating the cross-level instruments to implement the interventions (LSC, PP, crosslevel working groups), and spread to other instances of cross-level management already present in the network." (Vargas et al 2020)* *"In Kenya, health professionals often work in remote district hospitals, overseeing clinical departments with little support or training. Many find this difficult, particularly without resources to provide high standards of care. Consequently, loss of motivation and burnout are common (Brown, 2016; Mbindyo et al., 2009). CIN leaders attempted to create a supportive network community to addressed this problem, by providing physical and online spaces in which to meet and share as a professional community. CIN encourages network participants to think about new approaches to problem-solving, and then implement, test and measure solutions, and facilitates sharing of learning across participating organizations, thus functioning as an improvement collaborative (English, 2013)." (McGivern et al 2017)* *"To help develop 'engaged and motivated' members of CIN at local levels and build a collective identity and community of practice, we hold twice yearly face-to-face meetings with paediatricians inviting the other CIN focal persons to one annual meeting.9 These meetings allow participants to discuss their audit reports (including offering suggestions for improving data collection) and to identify underlying problems and potential solutions with peers. They also provide a forum for short, specific skills building sessions focused on the 'soft skills' needed as a*

	manager (eg, how to run a team) and on building their understanding of research. Crosstalk among the scientific, clinical and policy communities in an arena promoting collegial relationships helps interpret results based on an understanding of practice in the real world. This enables all sides to understand how contexts interact with improvement approaches to bring about observed outcomes26" (Irimu et al 2018) *"The CIN has been relatively successful in creating an opportunity for frontline caregivers, health researchers and informatics specialists to learn as a community to improve availability of clinical data and begin to promote their use. The hospitals in the network have begun supplying and promoting the use of more structured medical records. This has been helped, we believe, by slowly changing the hospital culture through sustained engagement and by providing peer support by linking hospitals within the network.937 In this way, new staff quickly become familiar with the clinical forms and are integrated into thinking about data-informed quality improvement efforts at the hospital level, something that is not routine.37 38" (Tuti et al 2016)* *"At micro- level: absence of an enabling environment at facility level created a culture that gave little incentive for health facility staff to learn QI skills. It was further compounded by a rigid hierarchical system and partial administrative support especially encountered in the urban hub facility. Maintaining motivation in physicians was a challenge. Both the rural and urban facilities lacked dedicated hospital QI personnel, especially at the urban- hub facility; this made healthcare providers visualise QI as extra work, which distracted them from their regular patient care. Non-provision of transportation for hub mentors to their allocated spoke facilities added to poor motivation to undertake mentoring visits." (Srivastava et al 2020)*
6E. When network leadership and members identify that the network's culture is not aligned to existing cultures (context), then they may attempt to change the pre-existing cultures and instil a culture (outcome) because they do not identify with the existing ones (mechanism)	*"No restructuring of the physical environment in participating hospitals was conducted by the network team, but we did change the medical record systems and furnish information where it did not exist. This information on adherence to guidelines is aimed at creating a professional and social expectation to improve. Linked to a sharing of this information across groups and peers we were also aiming to create new norms and to revise socially constructed professional roles." (English et al 2017)* *"Between network inception and November 2016 hospitals have received 15 feedback reports. We observed that hospital teams are keen 'not to be in the red' but 'be green' in their report. Comparison of hospitals' performance especially during face-to-face meetings helped foster shared learning rather than potentially harmful competition and helped people gain confidence in their ability to achieve change. We attribute this to having a shared vision and referring to poor performance as 'offering opportunity for learning and improvement' while engagement with peers provided encouragement to complete quality improvement processes.25 As a result, clinical teams worked with their records department and hospital administration, drawing lessons from*

	across CIN, to ensure hospitals acquired infrastructure, reorganised service delivery and leadership provided effective mentorship and supervision to support delivery of quality care" (Irimu et al 2018) *"In addition to creating lines of communication and accountability, the hope is that, through their work, the committees will mitigate the mutual mistrust of the two joint venture partners by bridging their cultural differences. These cultural differences are not just a theoretical challenge, but also a source of significant tension in the applied work of co-planning. As one participant noted, the PCNs find themselves caught up in their members' cultural expectations and operational norms: Primary care doctors are used to getting the information [from a patient] and making decisions and getting out of the [exam] room in 12 minutes. And they bring that same attitude towards their PCNs and their PCN operations. Now obviously, PCNs can't make changes that fast. And so, [the doctors] already find PCNs slow. Then, [in the case of] PCNs working with AHS, AHS seems to move, from a primary care doctor's [perspective at] a glacial speed." (Leslie et al 2020)* *"These various changes were associated with a new culture of engagement with clinical guidelines and the intensification of in-service "drills," providing the software mechanisms which brought the pre-existing hardware strategies to life: It has also sensitized people about using the guidelines. People had guidelines but they were kept in the drawers, they were kept in the offices, locked up there … it has cultivated a culture of reading, reading the guidelines and discussing the guidelines. (DCST member)" (Schneider et al 2020)* *"A professional culture of compassionate service and pragmatism pervades the ranks of both public and private providers. Before formation of the Network of Care, this culture was not perceived as shared; each sector reportedly mistrusted the practices and intentions of the other." (Vergara et al 2020)*
Commitment	
7A. When networks members identify with the network's collective vision, identity, and culture (context), they are more likely to be committed to the network (outcome) because they believe in and value the vision, identity, and culture (mechanism)	*"Policies developed by the PCIC were adapted and tailored to meet the needs, resources, and abilities of the individual FHTs. FHTs' executive directors and lead physicians on the PCIC were supported and encouraged to use a 'bottom-up' approach to solve problems in a context-dependent manner, which fostered continued buy-in. Patients and family members who described their experience viewed the RTs as members of FHTs and did not see a division in the provided healthcare services. The shared development of the network led to shared success of the entire health team. Their co-creation of vision and goals led to shared commitment and ultimately shared success." (Sibbald et al 2020)*

	"Professionals' interest, enthusiasm and commitment, which increased as they participated in the joint meetings (Supplementary Box S2), emerged strongly in Chile and Colombia, in particular, and also in Mexico with regard to the joint training sessions in maternal and perinatal care. The aspects that mainly contributed to this interest were the opportunity to 'receive training' and 'improve quality of care through coordination'. The latter reason was also cited in Brazil, and 'CV improvement' was given as a further motive in Mexico and Chile. This interest led professionals in Colombia and Chile to change shifts, attend out of working hours, administrate meeting spaces and help to spread word of the intervention: .... for example, like in Unit XXX the doctors themselves took control, managed their own spaces, fought over their place to be able participate .... They didn't give them any time..., but they would walk in there with the clinical case and documents reviewed (LSC, Colombia)" (Vargas et al 2 2020)
7B. When networks members have support from leadership/administration /stakeholders (context), they are more likely to be committed to the network (outcome) because they feel valued (mechanism)	*"The 'institutional support' of network managers emerged in all five countries as the main organizational factor that influenced implementation of the interventions (Supplementary Box S2). In Chile, and in Brazil with the occasional interruption, it was identified as a facilitator that remained stable throughout the process. In Mexico, it was strengthened following political change; in Colombia, it was weakened; and in Uruguay, it remained frail. It was considered key in terms of whether the resources needed (professionals' time and materials) were available to implement the interventions (and in Brazil and Mexico also to solve operational problems—see Supplementary Box S2): '...there was support from the managers to protect these (allocated project) schedules, that normally doesn't happen with this kind of more low-scale project' (Professionals' inter-level working group, Chile); As for the managers, there was no interest. Not little interest, no interest! There should have been more coordination on our part, more involvement, because it depended exclusively on us (Healthcare manager, Colombia)." (Vargas et al 2 2020)* *"It was felt that local health service manager representation on network committees would ensure that networks deliver projects of relevance to the region covered by the health service and help to increase health service and local clinician buy-in to networks." (McInnes et al 2012)* *"change in authorities to ones with new priorities led to institutional support for the intervention, in conjunction with the participatory nature of its design, and the use of a reflexive method was implemented. On the other hand, regarding the joint training meetings on chronic diseases, a low impact was observed due to its limited implementation, which was related to the lower institutional support; thus, neither coordination nor its factors were affected" (Lopez-Vazquez et al 2021)*
7C. If a network has committed members (context), then they are more likely to act on their identified problem and collective vision (outcome) because	*"In the case of upwards referral of complicated cases and emergencies, communication capacity was improved. Every node in the network and each ambulance was equipped with smartphones connected by a closed user group (CUG). As the original phones have aged out of use, providers*

members are willing to put in the energy and effort (mechanism)	*shift to using their own handsets and utilize credits issued monthly by their facilities for that purpose. WhatsApp is currently the main channel of communication; there are at least five groups in the CCBRT NOC dedicated to different parts of NOC activity, including blood transfusion availability, maternal and perinatal death review, and ambulances." (D'Mello et al 2020)* *"Communication around referrals is standardized, where the clinical details of both inward and outward referrals are communicated by telephone before the patient arrives to prepare the receiving providers as well as to confirm that there is space available. Details are also documented on three-ply paper referral forms. QRP has a dedicated phone line, which the on-call Ob/ Gyn at QMMC carries, to contact when there is an obstetric emergency. Routine communication is also standardized; a group SMS is used for messages about QRP meetings and other updates, such as infrastructure work at facilities that may cause delays or reduce the number of available beds." (Vergara et al 2020)* *"Moreover, unlike in the wider Kenyan health system, there appeared to be a sense of ownership of data collection within CIN because: "It's very clear, [CIN] it's actually trying to use data to improve the quality of care … we own it … the fact that I don't have to send data to KEMRI does not stop me from collecting my own data" (Paediatrician 4). HRIO 29 commented: "I'm very passionate about CIN because, as our vision says … we are using this data, which we are generating to improve the quality of services to patients." Nurses were also described as "owning" CIN data and using it to "assess the nursing work … holding each other accountable" "(Paediatrician 11). (McGivern et al 2017)*
7D. When influential outside stakeholders are actively engaged in network processes (context), then they are more likely to be committed to the network (outcome) because they can be helped to understand the collective vision of the network (mechanism)	*"One of the key aspects to OHW's approach is collaborative co-investment from the municipalities. For any intervention that involves cost-sharing, birthing center renovations, for example, an MoU will be established between OHW and the municipality. The municipalities have increased their co-investments in birthing center renovations over time, from 21% in 2018 to a planned 47% in 2020." (Bhatta et al 2020)* *"EMAS approaches were designed to help districts and facilities operationalize existing Government of Indonesia policies and programs, and EMAS tools and approaches were included in local government policies; therefore, many EMAS approaches could be funded using local budgets. Tools and approaches were crafted to enable facilities to more readily meet established government standards and expectations regarding the provision of emergency maternal and newborn care within facilities and throughout the referral process." (Hyre et al 2019)* *"Getting hospital management to buy-in to the NOC structure was difficult at first because they feared losing income through outward referrals to lying-in clinics and had doubts about the quality of care possible at those sites. Persistent advocacy by QRP leadership eventually assured*

	hospital administration buy-in by contending that rational distribution of cases would improve quality of services delivered and not result in income losses, demonstrating early signs of this success through presentation of QRP data and less formal anecdotal evidence." (Vergara et al 2020) *"In order to engage local parish and municipal government representatives to promote awareness of and adherence to national laws mandating coordinated service provision through a public health-care system, the project organized several meetings where such laws and national priorities were discussed" (Broughton et al 2016)* *"Upon arrival, the maternal health workers conducted a series of meetings with local authorities, village heads, religious leaders, traditional healers, women's and other civil society groups, and local health workers and TBAs, to explain the programme. The meetings followed an informal, participatory approach, allowing stakeholders to offer opinions and make recommendations. This process of informing and sensitising the community was envisioned as a necessary and appropriate step to secure support for the project." (Mullany et al 2008)* *"A history of successful prior engagement with multiple stakeholders that fosters trust between parties is an important foundation supporting local ownership and leadership while it is important that the network addresses each party's interests." (Irimu et al 2018)* *"In the current study, we found that members of the community and staff routinely reported a sense of ownership and active involvement in ensuring its success. Participants also reported that this local participation and ownership in priority setting was pivotal for the community buy-in and continued success at 18 months of the RTT initiative." (Nahimana et al 2016)* *"It was seen that the district and state level administrative buy- in/ownership was deficient. This was possibly due to lack of insight on benefits of implementation of QI at scale.18 This became one of the major bottlenecks in the effective implementation of the HSM. The major learning from this implementation exercise was that in absence of effective handholding and support at macrolevel long- term sustenance of any micro- level and mesolevel interlinked process is a formidable challenge." (Srivastava et al 2020)* *"Lack of sensitisation about QI methodology among the district and NHM officials led to deficient buy- in/ownership and consequent support. Lack of active participation from the district officials and state NHM officials on account of other competing priorities for district and state health officials." (Srivastava et al 2020)*

	"Macro- level: lack of ownership and financial provisioning by the state administration for scaling up of this initiative across districts led to non- sustenance of the operational model. Irregular monitoring and evaluation of the QI work progress by the state and district officials led to lack of accountability for the process. The transfer of a senior official from health department led to significant delays in operationalising of the project." (Srivastava et al 2020) *"When we spoke with the authorities, some situations that could hinder the system (the offline virtual consultations) were perceived. One of them was the lack of computers and internet at the Health Centres, for which a census was carried out… and after the census, the Ministry of Health committed to correct this situation… when a government institution is committed, there is 20% of certainty they will comply, while 80% they won't comply. That happened here or at least primary care physicians still complain about this and they still report that they do not have a convenient internet access and they sometimes do not even have computers." (Local Steering Committee/Manager). (Lopez-Vazquez et al 2021)*
7E. When influential outside stakeholders are committed to the network and actively engaged in participating (context), then it may be easier for the network to achieve its aims (outcome) because network members feel empowered (mechanism)	*"In an effort to fill human resources gaps, which are particularly acute in rural and remote areas, municipalities directly contract health workers. A health facility will make a request for staff to the municipality, which advertises the post locally and selects applicants. Contracted providers' salaries are paid directly by the municipality from their local budgets. Given this local-level capacity to fill workforce gaps, OHW does not typically hire additional health workers to serve in the NOC." (Bhatta et al 2020)* *"There have been additional investments in infrastructure, human resources, drugs and supplies, and materials for women at the birthing center. The municipality built a maternity waiting home with the health council's budget and purchased three ambulances that, while they do not meet international standards, serve as dedicated transport for free maternal, neonatal, and child health care. They have recruited a laboratory assistant and, as they are not able to regularly rely on government stock, set aside a budget for medicines and created buffer stocks to support facilities. Additionally, the municipality provides blankets to mothers at the birthing centers and is now considering providing warm clothing for newborns. They have also provided FCHVs with cabinets to hold their job aids and training materials." (Bhatta et al 2020)* *"The CBMIS built on an existing but largely dormant system that relied on traditional leaders and CBAs to locate and document live births, stillbirths, maternal, and neonatal deaths. It also provided useful information for decision and policymakers to better understand health challenges for mothers and newborns at the community level. The responsibility of community data collection and analysis was transitioned to the LGA M&E officers and the state HMIS officers to ensure full government ownership and continuation of the CBMIS." (Fasawe et al 2020)*

	"To source funding for recurring costs such as fuel, CHAI worked with district and village heads and Ward Development Committees to establish sustainable contributory schemes. By June 2016, 65% of communities had taken full responsibility for maintenance and operation of the MBAs." (Fasawe et al 2020)
Engaged and motivated network members	
8A. When network leadership provides opportunities for network members to be supported, recognised, and learn (context), this creates engaged and motivated network members (outcome) because they derive direct benefits (mechanism)	*"To help develop 'engaged and motivated' members of CIN at local levels and build a collective identity and community of practice, we hold twice yearly face-to-face meetings with paediatricians inviting the other CIN focal persons to one annual meeting.9 These meetings allow participants to discuss their audit reports (including offering suggestions for improving data collection) and to identify underlying problems and potential solutions with peers. They also provide a forum for short, specific skills building sessions focused on the 'soft skills' needed as a manager (eg, how to run a team) and on building their understanding of research. Crosstalk among the scientific, clinical and policy communities in an arena promoting collegial relationships helps interpret results based on an understanding of practice in the real world. This enables all sides to understand how contexts interact with improvement approaches to bring about observed outcomes26" (Irimu et al 2018)* *"LKBK provided mentee facilities with a clear picture of good clinical governance and quality services, helping to generate a sense of urgency to change within those facilities across six provinces. Using mentoring on a large scale increased motivation and performance of health facility and health office staff and broke down barriers between public and private facilities" (Hyre et al 2017)* *"Initiatives that addressed workforce development and clinical education were cited as important outcomes as they were thought to lead to other desirable outcomes such as job satisfaction, the development of clinical career paths and the retention of a stable clinical workforce that could carry forward network initiatives. Obtaining funding for clinical positions; scholarships and speciality post-graduate studies; clinical fellowship posts; and conference support schemes and the establishment of new postgraduate courses in clinical specialties were all cited as desirable network outcomes because they contributed to retention of the workforce and enabled professional pathways into obtaining specialist qualifications: "We have been able to fund so many nurses to do post-graduate studies in neurology. So it's made stroke more of a career. In my opinion – it's been a major retention for neurosurgery."" (McInnes et al 2012)* *"In the experiences with joint meetings, with the exception of Brazil, informants agreed that the 'type of intervention based on personal contact' and the 'continuous adaptation of content to professionals' needs' fostered their motivation to participate and encouraged them to get to know and trust doctors of the other care level better." (Vargas et al 2 2020)*

	“The challenges with the branding of CLAHRC resulted in the need to actively sell the benefits and opportunities of getting involved. Those working in boundary spanning roles were particularly important in prompting connections through their interactions and activities with both academics and practitioners: And so establishing and doing these sort of teaching sessions at first, we did quite a lot of study days where staff came from the Trust. And [name of facilitator] was the biggest help in getting over any sort of barriers and boundaries because she was there, she knew the Trust, she could sort of go and…work with the staff at a ward level…and constantly reinforce the message. (Boundary spanner, Oakdown)” (Rycroft-Malone et al 2017) *"Further, they described how their team’s motivation was inspired largely by improved hospital management. When the medical officer in-charge and the hospital Matron walked around facilities to check-in with health workers, inquiring about maternity care and identifying how they could assist, it fostered a positive environment with improved teamwork. The clarification of a sense of purpose and confidence in leadership promoted by the NOC formation nurtured these and other better management practices." (D’Mello et al 2020)* *"The Dar es Salaam Regional Health Authorities, in collaboration with CCBRT, organized annual quality assessments to spur interfacility competition; rewards of recognition and prizes, such as baby warmers, vacuum extractors, and portable ultrasounds, are given at regional meetings. Later, management from one hospital independently organized cash rewards from their own budget for high-performing providers, as well as night shift allowances for labor ward staff. While financial incentives for increased motivation and teamwork reportedly made a difference in that setting, the NOC also used other modes of recognition of good performance without financial incentives; these also had positive effects noted through better performance, suggesting alternate ways to signal a caring professional culture can trigger and support better performance." (D’Mello et al 2020)* *"Use of facility data was enhanced by introducing a standardized set of service statistics to be collected by each facility. Data were aggregated monthly and analyzed to track coverage of evidence- based, high- impact clinical interventions. Facility staff charted monthly performance on laminated “data for decision making” posters and reviewed the data during regular internal meetings. Facilities reported the data to district health authorities using existing health information system processes and forms. Facility staff also presented selected data to the district-level MNH working group for joint problem solving. The most important clinical and operational indicators, defined by each ward/unit, were presented visually in wall- mounted data visualization dashboards to motivate teams to take action to address suboptimal performance." (Hyre et al 2019)*

	"The principal motivation for surgeons' continued participation in pooled effort events is the opportunity to learn from each other (regardless of seniority) about fistula surgery and engage in ongoing training, coaching, and mentoring with colleagues. Besides developing their own skills, they are also able to help each other by reducing backlogs (as well as forming a local network of surgical teams). Pooled effort events also provide visiting surgeons with an opportunity to focus on fistula repairs without having to spend time on other clinical and administrative duties." (Fistula Care 2010) *"Second, the working environment generated by the restructuring of the network, involving redundancies and salary cuts, reduced doctors' interest in participating: .... we got to do the meetings, and then before that they'd told off the doctors, they'd audited their accounts, they told them they were going to cut their salaries, etc. That creates bad feeling between people (...) that hindered to a certain extent the rollout of the sessions (PP, Colombia)" (Vargas et al 2 2020)* *"At micro- level: absence of an enabling environment at facility level created a culture that gave little incentive for health facility staff to learn QI skills. It was further compounded by a rigid hierarchical system and partial administrative support especially encountered in the urban hub facility. Maintaining motivation in physicians was a challenge. Both the rural and urban facilities lacked dedicated hospital QI personnel, especially at the urban- hub facility; this made healthcare providers visualise QI as extra work, which distracted them from their regular patient care. Non-provision of transportation for hub mentors to their allocated spoke facilities added to poor motivation to undertake mentoring visits." (Srivastava et al 2020)* *"In contexts where there was an absence of a history of established relationships and collaboration, where there has been less activity around the joint setting of priorities either at bid development stage, the need to sell the benefits of CLAHRC to encourage or incentivise engagement of mutual benefit was evident: I think that getting people engaged in it is about them seeing there's some mutual benefit and where there wasn't seen as any mutual benefit it doesn't happen…I know other CLAHRC Directors feel a bit the same, that you feel like you're a salesperson going round trying to sell things. (Leader, Hazeldean)" (Rycroft-Malone et al 2017)*
8B. When a network member gets 'emotional' benefits (positive feelings) or feel a sense of purpose from being part of the network (context), they are likely to be highly committed (outcome) because it is fulfilling for them (mechanism)	*"However, a lack of interest in participating also emerged in all five countries, with greater intensity in Uruguay and Brazil in general; and with regard to offline virtual consultations in Mexico, and replica meetings (meetings with other network doctors not in the PP) in Colombia. Contributing factors, according to interviewees, were: the 'limited adherence to the primary care-based model' of some SC doctors in Brazil, Chile and Uruguay and 'not knowing the doctors of the other care level', 'mutual mistrust' and PC doctors' 'shyness and fear to express their doubts' in Chile, Colombia and Mexico. However, these obstacles diminished as they participated: Yes, yes,*

	at the start I found it really difficult to participate (.. .) at first it was like: 'um...what am I going to do there? They're all going to be looking at me, I've got to give a reply, it's scary, I don't want to do this' (.. .). But it's all got a lot better, (...) they want to participate, because they're enjoying it. (Administrative personnel, Chile)" (Vargas et al 2 2020)
8C. When network members' personal identity strongly aligns with a network's identity and culture (context), then this will result in engaged and motivated network members (outcome) because they feel they belong (mechanism)	*"Our findings demonstrate that when beliefs, values and priorities among members of the referral network converge, this fosters cooperative behaviours which are beneficial for individuals and the network as a whole. When values, beliefs and priorities diverge, self-interest prevails to the benefit of individual clinicians but impacting negatively on other clinicians and potentially on patients." (Pittalis et al 2021)*
8D. When network members actively participate in network change practices that align with the professional values they live by (context), this creates engaged and motivated network members (outcome) because it helps them to fulfil their moral obligation or vocational calling (mechanism)	*"The effect on motivation of the intervention described is mainly perhaps through the reflective pathway with participants engaged in developing plans and evaluating progress against goals that are shared with experts and peers (in common with more specific quality improvement strategies [26]). However, we believe automatic motivation may be triggered by a link to an innate desire to provide good care encompassed in the idea of vocation amongst health workers [27]." (English et al 2017)* *"Many doctors and nurses we interviewed were motivated by providing good patient care "The most satisfying thing about my job is when I see my children [patients] going home healthy" (Paediatrician, 10) and/or developing younger colleagues ("the satisfying thing has been teaching younger colleagues; to see the transformation from a doctor who had just learnt the theoretical knowledge to actually being able to apply it at the bedside" (Paediatrician 11)" (McGivern et al 2017)* *"The principle of multidisciplinary collaboration was also believed to foster goodwill amongst clinicians and had fostered an ethos which was 'collaborative rather than antagonistic'. This was thought to have resulted in two positive effects: i) reinvigoration of clinician interest in participating in projects to improve quality of care and facilitate health system changes, and ii) provision of a forum for developing projects that addressed patient health needs in collaboration with the state-based Ministry of Health and other external partners. This is summarised in a quote from a network chair: Networks make it easier for change and broad planning, it is the composition, structure and organisation of networks that has enabled achievements to take place." (McInnes et al 2015)* *"Most participants stated that successful networks were strengthened by formal organisational structures and processes and having 'solid systems' in place that facilitated effective planning and communication. These systems included project workgroups focused on project planning and implementation, with broad clinical and consumer representation and meetings with structured agendas and minutes: 'Not chat-fests that result in nothing'. Those networks where the main*

	objective was 'just about showing up at meetings and giving a progress report' were perceived by many as those that made little impact. Open governance and leadership rotations were regarded as important for securing and maintaining engagement and for ongoing reinvigoration of the network: Makes people feel engaged, willing to give solid commitment and feel part of the network's mission" (McInnes et al 2015) *"Across the spectrum of stakeholder groups, the overall impetus for participation in network activities and establishment of networks was to work for the patient cohort and to improve the effectiveness of clinical services. This could be done through network projects that add value to existing services by becoming involved in service planning and improving the delivery of services. This was expressed in comments such as: 'removing the waste in the system'; and 'breaking down the barriers to the provision of care for patients in NSW'." (McInnes et al 2012)* *"Coordinated action was driven by shared goals, recognition of inter-dependence, and greater shared responsibility: We all share the same goal and it's kind of motivating. (Dietitian) It is like a link, everyone is linking with the other so everyone is playing his or her role, that's what I can say … We are working like this because the one can't survive without the other. (Hospital manager)" (Schneider et al 2020)* *"To help develop 'engaged and motivated' members of CIN at local levels and build a collective identity and community of practice, we hold twice yearly face-to-face meetings with paediatricians inviting the other CIN focal persons to one annual meeting.9 These meetings allow participants to discuss their audit reports (including offering suggestions for improving data collection) and to identify underlying problems and potential solutions with peers. They also provide a forum for short, specific skills building sessions focused on the 'soft skills' needed as a manager (eg, how to run a team) and on building their understanding of research. Crosstalk among the scientific, clinical and policy communities in an arena promoting collegial relationships helps interpret results based on an understanding of practice in the real world. This enables all sides to understand how contexts interact with improvement approaches to bring about observed outcomes26" (Irimu et al 2018)* *"Yet good intentions were frustrated by the Kenyan health system. Paediatrician 3 noted: "Frustration is actually top on the list… I wish I had this [equipment/drug], I would be able to save this baby … your potential is being utilized 20–30%, you get bored … your hands are tied." This undermined motivation to improve care. Paediatrician 21 noted: "Motivation … is gone. You go to work at eight and you leave at four. It's just work now, it's not how can I make [health care] better."" (McGivern et al 2017)*

	"There was, however, only a small improvement in recording blood glucose levels overall in seriously ill children although two hospitals achieved the >60% target (figure 2C). Informal discussions with CIN focal teams suggested this was in many cases linked to difficulties in securing adequate supplies for bedside or laboratory-based glucose testing. Lack of resources then undermined clinicians' motivation to request the test." (Irimu et al 2018) *"Some in the network groups mentioned that not having 'power or teeth to implement changes' placed networks at risk of losing the enthusiasm of involved clinicians. The need for networks to be empowered to make changes was also acknowledged by some in the Senior policy-maker group: 'need to sort out who is responsible for implementation. Feedback from the Senior manager group highlighted that to facilitate implementation, networks needed to garner the support of local health services to implement and ensure that projects and innovations are clinically relevant." (McInnes et al 2012)*
8E. When a network can show its members that it can affect some change (context), members are more likely to continue their engagement with it (outcome) because of they can see its value (mechanism)	*"Other more subtle techniques were employed to create a culture of change at QMMC in particular. For example, as the doctors were being introduced to the idea of the QRP, the Ob/Gyn ward was repainted with the intention of creating the feeling that change was afoot. The midwives were also invited to come to QMMC to see the changes. The culture of change was projected toward the patients as well, to promote the perception that the launch of QRP represented quality improvement. Even cleaning of the delivery suites at QMMC was used as an opportunity to promote the new culture: the head of the Department cleaned alongside janitors to demonstrate dedication to service, high standards, collaboration, and teamwork. This was observed and cascaded out to the lying-in clinics as a part of "the new QRP culture." (Vergara et al 2020)*
8F. When engaged and motivated network members are provided with the resources and opportunity to act (context), then they will attempt to enact changes in practices (outcome) because they feel empowered to change practice or work towards solving the problem (mechanism)	*"Between network inception and November 2016 hospitals have received 15 feedback reports. We observed that hospital teams are keen 'not to be in the red' but 'be green' in their report. Comparison of hospitals' performance especially during face-to-face meetings helped foster shared learning rather than potentially harmful competition and helped people gain confidence in their ability to achieve change. We attribute this to having a shared vision and referring to poor performance as 'offering opportunity for learning and improvement' while engagement with peers provided encouragement to complete quality improvement processes.25 As a result, clinical teams worked with their records department and hospital administration, drawing lessons from across CIN, to ensure hospitals acquired infrastructure, reorganised service delivery and leadership provided effective mentorship and supervision to support delivery of quality care" (Irimu et al 2018)* *"The ability of the network chair to engage the multidisciplinary clinical workforce in network initiatives, collaborate with external stakeholders, and to drive the implementation of network*

	objectives was seen as critical for providing the foundation for the delivery of high-impact projects and creating a momentum towards successful network outcomes." (McInnes et al 2015)

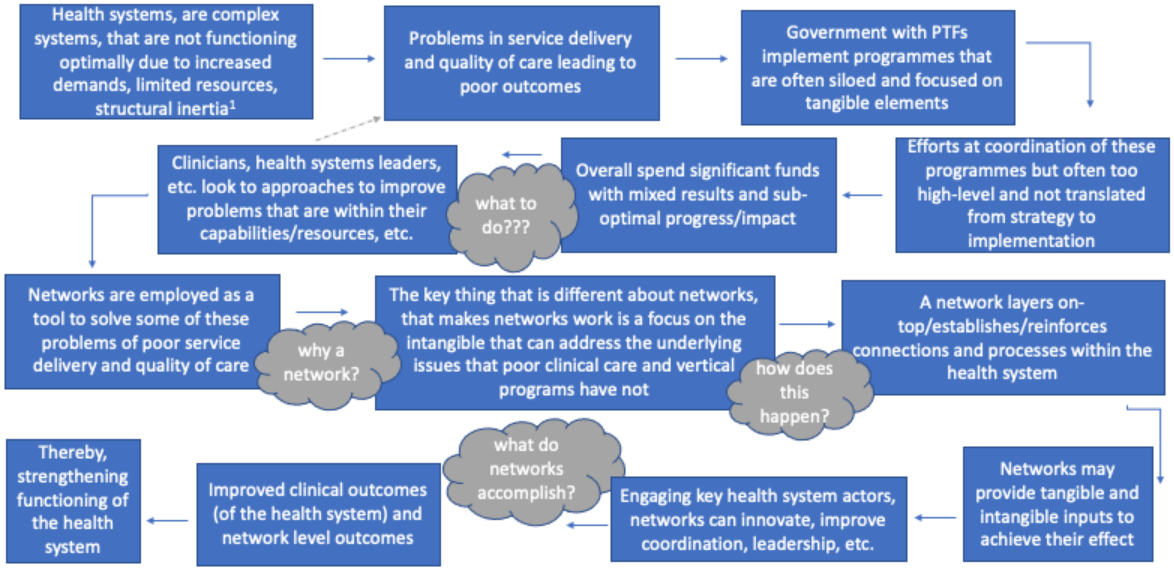
Creating a psychological safe space	
9A. When network leadership is available and approachable, invites input and feedback, and models openness, fallibility, and non-judgmental behavior (context), then this promotes a network's psychological safety (outcome) because network members feel empowered and not threatened when they speak up or make a mistake (mechanism)	*"In the case of QRP, the key transformation in trust required to make the Network of Care effective was between the midwives and Ob/Gyn staff. Several midwives described how, when accompanying a patient with an obstetric emergency to a tertiary care facility, they were escorted to a room for interrogation, were asked what they did to cause the emergencies, and were implored to produce their professional credentials, which were then confiscated. The obstetricians in QRP have admitted that they mistrusted the quality of care clients might receive in a private lying-in clinic. The founder of QRP herself admitted to this prejudice, and so made a point to travel to all the private lying-in clinics in the catchment area to see in person what the facilities were like and to meet the people running them. She states that, after making those in-person visits, her reservations about entering into a network agreement with the lying-in clinics dissipated." (Vergara et al 2020)* *"The network is led by inspiring, dynamic leaders. Many participants credited the leadership with creating a positive, empowering culture. Several participants described this as the result of equal and non-competing power dynamics, enabling the team to function optimally: "…we don't have that hierarchical structure, we have more of a flat line I believe, when it comes to the allied health professionals and physicians in our model. There is that flat line respect and a flat line understanding that there's a fit, you're doing what is helping me, right. It's like part of it, you're part of the team" (Provider FG #2)". (Sibbald et al 2020)* *"At micro- level: absence of an enabling environment at facility level created a culture that gave little incentive for health facility staff to learn QI skills. It was further compounded by a rigid hierarchical system and partial administrative support especially encountered in the urban hub facility. Maintaining motivation in physicians was a challenge. Both the rural and urban facilities lacked dedicated hospital QI personnel, especially at the urban- hub facility; this made healthcare providers visualise QI as extra work, which distracted them from their regular patient care. Non-provision of transportation for hub mentors to their allocated spoke facilities added to poor motivation to undertake mentoring visits." (Srivastava et al 2020)*
9B. When network members form trusting and respectful horizontal relationships (leading to flattened hierarchy) (context), then this promotes a network's psychological safety (outcome) because network members feel equal (mechanism)	*"The network is led by inspiring, dynamic leaders. Many participants credited the leadership with creating a positive, empowering culture. Several participants described this as the result of equal and non-competing power dynamics, enabling the team to function optimally: "…we don't have that hierarchical structure, we have more of a flat line I believe, when it comes to the allied health professionals and physicians in our model. There is that flat line respect and a flat line*

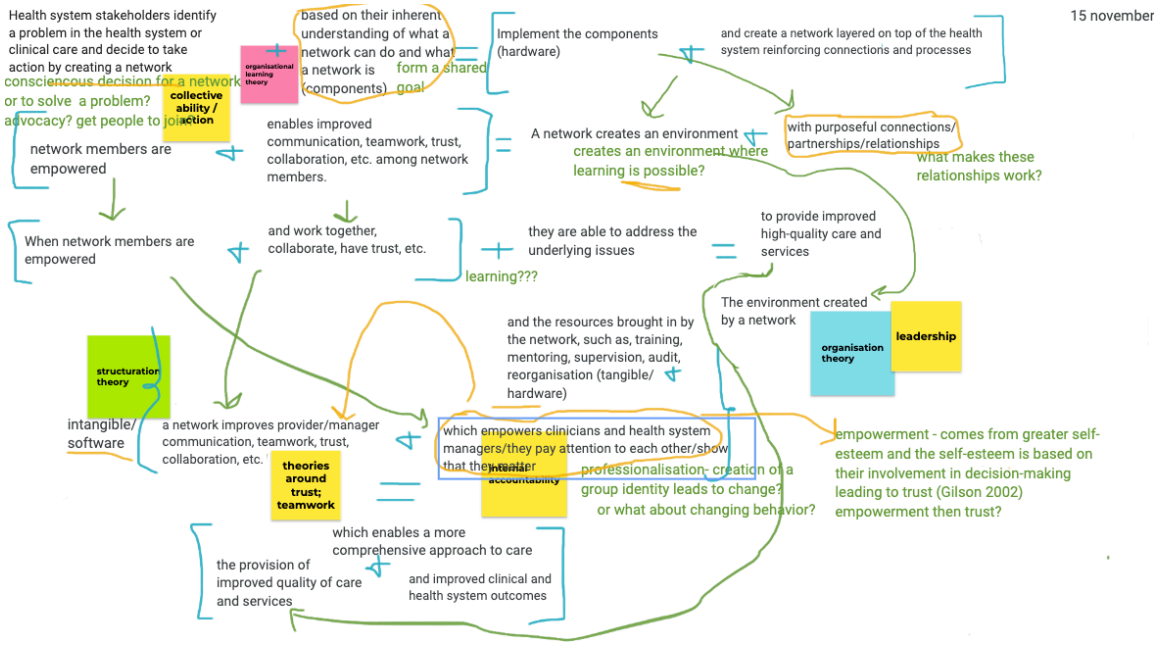
	understanding that there's a fit, you're doing what is helping me, right. It's like part of it, you're part of the team" (Provider FG #2)." (Sibbald et al 2020) *"It was clear that network members trusted one another and fostered psychological safety; members understood their role and felt safe to take risks (try new things, learn from mistakes). Psychological safety has been shown to drastically improve network performance and outcomes [32, 33]; in this case, it supported the implementation of innovative and emerging practices." (Sibbald et al 2020)* *"Regarding the training method, informants considered that the open attitude and absence of hierarchies shown by facilitators of the joint training meetings on maternal health, as well as including practical activities and resolution of clinical cases, enhanced dialogue, interest and involvement in the sessions. Thus, the initial defensiveness of primary care physicians was eliminated, a climate of equality (Table 4d) was fostered, and the resolution of doubts via direct communication between peers was promoted: "Now, I was able to stay in touch with a gynaecologist, and any particular doubt I could not solve by reading (regarding CPG), so I could trust them, I was able to detect a greater close relationship" (Professional Platform/Primary Care)." (Lopez-Vazquez et al 2021)* *"Interdisciplinary and consumer collaboration was highly valued as a desirable outcome by those in network groups as it was seen as facilitating 'new ways of working', and providing 'a voice for all disciplines'. These new ways of working in turn, promoted the sharing of knowledge and development of collaborations for improving patient outcomes: "Nurses and allied health particularly, have felt, probably to start with, intimidated by the process but now feel equal partners in it. So, that is a sign of success to me, before you even get to patient care."" (McInnes et al 2012)* **"***The development of interdisciplinary and consumer collaboration were thought by many participants across all stakeholder groups to have shifted some clinical groups from a stance that was often 'competitive, defensive and protective' to a more 'co-operative and collegial ethos'. This ethos was said to have led to 'a lot of renewed optimism' in working in health care, which was also cited as a desirable outcome by one participant in the network participant group." (McInnes et al 2012)* *"In Kenya, health professionals often work in remote district hospitals, overseeing clinical departments with little support or training. Many find this difficult, particularly without resources to provide high standards of care. Consequently, loss of motivation and burnout are common (Brown, 2016; Mbindyo et al., 2009). CIN leaders attempted to create a supportive network*

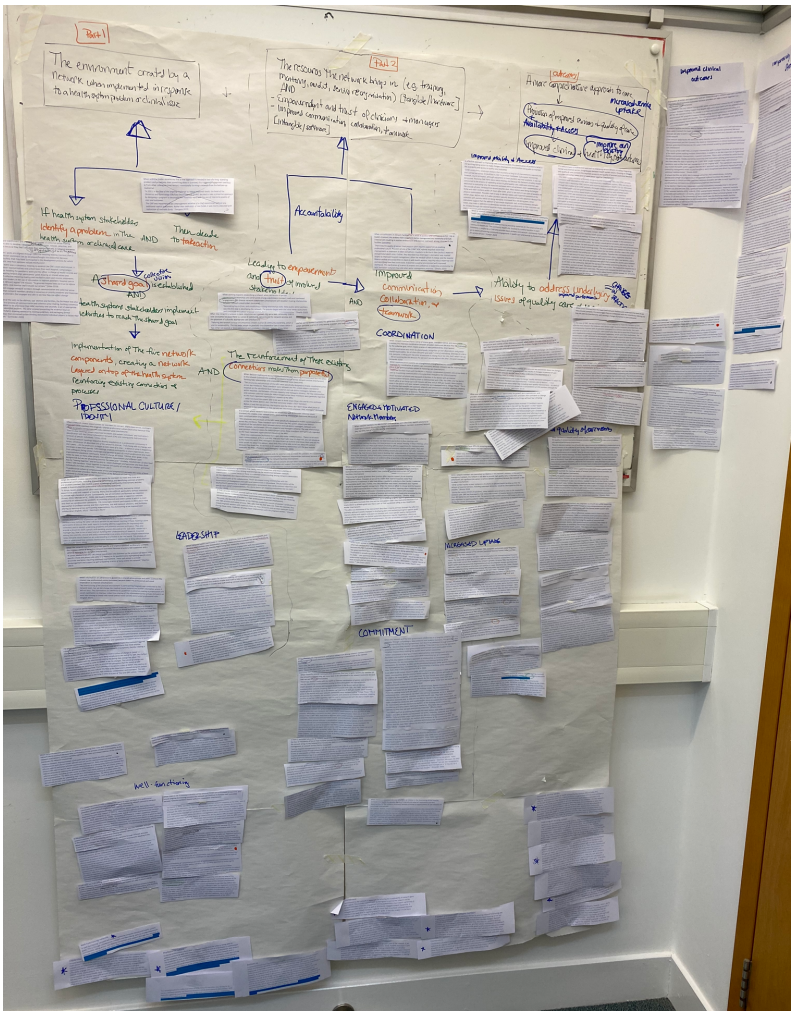
	community to addressed this problem, by providing physical and online spaces in which to meet and share as a professional community. CIN encourages network participants to think about new approaches to problem-solving, and then implement, test and measure solutions, and facilitates sharing of learning across participating organizations, thus functioning as an improvement collaborative (English, 2013)" (McGivern et al 2017)
9C. When a network has a shared network identity and culture that promotes a psychological safe space (context), then network members are more likely able to learn, improve, and seek feedback (outcome) because they feel empowered and feel a reduced fear of negative consequences (mechanism)	*"Between network inception and November 2016 hospitals have received 15 feedback reports. We observed that hospital teams are keen 'not to be in the red' but 'be green' in their report. Comparison of hospitals' performance especially during face-to-face meetings helped foster shared learning rather than potentially harmful competition and helped people gain confidence in their ability to achieve change. We attribute this to having a shared vision and referring to poor performance as 'offering opportunity for learning and improvement' while engagement with peers provided encouragement to complete quality improvement processes.25 As a result, clinical teams worked with their records department and hospital administration, drawing lessons from across CIN, to ensure hospitals acquired infrastructure, reorganised service delivery and leadership provided effective mentorship and supervision to support delivery of quality care" (Irimu et al 2018)* *"Participants across all data sources discussed feeling empowered in their role in the network and the Lung Health program. The PCIC network members described being empowered through the trust that was developed that allowed them to take risks and try new things. One PCIC participant explained, "once we had some experience and some time working together and a trusting relationship, and that freeness and openness of sharing then it just sort of allowed us to grow, mature, and branch off into other areas." (Provider FG#1). The RTs were empowered through training, collaboration, and mentorship to work independently to their full scope of practice allowing them to feel confident in their role. Further, the RTs ideas are reported in PCIC network meetings and contribute to network decision making. Other Providers felt empowered in their role collaborating with RTs to provide their patients with high quality respiratory care. Physicians trusted RTs to bring best practices into their clinic and support patient care." (Sibbald et al 2020)*
9D. When a network is a psychological safe space for network members (context), it enables members to openly raise concerns or problems (outcome) because they know they will be supported and there will not be negative repercussions (mechanism)	*"Managers and providers were described, and saw themselves, as more accountable than before: The MRU has brought about ownership and accountability on the part of the managers and also the health professionals at facility level. Because even though we are not making it a whip to whip people, we [hold] people accountable. (District program manager) You start thinking now … if I am going to report in front of a group of people, why the baby died, I want to make sure that when I am on duty that baby is not going to die because I don't want to go in the report. (Pediatric ward manager)" (Schneider et al 2020)*

	"Many CIN participants drew upon the visibility mechanisms of audit and data collection and related pastoral inspection practices to discipline themselves. Paediatrician 27 noted: "It has changed the way I practise … we were audited and we discovered we are actually not doing a hundred percent… previously we were not paying attention to detail but now we are." Nurse-in-charge 14 commented: "Someone coming to check on what you are doing … When you have a trigger of somewhere somebody watching how do you do things, you become better and more conscious." Paediatrician 13 noted: "CIN is like someone coming to audit me … an external supervisor … coming to see how things are being done … to make you rectify the wrong things … for me it is a fantastic thing." "(McGivern et al 2017) **"***that the referral network provides or enhances service delivery to the population in two ways. Firstly, it facilitates access to specialist advice or Intensive Care Unit care which are not available at district level, or diagnostic services only offered centrally, such as computerized tomography scans or magnetic resonance imaging. This is in line with the intended scope of the referral network. RH respondents reported that the fact that district surgical teams are able to recognise their skills limits and refer patients is beneficial for the patient and the functionality of the care system." (Pittalis et al 2021)*
9E. When a network is a psychological safe space for network members (context), it encourages innovation and innovative behaviour (outcome) because members know they will be supported and there won't be negative repercussions (mechanism)	*"Participants across all data sources discussed feeling empowered in their role in the network and the Lung Health program. The PCIC network members described being empowered through the trust that was developed that allowed them to take risks and try new things. One PCIC participant explained, "once we had some experience and some time working together and a trusting relationship, and that freeness and openness of sharing then it just sort of allowed us to grow, mature, and branch off into other areas." (Provider FG#1). The RTs were empowered through training, collaboration, and mentorship to work independently to their full scope of practice allowing them to feel confident in their role." (Sibbald et al 2020)*
9F. When a network creates a psychological safe space for network members (context), it enables them to more easily collaborate across the network's facilities, levels, and sectors of care (outcome) because they already have a common ground and understanding (mechanism)	*"In regard to informal (relational) coordination, the main finding of our research is that the operating environment within the hospital sector is not always conducive to collaborative work, and is permeated by mistrust between DLHs (afraid of reprimand) and RHs (fearing opportunistic behaviour by district clinicians). Blaming an individual hospital or clinician, and ignoring the systemic picture, will not improve the system. The combination of technical, organisational and human weaknesses in the referral system play a central role in the development of these patterns41 ; and when discretionary decisions occur, as shown in our findings, there are usually underlying factors such as lack of confidence and professional support, pressing workloads and resource constraints. Hence, addressing these challenges will require interventions at multiple levels." (Pittalis et al 2021)*

Appendix 4F. Programme theory drafts






Part 1
The environment created by a network when implemented in response to a health system problem or clinical issue
Part 2
Accountability
COORDINATION
COMMITMENT
LEADERSHIP
PROFESSIONAL CULTURE / IDENTITY

Appendix 5A. Newborn Essential Solutions and Technologies

This appendix provides additional details on the Newborn Essential Solutions and Technologies (NEST360) programme network.

What is NEST360?

The NEST360 programme is an international alliance of 22 governments, institutions, and organisations working to end preventable newborn deaths. NEST360 collaborates with governments in four countries "to prevent newborn deaths in hospitals by adopting a co-created health systems package with innovative technologies, mentoring for clinicians and engineers, and evidence-based implementation strategies for sustainability."[1] Phase 1 of the programme ran from 2019 to 2023 in 65 hospitals in Kenya (13), Malawi (38), Nigeria (11), and Tanzania (7) with $US 68 million in support from the Bill and Melinda Gates Foundation (BMGF), the Children's Investment Fund Foundation (CIFF), and The ELMA Foundation. Across the four countries in Phase 1, NEST360 aimed to:

- Establish a bundle of technologies to support quality comprehensive newborn care
- Create distribution systems to make the NEST360 bundle accessible and affordable
- Scale the NEST360 package nationally in Malawi
- Test and refine the NEST360 package in Kenya, Tanzania, and Nigeria
- Build an investment case for comprehensive care of small and sick newborns
- Measure and mitigate the impact of COVID-19 to build resilient systems for small and sick newborn care[1]

Phase 2 (2024-2028) of NEST360 began in 2024 with commitments from BMGF, CIFF, ELMA, and individual contributions of $US 65 million. In Phase 2, the programme will expand to additional hospitals in the four countries and to Ethiopia.[2]

Across the four countries between 2019 to 2022, 9,400 clinical staff received pre- and in-service training and 1,470 biomedical engineers and technicians (biomeds) were trained.[3] NEST360 has qualified 23 products across 11 different product categories.[3] 98,691 newborns were admitted to NEST360 supported hospitals in the first four years of the programme.[3]

NEST360 Structure & Relationships

The NEST360 organisations include clinical, technical, and public health experts working across and within the four countries. Table 5A.1 list the global and Kenya based NEST360 organisations.

NEST360 Global	NEST360 Kenya
Rice360 Institute for Global Health Technologies	Aga Khan University
London School of Hygiene and Tropical Medicine	Kenya Medical Research Institute (KEMRI) Wellcome Trust Research Programme (KWTRP)
Northwestern University	Kenyatta University
3rd Stone Design	
Hatch Technologies	

Table 5A.1: Global and Kenya NEST360 organisations.

NEST360 global develops and sources medical devices for the NEST360 equipment bundle, supports the development of clinical and biomedical training materials, facilitates device distribution, and supports medical device use across countries, as well as develops relevant global public goods, such as a Small and Sick Newborn Implementation Toolkit. A Nairobi, Kenya-based team, led by a clinical country lead and a country liaison with clinical, biomedical, and data systems experts, supports the 13 hospitals.

A Committee of Experts, led by the Kenyan Ministry of Health's (MoH) Department for Family Health, (including the United Nations Children's Fund (UNICEF), World Health Organization (WHO), United Nations Population Fund (UNFPA), United States Agency for International Development (USAID), KWTRP, Kenya Paediatric Association (KPA), Save the Children, PATH, Health Sector Coordination & Intergovernmental Relations, Kenya Medical Training Colleges (KMTCs), Moi Teaching and Referral Hospital, University of Nairobi (UoN), Division of Reproductive Health, and Association of Neonatal Nurses) guides NEST360 implementation and leverages learnings from NEST360 to inform changes to national policy. These quarterly meetings facilitated the integration of NEST360 educational materials into national curricula and the adoption of guidance for a standard newborn unit (NBU) layout.[4 5]

Kenya

NEST360 sites

In Kenya, NEST360 is a network of 13 hospitals that are also part of the Clinical Information Network (CIN). Only hospitals from the 23 CIN sites were considered for the NEST360 network because of the high-quality data collection in place across the CIN. Hospitals in the NEST360 network have a high volume of newborn patients and are teaching hubs for public and private medical and nursing colleges. The 13 hospitals are across 10 counties in central and western Kenya with high neonatal mortality. Table 5A.2 lists the hospitals and their respective counties.[5]

Hospitals

Hospital	County
Bungoma County Referral Hospital	Bungoma
Embu County Referral Hospital	Embu
Jaramogi Oginga Odinga Teaching and Referral Hospital	Kisumu
Kakamega County Referral Hospital	Kakamega
Kenyatta National Hospital	Nairobi
Kerugoya County Referral Hospital	Kirinyaga
Kiambu County Referral Hospital	Kiambu
Machakos County Referral Hospital	Machakos
Mama Lucy Kibaki Hospital	Nairobi
Nakuru County Referral Hospital	Nakuru
Nyeri County Referral Hospital	Nyeri
Pumwani Maternity Hospital	Nairobi
Thika Level 5 Hospital	Kiambu

Table 5A.2: NEST360 hospitals.

To support clinical and biomedical training, six clinical and two technical skills labs were set up at KMTCs and universities. Table 5A.3 lists the clinical and technical skills labs.

	Clinical Skills Lab	Technical Skills Lab
Eldoret KMTC	X	
Kisumu KMTC	X	
Nairobi KMTC	X	
Kilifi KMTC	X	
Meru KMTC	X	
Oloitoktok KMTC	X	
Kenyatta University School of Engineering and Technology		X
Technical University of Mombasa		X

Table 5A.3: NEST360 clinical and technical skills lab.

Products

In Kenya, NEST360 has distributed, installed, trained, and supported maintenance on nine different types of equipment for small and sick newborn care. The equipment provides hydration, nutrition, and drug delivery (syringe pump), management of jaundice (bilirubinometer, LED phototherapy machine), respiratory support (oxygen concentrator, flow splitter, BubbleCPAP machine, pulse oximeter, suction pump), and thermal management (radiant warmer).[6]

Training

At the start of NEST360, a team of experts, including neonatologists, paediatricians, and neonatal nurses came together to revise the existing comprehensive newborn care protocols (known as Emergency Triage Assessment and Treatment plus admission (ETAT+)) to include current best practices and devices. Technical guidelines for maintenance and troubling shooting of newborn devices were developed as well. Training

materials on newborn care were updated to reflect changes to the guidelines. The clinical training materials were accredited by KPA, the Nursing Council of Kenya, and Kenya Medical Practitioners & Dentists Board. Since the start of NEST360 in Kenya, over 2,000 clinicians and 400 biomeds have received pre- or in-service training on newborn care and devices.[6] Between 2019 and June 2022, in NEST360 supported hospitals, 440 clinical and 123 biomedical staff had participated in in-service training.[7]

In addition to training clinicians and biomeds, NEST360 also supported the development of an instructor course. In Kenya, the General Instructor Course (GIC) has seven fully qualified course directors and 59 full instructors. 135 biomeds, nurses, clinical officers, and doctors have participated in the GIC.[7]

NEST360 Phase 1 network activities

Figure 5A.1 provides an overview of the NEST360 activities in Kenya during Phase 1 (2019-2023).

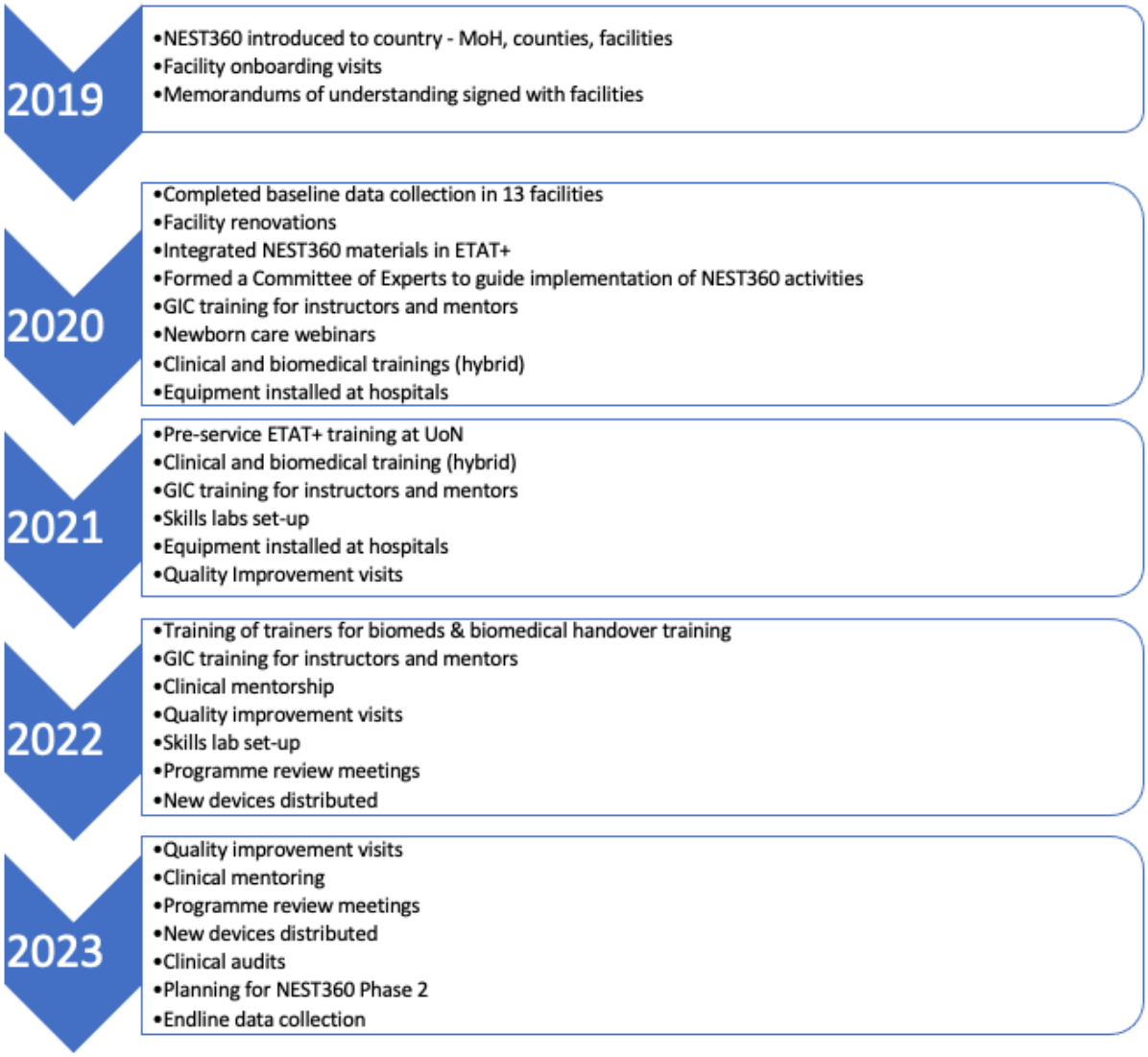


Figure 5A.1: NEST360 timeline in Kenya.

Year 1 – 2019

Year 1 of NEST360 in Kenya consisted of planning and introducing the network and activities. NEST360 aligned with Kenya's Every Newborn Action Plan targets.[8] [9] Detailed implementation plans were developed, stakeholder engagement was undertaken, and network sites were selected with the MoH. Curricula for pre-service and in-service training for clinicians and biomeds were developed. An equipment inventory and Health Facility Service Readiness Checklist were completed for each site to help inform the introduction of NEST360 to the selected hospitals. Monitoring systems were also established to collect and monitor outcomes and provide feedback. A Committee of Experts was formed to provide oversight of NEST360 to ensure alignment with country priorities. Meetings of the Committee of Experts, planned to be held quarterly, are responsible for providing updates to the National Neonatal Technical Working Group to facilitate the dissemination of evidence generation and for consideration in national guideline and policy updates.[4]

Year 2 - 2020

Year 2 of NEST360 was challenged by Covid-19. Inception meetings to introduce NEST360 to the selected hospitals were done either in-person or virtually. The NEST360 team held webinars on Zoom from April to June 2020 on newborn care open to all health workers; clinicians even joined from other countries (Uganda, Nigeria, Cameroon, Ethiopia, Rwanda, Mauritius). Zoom participant limits had to be increased to 500, which was still insufficient to meet the demand. Following the success of the webinars, trainings for NEST360 hospitals were moved to a hybrid approach – three days of virtual teaching followed by two days of in-person practical training. 17 instructors and mentors were trained to support quarterly mentorship and supportive supervision. NBUs were mentored post-training to support adoption and mastery of new knowledge and skills.[5] [10]

Year 3 – 2021

In Year 3 of NEST360 in Kenya, installation of all devices was completed across the 13 hospitals and skills labs were set-up. The Comprehensive Newborn Protocols were validated and made available in an electronic version for ease of use on mobile phones. All trainings were completed; in-service training targets were exceeded for clinicians, nurses, and biomeds. Targets for pre-service training were not reached due to the closure of pre-service training institutions during the pandemic.

About 30% of biomed members of the Association of Medical Engineering of Kenya (AMEK) participated in trainings supported by NEST360 in Year 3. There were in-service training webinars for biomeds which focused on component-based learning and case studies. NEST360 worked with AMEK to accredit and embed training materials developed with the support of NEST360 into the national biomed in-service training. Additionally, a pilot three-day neonatal equipment workshop was held for final year undergraduate and biomedical diploma engineering students at Kenyatta University and the KMTC in Nairobi. The training included experiential learning opportunities; faculty from the training institutions taught with mentorship from NEST360. NEST360 education content, focused on diagnostic and therapeutic equipment for maternal and newborn care, was integrated into the curricula at the KMTCs.

Quality improvement (QI) visits were piloted in Year 3 at three hospitals. The QI visits focus on four areas: clinical, biomedical, data systems, and governance, involving biomeds, clinicians, health records

information officers (HRIOs), and hospital administrators (medical superintendents). Learnings from these pilot QI visits were identified and a refresher workshop was held. QI visits were then conducted at seven hospitals.

In collaboration with CIN, NEST360 supported automated high-quality hospital reporting. These reports are shared directly with the Department of Neonatal and Child Health at the Ministry of Health in place of reports generated by NBU nurses, freeing up time of NBU nurses for clinical care.[11]

Year 4 - 2022

Over the course of Year 4 with the devices distributed and trainings completed, NEST360 worked to institutionalise their efforts in improving small and sick newborn care.

The Comprehensive Newborn Care protocols was officially launched by the Cabinet Secretary for Health. Three clinical skills labs were established at the KMTCs in Kisumu, Eldoret, and Nairobi. The skills labs helped to integrate the teaching of medical devices into pre-service training. A handover skills training for biomeds on preventive and corrective maintenance was held. Engineering toolkits were distributed to the biomeds to help maintain and repair devices onsite. GIC trainings were held at the skills labs and hospitals to support participants in lecturing, teaching, simulation teaching, and facilitating small group discussions. Trained participants will be able to lead future trainings and provide on-site training and mentorship for biomeds and clinicians. There were three rounds of multidisciplinary QI visits at all NEST360 hospitals.

NEST360 held a three-day community of practice meeting with biomeds, clinicians, HRIOs, and national and sub-national MoH officials to exchange learnings and discuss cross-cutting issues affecting the NBUs in hospitals in the network. At this meeting, participants agreed to better engage national and county government leadership to integrate the newborn agenda in their workplans and budgets.[1] By the end of year four, 27,301 newborns had been admitted to NEST360 hospitals in Kenya.[3]

Year 5 – 2023

In the final year of Phase 1 of NEST360, network activities continued to be integrated into routine practice. Three rounds of QI visits were undertaken under leadership of the Directorate of Health Standards, Regulation, and Quality Assurance within the MoH, clinical mentoring continued for nurses, network wide programme review meetings were held, new devices were distributed, and clinical audits were undertaken. The NEST360 team began planning for Phase 2 in collaboration with the MoH, counties, and NEST360 global organisations. Phase 1 endline data collection occurred.

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Appendix 5B. Developing an understanding of the processes involved in the formation and functioning of networks to change practices: learnings from a Realist Evaluation of the Newborn Essential Solutions and Technologies programme in Kenya: protocol

Abstract

Networks are becoming a more frequently used approach to solve problems of poor service delivery, quality of care, clinical outcomes, and health system functioning in low-and-middle income countries. While networks may undertake standard health system strengthening activities, there are certain less tangible but very key processes and interactions that occur in networks which enable the activities to happen. The ability to articulate these less tangible elements of a network are important to understanding how and why networks form and work. A realist review developed a programme theory that explained how and why networks form and function to change practices. Following on this realist review, a realist evaluation will aim to further uncover and understand the processes involved in the formation, functioning, and performing of an internationally supported programme network in an LMIC health system that has led to changes in practice to improve quality of care and services. This realist evaluation will confirm, refute, or refine the programme theory through a multiple-methods single embedded case study of the Newborn Essential Solutions and Technologies programme in Kenya. Data collection methods will include semi-structured realist interviews, document review, and non-participant observation. The findings from this realist evaluation will enable a greater understanding of the processes involved in network formation, functioning, and performing that enable changes in practices in internationally supported programme networks. This can lead to a more considered implementation of these networks, thereby improving health system functioning and performance.

Background

Networks in health systems

Health systems are complex systems and their sub-optimal functioning due to increased demands, limited resources, and structural inertia[1] may lead to poor service delivery, quality of care, and clinical outcomes. Health sector actors look to approaches to improve under-performing systems, services, and the resultant poor outcomes that are within their capabilities and resources. Networks are an increasingly frequent approach to solve these problems.[2]

A vast and diverse range of networks exist in the field of healthcare; they range from global advocacy networks to service delivery networks to community-based networks. While there are various network definitions, typologies, and frameworks in the health and non-health literature, there is "no single, consensually agreed definition of what constitutes a 'network.'"[3] For a scoping review on networks in low-and-middle income country (LMIC) health systems, we defined networks as "groups of facilities and/or healthcare stakeholders (including but not limited to all types of providers, technicians, government officials, professional associations, non-governmental organisations, and donors) linked formally or informally, horizontally or vertically, through programs, interventions, activities, or initiatives." The scoping review identified five key components that make up networks (form and structure, governance

and leadership, method of functioning, resources, and communication) and mapped network uses, purposes, and stakeholders.

While the activities networks undertake are often similar to other health system strengthening initiatives, there are certain less tangible but very key processes and interactions that occur in networks which enable the activities to happen. The ability to articulate these less tangible elements of a network are important to understanding how and why networks form and work. If those interested in establishing networks are able to deliberately take these considerations into account, it could support achieving the desired network outcomes. This evaluation seeks to learn transferable lessons about how networks (as defined above) form, function, and perform in order to change practices. Data will come from the Newborn Essential Solutions and Technologies (NEST) programme in Kenya (see below for more details).

Kenya

Despite substantial declines in global child mortality over the last 30 years, significantly less progress has been made in the reduction of newborn deaths. Globally, in 2018, newborn deaths made up 47% of all under-5 deaths.[4] In Kenya, while under-5 mortality notably reduced between 2003-2014 (from 115 to 52 deaths/1000 live births), newborn deaths only declined by one-third (from 33 to 22 deaths/1000 live births).[5] 40% of all under-5 deaths occur during the newborn period[6] and over 50% of sick newborns lack access to a health facility able to provide appropriate care.[7] Improvements in the availability and quality of newborn care are essential to reduce newborn mortality as 71% of newborn deaths could be reduced with high-impact low-cost interventions.[8]

Newborn Essential Solutions and Technologies

NEST is a multi-country multi-stakeholder programme in Kenya, Malawi, Nigeria, and Tanzania which has the goal of implementing high-quality, safe, inpatient care for small and sick newborns.[1] The programme works with governments, bi and multilateral organisations, global health donors and organisations, civil society, academic institutions, and the private sector. NEST provides in-patient newborn wards in hospitals across the four countries with a bundle of medical devices for the care of small and sick newborns (e.g., CPAP machines, radiant warmers) and supports their installation and maintenance, updates pre-service and in-service educational materials for clinicians and biomedical engineers and technicians, and implements tools and dashboards for data management and quality improvement. The programme also works globally to improve market access for these medical devices and develop global materials, such as an investment case, cost planning tools, and an Implementation Toolkit for small and sick newborn care.

In Kenya, NEST supports 13 hospitals in 11 counties. NEST is an example of a network initiated by external organisations with aims to engage and empower national and country level partners. It is a large, complex programme with international financial support to build networks. NEST takes an approach of trying to build networks at the country and facility levels amongst clinicians, biomedical engineers and technicians, the Ministry of Health (MoH), and other stakeholders. By doing this, it affords the opportunity to develop committed, engaged, and motivated network members to change practices, transfer knowledge, and sustain results.

[1] www.nest360.org

Over the past three years of the NEST programme, in collaboration with the MoH, NEST has leveraged opportunities to develop networks between clinicians to build clinical capacity, highlighted in Table 1.

Activity	Materials
Quarterly clinical mentorship and supportive supervision: A clinical training team trains and provides quarterly mentorship and supportive supervision to clinicians. The training includes opportunities for clinicians to practice together in simulation situations. This has created a network of newborn care champions in hospitals across the country.	https://nest360.org/kenya-holds-gic-for-pre-service-and-clinical-mentorship/
Adaptation of clinical mentorship: During Covid-19, these trainings were moved to webinars open to all healthcare workers. To ensure accessibility to frontline healthcare workers, in particular, the clinical training team undertook outreach on using Zoom, by leveraging existing WhatsApp groups to provide instruction on how to use the platform.	
Adaptation of in-service training: The clinical training team built on the success of these webinars to transform in-person newborn care trainings into a three-day virtual training for facilities during Covid-19.	NEST Clinical Modules https://nest360.org/project/clinical-modules/ NEST Clinical Scenarios https://nest360.org/project/clinical-scenarios/
Integration of NEST materials into the national curricula: NEST clinical training integrated into the Newborn Emergency Triage Assessment and Treatment (ETAT) course	
Pre-service training and training materials for biomedical engineers and technicians: Biomedical training and training of trainers at Kenyatta University on repair and maintenance of NEST technologies	NEST Technical Modules https://nest360.org/project/technical-modules/ NEST Technical Scenarios https://nest360.org/project/technical-scenarios/
Clinical – Biomedical linkages: NEST has created linkages between clinicians and biomedical engineers and technicians, which in many cases may have not previously been that strong.	
Generic instructor courses: Training of potential clinical and non-clinical healthcare professionals as instructors	Generic Instructor Course https://nest360.org/project/gic/ https://nest360.org/kenya-holds-gic-for-pre-service-and-clinical-mentorship/

Table 1: Examples of NEST clinical and relationship building activities

A Committee of Experts, led by the Kenya MoH's Department for Family Health and includes partners such as USAID, Unicef, and Path, guides NEST implementation and leverages learnings from NEST to inform

changes to national policy. These quarterly meetings have helped facilitate integration of NEST developed educational materials into national curricula and the adoption of a standard neonatal unit layout.

NEST has a theory of change that describes the programme and its main activities across the four countries. However, processes of network formation and functioning are not articulated in the theory of change and are likely country specific. These complex processes of network formation and functioning are important for successful implementation of NEST's programme activities, impact the success of the programme, and sustain (or not) changes in practice that improve quality of care and service delivery for small and sick newborns. This realist evaluation will attempt to articulate and understand what these processes of network formation and functioning are and how and why they facilitate NEST to achieve its goals.

While NEST is implemented across four countries, this evaluation will only focus on the NEST programme in Kenya. This is to achieve sufficient depth in the data collection and analysis that would be difficult to reach across the four countries without extensive resources and time. We will aim to achieve maximum variation in the NEST sites selected. The methodological approach of realist evaluation lends itself to analysis at the middle range theory level of abstraction and therefore transferable lessons can still be identified from data collection in one country. Additionally, there are pre-existing relationships with stakeholders and the MoH in Kenya, which will facilitate access to hospitals, interview participants, and meetings as well as logistics.

Realist Evaluation

The realist evaluation approach seeks to understand causation in phenomena, such as social programmes, initiatives, or interventions.[9] Realism acknowledges that actors respond differently to interventions in diverse circumstances and that programmes are not universally successful, working better in certain contexts than in others. According to the realist philosophy of science, patterns of observed outcomes are the result of underlying generative mechanisms, that may or may not function in certain contexts.[9] The approach is regularly used to make sense of complex social programmes or interventions.[10]

All programmes and interventions have underlying theories explaining how and why they produce certain outcomes which may or may not be explicit.[11] Realist programme theories explain what works, for whom, in what respect, to what extent, and how using the concepts of context, mechanism and outcome (see below for more details). They are a form of 'middle range theory' because they are specifically expressed at the level of abstraction that permits empirical testing.[12]

The realist approach to evaluation helps to develop an understanding of how and why things work and in what context and cause various outcomes in different circumstances, which can have broader implications for the implementation of social programmes, initiatives, or interventions. A realist evaluation tests (i.e., confirms, refutes or refines) programme theories with primary data collection. Data collected is interpreted to identify what mechanisms are triggered in what contexts to produce the observed outcomes; the mechanisms are key to understanding how the outcomes are produced.[13] Mechanisms are the interaction between the resources provided by a programme or intervention and how actors interpret and act upon the resources; mechanisms are always present but their operation is context dependent.[14] Contexts are elements of the programme or intervention environment that may or may not trigger the mechanism.[15] Data on context, mechanisms, and outcomes are formed into Context – Mechanism –

Outcome Configurations (CMOCs) to show which mechanisms are triggered by which context to produce certain outcomes within the programme theory.

Rationale

This realist evaluation builds on a scoping review on networks in LMIC health systems and a realist review that developed a programme theory on how networks are initiated, form, and change practices. The realist review drew on studies on networks in LMIC health systems and a selection of relevant High-Income Country (HIC) literature and substantive theories to develop and refine the CMOCs contained within the initial programme theory. This literature-based programme theory, which looked across many different types of networks is therefore relatively generic. The realist evaluation will test the programme theory from the realist review to confirm, refine, or refute it using primary data for an internationally supported programme network exemplified by NEST. From the refined programme theory recommendations will be drawn for developing and implementing these types of networks in LMIC health systems.

Health systems are complex systems "composed of many interdependent, heterogenous parts that self-organize and co-evolve."[16] Networks, implemented in a complex system, can be considered complex interventions because they are made up of many interacting components.[17] In the Science of Evaluation (2013), Pawson describes the realist perspective of complexity through seven concepts: volition, implementation, context, time, outcome, rivalry, and emergence (i.e. VICTORE).[18] Therefore, as the realist approach is often employed to make sense of complex interventions and programmes, networks are a suitable candidate for the realist approach to research. Table 2 applies these concepts to networks in health systems to exemplify how they meet Pawson's criteria of complex interventions.

Concept	Explanation	Application to networks in health systems
Volition	People make choices	Networks are composed of stakeholders who make decisions on what, how, and when to implement activities to set-up and run a network. Stakeholders can be an individual, institution, or organisation. In a network a stakeholder may be represented individually as well as with an institution or organisation.
Implementation	Programmes have long implementation chains	There may be many different activities, relationships, and steps involved to implement and run a network, and they may occur over time.
Context	Pre-existing from micro to macro levels, influences outcomes	Networks involve all levels and sectors of the health system, and these have different contexts which can affect the network in different ways.

Time	Programmes and interventions come from somewhere	Networks are not a new intervention in health systems and there is relevant existing research that can be drawn on to understand them. Networks are often developed from or linked to prior relationships or existing structures.
Outcome	Desired, undesired, predictable, unpredictable, intermediate	Networks can support the production of clinical outcomes, health system outcomes, and network specific outcomes. These outcomes may be intended or an unintentional biproduct of the network.
Rivalry	Interactions with other programmes or interventions	A multitude of interventions and programmes occur in health systems; networks are not implemented in isolation.
Emergence	Things change	Health systems and networks are dynamic and subject to change.

Table 2: Explanation of networks in health systems as complex interventions, using Pawson's VICTORE framework

Study aims and objectives

Study aim

The aim of this study is to uncover and understand the processes involved in the formation, functioning, and performing of internationally supported programme networks in LMIC health systems that have led to changes in practice to improve quality of care and services. This study will undertake a multiple-methods case study of the NEST programme in Kenya to explore if there have been changes in practice, what they are, what has enabled the changes in practices and whether the programme theory (from the realist review) is able to explain why, in what context and for whom these happened. Where necessary modifications to the programme theory will be made based on the data collected.

Study objectives

1. Test (confirm, refute, or refine) the realist programme theory (developed in preceding realist review) on the NEST programme in Kenya to develop an understanding of the processes involved in the formation, functioning, and performing of the programme's network that enable changes in practice to improve quality of care and services
2. Use the refined programme theory to identify transferable lessons and best practices for ministries of health, health system managers, clinicians, and health sector partners interested in establishing or scaling up networks, highlighting how networks can change practices to improve quality of care and services

Research questions

Using NEST in Kenya as a case study,

1. What are the changes in practice in NEST's programme network?
2. What are the processes involved in the formation, functioning, and performing of the programme's network that enable changes in practices to improve quality of care and services?

3. How do the processes involved in the formation, functioning, and performing of the programme's network enable changes in practices to improve quality of care and services?
4. Why do the processes involved in the formation, functioning, and performing of the programme's network enable changes in practices to improve quality of care and services?
5. What are the mechanisms in the processes involved in the formation, functioning, and performing of the programme's network that enables changes in practices to improve quality of care and services?
6. What contexts trigger the mechanisms in the processes involved in the formation, functioning, and performing of the programme's network that enables changes in practices to improve quality of care and services?

Study Design and Methods

Study design and setting

This realist evaluation will be a multiple-methods single embedded unit case study to confirm, refute, or refine the programme theory. The evaluation will take place in and around Nairobi County, Kenya. A case study is an in-depth exploration of a complex phenomena in its environment.[19] The case study approach in a realist evaluation allows for refining the programme theory across contexts and deepening an understanding of causal processes.[20] The NEST programme in Kenya is considered the case and NEST stakeholder organisations and 2-4 hospitals as embedded units. Data collection methods will consist of semi-structured realist interviews, programme document review, and non-participant observation. Analysis of the data will confirm, refute, or refine CMOCs from a previous realist review or develop new ones and the programme theory. The evaluation will run from January - December 2023.

Phase I: Initial programme theory development

A programme theory was developed through the realist review "Developing an understanding of networks in LMIC health systems: how and why clinical and programmatic networks improve and provide high-quality healthcare and services: a realist review." This review developed and refined a programme theory that explains how and why networks in health systems are initiated and form in a way that sets them up to be able to change practices, leading to improved quality of care and service delivery. The review selected 32 pieces of peer-reviewed and grey literature and nine substantive theories to develop and refine 58 CMOCs and refine the programme theory.

The realist review programme theory is presented in Figure 1; the programme theory provides an explanation of how and why networks are initiated in a way that sets them up to be able to change practices. The formation of a network starts with the identification of a problem by health system actors. This problem, in service delivery or health system functioning, causes a strain among health system actors that triggers an energy to work towards improving the identified problem. Health systems actors realise that there are others who feel the same strain and that they can pool their energy to collectively take action toward solving the problem. With similar perspectives and experiences, the potential network members are able to coalesce around a collective vision. Network members will form or strengthen existing purposeful relationships, linkages, and partnerships. These relationships, linkages, and partnerships differentiates the network from the health system. Network leadership emerges early in the formation of the network and evolves as the network matures. Overtime, a network identity and culture

begin to emerge. Network members become committed, engaged, and motivated to the network's collective vision, identity, and culture and the network becomes a psychological safe space.

The combination of the network, as a psychological safe space, and the network members as committed, engaged, and motivated enables them to act with accountability and trust allowing for improved teamwork, communication, coordination, and collaboration. This facilitates changes in practices to improve quality of care, service delivery, and health system functioning and ultimately clinical outcomes. However, there are many outside factors that may prevent changes in practices, the provision of care, or outcomes that are beyond the network members' control.

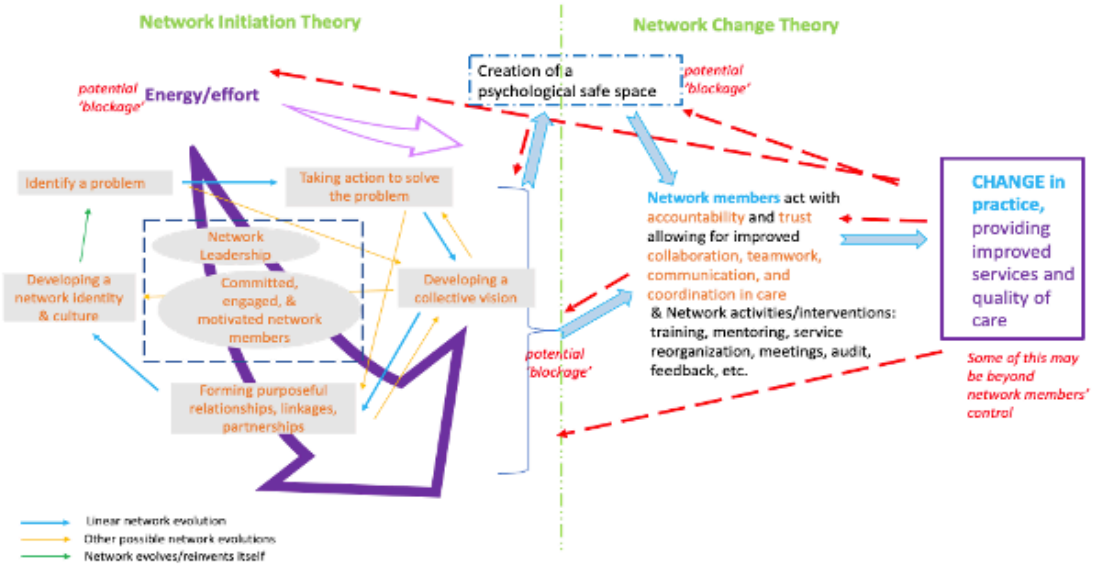

Figure 1: Realist Review Programme theory

Phase II: Programme theory testing

The process of testing the programme theory will aim to uncover and understand the processes involved in the formation, functioning, and performing of NEST as a network. Data collection will centre around the different phases of the programme theory, providing data to further support, refine, or refute CMOCs developed during the realist review and the programme theory. During data collection, it may become apparent that certain parts of the programme theory are particularly important, and the evaluation will progressively focus on those areas. It may as well become apparent that there are certain phases of the programme theory that are not happening, and it will be important to understand why.

Data collection and sampling

This study will include three methods of data collection: semi-structured realist interviews, programme document review, and non-participant observations. A fieldwork journal will be kept to document reflections and to take into account positionality and potential biases. This is particularly important in realist research as, unlike with qualitative constructivist interviews, the interviewer abandons neutral

territory in order to engage with participants.[21] Data collection will be done in batches to provide time for preliminary analysis and reflection, which may progressively focus the evaluation and target subsequent interviews and observations until theoretical saturation is reached.

1) **Semi-structured realist interviews:** The anticipated main source of data will be collected using semi-structured realist interviews. Questions for realist interviews are based on the programme theory to understand how, where, when, and why the programme is and is not effective. Researchers draw on the experiences from study participants because they can provide information on programme processes and outcomes. Realist interviews are structured in a 'teacher-learner cycle' in which participants respond to the programme theory or part of to either confirm, refine, or refute the theory.

   An interview guide will be developed and will include the following types of questions: 1) participant's role in, experiences with, and views of the programme; 2) examples of participant's specific experiences of the programme that targets different aspects of the programme theory; and 3) test specific elements of the programme theory. Early interviews will be more exploratory and become more specific throughout the data collection process; possibly reinterviewing participants interviewed earlier on in the data collection process. Interview questions will evolve as we understand the case in greater depth and fieldnotes and post-interview reflections will be used to identify areas that seem most relevant to explore in later interviews.

   Participants will be purposively sampled and will include NEST researchers and implementers based internationally and in Kenya, programme stakeholders, Kenya MoH representatives, biomedical engineers and technicians affiliated with NEST, hospital administrators, and Newborn Unit clinical and non-clinical staff. Purposively sampling enables the selection of information rich cases which best provide insights relevant to the research questions.[22] Interviews will be organised in waves starting with NEST researchers and implementers based internationally and in Kenya, followed by programme stakeholders, then the Kenya MoH, and then clinical, managerial, and administrative staff and biomedical engineers and technicians in NEST sites. As we begin to understand the case to a greater degree, the sampling will be informed by parts of the programme theory to be able to test it. Individuals will be targeted for recruitment with guidance from the project managers, investigators, and research officers on the Learning to Harness Innovation in Global Health for Quality Care (HIGH-Q) project at the KEMRI Wellcome Trust Research Programme (KWTRP), implementing the study Evaluating the effects of technology and workforce enhancement to support neonatal hospital care in Kenya (HIGH-Q Kenya team). As much variation as possible will be sought from the types of interviewees to provide the contrasts necessary to draw out learnings. Hospital sites will be selected based on pre-defined criteria, included in Table 3.

Criteria	Rationale
Part of NEST and HIGH-Q (non-workforce intervention hospitals)	NEST/HIGH-Q programme documents
Urban – rural	Kenya MoH classification
Well – poor performing	NEST health facility assessments
Likely to have relevant information	Guidance from HIGH-Q Kenya team

Table 3: Pre-defined selection criteria for hospitals

   Interview participants will hopefully be able to provide relevant information in respect to different aspects of the programme theory. The number of participants will be based on the concept of

Information Power – the more relevant information in a sample, the few participants needed.[23] It is anticipated up to 40 interviews will be undertaken at hospitals and 10 with NEST researchers and implementers based internationally and in Kenya, programme stakeholders, and Kenya MoH representatives. Interviews will be recorded and transcribed. Researcher's reflections will be captured in a fieldwork journal and transcribed. This source of data will try to uncover the processes behind the formation, functioning, and performing of NEST as a network and how participants understand and see the network working.

2) **Document review:** Programme documents and reports will be identified from NEST globally and specific to Kenya as well as relevant strategic and operational documents from the Kenya MoH. Programme documents and reports will include hospital quality improvement reports, annual NEST programme reports, and quarterly NEST newsletters. Meeting minutes from NEST Kenya meetings will also be sought for inclusion. This source of data will provide background information on the NEST programme, particularly to provide an understanding of how the programme was planned to work, as well as important context on the Kenya health system to understand how the programme fits into the health system, shining some light on its complexity.

3) **Non-participant observations:** Non-participant observations will be undertaken at 5-7 NEST meetings online and in-person. These may include quarterly national multi-stakeholder group newborn meetings, quality improvement meetings with facilities, and other NEST multiple stakeholder meetings. The selection of meetings will be purposeful and based on potential relevance to the programme theory. Meetings will be identified and selected with guidance from the HIGH-Q Kenya team. This source of data will provide insights into interactions and communication between the different network actors and how they work together; looking particularly for information that relates to aspects of the programme theory or new insights not identified from the realist review. Observer notes will be made by hand and transcribed following the meetings.

Data analysis

Interview transcripts, programme documents, and notes from interviews and non-participant observations will be imported into NVivo QRS International, a data management software tool for qualitative analysis. The data analysis process will be iterative. Interview transcripts, programme documents, and notes from interviews and non-participant observations will be reviewed and analysed in waves, starting with data that is most likely to hold the most relevant information. Data will be coded deductively with codes developed from the programme theory and CMOCs from the realist review and inductively coded with new codes that emerge from the data that are relevant to the research questions. Coded data will be reviewed and organised according to parts of the programme theory and CMOCs developed during the realist review. Data will be used to further support, refine, or refute the previously developed CMOCs or to develop new CMOCs, employing retroductive reasoning. Retroduction, which falls between inductive and deductive reasoning, is the process of identifying the mechanisms behind the observed pattern of outcomes.[24]

Phase III: Theory consolidation

The programme theory will be iteratively refined with CMOCs that have been revised or developed based on interpretations from the primary data collected. Substantive theories supporting the programme theory in the realist review will be reconsidered for relevance to the refined programme theory and

additional substantive theories will be considered if necessary. Furthermore, based on the findings from the evaluation, modifications to the substantive theories may be suggested.

Ethics and research governance

This research falls under the ethics approval of the study Evaluating the effects of technology and workforce enhancement to support neonatal hospital care in Kenya. The study has ethical approval from the Oxford Tropical Research Ethics Committee at the University of Oxford (OxTREC Reference 26-21) and the KEMRI Scientific and Ethical Review Unit (Protocol No. KEMRI/SERU/CGMR-C/229/4203). Written informed consent will be obtained from all participants interviewed and from participants in the observed meetings. Interview and observation data will be anonymised, all identifiers removed, and participants will have unique study codes.

Data Management

Interviews will be audio recorded with an encrypted digital voice recorder and will be uploaded to a secure and encrypted file space at KWTRP or University of Oxford and deleted from the recorder. Recordings will be sent to a transcription service in batches to be transcribed verbatim. Recordings will be archived and destroyed after the study has ended.

Field notes from interviews and observation notes will be anonymised. A separate document containing any identifiers will be kept in a separate KWTRP or University of Oxford secure location. Notes will be typed or scanned into an electronic format and stored on secure KWTPR or University of Oxford servers; paper documents will subsequently be shredded.

All files will be stored on secure servers at the KWTRP or the University of Oxford accessible only to specific researchers with password-protected access. This evaluation will follow the data management plan of the HIGH-Q project.

Communication and dissemination of results

The findings from this realist evaluation will be written-up according to the Realist and Meta-narrative Evidence Syntheses (RAMESES) for Realist Evaluation and submitted for publication in a peer-reviewed journal. In addition, a brief on the key findings and transferable lessons and recommendations from the final programme theory or other types of materials may be developed. Dissemination of the results will be targeted at stakeholders in Kenya and to the broader NEST programme, as well as other government and organisation stakeholders who have implemented or are interested in implementing a network in their health system context. This may be done through presentations, small group or individual discussions, or sharing of materials (e.g., brief, summary slide deck, publication).

Discussion

Importance of the research

Networks are an increasingly employed approach to improve health systems functioning and performance, service delivery, and quality of care, particularly in LMIC health systems. They potentially

offer a solution to an important health systems problem: "Health systems are inherently relational and so many of the most critical challenges for health systems are relationship problems."[25] The findings from this realist evaluation will enable a greater understanding of the processes involved in network formation, functioning, and performing that enables changes in practices in internationally supported programme networks. This can lead to a more considered implementation of these networks, thereby improving health system functioning and performance. Furthermore, this evaluation will contribute to the growing literature on networks in LMIC health systems and is the first realist evaluation, to our knowledge, specifically focused on a network in a LMIC health system. The refined programme theory provides an opportunity for additional research to test the theory in other contexts and on other types of networks.

Limitations and risks

In undertaking this realist evaluation, there are methodological limitations and challenges that need to be considered. In terms of data collection, there may be challenges with identifying a sufficient number of available and willing participants for interviews. This will be mitigated by relying on the guidance of the HIGH-Q Kenya team and taking a broad approach to identifying people who would fit the different profiles of interviewees. It will also require flexibility and adaptability on the part of the interviewer. Secondly, there may be a risk that meeting organisers and participants are reluctant to have meetings observed. Furthermore, the presence of an observer may have a stifling effect on the discussion causing some of the unarticulated aspects of processes that we are looking for to be altered or not appear as easily. In an effort to mitigate concerns of meeting organisers and participants, the observed meetings will not be recorded and observation notes will be anonymised. Prior to data collection familiarisations visits will be undertaken at the hospitals which will also assist with understanding of the context. Lastly, this study is only able to look at one of the four NEST countries, which may limit transferability of recommendations to other settings.

Reflections from Gilmore (2019) on the challenges of undertaking a realist evaluation as a foreign researcher identified four main concerns that merit taking into consideration: 1) power imbalances between researchers and participants during data collection; 2) working through translators and across languages; 3) being 'engaged' with limited contextual familiarity; and 4) bringing in appropriate substantive theories.[26] Recommendations to counter these challenges potentially relevant to this evaluation are summarised in Table 4. Interviews are planned to be conducted in English and observed meetings will likely be as well, so translation (challenge #2) is not anticipated to be necessary.

Challenge	Recommendations
1) Power imbalances between researchers and participants during data collection	• Employ standard high-quality qualitative interview techniques • Avoid overly technical language and consider how the structure of the interview is presented • Include open interviews before theory testing interviews • Be reflexive about the interview process and consider how power might have played a role and bring this into the analysis (fieldwork journal)

2) Working through translators and across languages	• Document decision-making processes and reflexivity (fieldwork journal) • Iteration is very important • Make sure that meaning and explanations are not lost during translation • Share findings to translators or research assistants • Interview translators as research participants following data collection
3) Being 'engaged' with limited contextual familiarity	• Spend as much time as possible in the research setting before and during the study • Review relevant literature from other disciplines • Draw on insights into the context of the study from local collaborators • Actively engage with the surroundings
4) Bringing in appropriate substantive theories	• Iterative theory development • Avoid bringing in theories based on the study of western, educated, industrialised, rich, democratic people early in the research process but use them to help explain findings and place within the wider literature

Table 4: Adapted from Challenges and recommendations for undertaking a realist evaluation as a foreign researcher, Gilmore (2019)

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Appendix 5C. Interview guide

Semi-structured realist interview guide

Interviewee Code	
Place and date	
Period worked on NBU/hospital/organisation	

Introduction:

- *Introduce myself: My name is Katherine Kalaris. I am a 3rd year DPhil student at the University of Oxford. I am in Kenya for a few months as part of my DPhil project. My research looks at understanding how clinical and programme networks of people, organisations, facilities, etc. form, function, and perform. I am looking at the NEST programme in Kenya as a case study of a programme network.*
- *Explain purpose of the interview and how it is structured: The purpose of this interview is to speak with you about how you see NEST working as a network. I will start with a few general questions about your experiences and interactions with NEST and then go into more detail on how you see things working as a network and any changes you have experienced.*
- *If it's ok with you I would like to record this interview. Everything will be anonymous and we can stop at any time. Seek consent*

1) Please describe your professional/clinical role?

2) For hospital base staffed (clinical and non-clinical), who do you interact with in your role? For NEST/MoH/stakeholders who do you interact with in respect to the NEST programme?

3) When did you start engaging with NEST? / How long have NEST activities been going on in your facility? / How did you get involved with NEST activities?

4) Could you explain to me what NEST is? How does it work?
- In hospitals, how do you distinguish it from CIN activities?

5) Thinking of NEST, how do you feel part of a programme or network or initiative? (probe do you feel part of something specific from your standard activities)

6) What have your experiences been with NEST? Could you give some examples? What have these experiences enabled you to do?

For example: Meetings (What is it like going to a NEST meeting and connecting with others?), trainings, newborn clinical protocol updates, quality improvement activities/QI visits, mentoring and supportive supervision visits, virtual connections, etc.

Would you be able to tell me more about…….
(*focus on exploring specific elements of the programme theory based on interviewee or responses above*)

7) How has NEST changed in your facility overtime? / How have your interactions with NEST changed over the course of the programme? Could you give any examples?

8) From your perspective, could you describe any changes in practice on NBUs since the start of NEST? Or in the larger network? Could you give any examples?

9) What do you think has enabled (each of) those changes?

Probe to see what the deeper causes may be and map to parts of the programme theory

Would you be able to tell me more about….
(focus on exploring specific elements of the programme theory based on interviewee or responses above)

10) Are there things that don't work well in terms of NEST being a network? Could you give me some examples? How does it compare to other (multi-organisation) programmes that you have worked with?

11) Is there anything else you would like to add?

Close:

- *Thank the interviewee for their time*
- *Inform them that they will be made aware of findings*

Map any responses to parts of the programme theory and probe deeper

- Identifying a problem
- Taking action to solve a problem
- Developing a collective vision
- Forming purposeful relationships, linkages, and partnerships (Through what activities have relationships, linkages, and partnerships evolved?)
- Network Leadership
- Developing a network identity and culture
- Commitment
- Engaged and motivated network members
- Creation of a psychological safe space

Appendix 5D. List of analysed documents

Newsletters

NEST360 Newsletter Q1 (2021)
NEST360 Newsletter Q2 (2021)
NEST360 Newsletter Q3 (2021)
NEST360 Newsletter Q4 (January 2022)
NEST360 Newsletter Q1 (April 2022)
NEST360 Newsletter Q2 (July 2022)
NEST360 Newsletter Q3 & Q4 (December 2022)

Annual reports

NEST360 Annual Impact Report 2020
NEST360 Highlights 2021
NEST360 Highlights 2022

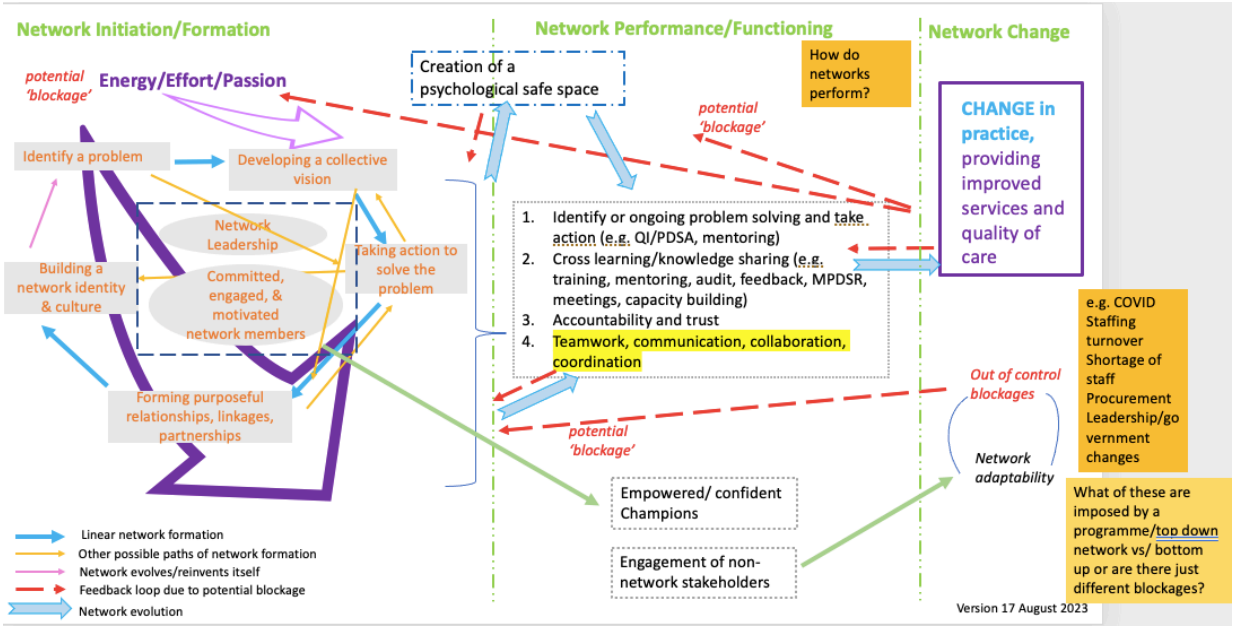
Stories

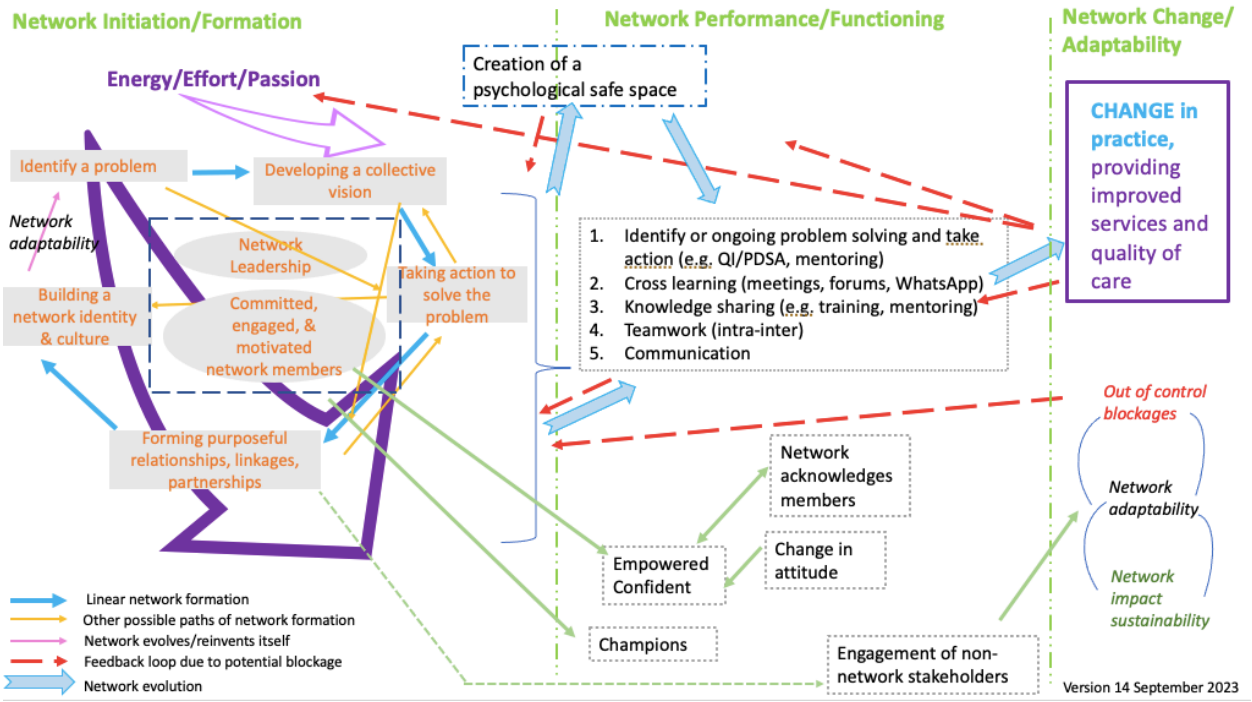
Opportunity in adversity (March 8, 2021)
A look into biomedical engineers and technicians training (May 2, 2022)
Kenya holds GIC for pre-service and clinical mentorship (August 2, 2022)
World Prematurity Day Celebrations (November 30, 2022)
Partners updates – an overview of the past few months (November 29, 2022)
Fellow spotlight: Natalie Nichell, Celsi Warmer Study Kenya (February 3, 2023)

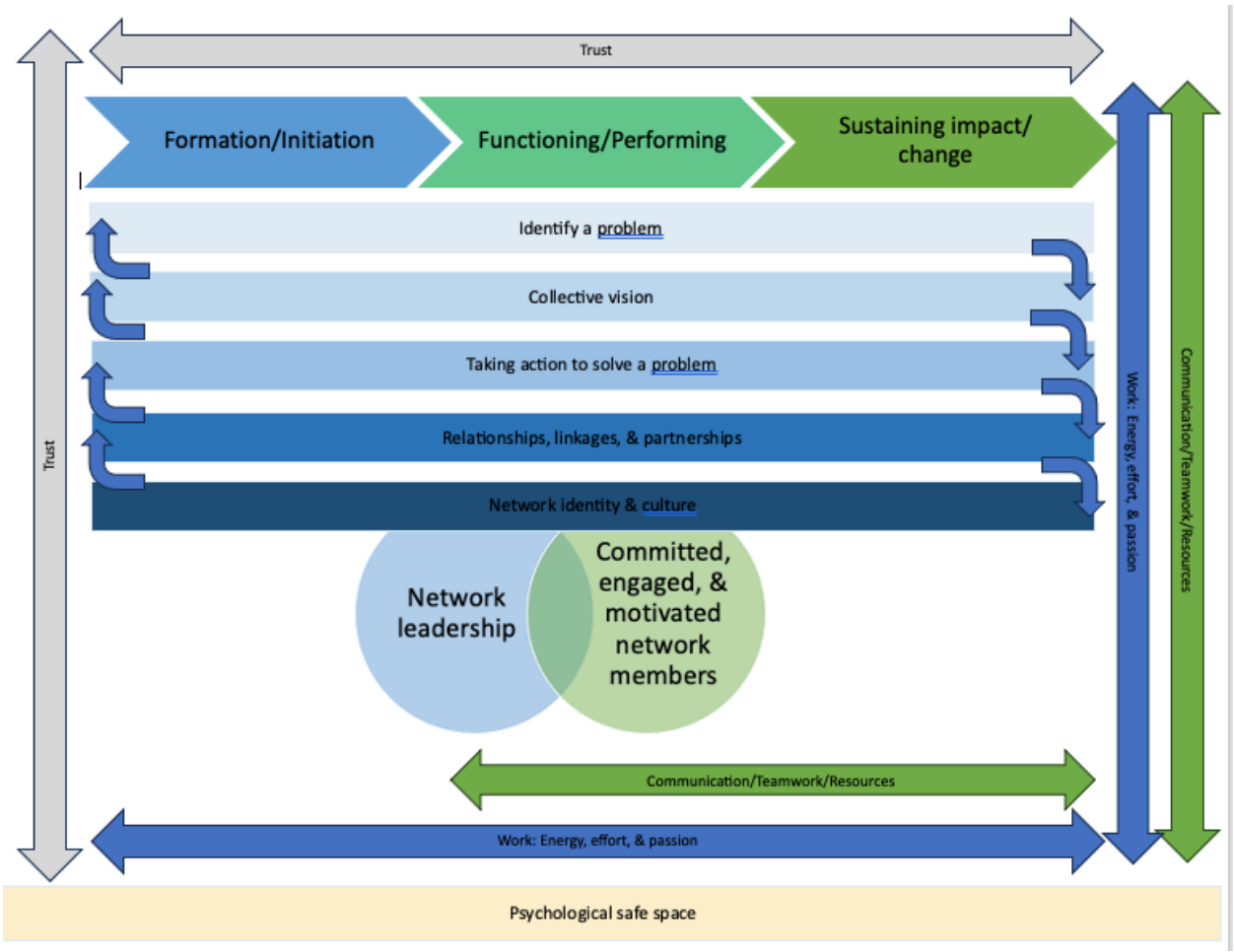
Personal communications

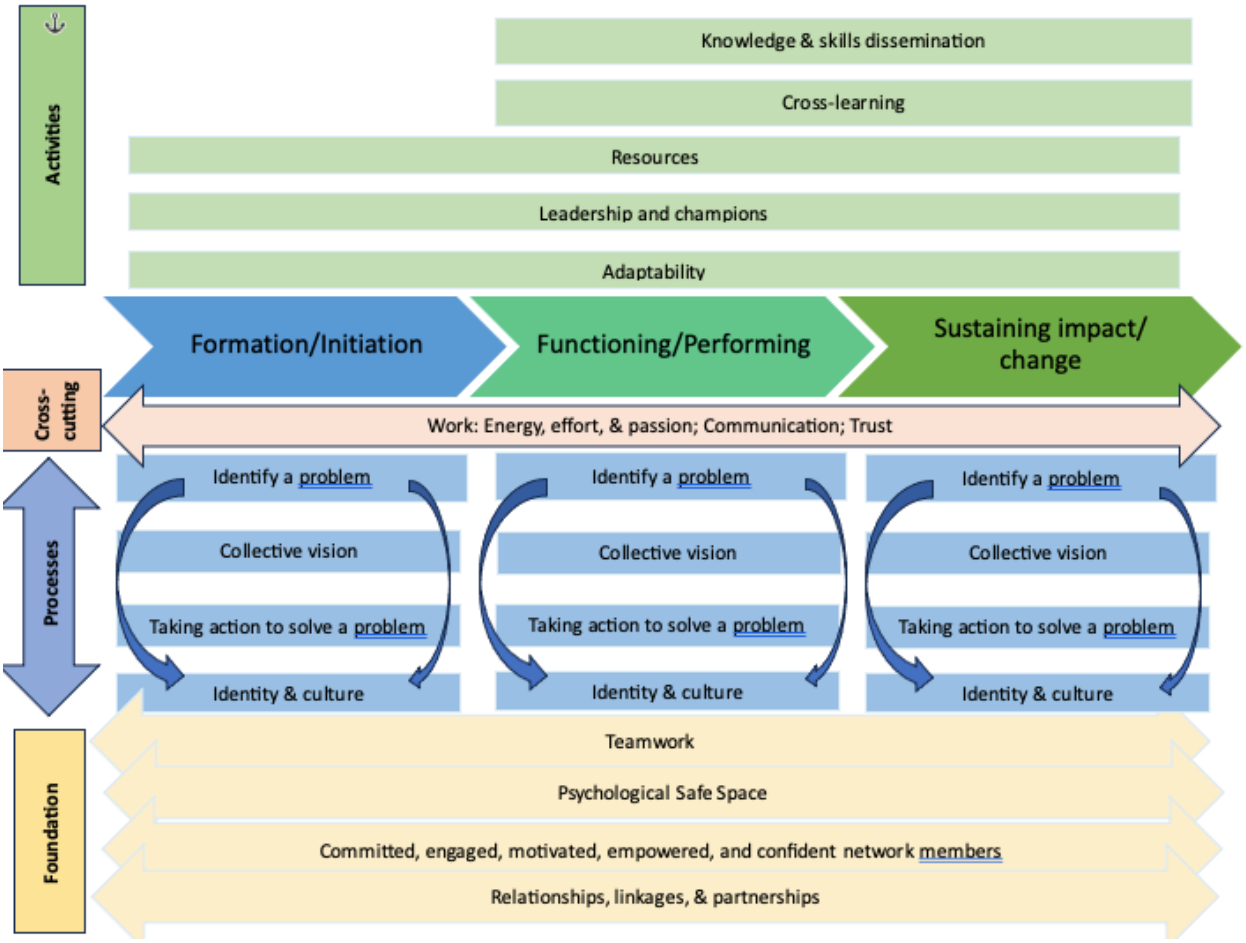
NEST360 Annual Progress Report 2020
NEST360 Annual Progress Report 2021
NEST360 Annual Progress Report 2022
NEST360 Annual Progress Report 2023

Appendix 5E. Realist Evaluation programme theory drafts






Trust
Formation/Initiation
Functioning/Performing
Sustaining impact/ change
Identify a problem
Collective vision
Taking action to solve a problem
Relationships, linkages, & partnerships
Network identity & culture
Network leadership
Committed, engaged, & motivated network members
Trust
Work: Energy, effort, & passion
Communication/Teamwork/Resources
Communication/Teamwork/Resources
Work: Energy, effort, & passion
Psychological safe space


Activities
Knowledge & skills dissemination
Cross-learning
Resources
Leadership and champions
Adaptability
Formation/Initiation
Functioning/Performing
Sustaining impact/ change
Cross-cutting
Work: Energy, effort, & passion; Communication; Trust
Processes
Identify a problem
Collective vision
Taking action to solve a problem
Identity & culture
Identify a problem
Collective vision
Taking action to solve a problem
Identity & culture
Identify a problem
Collective vision
Taking action to solve a problem
Identity & culture
Foundation
Teamwork
Psychological Safe Space
Committed, engaged, motivated, empowered, and confident network members
Relationships, linkages, & partnerships

Appendix 5F. Programme theory framework with CMOC references

	Initiation & Formation	Functioning & Performing	Sustaining Change & Impact
Network Processes			
Identify a problem	- Initial strain or recognition of a problem (1A, 1B) - Identifying an opportunity achievable by their capabilities & (potential) resources (1C) - Recruitment (1D, 1F, 1G)	- Ongoing problem identifying, problem solving, and solution identification (1E, 1H-1J)	- Imbedding ongoing problem solving and solution identification in routine systems with ownership from government/hospitals (1H, 1J)
Collective vision	- Developing the vision (2A, 2B, 2C) - Introducing and communicating the vision (2D, 2H, 2I) - Committing to the vision (2D-2J)	- Sustaining and engagement with the vision (2K, 2M) - Formalise the vision with agreements (2L) - External awareness of the vision (2N, 2O)	- Engage stakeholders in the network's vision (2O, 2P) - External spread of the vision (2N, 2P)
Taking action to solve the problem	- Recruitment to the cause (3A-3C) - Opportunities for network members to connect (3E, 3F) - Support from leadership and champions and resources (3D, 3G) - Knowledge sharing (3H.1, 3H.2)	- Ongoing problem solving (3H.3) - Leadership effort and engagement (3J.1-3K) - Cross-learning (3I) - Knowledge sharing (3H.1, 3H.2, 3J)	- Ongoing problem solving (3H.3) - Leadership effort and engagement (3J.1-3K) - Cross-learning (3I) - Knowledge sharing (3H.1, 3H.2)
Network identity & culture	- Establishing an identity and culture (6A-6D)	- Sustaining through cross- learning, knowledge sharing, teamwork, communication (6E, 6G, 6H) - Demonstration and reinforcement by leadership (6F)	- Sustaining and evolving through cross-learning, knowledge sharing, teamwork, communication (6E, 6G, 6H)
Network Activities			
Knowledge & skills dissemination	- Training and Mentorship (14A-14B.2)	- Training and mentorship (14A-14B.2) - Out of department/network (14C, 14D)	- Training and mentorship (14A-14B.2) - Out of department/network (14C, 14D)

Communication; Trust; Energy, effort, & passion

Cross-learning	- Inter-professional (13A) - Inter-facility (13B.1-13C)	- Inter-professional (13A) - Inter-facility (13B.1-13C - Continuing remotely (13D) - Beyond the network (13E)	- Inter-professional (13A) - Inter-facility (13B.1-13C) - Continuing remotely (13D) - Beyond the network (13E)
Resourcing	- Initial resources (2J, 3D, 6E, 8F, 4H)	- Human resources (16C) - Engage stakeholders (16D) - Engage sub-national level (16E)	- Transition and sustainability (16A, 16B) - Human resources (16C) - Engage stakeholders (16D) - Engage sub-national level (16E)
Leadership & Champions	- Recruit leadership (5A) - Enacting leadership roles (5B- 5H, 5J, 5Q) - Communication (5B, 5C) - Provide support (5D, 5E, 5H- 5K, 11C-11E) - Engage champions (11A-11D)	- Sustaining and cultivating leadership and champions (5L, 5O.3, 5R, 5S, 11F, 11G) - Engage stakeholders (5P, 5T) - Enacting leadership roles (5B- 5H, 5J, 5Q) - Provide support (5D, 5E, 5H- 5K, 11C-11E)	- Engage stakeholders (5P, 5T) - Sustaining and cultivating leadership and champions (5L, 5O.3, 5R, 5S, 11F, 11G)
Adaptability	- Adapt for viability (15A)	- Adapt to optimise functioning (15B) - Human resource changes (15C-15E)	- Adapt for changing members and leaders (15C-15E)

Network Foundations			
Teamwork	- Multi-disciplinary (12A, 12B)	- Multi-disciplinary (12A, 12B) - Provide support (12C, 12F) - Change practices (12D, 12E)	- Multi-disciplinary (12A, 12B) - Provide support (12C) - Change practices (12D, 12E)
Psychological safe space	- Trusting and respectful horizontal relationships (9A, 9B)	- Improved communication, collaboration, and working (9C, 9D, 9F) - Innovation (9E)	- Improved communication, collaboration, and working (9C, 9D, 9F) - Innovation (9E)
Committed, engaged, motivated, empowered, & confident members	- Identify with collective vision, identity, and culture (7A, 7B, 7E, 8B, 8C, 8E, 8G) - Support from leadership and network activities (7C, 8A, 10B, 10C) - Availability of resources (8F)	- Change practices (7D, 7F, 7H, 8C, 8D, 10E) - Engage stakeholders (7F, 7G, 7J, 7K, 8I) - Knowledge sharing (7I, 8H, 10B-10D) - Continued commitment to collective vision, identity, and culture (8G) - Champions emerge (10A) - Change in attitude (10F)	- Change practices (7D, 7F, 7H, 8C, 8D, 10E) - Engage stakeholders (7F, 7G, 7J, 7K, 8I) - Knowledge sharing (7I, 8H, 10B-10D) - Continued commitment to collective vision, identity, and culture (8G)
Purposeful relationships, linkages, & partnerships	- Identify with collective vision and identity (4A, 4D) - Invest in developing relationships (4B, 4C, 4G) - Understanding of expectations (4E, 4F) - Availability of resources (4H) - Cross-learning (4I)	- Cross-learning (4I) - Improved communication (4J) - Ownership (4K) - Trust (4L) - Psychological safe space (4M) - Provide support (4N) - Change attitudes (4P)	- Cross-learning (4I) - Ownership (4K) - Psychological safe space (4M) - Resilience of relationships (4L, 4M, 4O, 4P)

Communication; Trust; Energy, effort, & passion

Appendix 5G. Realist Review and Evaluation CMOC comparison table

This table shows how the Context – Mechanism – Outcome Configurations (CMOCs) from my Realist Review were confirm, refined, or if I did not find supporting data from the primary data in my Realist Evaluation. The parts of the programme theory are arranged in line with the revised programme theory from my Realist Evaluation. I have not included the CMOCs that belong to new sections of the programme theory developed through the Realist Evaluation. The red text shows how CMOCs have been refined.

Identify a problem

	Realist Review CMOC		**Realist Evaluation CMOC**	**Result**
1A	When potential network members feel a sense of dissatisfaction (misaligned with expectations or values) with an issue (e.g. in clinical care, service delivery organisation, or health system management) (context), they will have the energy, excitement, and motivation to do something about it (outcome) because of their frustration (mechanism)	1A		*No supporting data*
		1B	When potential network members feel a sense of dissatisfaction (misaligned with expectations or values) with an issue (e.g. in clinical care, service delivery organisation, or health system management) (context), they will get annoyed/angry/fed up (outcome) because of their frustration (mechanism)	*New*
		1C	In the formation of an externally initiated network, when future network members/leaders/initiators are helped to believe that improvement/change with an issue (e.g. newborn care, morbidity, and mortality) is achievable (context), they will have the energy, excitement, and motivation to do something about it (outcome) because they feel doing so is a worthwhile use of their time and energy (mechanism)	*New*
1B	When a network is in the initial stages and potential network members reflect together on problems (context), they will recruit others to the cause (outcome)	1D	When a network is in its formation stage and potential network members reflect together on problems (context), they will recruit others to the cause (outcome)	*Refined*

	because there is a realisation that they can be part of the solution to some degree (mechanism)		because there is a realisation that they can be part of the solution ~~to some degree~~ (mechanism)	
1C	When potential network members share and discuss their collective experiences, emotions, understanding, or perspectives for a commonly felt problem (context), they are better able to understand what needs to be done and find solutions (outcome) because they have more knowledge to draw on (mechanism)	1E		*Confirmed*
		1F	In a setting with change potential, when network initiators meet and select others who share and amplify their concerns about the identified problem (context), this helps form ties that support network formation (outcome) because the shared concerns about the identified problem are mutually reinforced (mechanism)	*New*
		1G	When the network initiators get input from potential network members on the magnitude and resources needed to begin solving the identified problem (context), this starts to generate commitment from potential network members (outcome) because the potential network members feel their perspective and experiences are respected and valued (mechanism)	*New*
1D	When members in an established network feel it is safe to critically examine and reflect on existing practices (context), they are able to identify new problems and potential solutions (outcome) because they feel enabled to challenge the status quo or feel in a psychological safe space to be able to challenge the status quo (mechanism)	1H	When members in an established network feel it is safe to critically examine and reflect on existing practices together (context), they are able to identify new problems and potential solutions (outcome) because they feel enabled to challenge the status quo (mechanism) and/or feel in a psychological safe space to be able to challenge the status quo as a team (mechanism)	*Refined*
		1I	In an externally initiated network, when there is support and partnership from network initiators and organisers (e.g. through quality improvement and mentorship activities) (context), this can help to continue to identify problems that are within the network member's capacity to change and determine appropriate solutions (outcome) because the network members feel in a psychological safe space to be able to challenge the status quo as a team (mechanism)	*New*

		1J	When the network enables members to regularly identify problems they can work together to address (context), this supports network functioning (outcome) because they can appreciate the value of the network (mechanism)	*New*

Developing a collective vision

	Realist Review CMOC		Realist Evaluation CMOC	Result
2A	When potential network members engage in an open process of collective sense-making around a problem (context), they can identify what they share in common (outcome) because they learn about each other's experiences, emotions, understandings, or perspectives (mechanism)	2A	When potential network members or network initiators engage in an open process of collective sense-making around a problem (context), they can identify what they share in common (outcome) because they learn about each other's experiences, emotions, understandings, or perspectives (mechanism)	*Refined*
2B	If potential network members identify and articulate commonalities among each other (context), then this enables the development of a collective network vision (outcome) because they understand each other's perspectives (mechanism)	2B	If potential network members or network initiators identify and articulate commonalities among each other (context), then this enables the development of a collective network vision (outcome) because they understand each other's perspectives (mechanism)	*Refined*
2C	When network members have common professional or vocational identities or calling (context), this facilitates the development of a collective network vision (outcome) because they are more likely to have common professional ideals or identities (mechanism)	2C	When potential network members and/or network initiators have common professional or vocational identities or calling (context), this facilitates the development of a collective network vision (outcome) because they are more likely to have common professional perspectives and values (mechanism)	*Refined*
		2D	When network initiators introduce the idea/intention of the network to potential members when the network is forming and recruiting network members (context), this will generate early commitment to the collective vision (outcome) because potential network members understand the network's purpose (mechanism)	*New*
2D	If the collective vision of a network is based on shared experiences, emotions, perspective, and understanding among the network members (a similar specific way in which reality is perceived) (context), then this will lead to	2E	If a network's collective vision is based on shared experiences, emotions, perspective, and understanding among the potential network members and network initiators (a similar specific way in which reality is perceived) (context), then this will lead to commitment to	*Refined*

	commitment to the collective vision (outcome) because network members feel represented (mechanism)		the collective vision (outcome) because potential network members feel represented (mechanism)	
		2F	If potential network members know each other prior to network formation (context), this can help generate commitment to the collective vision (outcome) because there is existing trust between the potential network members (mechanism)	*New*
		2G	When potential network members engage in an open process of collective sense-making around a problem (context), this generates a sense of ownership around the collective vision (outcome) because potential network members feel heard/represented (mechanism)	*New*
		2H	When network leaders/champions consult and engage hospital/facility leadership (context), this generates commitment to the collective vision from the administrative hierarchy even if they have no leadership role within the network (outcome) because they understand its value (mechanism)	*New*
2E	If the collective vision of a network is communicated and explained by network leadership in a way that appeals to professional ideals and values shared by network members (context), then this will lead to commitment to the collective vision (outcome) because network members feel engaged (mechanism)	2I	If the collective vision of a network is communicated and explained by network leadership in a way that appeals to professional ideals and values shared by potential network members (context), then this will lead to commitment to the collective vision (outcome) because potential network members feel engaged (mechanism)	*Refined*
		2J	When the network provides resources to support making changes to the physical infrastructure of facilities within the network (context), this encourages potential network members to commit to the collective vision (outcome) because potential network members feel that the network is doing something for them (mechanism)	*New*
2F	When formal agreements have been negotiated and agreed between network members (context), then the network members will be more likely to follow a collective vision (outcome) because this helps network members to understand their roles and responsibilities (mechanism)	2L	When formal agreements have been negotiated and agreed between network members (context), then the network members will feel solidified in a network and be more likely to follow a collective vision (outcome) because the agreement helps network members to understand their roles and responsibilities (mechanism)	*Refine*

2G	When potential network members establish and agree to a collective vision (context), this purposefully links them into a network (outcome) because they have common understanding and perspectives on what the goals of the network are (mechanism)	2K	When potential network members agree to an existing collective vision (context), they will be more willing to take on activities to enact the collective vision (outcome) because they have an understanding of what is expected of them (mechanism)	*Refined*
2H	If there is no collective vision or if network members do not follow the network's collective vision (context), then they will be less successful in implementing network activities (outcome) because network members do not feel committed to the network (mechanism)	2M		*No supporting data*
		2N	When the network makes an effort to disseminate its vision to solve the identified problem beyond the network (context), then non-network stakeholders (e.g. partners, donors) will be more aware of the network (outcome) because network members have advocated for its purpose (mechanism)	*New*
		2O	When the network engages with government officials and takes their inputs into consideration (context), greater support is generated for the network and network activities (outcome) because there is closer alignment of vision between the network and the government, and government officials feel valued and respected (mechanism)	*New*
		2P	When network leadership/organisers are engaged in government meetings (e.g. technical working groups) (context), this can improve the enabling environment for the identified problem/collective vision (outcome) because more stakeholders are aware of and engaged with the problem/vision (mechanism)	*New*

Taking action to solve a problem

	Realist Review CMOC		**Realist Evaluation CMOC**	**Result**
3A	In a bottom-up network when potential network members realise they alone are unlikely to be able to solve a problem (context), they will recruit likeminded	3A	In a network formed from the bottom-up when ~~potential~~ network members realise they alone are unlikely to be able to solve a problem (context), they will recruit	*Refined*

	colleagues for their cause (outcome) because they believe collective action is needed (mechanism)		likeminded colleagues for their cause (outcome) because they believe collective action is needed (mechanism)	
3B	While in a top-down/more directed network when health system administrators or managers realise that they need diverse health system actors to be able to solve the problem/meet the target (context), they will recruit/mandate/encourage colleagues they perceive to be capable to their cause (outcome) because they believe that collective effort/action is needed (mechanism)	3B	In an externally initiated network when ~~health systems administrators or managers or~~ network initiators and organisers realise that they need diverse health system actors to be able to solve the problem/meet the target (context), they will recruit/mandate/encourage colleagues they perceive to be capable of helping their cause (outcome) because they believe a collective approach is needed (mechanism)	*Refined*
3C	When potential network stakeholders think collective action is needed to solve the identified problem (context), they will seek out other individuals with common experience or perspectives (outcome) because they believe such people may be willing to help them (mechanism)	3C	When ~~potential~~ network members think collective action is needed to solve the identified problem (context), they will seek out other individuals with common experience or perspectives (outcome) because they believe such people may be willing to help them (mechanism)	*Refined*
3D	When members in an established network have access to resources that will help them solve the problem they have identified (context), they may be more prepared/more likely to intend to take action (outcome) because they believe they have a more realistic chance of success (mechanism)	3D		*Confirmed*
		3E	When an externally initiated network is forming and opportunities are provided to network members to meet, discuss, and find solutions to problems (context), this will support network members to take action and shape an identity and a sense of belonging (outcome) because they are able to coordinate their work and work together	*New*
		3F	When network members of different roles/cadres/units/organisations work together as a functioning team (context), this enables them to take collective action towards solving the problem (outcome) because they have a common understanding of what needs to be done (mechanism)	*New*
		3G	When network leadership or organisers are supportive of network members taking action (context), network members will be more likely to take practical and concrete action to solve problems (outcome) because	*New*

			they feel their efforts are valued and worthwhile (mechanism)	
		3H.1	When trained network members are provided with support (e.g. quality improvement and mentoring) that is relevant to the problem they are addressing (context), they are more able to take practical and concrete action to solve problems (outcome) because they feel empowered (mechanism)	*New*
		3H.2	When information that makes challenges visible emerges from supportive activities (e.g. quality improvement and mentoring) (context), network members feel a greater need to address the problem (outcome) because they feel accountable to network leaders/organisers (e.g. mentors, quality improvement team)	*New*
		3H.3	When network members take practical action as a team (context), this mobilises the network members' efforts and resources (outcome) because they feel internal accountability towards other network members (mechanism)	*New*
		3I	When network members are provided with a platform for them to easily communicate (e.g. WhatsApp groups) (context), they are more able to take practical and concrete action to solve problems (outcome) because they can access and gain the knowledge and reassurance they need (mechanism)	*New*
		3J.1	If network leaders/organisers continue to put effort and work into solving the identified problem (context), this supports network members to make progress towards changes in practice/improvements (outcome) because they feel encouraged to do so (mechanism)	*New*
		3J.2	When efforts are made to provide consistent support to network members from network leadership/organisers (e.g. through quality improvement and mentorship) (context), it promotes network members to take action (outcome) because network members develop a bond with those providing support (feeling part of a larger team) and feel empowered by and accountability to them (mechanism)	*New*

		3K	If, despite the support provided, network members fail to act or make progress (context), this starts to undermine the relationships between network members and those providing support (outcome) because those providing support feel the network members do not value their efforts (mechanism)	*New*

Developing a network identity and culture

	Realist Review CMOC		Realist Evaluation CMOC	Result
6A	When network members with a collective identity come together to solve a shared problem (context), this makes them feel fulfilled (outcome) because of a sense of shared purpose (mechanism)	6A		*Confirmed*
6B	When network members feel fulfilled from working with likeminded people in a network (context), they want to belong to the network (outcome) because they feel it is worthwhile (mechanism)	6B		*No supporting data*
6C	When network members identify with other network members and the network's vision (context), they develop a network identity (outcome) because it gives them a sense of purpose (mechanism)	6C		*Confirmed*
		6D	When a network celebrates the contributions made by previously unrecognized/ unacknowledged hospital unit/facility leaders (context), this gives hospital unit/facility leaders an identity in the network as important network members (and in the hospital/facility) (outcome) because their expertise and role is now more valued by others (mechanism)	*New*
		6E	When the identity of a network is linked with network partners/initiators providing resources to the network (context), the network has a separate (not integrated into the health system) identity that may make it less sustainable (outcome) because the network partners/initiators have not put in sufficient effort to integrate the network in the health system (mechanism)	*New*

		6F	When network leadership and members consistently and regularly demonstrate and reinforce the network identity (context), this helps other network members adopt the network identity (outcome) because of role modelling (mechanism)	*New*
6D	When a network creates opportunities for members to connect, share experiences, and learn from each other in an open and safe environment (context), this creates a positive network culture and a feeling of belonging to the network (outcome) because they feel respected and valued (mechanism)	6G	When a network creates opportunities for members to connect, share experiences, and learn from each other in an open and safe environment (context), this creates a positive network culture and a feeling of belonging to the network (outcome) because members feel respected, valued, and acknowledged (mechanism)	*Refined*
6E	When network leadership and members identify that the network's culture is not aligned to existing cultures (context), then they may attempt to change the pre-existing cultures and instil a culture (outcome) because they do not identify with the existing ones (mechanism)	6H	When local network leadership and members recognise that the network's culture is not aligned to existing cultures in their environment (context), then they may attempt to change the pre-existing cultures to make room for the network culture and practices (outcome) because they no longer identify with the pre-existing culture and see value in the network culture (mechanism)	*Refined*

Network leadership

	Realist Review CMOC		**Realist Evaluation CMOC**	**Result**
		5A	Networks, initiated and supported by outside organisations/partners (context), will recruit organisations or individuals into leadership positions that they think are competent for network formation and functioning (outcome) because they believe these organisations or individuals understand what the network needs to succeed (mechanism)	*New*
5A	When networks have a member(s) that clearly takes on a leadership role, focuses on building linkages between potential network members and stakeholders, and creates communication channels (context), this helps the network to form (outcome) because it brings people together (mechanism)	5B		*No supporting data*
5B	When networks have a member(s) that clearly takes on a leadership role and communicates the network's	5C	When networks have a member(s) that enacts leadership capabilities, communicates the network's vision, and	*Refined*

	vision and helps to set collective goals (context), this helps to bring network members around the collective vision and to move forward in the same direction (outcome) because they have the same understanding (mechanism)		helps to set collective goals (context), this helps to bring network members around the collective vision and to move forward in the same direction (outcome) because they have the same understanding of the network's value (mechanism)	
5C	When networks have a member(s) that clearly takes on a leadership role and actively coordinates network members (context), this helps the network to form (outcome) because there is a central figure bringing people together (mechanism)	5D		*No supporting data*
5D	When networks have a member(s) that clearly takes on a leadership role and provides support and feedback to network members (context), this can help the network function and take more appropriate action towards the identified problem (outcome) because network members are engaged and see what they need to do to help achieve the vision (mechanism)	5E	When networks have a member(s) that enacts leadership capabilities and provides support and feedback to network members (context), this can help the network function and take more appropriate action towards the identified problem (outcome) because network members feel empowered to take action to work towards achieving the vision (mechanism)	*Refined*
5E	When networks have a member(s) that takes on a leadership role and gets things done (context), network members develop greater commitment, engagement, and/or motivation (outcome) because they believe belonging to the network is worthwhile (mechanism)	5F	When networks have a member(s) that enacts leadership capabilities and gets things done (context), network members develop greater commitment, engagement, and/or motivation (outcome) because they believe belonging to the network is worthwhile (mechanism)	*Refined*
5F	When networks have a member(s) that takes on a leadership role and dedicates time to setting up and the functioning of the network (context), network members develop greater commitment, engagement, and/or motivation (outcome) because they believe belonging to the network is worthwhile (mechanism)	5G		*No supporting data*
5G	When networks have a member(s) that clearly takes on a leadership role and actively engages network members (context), network members develop greater commitment, engagement, and/or motivation (outcome) because network members feel part of the network (mechanism)	5H		*No supporting data*
5H	When network leadership consistently and regularly supports and provides resources to network members (context), this helps network members act to achieve	5I		*Confirmed*

	the network's collective vision (outcome) because the network members feel empowered (mechanism)			
5I	When network leadership consistently and regularly promotes, encourages, or champions practices or influences network members to take up certain practices (context), this helps network members to adopt these practices (outcome) because it allows network members to fulfil a latent desire to practice better (mechanism)	5J	When network leadership and members consistently and regularly promote, encourage, or champion practices or influence network members to take up certain practices (context), this helps other network members to adopt these practices and sustain them in the network/unit (outcome) because of role modelling (mechanism)	*Refined*
5J	When network leadership creates a welcoming and inclusive environment within the network (context), members feel more able to critically discuss issues and suggest possible solutions (outcome) because network members feel that they are in a psychologically safe environment (mechanism)	5K	When network leadership creates a welcoming, supportive, and inclusive environment within the network (context), members feel more able to seek support to improve knowledge, skills, or manner of working (outcome) because network members feel that they are in a psychologically safe environment (mechanism)	*Refined*
5K	When networks have processes in place to identify and enable those with the necessary skills, motivations, or attitudes to take on leadership roles (context), this may support network functioning and may lead to changes happening (outcome), because the network can draw on a wider pool of engaged resources (mechanism)	5L	When networks have processes in place to identify and enable those with the necessary skills, motivations, or attitudes to take on leadership roles from a wider pool of engaged human resources (context), this may support network functioning and may lead to changes happening (outcome), because the network is able to create a distributed form of leadership across the network (mechanism)	*Refined*
5L	If a network is highly dependent on a few people to implement network activities (context), then it is at risk of being unsustainable (outcome) because of burnout and/or loss in those tasked with implementation (mechanism)	5M	If a network is highly dependent on a few people or leaders to implement network activities or leaders that support their implementation (context), then it is at risk of being unsustainable or functioning poorly (outcome) because the leadership structure is fragile (mechanism)	*Refined*
		5N	When there is misalignment of priorities between network leaders/partner organisations (context), then one leader/partner organisation may feel they need to leave the network (outcome) because they do not feel they are moving in the same direction (mechanism)	*New*
		5O.1	When there is a leadership/partner organisation change within the network and a new leader/partner organisation comes in (context), this can jeopardise maintaining the network's collective vision, existing relationships, and functioning (outcome) because the	*New*

			new leader/partner organisation is external and has not assimilated into the network (mechanism)	
		5O.2	When a leadership change within the network introduces new working practices in the network (context), this can disrupt network activity implementation and functioning (outcome) because network members need to learn about new practices (mechanism)	*New*
		5O.3	When a leadership change within the network introduces new working practices without first discussing and negotiating these with network members (context), network members can become frustrated (outcome) because their experience and expertise in the network is not valued (mechanism)	*New*
		5P	When non-network health system leaders, whose buy-in/commitment to the network is important for network functioning, change (context), this can disrupt network activity implementation and functioning (outcome) because it puts at risk relationships essential for network functioning (mechanism)	*New*
5M	When network leadership is not able to get the network to develop and agree on a shared vision (context), then it is at risk of not performing well and becoming unsustainable (outcome) because members are unclear as to what the network is for (mechanism)	5Q		*No supporting data*
		5R	If network members take appropriate action to mitigate any disruption leadership changes might bring (context), then the network is more likely to keep functioning (outcome) because the impact of any disruptions are minimised (mechanism)	*New*
		5S	When there is a change of leadership within the network and new network leadership puts in efforts to maintain network functioning (context), network members feel that it is still worthwhile to be part of the network (outcome) because they feel the leaders value the network (mechanism)	*New*
		5T	When hospital/facility leadership sees the effort that the network is making and the changes that have resulted	*New*

			(context), this encourages them to take action to work towards the collective vision (outcome) because they understand the value of the work (mechanism)	

Psychological safe space

	Realist Review CMOC		Realist Evaluation CMOC	Result
9A	When network leadership is available and approachable, invites input and feedback, and models openness, fallibility, and non-judgmental behaviour (context), then this promotes a network's psychological safety (outcome) because network members feel empowered and not threatened when they speak up or make a mistake (mechanism)	9A	When network leadership/organisers are available and approachable, invites input and feedback, and models openness, fallibility, and non-judgmental behaviour (context), then this promotes a network's psychological safety (outcome) because network members feel empowered and not threatened when they speak up or make a mistake (mechanism)	*Refined*
9B	When network members form trusting and respectful horizontal relationships (leading to flattened hierarchy) (context), then this promotes a network's psychological safety (outcome) because network members feel equal (mechanism)	9B		*Confirmed*
9C	When a network has a shared network identity and culture that promotes a psychological safe space (context), then network members are more likely able to learn, improve, and seek feedback (outcome) because they feel empowered and feel a reduced fear of negative consequences (mechanism)	9C		*Confirmed*
9D	When a network is a psychological safe space for network members (context), it enables members to openly raise concerns or problems (outcome) because they know they will be supported and there will not be negative repercussions (mechanism)	9D		*Confirmed*
9E	When a network is a psychological safe space for network members (context), it encourages innovation and innovative behaviour (outcome) because members know they will be supported and there won't be negative repercussions (mechanism)	9E		*Confirmed*
9F	When a network creates a psychological safe space for network members (context), it enables them to more	9F	When a network creates a psychological safe space for network members (context), it enables them to more	*Refined*

	easily collaborate across the network's facilities, levels, and sectors of care (outcome) because they already have a common ground and understanding (mechanism)		easily communicate and collaborate across the network's facilities, levels, and sectors of care (outcome) because they already have a common ground and understanding (mechanism)	

Commitment

	Realist Review CMOC		Realist Evaluation CMOC	Result
7A	When networks members identify with the network's collective vision, identity, and culture (context), they are more likely to be committed to the network (outcome) because they believe in and value the vision, identity, and culture (mechanism)	7A		*Confirmed*
		7B	When network members' professional identity/calling align with the network vision (context), they are more likely to be committed to the network and enact affective commitment (outcome) because they professionally value/find importance in the network vision (mechanism)	*New*
7B	When networks members have support from leadership/administration/stakeholders (context), they are more likely to be committed to the network (outcome) because they feel valued (mechanism)	7C	When networks members have support from network leadership/~~administration/stakeholders/~~ organisers (context), they are more likely to be committed to the network (outcome) because they feel valued (mechanism)	*Refined*
		7D	When networks enable members to achieve professional norms (that are part of their professional identity) (context), they will be committed to the network (outcome) because of affective commitment (i.e. the alignment between their professional and the network's norms) (mechanism)	*New*
8B	When a network member gets 'emotional' benefits (positive feelings) or feel a sense of purpose from being part of the network (context), they are likely to be highly committed (outcome) because it is fulfilling for them (mechanism)	7E		*Confirmed, moved from 'Engaged and motivated network members to 'Commitment'*
		7F	When a network shows network hospital/facility leadership it can improve care practices (context), this can generate commitment from them (outcome) because they see its value (mechanism)	*New*

		7G	In an externally initiated network, when the network initiators promote the efforts and accomplishments of the network to donors and the interested global community (context), this increases network member commitment to the network (outcome) because network members feel their efforts are acknowledged and valued (mechanism)	*New*
7C	If a network has committed members (context), then they are more likely to act on their identified problem and collective vision (outcome) because members are willing to put in the energy and effort (mechanism)	7H	If a network has committed and proud members (context), then they are more likely to act on the identified problem and collective vision (outcome) because members are willing to put in the energy, effort, and passion (mechanism)	*Refined*
		7I	When committed network members take action to disseminate knowledge to network members and others outside the network (context), this extends network benefits to network members and others outside the network (outcome) because of a greater availability of knowledge and skills (mechanism)	*New*
7D	When influential outside stakeholders are actively engaged in network processes (context), then they are more likely to be committed to the network (outcome) because they can be helped to understand the collective vision of the network (mechanism)	7J		*Confirmed*
7E	When influential outside stakeholders are committed to the network and actively engaged in participating (context), then it may be easier for the network to achieve its aims (outcome) because network members feel empowered (mechanism)	7K	When influential outside stakeholders (often specific individuals within an organisation) are committed to the network and actively engaged in participating (context), then it may be easier for the network to achieve its aims (outcome) because network members feel empowered (mechanism)	*Refined*

Engaged and motivated network members

	Realist Review CMOC		**Realist Evaluation CMOC**	**Result**
8A	When network leadership provides opportunities for network members to be supported, recognised, and learn (context), this creates engaged and motivated network members (outcome) because they derive direct benefits (mechanism)	8A	When network leadership provides opportunities for network members to be supported, recognised, and learn through training, equipment provision and support, and facility renovations (context), this creates engaged and motivated network members (outcome) because they	*Refined*

			derive direct benefits and feel like they belong to the network (mechanism)	
8B	When a network member gets 'emotional' benefits (positive feelings) or feel a sense of purpose from being part of the network (context), they are likely to be highly committed (outcome) because it is fulfilling for them (mechanism)			*Confirmed as 7E*
8C	When network members' personal identity strongly aligns with a network's identity and culture (context), then this will result in engaged and motivated network members (outcome) because they feel they belong (mechanism)	8B		*Confirmed*
8D	When network members actively participate in network change practices that align with the professional values they live by (context), this creates engaged and motivated network members (outcome) because it helps them to fulfil their moral obligation or vocational calling (mechanism)	8C		*Confirmed*
8E	When a network can show its members that it can affect some change (context), members are more likely to continue their engagement with it (outcome) because of they can see its value (mechanism)	8D		*Confirmed*
		8E	If a network can leverage the affective or normative professional commitment of its members to work towards achieving network goals (context), then they can become more engaged with the network (outcome) because of a sense of shared purpose (mechanism)	*New*
8F	When engaged and motivated network members are provided with the resources and opportunity to act (context), then they will attempt to enact changes in practices (outcome) because they feel empowered to change practice/or work towards solving the problem (mechanism)	8F		*Confirmed*
		8G	When network members are committed to the collective vision that is strongly associated with their professional identity and are faced with issues that are beyond their control (context), they will not be deterred from continuing to engage with the network (outcome)	*New*

			because they believe what they are doing is worthwhile and feel accountable to other network members (mechanism)	
		8H	When network members are transferred to facilities out of the network or out of the network unit (context), this leaves a gap in trained, engaged, and motivated network members (outcome) because their skills and knowledge are lost (mechanism)	*New*
		8I	When networks engage with non-network stakeholders in network activities (e.g. quality improvement) and deliberately seek out feedback and advice (context), this can improve network activity implementation (outcome) because the non-network stakeholders provide a broader understanding of relevant issues (mechanism)	*New*

Purposeful relationships, linkages, and partnerships

	Realist Review CMOC		**Realist Evaluation CMOC**	**Result**
4A	When network members believe in the network's collective vision (context), then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because they are more willing to work with and value working with people whom they identify as being likeminded (mechanism)	4A		*No supporting data*
4B	When network members are open to and able to invest time in developing relationships and linkages through the network (context), then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because they have a better understanding of each other (mechanism)	4B		*Confirmed*
4C	If network members have strong pre-existing relationships (context), then this helps ensure that network members have purposeful and co-operative working relationships (outcome) because they are already familiar with each other (mechanism)	4C		*Confirmed*

		4D	When network members share a professional identity (context), this supports forming purposeful and co-operative working relationships (outcome) because they share common socialised perspectives (mechanism)	*New*
4D	If there are artefacts in place that outline the roles and responsibilities of network members (context), then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because there is a common understanding among network members about what they are expected to do (mechanism)	4E		*Confirmed*
		4F	When a common baseline understanding is created among network members of what is expected of them (context), this helps to develop purposeful relationships (outcome) because the network members have the same level of understanding about each other and their roles and responsibilities (mechanism)	*New*
4E	When a network creates opportunities for relationship building between network members (context), this may help in the creation of purposeful and co-operative working relationships and improve existing working relationships (outcome) because they get to know each other's personality, skills, ways of working, and motivations better (mechanism)	4G	When a network creates opportunities for relationship building between network members within and across facilities (context), this may help in the creation of purposeful and co-operative working relationships and improve existing working relationships (outcome) because they get to know each other's personality, skills, ways of working, and motivations better (mechanism)	*Refined*
		4H	When the network provides resources that support the network members' ways of working (context), this may help in the creation of purposeful and co-operative working relationships and improve existing working relationships across professions (outcome) because they are better able to collaborate and do their job (mechanism)	*New*
		4I	When network leadership creates a psychological safe space that enables cross-learning between network members (context), this may help in the creation of purposeful and co-operative working relationships and improve existing working relationships (outcome) because network members are able to openly share their experiences (mechanism)	*New*

4F	When network members have established purposeful relationships (context), this helps to improve communication between network members (outcome) because they are familiar with each other (mechanism)	4J	When network members have established purposeful relationships within and across network facilities (context), this helps to improve communication between network members (outcome) because they are familiar with each other (mechanism)	*Refined*
		4K	When purposeful linkages and strong working relationships are established between network members (context), this improves network members ownership of the network (outcome) because they feel connected to each other and to the vision (mechanism)	*New*
		4L	When purposeful linkages and strong working relationships are established between network members (context), this helps to build trust among network members (outcome) because network members have confidence in each other (mechanism)	*New*
		4M	When purposeful linkages and strong working relationships are established between network members (context), this supports the creation of a psychological safe space (outcome) because network members feel they can speak freely without fear of negative consequences (mechanism)	*New*
		4N	When purposeful linkages and strong working relationships are established between network members/organisers (context), this enables network members/organisers to provide support in enacting the collective vision (outcome) because they can develop a mutual understanding of the identified problem and potential solutions (mechanism)	*New*
4G	When purposeful linkages and strong working relationships are established between network members or between network members and external stakeholders (context), this bridges gaps between network members or network members and stakeholders (outcome) because of mutual understanding (mechanism)	4O	When purposeful linkages and strong working relationships are established between network members ~~or between network members and external stakeholders~~ (context), this helps them to be in agreement (outcome) because they can more easily develop a shared conceptualisation of the identified problem and potential solutions (mechanism)	*Refined*
		4P	When different professions within the network (e.g. clinical and technical) develop strong working relationships (context), their attitudes toward the other	*New*

			profession changes (outcome) because they understand each other's value (mechanism)	

Appendix 5H. Realist Evaluation CMOCs with illustrative supporting data

Identify a problem

1A	When potential network members feel a sense of dissatisfaction (misaligned with expectations or values) with an issue (e.g. in clinical care, service delivery organisation, or health system management) (context), they will have the energy, excitement, and motivation to do something about it (outcome) because of their frustration (mechanism)
	No supporting data
1B	When potential network members feel a sense of dissatisfaction (misaligned with expectations or values) with an issue (e.g. in clinical care, service delivery organisation, or health system management) (context), they will get annoyed/angry/fed up (outcome) because of their frustration (mechanism)
	No supporting data
1C	In the formation of an externally initiated network, when future network members/leaders/initiators are helped to believe that improvement/change with an issue (e.g. newborn care, morbidity, and mortality) is achievable (context), they will have the energy, excitement, and motivation to do something about it (outcome) because they feel doing so is a worthwhile use of their time and energy (mechanism)
	"Well, it started long before NEST in about 2006. I think, [redacted], who are the biomeds, who've been the initiators of all this came to [redacted], primarily to visit the new [redacted] HIV unit that had been was just being opened in [redacted]. And I was at that opening. And they, I just happened to have tea with them, you know, and they, they said, Is there anything their students could do? And I was, I've worked with government all my life, I feel that's extremely important. And so, I was a bit irritated with all the money that was pouring into Baylor. So, I said, if you want to see proper medicine, you should come down to Blantyre and see. So, to my surprise, they came and asked what their students could do. And they were obviously taken with the neonatal unit. And so, I suggested CPAP, which we didn't have a robust sort of CPAP. And also a that at that stage phototherapy, I think, and I think they were quite interested, because I'd already had some sort of DIY type of hot cots made. So, they went away, and I didn't think they'd come back, because lots of people are fired up when they come, but not so fired up when they return. And, yeah, they did, they came with the phototherapy that worked very well and cost something like $25 instead of several hundreds. And so from that, developed the CPAP, which was made, and then we decided to put that throughout the country. And it was clear when you actually went to all these hospitals that that was that, that they actually didn't have basic neonatal training. And so even if they could make the baby breathe, you know, if you don't keep the baby warm and fed, and everything else, you're in trouble. So it became clear that more was needed. And from that develop this concept of giving a more holistic approach. And then because they're biomedics, they were, they could see the importance indeed, we all can of keeping your equipment working, and also training people in country to innovate, and make things that are created for themselves." (FI 01) *"So now, when we came to the next year's conference, the issue of these equipments came in the NEST, the NEST bundles and all that things. So, when I was talking to with [redacted], he was like [redacted] is a very busy facility, it is well organized, we know the leadership is positive. So, do you think we can do*

	this and I was like, I really need that. So, that is how we started engaging now, how they could get the facility and how then they could be included into the NEST project programme." (FI 05)
1D	When a network is in its formation stage and potential network members reflect together on problems (context), they will recruit others to the cause (outcome) because there is a realisation that they can be part of the solution (mechanism)
	No supporting data
1E	When potential network members share and discuss their collective experiences, emotions, understanding, or perspectives for a commonly felt problem (context), they are better able to understand what needs to be done and find solutions (outcome) because they have more knowledge to draw on (mechanism)
	"They came with the phototherapy that worked very well and cost something like $25 Instead of several hundreds. And so from that, develop the CPAP, which was made, and then we decided to put that throughout the country. And it was clear when you actually went to all these hospitals that that was that, that they actually didn't have basic neonatal training. And so even if they could make the baby breathe, you know, if you don't keep the baby warm and fed, and everything else, you're in trouble. So, it became clear that more was needed. And from that develop this concept of giving a more holistic approach. And then because they're biomedics, they were, they could see the importance indeed, we all can of keeping your equipment working, and also training people in country to innovate, and make things that are created for themselves." (FI 01) *"So for Kenya, when we began oh, my God, it was it was quite intense, because we did not have level two. When they say Level 2, I mean special newborn care guidelines. We did not have. So, we didn't have anything to base our programme on. But we knew that we need to because NEST gives equipment. We didn't just want to do user training. Oh, this is a CPAP machine using like this, because I think that had been done before, it wasn't working. So myself and [redacted]. We thought it would be important to get the devices the best practices, marry the two and help the country to create guidelines on how to use how to really take care of a baby in a level two newborn unit. So, if they have hypoglycaemia, what is the standard? How do you identify a baby with hypoglycaemia? What do you exactly do? Which devices do you use? How do you monitor? How do you know you're doing well?" (FI 29)*
1F	In a setting with change potential, when network initiators meet and select others who share and amplify their concerns about the identified problem (context), this helps form ties that support network formation (outcome) because the shared concerns about the identified problem are mutually reinforced (mechanism)
	"The model that NEST has used across all these facilities which is very, very peculiar, very, very, it is a unique way of, of getting into these facilities. Because they didn't just get in. Others, other organisations will just get in, identify, you know a health facility and get in there. NEST has, you know, this health facility, I was talking about, health facility checklist that's I was talking about, health assessment checklist that's I was talking about. It is a very helpful tool because it gives you the rationale of why you are choosing a particular health facility. Unlike other organizations where they will choose any facility for the sake of choosing and you know you take an equipment there is no unit operating, there is no neonatal person. There is no nurse, there is no biomed. Then who is going to use that equipment? Those are the cases where by you realise two years down the line, and the equipment's are still in a box, packed nicely and kept in a store somewhere. Because it was with a very good intention but the person who was giving out these equipments, or donating the way NEST do, did not consider whether this, the readiness, the facility readiness to uptake this project." (FI 17) *"I think it was back in 2019. We're told about the NEST idea and we're told that they want to come to see how they can make a difference for a newborn unit. And first, they wanted to see which equipment, if they were improved and added to the unit, where they would make a difference. Some other time some two gentlemen came. And basically, they wanted to get information from us from which kind of equipment we would like to have, which improvement we like to have. And I think we had a discussion for like two hours, just looking at if there's a suction, which one would you prefer, why that one, and if a radiant warmer, where would you want and what you want, where we would want the probe, how would you understand that to be like*

	this kind of thing. And that it will say that there will be a study called NEST which will come give us equipment, then after some time we were told, the study is becoming reality. So, they came and I were informed about this study, it was just all of us in the newborn unit here and hospital, generally, the hospital management, about the study. And it was supposed to come first do a baseline study to see what we have how our newborn unit is how busy it is, and then see what equipment they can give us to make a difference for our babies because we're trying to lower the the neonatal mortality rate so that it can also help lower the infant mortality rate." (FI 23)
1G	When the network initiators get input from potential network members on the magnitude and resources needed to begin solving the identified problem (context), this starts to generate commitment from potential network members (outcome) because the potential network members feel their perspective and experiences are respected and valued (mechanism)
	"When they started, it's not that they started and went away. Okay, when they introduced this programme to this facility. Yeah. Many times they come and monitor the progress. They come do assessments, and we are working together. It's not like we are left to work on our own. After the assessment, we are assisting together, we plan together the interventions, what is it that we need to do first of all to identify the gaps? What is it we have implemented this? What are the gaps? And what are the possible solutions? And the good thing that they actually do is that they look at the things that we are able to manage the solutions that we are able to do not that not the external solutions. Like now we'd say fans, we don't have fans. So what but they're looking at what is it within our our reach that we can be able to use to be able to bridge that gap? Yeah, and you see now we are working together with them. They are pulling us and we're moving together. So, we feel really involved and starting from the management to the last person who is providing the service." (FI 09) *"I think when they came in there was an assessment of the facility, what we had, and also our outcomes, in terms of the neonatal outcomes. And there was a suggestion of providing an intervention, which was, which seems to be attractive to us. We agreed to sign up for the programme, because after the baseline survey was done, we're given a feedback, we're also informed of some form of interventions that will help us to improve the neonatal outcomes, and neonatal survival. So that is how I came to know about the programme. I think it was there was an elaborate entry in terms of what the programme wanted to achieve, what we where we were, and what are our targets in terms of improving neonatal outcomes and reducing neonatal mortality." (FI 12)*
1H	When members in an established network feel it is safe to critically examine and reflect on existing practices together (context), they are able to identify new problems and potential solutions (outcome) because they feel enabled to challenge the status quo (mechanism) and/or feel in a psychological safe space to be able to challenge the status quo as a team (mechanism)
	"The QI visits have also been happening again to just to improve the quality. I think we'll be having them every quarter. So, and during the QI visits, basically again, informed by our performance in as far as those documentation is concerned through the neonatal CIN, we're able now to identify just look at the data and then we are able to see where we are not doing well, where we're doing well and where we are doing well and we are able to maintain where the gaps. We come together even as we discussed with the QI team and even ourselves come up with ways of improving. And example is most of our QI visits and even documentation has shown that we have challenges with hypothermia so still working on that grouping in the maternity labour ward identify what are the issues we are putting forth to ensure heaters are provided in critical areas. So, we are hoping to see a drop in something like hypothermia which has been a major issue in this facility." (FI 25) *"And I think also the the growing recognition and appreciation of some of the problems that still continue to contribute to neonatal mortality, for instance, hypothermia management, you know, that's something that every meeting, every place we went, people recognise that hypothermia, both in inborns and outborns, is still a major, major challenge. And through those meetings, some of them put corrective measures. So, for instance, some hospitals*

	started using plastic wraps that they were not using before but after, you know, discussions with our teams, they took it back but taken it as an intervention." (FI 18)
1I	In an externally initiated network, when there is support and partnership from network initiators and organisers (e.g. through quality improvement and mentorship activities) (context), this can help to continue to identify problems that are within the network member's capacity to change and determine appropriate solutions (outcome) because the network members feel in a psychological safe space to be able to challenge the status quo as a team (mechanism)
	"The QI visits are very important, they're there even to make us put on more effort, whenever the lapses are noted on our sides, through QI. The QI visits have also impacted the… empowered us even to be more productive in our work, because without our Q..., okay, on that particularly, you see it gives us a to do on toes, knowing very well there's no room for lapses. For us to improve on the quality and the quality because in the event maybe we did notice some some lapses they come in to tell us on how to go about it to get a problem solved. For example, if you have a challenge, maybe during those visits they normally even engage us to tell some of the challenges we normally face, then how to after out of that QI assessment, they are able to pick some of those problems, then they then they are advise on how to tackle them they give some advice based on the priority what is supposed what is supposed to come first. For example, recently we had one of the problems we had in the in the unit they want to do with a baby incubator and infant that we have failed to get a probe. Yes. So to do that QI visit you are able to advise as to go for to get in the room for maybe to go for a replacement to buy just another another equipment and they give us some time like like by the time they give us some timeline when we are supposed to perfect so it gives us keeps us a reminder to us and even even gives us that motivation to work hard towards maybe beating that timeline. Because they suggested that we do a replacement of equipment because so far efforts to get a replacement for the temperature probe has been futile." (FI 13) *"However, there are six monthly mentorship I'm talking about is now where you have these mentors have an opportunity to go to another hospital, still, unless the implementing hospital where now they meet up with the mentors of that site. And before they go, they usually will have will have identified the mentorship needs. Okay, so there's some times we have a mentorship need that is across for all sites, like for now I know we are struggling with hypothermia. So, during this last mentorship, of course, we said, as much as we are doing so many other things, and hypothermia should really be a focus. So, every hospital will have identified their mentorship needs, maybe based on their day-to-day challenges. Sometimes we identify those needs from our data. So, looking at the data, you can see what people are struggling with. And then others, you just actually just see the need when you go there, the hospital might not have told you but as a visiting mentor, you can actually identify a problem and you'd want to just have the team deal with it or just support them in … that." (FI 14)*
1J	When the network enables members to regularly identify problems they can work together to address (context), this supports network functioning (outcome) because they can appreciate the value of the network (mechanism)
	"When I need a spare I could talk to the biomed from the NEST side. I could first of all identify the problem. Then when I if it comes to a need for a spare I could either call in direct and also WhatsApp in what I what I need. Then within a very short time the spare brought here sometimes you find the to repair the equipment might be a bit tricky. We could they could also tell us to forward the equipment back to them so that they may also repair from their side then the equipment is brought back again." (FI 21)

Collective vision

2A	When potential network members or network initiators engage in an open process of collective sense-making around a problem (context), they can identify what they share in common (outcome) because they learn about each other's experiences, emotions, understandings, or perspectives (mechanism)
	No supporting data
2B	If potential network members or network initiators identify and articulate commonalities among each other (context), then this enables the development of a collective network vision (outcome) because they understand each other's perspectives (mechanism)
	No supporting data
2C	When potential network members and/or network initiators have common professional or vocational identities or calling (context), this facilitates the development of a collective network vision (outcome) because they are more likely to have common professional perspectives and values (mechanism)
	"These people trusted us because maybe they knew us before but they also trusted that the content we're giving them what's recent. And then we have experts in Kenya. Like all the neonatologists were on board, and they're all speaking the same language. And they're all wanting to input and say, 'Oh, no, in Canada, this happened, or in a SA this happened, maybe we should try this,' you know. So, Everybody owned the whole thing. I feel that is what was probably the link. That helped, everybody was always constantly informed. What was happening." (FI 29)
2D	When network initiators introduce the idea/intention of the network to potential members when the network is forming and recruiting network members (context), this will generate early commitment to the collective vision (outcome) because potential network members understand the network's purpose (mechanism)
	"On the biomedical side, I think we were introduced to NEST at a time when there was needed. And the I came to learn that the main, the main reason why NEST was established, they wanted to reduce the mortality rate, neonate newborn mortality rate by the 20 was 20 2050 or 30. They want to reduce it by a half. Yeah. Yes. So we were, we were introduced to NEST, they told us the intention of the program to do to do away with the neonatal death. Because they, particularly in Africa, it has been on the rise. So, the target was to have it reduced by half when it comes to by the by 20 2050. I'm not sure of the 2030? 2030, maybe, Do you think so? 2030 Yeah, yes. Yes. So, they introduced us, they told us about the intention, then apart from that, they went as far as far as training us, on the packages they're going to give to assist the newborn. So, for us to realise the goal, the vision they have for in the first-year arrangement, we were trained on how to handle the equipment, on how to handle to know more about the the working phase for the equipment." (FI 13) *"I know the hospital, the hospitals that were selected to join the NEST implementation are hospitals that were in the CIN network. So of course, [redacted] was a CIN site, then of course, there are a lot of factors, I think they looked into the workload, in terms of deliveries, do you have a newborn space and all that. So, for NEST to come in, I know, of course, the there was an introduction to the hospital. And then now there was an introductory meeting, where the NEST leadership at that time met up with the hospital management of the hospital. So of course, they introduced what the programme was intending to achieve, and how they were planning to do it. And everything they had planned in terms of implementation, then after that, an MoU was signed, between NEST and the hospital. And so, I think that is where the journey started." (FI 14)*
2E	If a network's collective vision is based on shared experiences, emotions, perspective, and understanding among the potential network members and network initiators (a similar specific way in which reality is perceived) (context), then this will lead to commitment to the collective vision (outcome) because potential network members feel represented (mechanism)
	"Then the staff on the ground also being willing to take up those those changes as they come. So, you have to believe in what is coming also." (FI 03)

	"More like I'm part of this movement. Like, we can do better. I think people feel that way because you will find everybody was kind of inspired because we would always think that mechanical ventilation is a solution. But really it's the small things it's how you assess your baby when you go into the ward. It's how you talk to the mother. It's how you do infection prevention. It's how you, you know, small things. It's how you communicate to the person you're handing over to. So, I think that when we change people's mindset, they were able to feel like part of this movement." (FI 29)
2F	If potential network members know each other prior to network formation (context), this can help generate commitment to the collective vision (outcome) because there is existing trust between the potential network members (mechanism)
	"Some of these people we knew them. Because either [redacted] taught them or I taught them. So, they already like trusted us……These people trusted us because maybe they knew us before but they also trusted that the content we're giving them what's recent. And then we have experts in Kenya. Like all the neonatologists were on board, and they're all speaking the same language. And they're all wanting to input and say, 'Oh, no, in Canada, this happened, or in a SA this happened, maybe we should try this,' you know. So, everybody owned the whole thing. I feel that is what was probably the link that helped, everybody was always constantly informed what was happening." (FI 29) *"Number two is that there is already an informal relationship that has formed within the CIN hospitals, professionals. So, when they meet, when they show up in a meeting, almost some of these 90% of the room or 80% of the room knows each other in some way or form." (FI 32)*
2G	When potential network members engage in an open process of collective sense-making around a problem (context), this generates a sense of ownership around the collective vision (outcome) because potential network members feel heard/represented (mechanism)
	"Some of these people we knew them because either [redacted] taught them or I taught them, so they already like trusted us. What we're doing is useful and but we needed, we were very open. And we spoke of what we saw, what needs to be done. And we listened a lot. We really listened, we we created opportunities for people to, to feel like. Me and [redacted] didn't want to be the ones to create these things. We wanted them to feel like this is ours. Right? And I think that is still there even now. Because you would hear people to say during the validation meeting, 'no, you can see when you remember, we tested this, this cannot work we have to do.' So, we involved them from the very beginning. Those meetings we used to have the monthly meetings. I think those were very good, because we people would ask questions and clarify. And we would agree. This is the best way to to go forward with this. And we were involved everybody. And everybody owned the idea." (FI 29) *"These people trusted us because maybe they knew us before but they also trusted that the content we're giving them what's recent. And then we have experts in Kenya. Like all the neonatologists were on board, and they're all speaking the same language. And they're all wanting to input and say, 'Oh, no, in Canada, this happened, or in a SA this happened, maybe we should try this,' you know. So, everybody owned the whole thing. I feel that is what was probably the link that helped, everybody was always constantly informed what was happening." (FI 29)*
2H	When network leaders/champions consult and engage hospital/facility leadership (context), this generates commitment to the collective vision from the administrative hierarchy even if they have no leadership role within the network (outcome) because they understand its value (mechanism)
	"In fact, at that time, I was not the medical superintendent. I was just the in-charge of the department. And the hospital management team, upon sharing with them the objectives of NEST and how useful it was going to impact the outcome of the neonates it was accepted. Yes, they bought into it. We've got the initial support. In fact, the initial meetings involving the medical superintendent and and others that were held in Nairobi, from [redacted] came with that team. And they were very happy. We have received support throughout. Yeah, from the time NEST came on board." (FI 04) *"Was receptive because, you know, critical care for newborns is one of the neglected areas in our setting. And it's an area that has very high mortality if you go into these hospital. So, an intervention that promises to cut that back, I think is quite attractive to hospital managers and Ministry of Health*

	officials, so it was quite well received. In fact, you see, government purchasing quite a number of the NEST equipment even beyond what was donated. So that's normally my test of acceptability. Can they put their own money into it? And we've seen that coming up." (FI 31)
2I	If the collective vision of a network is communicated and explained by network leadership in a way that appeals to professional ideals and values shared by potential network members (context), then this will lead to commitment to the collective vision (outcome) because potential network members feel engaged (mechanism)
	"But I feel that open communication, trust, constant, updating, letting people give you input, I think that really helped. For us, it really helped us. And I thank God in Kenya, we have good internet, that was also very helpful, that we can we can be able to reach people with a click of a button, right? Yeah, that was very, very useful. And also, I think we had a very good foundation on what we wanted to achieve. We were very clear on what we want to do. And we're both very passionate. So, any opportunity, we got to talk about it, we talked about it and everybody was everybody was onboard." (FI 29) *"I think there was, you know, the quantification of the problem, the magnitude of the problem, for people to really understand what they're dealing with. And, you know, visualizing that, you know, just how many babies are dying and promising with a promise that, you know, at a very, you know, with a very low cost, cost-effective solution, you can reverse that was. Those that conversation helped a lot, because we all working together towards a common problem where we think we have an opportunity to do something." (FI 31)*
2J	When the network provides resources to support making changes to the physical infrastructure of facilities within the network (context), this encourages potential network members to commit to the collective vision (outcome) because potential network members feel that the network is doing something for them (mechanism)
	"A lot of changes, a lot of changes. I didn't even say initially that they actually renovated the unit. Yes, soon it was renovated. It initially it used to have few power points, but then after the renovations, there were power points everywhere. We used to really suffer because we didn't know when you had several gadgets to be put on to power. There was a challenge. But when NEST came in and it renovated this unit, it put power points in every room, several of them. So that's the those renovations were good. They actually put in when washing hand, washing points like this one you see outside there was not there, it was by NEST. And see when mothers come in even before they do anything else. They wash your hands. Yes. Yeah. So those renovations also really helped." (FI 22) *"See, we were able to able to renovate the newborn unit and repainting. We're proud of that. Okay, it is been NEST who did for us…When you're working in a clean environment in a beautiful place, it motivates you to work... in a clean environment, beautiful place it motivates you to work." (FI 26)*
2K	When potential network members agree to an existing collective vision (context), they will be more willing to take on activities to enact the collective vision (outcome) because they have an understanding of what is expected of them (mechanism)
	"We really felt great because the next training we figured, oh look at us we could do three sites. Because by when we had enough trainers, we had enough paediatricians, I think we had almost 100 people who we had taken through GIC both paediatricians, nurse, neonatal nurses, specifically neonatal nurses who work in the newborn unit, who have experience with these devices. And the neonatologists we trained. So, we had a pool of almost 100 of those. So, we thought let's do three sites at the same time. So, we did that. So, we had a team of five in [redacted], neonatologist, two paediatricians, two neonatal nurses. Same team [redacted], same team in [redacted] all everybody was taught online and we had people on the ground. So, we covered three sites. So, by the time we finish the year, we had done eight okay eight sites. Yes, so which was quite some impact created a very good communication network. So, by time we're coming to the New Year, COVID rules had kind of become easy. Now we did, we still did the online for introduction to the hospital HMT, the hospital management team, we still did Zoom, but the trainings were on on site. So, we in the end, we had a huge network of people who had bought into the vision who knew about NEST who knew about the protocols." (FI 29)

2L	When formal agreements have been negotiated and agreed between network members (context), then the network members will feel solidified in a network and be more likely to follow a collective vision (outcome) because the agreements help network members to understand their roles and responsibilities (mechanism)
	"Working very closely with the Ministry of Health. I know when the programme was introduced, there was very little engagement of county teams. So the way the programme was introduced, because CIN was already existing, and CIN already had MoUs with hospitals. There was no engagement of the county leadership. So they went straight to the hospitals, had meetings with the hospital management teams, signed MoUs. And that is how the programme operated until last year, which has its limitations, because now as we interact with the county people, some of them don't know about NEST, because also the leadership changes. And what we are trying to do now is to have a meeting with the county leadership to tell them about NEST and change those MoUs from being hospital specific to county specific because as we transition some of our programmes, we want counties to model hospitals to take ownership, for instance, procurement of supplies and consumables. They need a budget for that, at the moment, hospitals rely on county budgets. So, most of them don't have their facility improvement funds. And so their hands are tied, you're telling them to procure things that they cannot purchase. And the counties don't know about the programme because some of the devices require very specific consumables that are not even available within KEMSA at the moment. Yeah, so that's going to change and we already having those engagement meetings." (FI 18) *"Then, I think after that, at some point, we signed a memorandum of understanding with the facilities, all these facilities, because it's very key in ensuring that it's just a binding document, because you see that NEST programme is also a programme that is on a research basis. Yeah. So, involving them and all that there has to be a binding document for this." (FI 20)*
2M	If there is no collective vision or if network members do not follow the network's collective vision (context) then they will be less successful in implementing network activities (outcome) because network members do not feel committed to the network (mechanism)
	No supporting data
2N	When the network makes an effort to disseminate its vision to solve the identified problem beyond the network (context), then non-network stakeholders (e.g. partners, donors) will be more aware of the network (outcome) because network members have advocated for its purpose (mechanism)
	"NEST has come to revolutionize how we deliver newborn care," Edith says, "Now everyone is talking about newborn care, because we have created an environment where there is continuous conversation about improvement, change, and collaboration." (document - NEST360 blog- Opportunity in Adversity) *"It has also now made the government think about all this space is small and now we need to expand. So, it's they have been talked about a neonate as also as a person to be taken care of not just as a blanket or their paediatrician yet, paediatric children or whatever we need to talk about. So now we know that we need to invest what newborn care." (FI 12)*
2O	When the network engages with government officials and takes their inputs into consideration (context), greater support is generated for the network and network activities (outcome) because there is closer alignment of vision between the network and the government, and government officials feel valued and respected (mechanism)
	"Anytime we have these changes, it's just important for for these officials, the Minister of Health officials to be put to speed that A-B-C-D because as I said earlier, each and every person who sits in an office will always come up with their own system of working of doing things. So even this Ministry of Health, that is what happens. So, whenever they come we had already established a momentum on how we're doing things with the previous officials now you know. So now, of course, the NEST Kenya leadership has to always approach them and ensure that the collaboration still exists. And that whenever we have to involve these people in any activities, we we just have their support as Ministry of Health throughout to be able. And all this can

	only happen through constant involvement of the new people who have sat in their offices who are now currently sitting in their offices. And as long as they are well versed and with the programme, then everything else will always you know, smooth will seamlessly take less." (FI 20) *"And the Ministry was very supportive because when we did invitations for training, they were under the Ministry. So, people also trusted that this is not a KEMRI project right its being run from KEMRI. But this is Ministry work. So that also I think really gave us huge mileage. And one thing I liked about everything is the things we did, the things we talked about, actually helped people. So, people would try these things we were talking about. And then they would see change. They were like, 'Oh, we can actually save these very small babies. Oh, if we do phototherapy.' That for me, one of the biggest ones is the phototherapy work. What when we presented the LED light and we talked about it and taught people how to use it and people stopped doing exchange transfusion because the baby was within one day you don't need to do blood transfusion. Right? So, the interventions were working we had the Ministry." (FI 29)*
2P	When network leadership/organisers are engaged in government meetings (e.g. technical working groups) (context), this can improve the enabling environment for the identified problem/collective vision (outcome) because more stakeholders are aware of and engaged with the problem/vision (mechanism)
	"And maybe some assistance in advocating higher because it has to cascade from like government level down and it would translate for them into like the health allocation. I think NEST would be like a strong partner to talk about how those, you know, just what they have done is feeding back into the health system and saving money in terms of length of stay morbidity, mortality. If they could advocate at that level, I think it would be good also so that ministry can come in and it can cascade down." (FI 03) *"And that's because we we had a meeting yesterday. So, the new the new head of the division, all the stakeholders working on maternal child health had meeting together sharing their plans and saying what they're doing. And what I realised from that from the presentation is that not there are not many people or organisations that are focusing on newborns. So, there are people working on early childhood there are people that are targeting the older children, but very few that are working in that newborn. And it's, it could be the way that the meeting was mobilised. Maybe there are people doing newborn that have not just been invited and for examples, I was asking them, 'why is Jacaranda Health not at this meeting?' And they are they are the people leading on the service delivery redesign project in Kakamega. And so so I think what we want to do when we have a meeting with the Ministry on the 31st of this month with the new leadership is to discuss exactly that, apart from the general TWG. Well, that includes all these people working on, you know, the entire space. Can we have a newborn specific technical working group, that includes, you know, the partners, the organisations implementing this, but also the the technical people – the neonatologists, the University of Nairobi, for instance, are coming together and discussing more country specific policies and regulations that we need to put in place. Like ENAP remains a gap in Kenya, can we discuss, go into more details in those discussions, because again, the general TWG, we really don't have enough time and room to go into the in-depth discussions round the systems and policies that we need to put in place to organise or to govern this space for the country. So that's something that we are definitely going to work with the Ministry, support the Ministry to strengthen. Its forming a core component of phase two proposal, making sure that that enabling environment that allows allows or enables the country to, you know, move closer to the ENAP target." (FI 18)*

Taking action to solve a problem

3A	In a network formed from the bottom-up when network members realise they alone are unlikely to be able to solve a problem (context), they will recruit likeminded colleagues for their cause (outcome) because they believe collective action is needed (mechanism)

	No supporting data
3B	In an externally initiated network when network initiators and organisers realise that they need diverse health system actors to be able to solve the problem/meet the target (context), they will recruit/mandate/encourage colleagues they perceive to be capable of helping their cause (outcome) because they believe a collective approach is needed (mechanism)
	"And so, I had the responsibility of introducing NEST in the country. It was a new, a new thing that we did, I did that in 2019. And that's the time when I also engaged [redacted] *so that she could work with me. And I had a choice of choosing many people for that position, who would assist me, but I looked at myself, and saw the gap I have. I'm a paediatrician, I didn't need a paediatrician. I'm hands-on myself. So, I didn't need another paediatrician. What I needed was a nurse because I don't know what nurses do, because I'm not one. So that's how* [redacted] *came on board that we can complement one another. Actually, it was a struggle convincing why not a paediatrician. But I'm happy that we chose* [redacted]*. Because she brought something which I didn't have. Yeah. Yeah. So, we were able to introduce NEST in the in the country." (FI 30)* *"I think, as happened, there's always a reason why things happen. And it's about the networks that you have. So it happens that one of the partners that CPHD had worked with before. We came in quite late into the NEST programme. Okay, the programme had pretty much been approved. Before we were included. And we came in because one of the funders, of NEST Elma philanthropies, was already funding CPHD for us, nurse anaesthesia work. And they felt that this would be a good fit. To have CPHD, Mediquip, as part of the solution, largely for two reasons one we were the only local, truly local partner in the NEST programme. And we had demonstrated core competencies that in their view would be relevant for the sustainability of the NEST programme. So, donor driven in some way we were donor introduced." (FI 31)*
3C	When network members think collective action is needed to solve the identified problem (context), they will seek out other individuals with common experience or perspectives (outcome), because they believe such people may be willing to help them (mechanism)
	"It is the the same I know even the other year our unit was get the cleanest and the best organized and it's amazing because one you go to the other units you find the doctor will just write and go away. But here there is a lot of teamwork. For all of us the cleaners, the nurses, the nutritionist, because actually one of the other things that is...being that teamwork has really helped us to identify the problem and be able to ask yourself, who should solve this problem? How can we solve as a team? So, like one of the problem, one time we discovered was our babies were not gaining weight and they were taking very long in the unit. We did a a small study. And the next question was, who should we include in this? So, when we sat down with our team, we discovered we only have two nurses in the unit per shift. Sometime this shift has 75 babies. So, you've got imagine if there are 75, you may be having 20 or 15 that are critical in CPAP or…so when we looked at it, we were like, no, we need more staff. So, then we asked ourselves with… with a team we have a WhatsApp group now for the newborn unit. So, in the WhatsApp, we asked ourselves, who do you think we can add in this group, and we decided we need a nutritionist. So, we work with the administration, and we are given a nutritionist, just for the newborn who has been very instrumental in helping mothers helping calculate feeds, observing babies who are not feeding, gaining weight well, which has also really helped us." (FI 05) *"Then we shifted gears a little bit when COVID hit. Cause we were like, well, okay, we can't do trainings, we can't go to the ward, what do we do? we stop? So, there's like two or three weeks, me and* [redacted]*, were like, okay, we need to be creative and the priority now is COVID. What do we do? And so, the ETAT+ trainers at* [redacted] *also are now not going to school. So, what do we do? And* [redacted] *had a brilliant idea. We should train people about COVID. Yeah. So, what do we do there is something called Zoom. We should use that. So, some of the postgraduate students came up with they read about COVID, and they prepared material about COVID. And then we called a Zoom meeting, we all had to learn what is Zoom. So, we learned about this, how do you use it? How do you download it? How do what happens when you're in a Zoom meeting. So it was definitely chaotic at the beginning. And what we found during the because we did like three or four sessions on COVID, we realized nurses don't attend these things. They're not attending what's going on. It's only doctors who come and we'd have like 50 between 50 and 100 people attending. But they were all doctors. So, it's so we so that was a concern, but we continued doing it and then we decided we need to get the nurses move involved. How do we go about it? And we*

	realise nurses don't know about Zoom. Nurses are overworked with new patients in the ward things have changed, people don't know what's going on. So, what do we do so we decided we must do like a rapid intervention. Let's get nurses on board so for two weeks, I did nothing but teach people how to get onto Zoom." (FI 29)
3D	When members in an established network have access to resources that will help them solve the problem they have identified (context), they may be more prepared/more likely to intend to take action (outcome) because they believe they have a more realistic chance of success (mechanism)
	"When I need a spare, I could talk to the biomed from the NEST side. I could first of all identify the problem then when I if it comes to a need for a spare I could either call in direct and also WhatsApp in what I what I need then within a very short time the spare brought here sometimes you find the to repair the equipment might be a bit tricky. We could they could also tell us to forward the equipment back to them so that they may also repair from their side then the equipment is brought back again. Yes. So, I do not have challenge when it comes to getting the spares and also repairing the equipment." (FI 21) However, if the network does not have the resources to take action, network members will be less likely to intend to take action because they feel the problem is out of their control. *"For biomed I think it has been good, it's one of the best tracks I think. But again now, you find you might solve issues, then what is picked is beyond NEST. Because, we have spare parts because I mean, if you look at the track itself, what are the issues that would affect? It is availability of spare parts, training, which we have done, so they now start picking small issues like, they, how do I call it? They can easily be solved unlike previously which means it is work in progress, I mean they are working. So, you find those, the ones that are remaining are systemic issues, things to do with facility equipment which we sometimes may not have control, or staff rotation but again we can use as programme, we can see what's the bare minimum that we can be able to, for clinical there is. And then just to mention, there is also very quite improvement in terms of the clinical, the biomed track in terms of data completeness from the facilitators themselves. They are really doing well I would say. In terms of governance we still have a long way to go. I think we still have a long long way to. First in terms of, even the people doing these tracks, it is a bit messy. We have fired a few, we are yet to fire others. Then the people also doing who are representing these tracks at the facility level, they will pick anything, no action point is worked on." (FI 16)*
3E	When an externally initiated network is forming and opportunities are provided to network members to meet, discuss, and find solutions to problems (context), this will support network members to take action and shape an identity and a sense of belonging (outcome) because they are able to coordinate their work and work together (mechanism)
	"We have very regular calls for the Kenyan team and the global team to discuss project progress and activities, the scheduled governance meetings and management structures, the steering committee, so there was quite a bit of that in place to ensure that the teams were coordinating the global teams, of course, also visited Kenya, but often to just track progress. Yes, but as you rightly put, it was a big team, very complex team, a very complex project to manage just given the breadth of partners that were involved." (FI 31) *"In terms of the network's I would say that initially, we did have lots of meetings within country with the cross-country teams. Almost so within country, we had like a weekly meeting every Monday for one hour, keep track on what's happening with the facility what devices need support, what hospitals need support. In what things need to be addressed, these were relatively new devices, so which hospitals probably are finding it difficult to use a certain device, what do they need, do they need a clinical mentor, do they need a biomed person to go and fix it? What devices are not functioning optimally? So, there is a broken probe? What is the cost of that? How do we fix it? What are the what are the repairs needed for that, so there was a lot of activities happening there." (FI 32)*

3F	When network members of different roles/cadres/units/organisations work together as a functioning team (context), this enables them to take collective action towards solving the problem (outcome) because they have a common understanding of what needs to be done (mechanism)
	"It is the same, it is the the same I know even the other year our unit was get the cleanest and the best organised and it's amazing because one you go to the other units you find the doctor will just write and go away. But here there is a lot of teamwork. For all of us the cleaners, the nurses, the nutritionist, because actually one of the other things that is...being that teamwork has really helped us to identify the problem and be able to ask yourself, who should solve this problem? How can we solve as a team? So, like one of the problem, one time we discovered was our babies were not gaining weight and they were taking very long in the unit we did a a small study. And the next question was, who should we include in this? So, when we sat down with our team, we discovered we only have two nurses in the unit per shift. Sometime this shift has 75 babies. So, you've got imagine if there are 75, you may be having 20 or 15 that are critical in CPAP or…So when we looked at it, we were like, no, we need more staff. So, then we asked ourselves, with... with a team. We have a WhatsApp group now for the newborn unit. So, in the WhatsApp, we asked ourselves, who do you think we can add in this group, and we decided we need a nutritionist. So, we work with the administration, and we are given a nutritionist, just for the newborn who has been very instrumental in helping mothers helping calculate feeds, observing babies who are not feeding, gaining weight well, which has also really helped us." (FI 05) *"It made us feel yes, we are part of this team, part of that programme. And we are moving on well, another thing when they come to do the supervisions, assessments, yeah, we are doing it together. It's not that they're coming to do their assessments on their own and give us feedback without our knowledge, we are moving with them able to see from the data, there is a very good report, you know, they analyse how we've been performing, we move together, we are able to identify our gaps. And you see now the solutions. Again, they're coming from us. They're not saying that go and do 1,2,3. From all this, what are the possible solutions, we can come up with to bridge this gap. So it is, again, as a team coming up with a solution, something that we can be able to handle at our level. So, I feel they have actually tried as much as they can to involve us in service delivery in that newborn unit." (FI 09)*
3G	When network leadership or organisers are supportive of network members taking action (context), network members will be more likely to take practical and concrete action to solve problems (outcome) because they feel their efforts are valued and worthwhile (mechanism)
	"Something else, so that I feel have impacted on the changes is the goodwill of the management. Yeah, because the NEST program, we able to track our performance every quarter, because they're able to generate are reports, every quarter. And through these reports, we are able to tell where our challenges are. And once this is shared with the management, the management now becomes supportive, because we are able to make decisions based on data. That now decision is quite informative. And we feel like if there is a problem with the usage of CPAP, do you need more training is the equipment the problem, and we're able now to address those specific gaps. So, I feel the main use of data is quite quite important, and has really impacted on some of these changes that you're seeing within the facility. *And also the QI visits, I feel they are quite quite important as well, because they can means they're about to bring onboard are the four tracks. Those are the health information, the management, that's governance, the clinical and the biomedical and just gently have a discussion and see, where do you have a problem? How can we be able to address this? Is the management ready to support address so that, that as well has really supported in in helping and impacting and bringing about some of these positive changes that you're seeing in the unit." (FI 08)* *"They always come for the QI visits every quarter. And I must say it's, it's a good thing, they help us understand our problems. Some you have not even realized some we already know, but you don't know how to get to the root cause of it. So, the QI have been have been quite important in helping us improve and become better. Initially, I remember, when they came our biggest challenge was our babies were coming to the unit having hypothermia*

	from the labour ward. And, you know, we saw that we were noticing. But we know when you see the data and you see how bad it is you realise how badly you are performing. And because the QI brings together the clinical team, the management team, at least even though the management team are able to see what we have been saying that we have an issue with hypothermia. I'm not saying it's fully sorted, but you can see they're making some strides towards trying to sort out the issue. Yeah, so the QI have been quite important. And they help us improve, and everyone they want to become better to notice what we are not doing well then improve." (FI 23)
3H	**1.** When trained network members are provided with support (e.g. quality improvement and mentoring) that is relevant to the problem they are addressing (context), they are more able to take practical and concrete action to solve problems (outcome) because they feel empowered (mechanism) **2.** When information that makes challenges visible emerges from supportive activities (e.g. quality improvement and mentoring) (context), network members feel a greater need to address the problem (outcome) because they feel accountable to network leaders/organisers (e.g. mentors, quality improvement team) (mechanism) **3.** When network members take practical action as a team (context), this mobilises the network members' efforts and resources (outcome) because they feel internal accountability towards other network members (mechanism)
	"Of course, how can I leave an action plan that I was told in March to leave it up to December it can't happen. So, for them when they come you just put on toes to add on whatever you are given. And it has really brought change. You know at first when we were told of the QI visits, we were we were thinking of it was something like fault-finding. Yeah, but when we when we get to where when I got used to them, I've just seen that the something that just brings change, it's not about about faults. It's how you actually it's just, it helps you to understand how things are done and how they're done based not just doing them." (FI 11) *"The mentorship has been largely focusing on some simple things, like skills, for example, in creating and maintaining keep up of phototherapy getting it the right, the right normograms correctly. Those are some of the issues we've had. But also the other mentorship has also come in handy in areas of just documentation. What we have identified as a main gap is documentation...people have done, but they have not documented so the mandate is to tell you or to show you that yes, you are saying you have done but we cannot see it documented. And we have also tried through mentorship, get what we call task shifting. So, get some clerical people to do a bit of work, but NEST also does a bit of support on that one. So those are some of the mentorship areas that we're seeing help us a lot. And just building the confidence of the people who are on the ground." (FI 25)*
3I	When network members are provided with a platform for them to easily communicate (e.g. WhatsApp groups) (context), they are more able to take practical and concrete action to solve problems (outcome) because they can access and gain the knowledge and reassurance they need (mechanism)
	"But by that time, we had a technical working group, we created a WhatsApp group. And if if anybody was having an issue in [redacted], oh how do we deal with this, then people would respond immediately. Maybe you should try this, like live issues are happening. I would put them there people would respond and support immediately." (FI 29) *"There were they were a couple of WhatsApp groups that were created that were specifically for NEST that were very instrumental at that early age for people to bond to chat to say what they're seeing, to actually say what devices are working what challenges are there. Was the same platform that was used for dissemination of doing information sharing materials, webinars, and getting people to invite people to webinars. So, I think there was a lot of that informal network, so to speak, in terms of in terms of how people interacted at that early stage." (FI 32)*
3J	**1.** If network leaders/organisers continue to put effort and work into solving the identified problem (context), this supports network members to make progress towards changes in practice/improvements (outcome) because they feel encouraged to do so (mechanism)

	2. When efforts are made to provide consistent support to network members from network leadership/organisers (e.g. through quality improvement and mentorship) (context), it promotes network members to take action (outcome) because network members develop a bond with those providing support (feeling part of a larger team) and feel empowered by and accountability to them (mechanism)
	"Yeah, once we've identified and we intervene, so our role is are we able to are we able to to maintain it for quite some time for quite some time. And the role of a manager in that department is just to see to encourage, to encourage your staff to maintain that practice, just to maintain that practice. And still, we usually also have our our QI, our QI team from the county. Yeah we should have our QI credits from the county usually visit the department monthly two months. So those are the things they also look at those other things they usually look at because our our workplan plan. After I've submitted the work plan to our nursing officer in-charge, she may also she may also see the need of submitting the same to higher level. So that during the QI QI meetings QI assessment in the department, those are the things that are going to base to base on them, yeah. This was your problem, yeah. How far have you gone with it? Yeah. Is there any change from that time to this place? So, I think that is how we do something." (FI 07) *"After training, they didn't go away and they still are still with us. They come back to do the assessments. You're trying to find out how are we doing? Where are the challenges? They are able to look at the performance. Where are the challenges? We set targets with them. Yeah, why didn't we achieve this target? What could be the problems? And the solutions? Again, they tell us we work as a team, they are the solutions that are within us. Yeah. So that involvement, that partnership. To me, I feel very good in that where you feel this one can't work, they are there to give us a way out. But working as a team, we again come up with a way forward."* (FI 09)
3K	If, despite the support provided, network members fail to act or make progress (context), this starts to undermine the relationships between network members and those providing support (outcome) because those providing support feel the network members do not value their efforts (mechanism)
	"The other gap is the monitoring, so between March and maybe the next time we will have, okay let us compare even between February and March, when there was those two QIs, we don't know what happens in between here, what challenges the facilities experience. Because you know in as much as I want to know, did you achieve your previous action plan?, yes or no. That's not enough, yes, why were you able to do it? No, why weren't you able to do it? These are maybe two facilities in [redacted] *County so why were you not able and the other facility. You know, just trying to understand the dynamics of this facility. So, I don't think we have a monitory tool on our side also, or a follow-up, let me call it a follow-up on our end, we don't have that structure. So, bringing the county onboard and the QI facilitators will help fill that gap. Because as they do their routine supervisions, we will ensure that they give us feedback that, I went to* [redacted] *and as I was doing support supervision. So that we also don't handle the financial part of transport, I went to the newborn unit and they were able, they have been able to do this far. However, these are the challenges."* (FI 16) *"But in fact some of them call you to ask you "what was my joint action plan? Can you share it with me?" You get? Maybe a week, two, if you call the facilities and tell them, next week you are having QI. Send me the joint action plan for this facility, so that they see where they are. If they are not there, they will so you can't tell me you will achieve within two weeks. And you see even with these three months you should be monitoring and changing what you are doing in case you are not able to achieve the joint action plan. Like if you read about the QI, the successful QI initiatives, there is always a monitoring in between. Like if I have said I will reduce hypothermia by supplying plastic wraps and it is not working, I change the technique as long as I want to achieve the reduction of hypothermia. So, then that means our facilities don't monitor. They wait. NEST communicate there is QI next week and then now we start working two weeks to the time. Then we are there, did you achieve? Yes. What was it? Making sticking target it doesn't make sense what we are doing."* (FI 16)

Identity and culture

6A	When network members with a collective identity come together to solve a shared problem (context), this makes them feel fulfilled (outcome) because of a sense of shared purpose (mechanism)
	"And you see, you are part of that NBUs. It's NBUs this machine is not working, you see in you you are part and parcel of that. And when everything goes well, you know that everything is okay, today we are okay. You feel good. Because you know that newborn that premature baby will be there maybe for one week, two weeks, and if they are, okay. Now with that you see now, in your profession, you are something you are proud proud of." (FI 24)
6B	When network members feel fulfilled from working with likeminded people in a network (context), they want to belong to the network (outcome) because they feel it is worthwhile (mechanism)
	No supporting data
6C	When network members identify with other network members and the network's vision (context), they develop a network identity (outcome) because it gives them a sense of purpose (mechanism)
	"Let's say we feel proud to be part of NEST, we feel we refer ourselves as the NEST hospitals. And because it came and changed how we do things. It's changed how we you know, we perceive things, it's changed our outcomes. So, we are very proud to be part of it. I must say, it's like, yeah, it's like a movement sort of. So, first of all, you are always motivated to do the best you can, you're motivated to make a difference for that child. And, you know, you stop doing things just the way you were doing them before, because now you know, better. So, I think it's more than just adding the group of people but from within, they found it changed in you. And then when you come together as a group, I think it's more of a movement. We want to make a difference for the children. So, I hope that can continue." (FI 23)
6D	When a network celebrates the contributions made by previously unrecognized/unacknowledged hospital unit/facility leaders (context), this gives hospital unit/facility leaders an identity in the network as important network members (and in the hospital/facility) (outcome) because their expertise and role is now more valued by others (mechanism)
	"They became very respected people, even up to now. People know the newborn units are led by nurses and they know what they're doing. Before people think hadn't recognized that nurses are knowledgeable. But now I think that it's something something we achieved to give the nurses an identity and they're very proud. Even when they come to train we look for them for trainings in the area. And that area even that Professor of Paediatrics cannot neonatology cannot doubt it because I mean you have nothing to add because that is what they're doing and that is and maybe you're also not an expert in." (FI 30)
6E	When the identity of a network is linked with network partners/initiators providing resources to the network (context), the network has a separate (not integrated into the health system) identity that may make it less sustainable (outcome) because the network partners/initiators have not put in sufficient effort to integrate the network in the health system (mechanism)
	"All activities are trying to align with the fact that we cannot continue operating the same model we had in phase 1. Maybe phase 1 was about proving a point that this can work and teaching the MoHs and the governments that if you bring in these changes this will work. So, it was instilling a culture of you know IPC, education all that. They have done a really wonderful job, the education team training nurses training clinicians University of Nairobi, University of Kenyatta, University … Malawi so they have done a lot of work in terms of education, and even the technical universities for the biomedical engineers in terms of also distribution. So it's all in line with trying to make whatever was done now sustainable and the way to do that is strengthening the local health systems may it be distribution part of it, so we will not use the same approach" (FI 19) *"But I think the one that is top of my head that we haven't really done a good job at is transitioning NEST to hospitals. Even when you go to hospitals, people still call them NEST devices. If it's broken, people call us, which is not a great thing. Because NEST will not be there forever. So, I think the biggest*

	benefit is this relationships and networks we've created and functional within hospitals. But at the start, I think we ought to have communicated better on what NEST actually is going to do and how much support is going to give and what we expect. So, with that conversation was not had early, early enough. And I think it's something that should be a priority... is still very clear that, you know, by the second year of phase two there should be a lot of efforts to get things happening within the country teams, be it data, be it evaluation, be it reports, dashboards and all that. But I think that's the one thing I would say would need better better thinking, communicating, including you know if we possibly heading towards the five-year mark a lot of those devices that were put in five years ago probably have lived their lifetime. Right? So, they need a new device, for instance. So how do they procure that? Should they call NEST, right? Should they call up the county? And how does that work? So, I think that's something that needs to be to be prioritised. If if we were to transition NEST to something sustainable beyond NEST, I think that would be a priority for me, and also thinking about the degree of support and wherever that goes. So how much of the international teams to what proportion of support from international teams should be be given to countries? And how much autonomy and independence should we be giving country teams to actually take up a lot of these activities?" (FI 32)
6F	When network leadership and members consistently and regularly demonstrate and reinforce the network identity (context), this helps other network members adopt the network identity (outcome) because of role modelling (mechanism)
	"Continue to like, when you have new people inducting them into this is how the unit runs. This is what NEST is, this is the training, this is why you need it. So that continuity can go on even when you don't have to have specific key people to train like a core number of people so that that concept can continue going on and not drop off and data, your monthly data coming back. So, it keeps you on the ball and because you have to keep doing the simple things perfectly. Hypothermia is not just a one-off thing. If it fluctuates downwards, to go back to the upstream, and so data also helps you to to keep up with your improvements show you where you need to keep working." (FI 03) *"Once we've identified and we intervene, so our role is, are we able to are we able to to maintain it for quite some time, for quite some time. And the role of a manager in that department is just to see to encourage, to encourage your staff to maintain that practice, just to maintain that practice." (FI 07)*
6G	When a network creates opportunities for members to connect, share experiences, and learn from each other in an open and safe environment (context), this creates a positive network culture and a feeling of belonging to the network (outcome) because members feel respected, valued, and acknowledged (mechanism)
	"I do and I think they they go out of their way to also make you feel like that, like with the meetings they they regularly call us for where they I asked us to present or present like discuss our points of view, and they bring different centres together. And you realise that what I'm grappling with in my centre somebody else in another part of the country is grappling with the same thing or they have approached it in a different way that has worked. So, I feel so, I feel like we are part of a group and just listening to what other hospitals are saying that they they can see it and they want to join NEST also. So, yeah, so I think we do not just because of the innovations, but also the meetings that make you try and think about some of the interventions and how to get better." (FI 03) When a network calls members for meeting for facilitates network activities, this amplifies their feeling as belonging to a network. *"In most places, if you don't if you if you don't show up at the hospital, I think people a lot of people see themselves as CIN, it's when we call them for meetings that people differentiate what they're being called for. And the reason for that is one is nothing fundamentally changed in terms of the Clinical Information Network. So, the only issue, the only difference is that hospitals implementing NEST, they got an extra bag of interventions, right. But there is nothing that where there are no activities that were being done as part of the Clinical Information Network that this, these hospitals were told, you can't have this because it's CIN and you can only have this because it's NEST. So, a lot of people tend to differentiate when you call them for meetings,*

	when you tend to go to the hospitals and show up and then say, 'Oh, I'm here for NEST,' or 'I'm here for HIGH-Q,' because you know, it's the same people who will show up in those places. So, it's when you invite a paediatrician, because those paediatricians, wear very many hats. And CIN is also running a couple of studies. So, so it's when you invite them that you're very explicit that you're inviting them for NEST meeting, inviting them for a CINEMAR meeting, which is a study running in their hospitals." (FI 32)
6H	When local network leadership and members recognise that the network's culture is not aligned to existing cultures in their environment (context), then they may attempt to change the pre-existing cultures to make room for the network culture and practices (outcome) because they no longer identify with the pre-existing culture and see value in the network culture (mechanism)
	"[redacted] doesn't have very many deliveries. But we chose [redacted] because of the it has got a good culture of uptake uptake of of of interventions. So, when you're bring an intervention, you at least need to be sure at least in one or two, you're going to succeed. So, it turns a good culture. So that's why we fit it in. We have a team there, although it was not, doesn't have very many deliveries. Yeah, the other facilities, they were there because of the number of deliveries they have." (FI 30)

Knowledge and skills dissemination

14A	When the network adequately shares knowledge and skills throughout the network by creating training opportunities (context), this changes/improves practices around the identified problem (outcome) because network members are more capable (mechanism)
	"And then the educational piece, which is also very heavy, I think it's it's unique in a way. Because the first one we do is to provide a course that brings together the clinicians and the biomeds and that allows cross collaborative learning. And what we've seen happen with that is at the facility then there's a lot of collaboration between the nurses and the biomeds and so the nurses telling us that sometimes they're able to see when a device is not working and they can call the biomeds. So that's something that was not happening before." (FI 18) *"We had the programme, they started, it had a fabulous training, we had programmes going on, we are trained on the new equipment, on how to relate with them, and how we can assist the patient. Because they were new and we have many nurses in the department. So, we had to train even the other biomeds, how to assist the the patient now with the new equipment. And we have from the time we had the the other equipment and the added equipment from the NEST. We have a lot of improvement both in the workforce. Because if you have the right equipment, it's easier even for the patient. Maybe she stays maybe three, four days. And the other time maybe we call to you, see now there are good progress, even with the patient now." (FI 24)*
14B	1. When network members disseminate knowledge and skills through mentorship activities (context), network members feel supported and capable (outcome) because they develop the knowledge and skills needed to do their job well (mechanism) 2. When network members regularly disseminate knowledge and skills through mentorship activities (context), network members are more likely to adopt new practices (outcome) because the mentors continuously reinforce the practices (mechanism)
	"The mentorship, for example, if I'm from [redacted], there is list that I will take. Like the other time I was in [redacted], then April I've been in [redacted]. So, you get [redacted], the normal shift that is reported 730 and they leave at 5. Yeah, you see what they are doing, maybe it's if it's drug administration, you join them and see what they're doing wrong and do what you want to right. Then if it's, then we also teach them on how resuscitation is done, we do recap on warm chain, we do recap on use of failure of warmers and phototherapies. So, you know, when the training and changeovers people might be leaving and the new ones are coming in. So, we do that rotational, rotational mentorship so that even if there is a new staff, they understand what equipments are in the NBU and how are these patients handled." (FI 11)

	"Apart from the trainings and equipment, and also I was privileged enough to be chosen to the in the mentorship program. So, I have taken part as the host mentor here in [redacted], where visiting mentors come. And so, we go through in the department seeing what is good, what is the done well, or what needs to be improved teaching. So, I've also participated in going to other hospitals as the visiting mentor I've visited hospitals like [redacted], have gone to [redacted], I've gone to [redacted], just during the mentorship programmes, teaching, or even correcting where we find that there is a problem or, okay, not a problem really, maybe there is a gap. Yeah, correcting them or even teaching them, participating even in teaching sessions in the areas where we find maybe they need to improve and those visits have really helped even here in [redacted]." (FI 22)
14C	When network members include colleagues in other hospital/facility departments in knowledge sharing opportunities (context), this improves linkages between network members and other departments (outcome) because they respect and value the help provided (mechanism)
	"But another thing is now the reproductive health team because the labour ward is an extension of my newborn unit, and we work quite closely, we work. It dawned on us that the outcome of this baby's depends on what has been done in the labour ward. And depends on what has been done during the antenatal period. So, we go all the way. And that linkage has really been strengthened by NEST. And in fact, when we were doing the ETAT training, ETAT+ training, and all that, I picked some of the nurses from the labour ward, and even the postnatal ward, so that they know when you talk of newborn resuscitation this is what we mean by immediate care of a newborn. This is what we mean. You know, so they have that knowledge. So more often than not, I would have a joint CMEs to discuss this with obstetricians and all that. So that's really opened our interaction." (FI 04) *"And by you do you doing so you will spot like, either, there is one person who is either quiet all through or afraid, doesn't want to mingle with the others, seemingly suppressed like I don't know when you try to inquire further and you actually come to a conclusion, like he or she is either outshined by the rest, simply because they are either new to the field recently posted or maybe from a different department now they've joined this department and they're like, they have no clue. So that kind of knowledge transfer. Cross team is still something that people tend to grab on it. Some are I'll say, okay, some are jealous to share. Some either do not have the time. Some want to share but the people to be given that knowledge, maybe have no interest, for example…They are avoiding future calls that will replace to them simply because somebody would have known Oh[redacted] was taught. What does that translate to? I want to be going to that department, that department cannot be assigned under me." (FI 15)*
14D	When network members include providers in non-network facilities in knowledge sharing opportunities (context), this supports their ability to improve practices (outcome) because they develop essential skills and knowledge (mechanism)
	"And I think for me, one of the other thing I have been trying. I'm lucky to have been the one of the officials of Kenya Paediatric Association in that region is also to think of not just the county government facility, even those private facilities are killing babies. So how do you improve those facilities? So, with the knowledge some of us have from NEST, how can we disseminate now even to the private facilities? So that is one of the areas we really I have really to think. So, one of the thing is is creating a forum where you if it's a CME being offered by NEST, I disseminate to them. So, I created a forum for the nurse-in-charges from the facilities, most of the facility in [redacted]County, I believe it's even beyond [redacted] County, because they even have in-charges from [redacted], which is not in [redacted]County. I also have a forum for clinical officers. So now with this forum of nurses, forum of clinical officer, a forum of paediatrician, a forum of nutritionist so if there is a CME being offered from whoever, even if it is NEST or wherever, then I'm able to put it there for and then I'll ask them whether they will listen to the to the meeting…So at the end of the day, the NEST what we have learned is not only for us, it is even for the people surrounding us, can we bring change. So, I think for me that the parting shot we need to do our best and improve care where we are and in our surroundings not just limiting ourselves to where we are." (FI 05) *"We have linkages with the lower-level facilities. We know those facilities that refer to us a lot. Even when we were doing the training, the newborn ETAT training, we incorporated them into the training. Yes, because we found that they were referring and there could be a knowledge gap. So, we*

	actually took two from the referring facilities and trained. And whenever we get opportunities for training because I have a book where I record all the referrals, referrals, so I see the facilities that refer so much. And whenever I get a training opportunity, I usually call them yeah for training. So, we have those linkages." (FI 22)

Cross-learning

13A	When the network brings network members together from different professions within the same facility to share their experiences on problems and solutions (context), this facilitates intra-facility cross-professional learning (outcome) because they understand the value of different roles in achieving the shared desirable change/outcomes and feel their challenges are acknowledged and inspired by different approaches from their peers (mechanism)
	"I think what NEST strengthened within the hospital was biomedical engineering. Like before, I forgot to mention them as well, but I feel since NEST that interaction has been strengthened because it was a very technical kind of interaction we used to have before, like when machines have completely broken down. But I feel that has been… since because we do a lot of they do pre-emptive maintenance. And it's now more of a discussion, not just us telling them it's broken down, but also them feeding back how we're using equipment and whether we are using it the right way." (FI 03) *"So, the biomed role has been improved. Biomeds never used to go to newborn units. Now they go. And I like what one of them said that they know if this machine is not working a baby could die. So, they make it a priority to pass through the newborn unit and make sure all the devices are working the way they should. Then another biomed from [redacted] said we took these concepts we learn about newborn technology and we are doing the same thing in ICU, in medicine. So, the other departments in the hospital are benefiting from the things because the biomed takes care of the whole hospital, right? There are not many, right? So, one or two are located in the newborn unit but they also take care of. So, what we are learning here, they are taking to, they have a path, so that for me, it reassures me that we won't have a graveyard. Because they will ask questions, they will try and look for a solution." (FI 29)*
13B	1. When the network makes an effort to connect network members from different facilities in the network (context), this facilitates inter-facility learning (outcome) because they feel their challenges are acknowledged and inspired by different approaches from their peers (mechanism) 2. When the network makes an effort to connect network members from different facilities in the network (context), this helps them learn new approaches to better solve problems (outcome) because network members can share their experiences and knowledge and see their own work/setting in a new light (mechanism)
	"Prior to NEST, [redacted] County and [redacted] County are just about 50 kilometres away. But trust me, I had never even visited that newborn unit. I didn't even know whatever was happening there. Currently, it's very easy, you know, you when you have a case, you can call your colleague say, 'We have this business or that, have you seen this before? How are you handling this scenario? How are you handling this, this, and that?' So, it's very, it's very good. It's and I'm even called by the nursing team, nurses from other hospitals, you know, they'll be like, 'Oh, Doc, we have this scenario. We've done A, B, C, D. And probably, we're not getting anywhere, what would be the best thing to do?' When it comes to consumables, the various things, you know, in the lab, and all that I'm able to ask my colleagues, 'Anyway, do you have this in excess? Could you give me this for some time?' You know, and all that." (FI 04)

	"Actually for me, I feel is even more advantageous because I get the to visit other facilities. And just apart from conducting the QI as as per the checklist, under the QI facilitator, I am also able to learn what they are doing there, that I can also be able to bring here, and also share to them what I've been doing from my facility that they can also be able to pick out. So, on that track, I've seen one, it helps the biomedical engineers in the facility to feel they're being supported, supported in terms of whatever they are doing, there is somebody externally, that is just coming to see the progress, and also to support in terms of where they have in the weak points. And with that advice, the management level to be able even to support the biomedical within the facility. So, to me that has been working so well, the facilities that have visited and even our own facility because every time I'm out there supporting that facility, there's somebody else coming here to track what I've been doing in my facility." (FI 08)
13C	When the network brings together network members through meetings (context), this helps them to better solve problems (outcome) because they get to learn from each other (mechanism)
	"I think they they go out of their way to also make you feel like that, like with the meetings they they regularly call us for where they I asked us to present or present, like discuss our points of view and they bring different centres together, and you realise that what I'm grappling with in my centre somebody else in another part of the country is grappling with the same thing or they have approached it in a different way that has worked. So, I feel so, I feel like we are part of a group and just listening to what other hospitals are saying that they they can see it and they want to join NEST also. So, yeah, so I think we do not just because of the innovations but also the meetings that make you try and think about some of the interventions and how to get better." (FI 03) *"One of the challenges we have had is the issue of we have not been doing very well with the CPAP uptake despite the fact that we got the machines. So, one of the meetings or in some of the meetings, we've tried to compare with other facilities, which are doing better. And so, we learned that some facilities were doing what they really invested in CPAP champions. So, these are people who are the ones who are running that idea. And because what we noticed is that after the initial training, over time, the confidence levels went down. But when we got now those sharings and the issue of champions, you know, we've tried to get one champion here. And we have seen that that has helped us quite quite a lot." (FI 25)*
13D	When network members have created purposeful relationships through network meetings and activities (context), they are able to continue their cross-learning remotely (e.g. WhatsApp) (outcome) because they have an already established bond (mechanism)
	"This was part of the initial plans and I'm happy that it got it kicked off well. After the training, in fact it usually starts before the training, so that we're able to do communication early enough to enable them to prepare well. After the training, we do have a WhatsApp group for ease of quick communication. Sometimes they even learn from themselves in those WhatsApp groups. And the good thing is that we do have biomedical WhatsApp groups, clinical team also has theirs. And then we have common shared groups of the focal the focal persons. These are the these are the to go to people that link the programme team that normally and [redacted] and even the other directors and the facility teams. So, they're the people who if we needed to get any updates, quickest possible, they're the people that we go to. So, we have also another common WhatsApp group for such kind of teams. So, this has both biomeds and clinical paediatricians. It's a mix of all those people. Then separate from that we have biomedical team aside, clinical team WhatsApp group aside, within the NEST much larger team. We also have cross-country. I mean, we have a common group for the cross-country teams. Like the training managers, both clinical and technical, we have one that is common for all the four countries. And of course led by the country liaison team that's now [redacted] and [redacted] again separate from that they do have clinical aside for the four countries. And then we have another technical one for the NEST engineers for the four countries together with Hatch team in that composition. So that's how we we are able to address issues quick as possible. Because sometimes, you will find in some other cases, like for example, let me give you an example of a device we have a device the Billidx Bilirubinometer machine. So far, we've experienced two errors that have been encountered in the field, Tanzania, Nigeria, Kenya, Malawi is yet to report. And those two errors do not exist within the user manual. They are not there. So, we whoever experiences it is free to post on WhatsApp and we

	try to discuss it there. If it's something that somebody already encountered and was able to manoeuvre around you can share how that you were able to do that." (FI 15) *"For the networking part, they're even WhatsApp groups, like the NEST nurse mentors, the senior nurses, senior newborn unit nurses. So, the interaction is on not only during the meetings, even during the WhatsApp groups, you can ask questions, maybe if there is something that is actually bothering you can posted it in the WhatsApp group and you will get answers from them. Like, for example, a good example yesterday, we had a challenge with our HemoCue. The one that we do the HB the bedside bilirubin bilirubin haemoglobin levels, it wasn't working. And so, I put it in the group. And as the having a challenge with my HemoCue what could be wrong because it's giving me this error? And then I got answers from there I was answered. I after doing what I had been instructed to do. It's it worked. So even those words are very good. Yeah, not only the physical meeting." (FI 22)*
13E	When the network makes an effort to connect network members with networks in other geographies (within or across countries) (context), this helps them to solve problems better (outcome) because network members can share their experiences and knowledge (mechanism)
	"And I think an important thing has been having the four different countries and learning from each other. You know, some are very good at advocacy, others are very good at negotiating their government, or their university. And I think everybody's learned from that and also valued the friendships that have been made. East and West Africa don't get together very often. So, it's nice that they do." (FI 01) *"I think that country team interactions with other country teams also played a huge role in reassuring people that challenges are the same and ways to engage with others, government or others to network work well, so so the clinical team would work we in Kenya would work with their counterparts in the other three countries to develop training materials that were relevant and context appropriate for the countries. So, from that perspective, I think that also wider network played a role in in some ways mentoring these national level implementers. And in how to navigate some of the … within their countries based on experiences of others." (FI 32)*

Resourcing networks

16A	When the health system is insufficiently resourced (context), transition and sustainability of the network and network activities may be challenging (outcome) because there is limited capacity to sustain the network's impact (mechanism)
	"Another thing that has been a hindrance a bit is the space. The space, I only have a six-bed capacity Kangaroo Mother Care, the KMC. So, you find a babies who are stable on this side, just waiting to gain weight that is still in the acute space. Yeah, acute rooms. It is such should be moved. Yeah, so space has been a problem. But that is a capital intense, you know? Yeah. Investment. Yeah, that has been an issue. The other challenge is the finances. Now, the budgetary allocation, Katherine, affects the availability of the lab reagents, the drugs that we need to manage these babies, and all that. And even the non-pharms, you know, things like gloves, things like granulars, you know those things? Yeah, so finances have been an issue. And we are just concluding the something called FIF, Facility Improvement Fund. What that means is that if we collect 10 million, the same same 10 million is sent back to us by the county. Previously, all the money collected at the county level was deposited in one common account and then redistributed at that level. What that means is that if I collect 25 million, I don't get the 25 million, probably 15 is taken somewhere else, so I'm only given 10. So, I'm unable to sustain the supplies. Right. Right. Right. You see that, so that you're getting. Yeah, yeah, yeah, but an actual an act has been passed at the county assembly. So, from first of July, the next financial year, all the money will be retained, that will really facilitate the day to day running of the hospital, in general, but the newborn unit in particular. Yeah. So those frequent stockouts can really affect the way we offer services. Yeah, it feels bad to ask a mother to go and buy granulars, you know, especially when this baby comes at night at 9pm. Most of the chemists are closed in town, where will they

	buy this? So that has been a little bit of a challenge that as I started with my disclaimer is that it is not within the mandate of NEST per se to do this. The team, it's the county that you would have weighed in a bit heavily to support so that we complement each other. So that one was a bit. It's delayed a bit but I know we were likely to sort out this. But other is on the side of the NEST, we have said we need more frequent trainings, probably even monthly meetings to reassess we don't want something to, you know, build up for like three months or so before we move in. Yeah. So, for me, I think NEST has done pretty well." (FI 04) *"They have got their own challenges, things which are, you know, are within their control, and they can do other things which are beyond their control, or very willing and supportive or their teams within the health facility. But remember, at the moment, most of those facilities are dependent on resources provided by their county governments, the funds that they collect, monies, which are available, they go to the county treasury. Then they have to request that process is very inefficient. So, they're starved for finances, minor things that could be readily sorted out if they had their own budgets, which were reasonably well funded, then you'd be able to sort them out. So, at times, we found that there are very minor things were very frustrating to the hospital administration themselves. They say as you've been hearing the cries of the needs and the importance, we understand because we are clinical in the newborn unit, but you have returned to the county government, we are waiting, we also as frustrated as you are." (FI 28)*
16B	When an externally initiated network is heavily dependent on external resources and not sufficiently integrated into the health system (context), this will make transition and sustainability of the network and network activities challenging (outcome) because the health system and stakeholders may not be able to prioritise absorbing the required investment (mechanism)
	"We have a programme that is not integrated into the routing system because if you look at our QI approaches its NEST, and you can hear me say, the NEST QI modules. It's really, it's programme driven the data system, it's not already, we've not embedded that into the routine system, as much as we are using the CIN platform. If you look at what is the devices at the moment, they have not been. So, most of most of our activities at the moment are very much driven by us. But in recognition of that, if you look at our phase two proposal, there's a very strong emphasis on embedding these things we do into routine systems, and also institutionalisation, making sure that these things are gradually taken over by the Ministry, by the county government, or by hospitals. And we've started doing that already. So, the QI model, the QI that we are doing this year, we want them to be led by the county QI focal person. So, in January, we invited them to a training and then sent them out to go with a QI team. So, for the first time, none of the NEST team members here went out to supervise QI, that was entirely supervised by the QI focal county QI focal persons. Now, the same thing we've done with the biomed. So, for a long time, maintenance of the devices was done by [redacted]*. But we've transitioned that after the transition training, and providing them with the equipment last year, we've entirely transitioned that to county bio...the hospital biomeds. And they're now taking charge of that. And what we do is we provide technical support only. So, we are not running around fixing every broken equipment. We only do that if they're stuck. And they've tried all the options that have been given. And they're not able to handle these, yeah trainings. Yeah. We supported the establishment of the newborn, the the curricula, the protocol that was launched last year, the newborn care protocol. And this year what we are doing is gradually starting to work on integrating the content of that curriculum of the of the protocol into national curriculum, there is someone that's going to lead that process. So that these things are taught as part of normal medical, normal in the medical school, and we don't have to wait for people to get out of college. And then we conduct all these in-service training. So that's also happening. And then, of course, because of institutionalisation. This is the reason why we're even thinking about how do we build the capacity of the Ministry to be able to lead this. So we want going forward into phase two, we don't want to be the ones that are inviting counties to come for a meeting. We want to support the Ministry, if we need a meeting, one to discuss newborn we want that meeting to be called, people to be invited to the meeting by the Ministry of Health because it's their mandate. They provide the policy and the regulatory framework and NEST when it comes to support with the logistics and if they need technical support. And how do we provide them with the technical support to successfully all that, that's going to be our approach next year. So, we are very much aware that the past three or*

	four years, the programme has been implemented as any other programme that comes and goes. But we don't want that to be the case with NEST, we want NEST to be embedded into routine systems. And even when we step out in 2030, then we can still see NEST going." (FI 18) *"Reflecting on what's happening in the other countries and what's happening in Kenya I would say looking for the right word I would say that a better engagement with Ministry would would because the idea is to if you're transitioning, you're transitioning to hospitals and government so to what degrees government actually involved in NEST, besides them coming to meetings, to what degree are they actually involved in implementation, for instance, and in the stewardship of the next steps. For NEST for instance in some of the other countries, the Ministry is quite involved, they're saying, 'This is what we want, this is the places we want you to go to, this is what is going to work for us.' In Kenya, I don't think we we have engaged Ministry to give some insights on that. But I don't think they're the ones saying, sorry, you can't go there, I think this is where as a Minister within we need more investments." (FI 32)*
16C	When the network does not have sufficient human resources required to change practices and sustain the changes (context), this will make transition and sustainability of the network and network activities challenging (outcome) because the network has limited capacity to institutionalise its impact (mechanism)
	"I would say, NEST has done us well, by and large. One thing that has been not so good, but why why I'm speaking slowly, is that it's not the work of NEST. It's been the human resource. NEST has trained the few human resource, we have quite motivated, but as I've told you, those ratios, yeah. Yeah. So, I have a nurse who is really equipped with a lot of knowledge but he's one person against 25 or 30 neonates like for real, we might not get somewhere with that. So, in fact, the last meeting we had between the NEST team and the county because now we we brought in the county executive was we need to employ, we need to recruit more nurses. For me, I cry for the nurses because, you know, these are the people on the ground. Yes. We need to recruit more nurses, we need the numbers. The good thing is that the county has stepped in and taken two general nurses to go and do neonatal nursing. So, after one year, we expect two newborn neonatal nurses being brought onboard. But the county has also promised in the next financial year to recruit more nurses, so that the numbers improve. The numbers, if you can only do so much, Katherine, you can't attend to everyone. Yeah, yes. Yes. Yes. So that has been a challenge. Because when you give me equipment, you train the few workforce I have and all that you expect some improvement, you know, so these are doing so well. And if you ask [redacted], she will tell you and she usually consults us because she looks and you know, interestingly, when NEST came onboard, and the overall outcome improvement, the numbers just increased." (FI 04) *"Well, personal opinion and observation is, I think, for CPAP, CPAP is one of those very unique devices. Because with CPAP, you need very good if you're giving CPAP, there has to be very close monitoring. But then again, when you go back to the hospitals, our staffing ratios have been bad, so that it's one baby to 13 or 14, we've looked at our data, a lot of the times when just on on the spot checks, our ratios are one to more than 20. But now, when you look at what is involved in actually just setting up CPAP and monitoring CPAP it improves a lot. So, if you're one person with 25, 30 children, you might not be able to have that time to set up. Or if you have that time to set up, you might not have time to monitor. So, in some conversations, I've had things like, 'No, we don't like CPAP, it kills babies.' Because a baby was put on CPAP, you see, unfortunately, if you're not able to monitor and change settings then it could be fatal. So, babies have died. So sometimes, you're there you started CPAP, one baby, two babies died. Ha, 'No. we're not going to do this a third time.' But it's because somebody has the challenge of actually monitoring this. So, some people just tend to shy away and just not start CPAP. So, for me, I think mostly it's the staffing issues, more than anything else." (FI 14)*
16D	When the network shares the collective vision with stakeholders (e.g. partner organisations) outside the network (context), this can help with sustainability and extending the network's reach (outcome) because they can understand the value of the network (mechanism)
	"The other thing that I didn't mention is that in the next phase of NEST, we also emphasising a lot on co- investment with other partners. So, this is why we want to have this forum where you know it's the county governments but also other partners in the newborn space. So, if, let's say USAID supplies

	Mombasa County with CPAP machines, can they get another partner who is working with them to get them warmers. So, it's also going to be about NEST working together with the Ministry to make sure that all the stakeholders in the working in newborn health with this same synergy, and we don't work in silos so that we don't end up providing 100 radiant warmers to a hospital and they don't have CPAP machines." (FI 18) *"So, this is Ministry of Health and then the other partners that we involved are now partners like UNICEF, during technical working group, yeah. At least I can say we've had an engagement with them whereby they became interested in these technologies, partners like USAID. Let me say, partners in the newborn space, because there are many. Yeah. The partners in the newborn space health partners, yeah. Aside from that I'm trying to look at other collaborations we've had all with the schools. So like, universities that we involved here. So, we've had the Dean for say School of Engineering, the head of department for School of Nursing in Kenya Medical Training College that we have that NEST is targeting." (FI 20)*
16E	When the network makes efforts to engage local/sub-national government in the network and the collective vision (context), members can use their skills and resources to support network activities and sustainability (outcome) because they appreciate the value of the network (mechanism)
	"I think maybe, importantly, maybe looking, in retrospect, one of the things we realised is that we didn't have enough government involvement. And I think this has actually contributed it's one of the challenges in implementation. And I think one of the challenges we have as a programme is because of the devolution aspect as well, because when NEST came in, well the national government was quite aware, but now this sub-national level, in most places was not aware, because MoUs were actually done with hospitals themselves rather than the county government. So I think that is one thing we are working to reverse and yeah …because now, initially, it was working very well. But then you see, as time goes, even leadership in hospital keeps changing. So, when you have a new team, a new leader, see a new nurse manager, a new, and so you go there as NEST, 'I'm not aware' or 'What is that?' Or sometimes they tell you, 'Oh, is the county aware that you're here? Don't you think you need to inform the county and that allow you to come into the hospital.' You know, so I think one of the things, I think where we missed a mark was getting the sub-national level government that we work in getting involved. But other than that, I think we are working well, everybody's happy here." (FI 14) *"This was varying from county to county, it's not all the counties that are the same when we entered into this facility. So, there are some counties where the Director the for Health is very supportive. Like I remember in [redacted], we had a very supportive Director for Health. And then in another county, you find that the Chief Officer of Health, like in [redacted], was quite involving. So, this varied from one county to another, but these are the people were involved yeah. I can't say that involved all the Chief Officers of Health and all the Directors for Health in these counties. But yes, it just varied from a county one county to another where these hospitals are located." (FI 20)*

Leadership

5A	Networks, initiated and supported by outside organisations/partners (context), will recruit organisations or individuals into leadership positions that they think are competent for network formation and functioning (outcome) because they believe these organisations or individuals understand what the network needs to succeed (mechanism)
	"I think, as happened, there's always a reason why things happen and it's about the networks that you have. So it happens that one of the partners that CPHD had worked with before, we came in quite late into the NEST programme, okay, the programme had pretty much been approved before we were included. And we came in because one of the funders of NEST, Elma Philanthropies, was already funding CPHD for us nurse anaesthesia work. And they felt that this would be a good fit to have CPHD Mediquip, as part of the solution. Largely for two reasons, one we were the only local, truly local partner

	in the NEST programme and we had demonstrated core competencies that in their view would be relevant for the sustainability of the NEST programme. So, donor driven in some way we were donor introduced." (FI 31)
5B	When networks have a member(s) that clearly takes on a leadership role, focuses on building linkages between potential network members and stakeholders, and creates communication channels (context), this helps the network to form (outcome) because it brings people together (mechanism)
	No supporting data
5C	When networks have a member(s) that enacts leadership capabilities, communicates the network's vision, and helps to set collective goals (context), this helps to bring network members around the collective vision and to move forward in the same direction (outcome) because they have the same understanding of the network's value (mechanism)
	"In fact, at that time, I was not the medical superintendent. I was just the in-charge of the department and the hospital management team. Upon sharing with them the objectives of NEST and how useful it was going to impact the outcome of the neonates, it was accepted. Yes, they bought into it. We've got the initial support. In fact, the initial meetings involving the medical superintendent and and others that were held in Nairobi from [redacted] came with that team. And they were very happy. We have received support throughout, yeah, from the time NEST came on board." (FI 04)
5D	When networks have a member(s) that clearly takes on a leadership role and actively coordinates network members (context), this helps the network to form (outcome) because there is a central figure bringing people together (mechanism)
	No supporting data
5E	When networks have a member(s) that enacts leadership capabilities and provides support and feedback to network members (context), this can help the network function and take more appropriate action towards the identified problem (outcome) because network members feel empowered to take action to work towards achieving the vision (mechanism)
	"I'm always proud of my Med Sup, so, who is the team leader. Yeah, when you go there, it's like, he's mentor, he's a friend. No, in certain areas, staff, you may find staff who are not very, very free with their in-charge, especially the Med Sup. But this one, so long as you are focused, you are, you know, you you are focused to quality to delivering quality services. Yeah, and you you need you want to learn is actually a friend, and he is ready to teach. He impresses teamwork. Yeah, and when there is, if the unit is able to identify one who's not maybe doing very well or has knowledge gap or skills gap. Yeah, they're able to bring her on board. There are some some, yes, we had some who had very poor attitude, they could shout at the mothers, such a person. Slowly, they're brought in and mentored and coached. And you know, somebody by the end of the day understands why is she or he is in that particular team. And with that, I'm seeing great improvement." (FI 09) *"It was a mixed bag. The good there is one ingredient that we don't talk about often, which is the leadership. So, in hospitals, where we deployed NEST, and we had a very strong leader, paediatrician that wanted to see things work, you could see massive improvement in a very short time. In some areas, you had mixed results. There wasn't leadership. Just deploying equipment didn't change much." (FI 31)*
5F	When networks have a member(s) that enacts leadership capabilities and gets things done (context), network members develop greater commitment, engagement, and/or motivation (outcome) because they believe belonging to the network is worthwhile (mechanism)
	"So, in terms of giving the feedback, it is also tricky sometimes because it is around twelve, twelve thirty…exactly, people have finished their shifts they are running elsewhere for locum or something. Then you you may want to miss the biomed the here is where you need the leadership of the facility. But you will rarely get them unless they are very passionate about the programme itself and the newborn. It is very rare to get a full quorum like the one you got in the morning, it is usually very rare. So, what happens is, they fill the joint action plan, they leave it to the they leave a copy in the facility.

	Then the leadership is supposed to go through it and I don't think they do that. It's, I don't think like, even if you are went to newborn, you know they are supposed to be somewhere. They don't have, in fact some disappear immediately we leave the facility, and they call back." (FI 16)
5G	When networks have a member(s) that takes on a leadership role and dedicates time to setting up and the functioning of the network (context), network members develop greater commitment, engagement, and/or motivation (outcome) because they believe belonging to the network is worthwhile (mechanism)
	No supporting data
5H	When networks have a member(s) that clearly takes on a leadership role and actively engages network members (context), network members develop greater commitment, engagement, and/or motivation (outcome) because network members feel part of the network (mechanism)
	No supporting data
5I	When network leadership consistently and regularly supports and provides resources to network members (context), this helps network members act to achieve the network's collective vision (outcome) because the network members feel empowered (mechanism)
	"NEST is one of the organisations that did not just apply and run away, they have actually stuck with the with the facilities like throughout the life of NEST, as long as NEST is still existing. Then I think it is a culture that was cultivated in at the onset of NEST because most of the organisations, they start a project and they run away. Even when they are still existing, probably they would have supplied the equipment and run away. Now they take care of everything. But here we are, we are stuck. And the facility biomeds are very comfortable. You should do a bit of the questions for the areas where NEST is existing, they will actually tell you, there is a very big change when it comes. There is a big change, there is a big difference between other organisations." (FI 17)
5J	When network leadership and members consistently and regularly promote, encourage, or champion practices or influence network members to take up certain practices (context), this helps other network members to adopt these practices and sustain them in the network/unit (outcome) because of role modelling (mechanism)
	"Continue to like, when you have new people inducting them into this is how the unit runs, this is what NEST is, this is the training, this is why you need it. So that continuity can go on even when you don't have to have specific key people to train like a core number of people so that that concept can continue going on and not drop off and data, your monthly data coming back. So, it keeps you on the ball and because you have to keep doing the simple things perfectly. Hypothermia is not just a one-off thing. If it fluctuates downwards to go back to the upstream and so data also helps you to to keep up with your improvements, show you where you need to keep working." (FI 03) *"Once we've identified and we intervene, so our role is are we able to are we able to to maintain it for quite some time for quite some time. And the role of a manager in that department is just to see to encourage to encourage your staff to maintain that practice, just to maintain that practice." (FI 07)*
5K	When network leadership creates a welcoming, supportive, and inclusive environment within the network (context), members feel more able to seek support to improve knowledge, skills, or manner of working (outcome) because network members feel that they are in a psychologically safe environment (mechanism)
	"I'm always proud of my Med Sup, so, who is the team leader. Yeah, when you go there, it's like, he's mentor, he's a friend. No, in certain areas, staff, you may find staff who are not very, very free with their in-charge, especially the Med Sup. But this one, so long as you are focused, you are, you know, you you are focused to quality to delivering quality services. Yeah, and you you need you want to learn is actually a friend and he is ready to teach. He impresses teamwork. Yeah. And when there is if the unit is able to identify one who's not maybe doing very well or has knowledge gap or skills gap. Yeah, they're able to bring her on board. There are some some, yes, we had some who had very poor attitude, they could shout at the mothers, such a

	person. Slowly, they're brought in and mentored and coached. And you know, somebody by the end of the day understands why is she or he is in that particular team. And with that, I'm seeing great improvement. You know, when I look at that, that nursing, the nurses, the nurses that I have, it's like that maternity team, especially NBU, that like a role model, the way they talk, the way they handle stuff and all that." (FI 09)
5L	When networks have processes in place to identify and enable those with the necessary skills, motivations, or attitudes to take on leadership roles from a wider pool of engaged human resources (context), this may support network functioning and may lead to changes happening (outcome), because the network is able to create a distributed form of leadership across the network (mechanism)
	"The approach was that you see [redacted] has been had been in another programme that's and the Clinical Information Network. So, as the hospital paediatrician, I had been involved in this data issues and all that. So, I was the point person. So, at that point [redacted] reached out to me. And she said that there was this new programme that was coming on board, whose main objectives was to empower the healthcare workers in terms of knowledge and also on the use of equipment or other technology to save or to improve the outcome of neonates in various hospitals. So, at that point, when she requested me to extend that leadership role, and be the point person for the hospital, and also get a nurse, preferably the in-charge of the newborn unit, to also be a focal person." (FI 04) The network may also do this to identify key people in network activity implementation, such as mentors. *"And then maybe just to mention from from from the training, that is where the team was able to identify mentors. And, of course, we had the focal persons, the in-charges of the board and all that. But now, for somebody who will be a mentor, we had to identify someone from the training someone who looked enthusiastic, and they were willing, of course, somebody had to be willing to be a mentor. I think that is now, that is where I was identified as a mentor myself. So, somebody who is enthusiastic about learning gets the content, clinical credibility, can actually teach, all that. So, mentors were identified. And then now the journey began so the devices got into hospital, then now there was that continuous support with mentorship, from then clinical training manager. And, yeah, the journey continues." (FI 14)*
5M	If a network is highly dependent on a few people or leaders to implement network activities or leaders that support their implementation (context), then it is at risk of being unsustainable or functioning poorly (outcome) because the leadership structure is fragile (mechanism)
	"When when [redacted] was handling this, I think she was more how do you call it? She was she was more hands on, which she was more involved. And so, it's made you feel better. And I think when when her influenced stopped, I don't know what exactly happened, I don't so now, it's a bit like the touch somehow, the energy, like it went away, don't necessarily know what happened when the energy went away something from so now I think the activities are just been done without even then used to have I think the clinical services manager that is [redacted] will come around." (FI 10) *"So, the major changes are staff turnover, which is a very negative, has a very negative impact to the programme. I think the other day the Med Sup for [redacted] was moved, I think it was last week we have [redacted] who has been moved. So, every time, and I think this is a gap we have like, we have to call but I assume the previous Med Sup is the one who is there. Then you are calling and then they are like 'no I think that Med Sup went,' and you are also shocked." (FI 16)*
5N	When there is misalignment of priorities between network leaders/partner organisations (context), then one leader/partner organisation may feel they need to leave the network (outcome) because they do not feel they are moving in the same direction (mechanism)
	"Yeah, we're no longer part of the NEST programme but we're still doing a lot of newborn solutions. I think just the nature of our partnership, at some point we had to just separate because of of programme development issues that were not fully aligned that basically made our continued participation there untenable. So, every contract has an exit clause, we chose we agreed mutually to separate between us, but we're still friends, who still do the distribution of some of the equipment, okay, through our Mediquip global. We are not deeply part of the programme." (FI 31)

	"I would first of all, discuss the ones related to the partnerships, management of partnership was one area, I think the priorities of different partners are quite different. We come from an operations we're keen on improving clinical services, in hospitals, not so much from research work done. We have partners who are very much interested in the fidelity of the research and exactly how you're collecting data. So, the level of effort you put depends on on what exactly your outcomes are. So, I think this was a bit of a challenge, because we mixed all these players without clearly separating where they go with the different teams of how if I was to do it, again, for people who want very clean data, I would pick a small subset of hospitals where thorough research activities will be implemented. And not try to go into an operation with a with a research lens that that to me, I saw a lot of push and pull between your core clinical support system and fidelity of research." (FI 31)
5O	**1.** When there is a leadership/partner organisation change within the network and a new leader/partner organisation comes in (context), this can jeopardise maintaining the network's collective vision, existing relationships, and functioning (outcome) because the new leader/partner organisation is external and has not assimilated into the network (mechanism) **2.** When a leadership change within the network introduces new working practices in the network (context), this can disrupt network activity implementation and functioning (outcome) because network members need to learn about new practices (mechanism) **3.** When a leadership change within the network introduces new working practices without first discussing and negotiating these with network members (context), network members can become frustrated (outcome) because their experience and expertise in the network is not valued (mechanism)
	"I'll honestly say that it has impacted it has okay let me say it has had an impact on the programme as such that the implementation slowed down at some point, yeah. As a programme manager, I think I can say for any programme manager something that can be frustrating is when you lack… to do something to to implement, to be able to implement, you know. So like, for example, when we move from CPHD, of course, there is a way there was a system on how, you know, you are running a programme, and then move to the next let me say stage where we are out of CPHD, and we have to continuously maintain the programme. And then just as when we are getting the momentum and coming up with systems to be able to implement smoothly, then another transitioning comes on board where we moved now to, I don't know Strathmore University. And then of course, then they have their own policies, they have, you know. Everywhere you go with a partner, they have their policies and system on how they're doing things. So, when you have a programme that is running that has to continue running and on the other side, you have to start abiding afresh, to the other partners, policies and system of how they're doing things you're used to doing. You know, it's not an emergency programme, yes. But it's that kind of a programme where we are managing technologies and if a technology breaks down today, we have to wait for its up time. Yeah, from down time. So, you see like maybe, initially, maybe, let me say now after CPHD, we are transition to our own kind of a system with Rice, where we were doing... And then now once we had established that, and we were having a momentum, it's when now we moved to Strathmore. So, you realise, when when you're having that momentum, where there's flexibility on how you're implementing something, you have just established that there is a downtime of equipment. And the biomed engineer, the NEST biomed engineer needs to rush the facility and ensure that because he has received a call from the hospital biomed engineers that are then unable to repair the equipment. So, within that 24 hours, at least, we have to send out the biomed, the NEST biomed engineer, to go, because remember, these babies are relying on these technologies for their life support. So, and ours is to ensure the survival and for these babies to also try as a programme. So, you realise, we have established a mechanism where and that flexibility where the NEST biomed can quickly rush to the facility and ensure the uptime. But now, when you move when we moved to, I'm just giving specific examples, this journey just to show how transition can actually affect a programme. Yeah, so then when you when you move, when you move now to Strathmore, they have their own system of how they do things. So, if someone had has to travel, you have to give a notice, have about 10 days for that to be planned and that to happen. So, it becomes frustrating, because now we can't give 10 days in the baby cannot wait for 10 days, I mean, that's a mortality yeah. For you to be able to give a go ahead and organise transport for biomedical engineer to travel and, you know, prepare the equipment. So those are the kinds of frustrations that were

	coming along with implementation of this programme. So, as a programme manager, I need to coordinate, I have a work plan in place with the team and the country director. And we know very well, from the work plan in the month of say January, we have these four activities that needs to happen. So in between the activities, if anything comes up with any programme implementation there has to the flexibility. So, you realise when something comes in between the planned activities in that particular month, now, having moved to having joined another partnership here, it becomes difficult to manage anything else that comes in between. So that was quite frustrating, especially the one that you're given restriction when it comes to timelines, you cannot do this at this time, we are time bound we cannot organize a training. In for instance, a training that maybe we could have organised within a span of a week and well-coordinated. No, I'm not talking about planning in terms of I'm talking about now executing the training. Planning of course has to happen probably a month back, but now you want to execute it and because you've moved to the new partnership, and they feel like no we are time bound we are not able to book a conference space for you, we are not able to organise transport for you, I mean it becomes frustrating. Then just as we are settling again, another transitioning happens now from Strathmore to now having to partner with a consultant, you know, to support us with the finance systems, the operation system, basically when it comes to logistics and you know finance. And then just as we are also picking up that momentum, now we have to transition again. Now we are currently in Aga Khan. I mean, it can be frustrating for any programme implementation because even now at Aga Khan they now have, of course, even that consultant had his own system and ways of doing things. This affects a lot the flexibility on how they programme activities can be implemented. And of course, now getting into Aga Khan now fully transitioning to Aga Khan, where now finance has to be, of course, operated by them, logistics, and when you want something to be to be done, there's a lot of bureaucracy of how things are going to be improved, approved. Sorry. And so that for that particular activity to take place, I mean, it's when you start settling down, you have to start over again. I mean, it's that kind of a cycle. So, we've been oscillating around transitioning more than how focusing on you know, programming implementation and ensuring quality of what we desire to achieve. Yeah, so I think that has also affected a little bit of the quality, but even so with that I can say, I can tap our backs, I mean, as the NEST Kenya team that we've actually managed to push through a lot of activities. I mean, just just becoming flexible ourselves, putting the frustrations aside, and, you know, trying to keep that focus and and yeah, moving on. And now I think we actually transitioned fully including the staff like, you know, now settling in under Aga Khan completely. So, I think after we settled in Aga Khan just a few months, I went on my maternity leave so. Yeah, now that I'm back. I'm sure the staff might my fellow, I mean, Kenyan team, I think, then they've now been able to, they're sort of getting a momentum. Rather, they're settling down in Aga Khan, and be able to continue with this implementation of the programme. Yeah. So basically, the transitioning has had an effect big an impact big time on programme implementation. Yeah, and it can be very frustrating." (FI 20) *"So, the honest truth is it has had I'm looking for a bet... so I don't want to say it's significant, because you know, NEST is still functional still goes on, but it actually did have impacts on implementation. Mainly, because transitioning, so each organisation had its roles and responsibilities, and there was very little duplication across those organisations. So, then moving from one organisation to another creates like a vacuum, sort of impact stream of work. So, if see CPHD was responsible for looking after the biomedical side of things, then transitioning that to another organisation or figuring how that will work in the absence of CPHD, then that means a lot and the institutional arrangements, therefore, of how, say, colleagues in KEMRI, would reach out to CPHD to get devices for training, then that has now to go to another partner who has to understand why should we give you devices for training? How does that work? How do we loan them? How can we trust that you take care of them? Because the also at an institutional level, there is some amount of time that takes before you can you can establish like a working relationship trust and all that. And that's not just at the beginning, because we transitioned from CPHD, then, I think, had a gap where the team in Kenya tried to run the show, then it was quickly realised that there is a lot of logistics that CPHD would run in terms of coordinating trainings and couriering things to sites that needed an institutional base so we then transition to another institution, which also took a bit of time. And then each institution has its own administrative processes, which now people have to learn how to engage with they need a lead time of, for instance, 14 days to action on anything. And at that point, the implementation of NEST didn't*

	have a lot of we'd already lost time by this transition. So, a 14-day lead time to organise a training. And it's a long time. And things can easily quickly change. So that that I can confidently say that there was some delays in getting some hospitals of the ground, and some of them activities running, as per expected. So, we would have challenges in, for example, having quarterly meetings in good time, or getting the QI activities up and running. And as frequently as they should be, because of those institutional changes, but also leadership changes as well, because we also had, so we had an institutional change, then a couple of months, I think maybe a year later, we had a change in senior leadership, then a couple of months after that we had another institutional change, then another leadership change. So, and I think in all these changes, the hospitals also now have also to adjust to who, which organisation, now are we dealing in terms of when things are sent to them? Where are they coming from? Why are they coming from this other organization? As opposed to this? What happened to the other organization? What does that mean? So, I think, to some degree, yes, that that created some bit of challenges, also, working within the implementation teams. Also, there was a bit of hiccup on how to who to go for what and because each institution, will will get some sort of the understanding of what their role is, which might be different from what the previous role of the previous organisation was. And there are some few things falling through the cracks on who now takes responsibility of this." (FI 32)
5P	When non-network health system leaders, whose buy-in/commitment to the network is important for network functioning, change (context), this can disrupt network activity implementation and functioning (outcome) because it puts at risk relationships essential for network functioning (mechanism)
	"And the latest one is that the head of the division just changed, three or four weeks ago, of course, that's a setback, because you've been engaging this person in the purpose of, I'll give you an example, phase two. So, we were engaging the previous head, inviting her to our meetings and sharing with her our plans for phase two, and then she's moved. And then someone completely new is brought. And you are at the tail end of your writing a proposal. So, what does that mean, you have to start re-engaging. So, we have a meeting in Malawi, where we are finalising on the proposal. But mean, you have to bring someone new, that means you really have to do a lot of re-orientation of this is what NEST is about that people have also their own interests, they have their own priorities. So so that that then becomes a major problem. Same with the counties, you know. Yeah, but we've not engaged them very well." (FI 18) *"You know, in every country, there is the political will, as to that affects, in addition, either positively or negatively. So, like I can say, when it comes to governance, like as we speak, I forgot to mention this, thank you for reminding me. For governance, you realise that there are changes that are happening even in the Ministry of Health. So just last year, by December, we had, so they like the entire year, last year, by December, we already had changes with the head of, you know, DFH. And and and the unit, the DNCH, so as you began the year, with the new elections, things have also changed again, we have a totally new head, for DFH, we have a totally new person when it comes to the head of the DNCH. So, there has been changes in those with the of the government officials in their offices. So of course, this impacts on the programme, because you see, every time there is a change, as a programme, we have to go and put them to speed. You know, this is NEST programme. And remember some of these people, are not even conversant with reproductive health or newborn health, you realise this is someone who has been put in that seat and has come from a TB departments, from you know, the other side of Ministry of Health or even monitoring. So, this is someone you have to start putting them to speed, this is NEST, this is what NEST stands for, it's implemented here, and here and here. So, you know, definitely, it sort of makes us lag behind a bit." (FI 20)*
5Q	When network leadership is not able to get the network to develop and agree on a shared vision (context), then it is at risk of not performing well and becoming unsustainable (outcome) because members are unclear as to what the network is for (mechanism)
	No supporting data
5R	If network members take appropriate action to mitigate any disruption leadership changes might bring (context), then the network is more likely to keep functioning (outcome) because the impact of any disruptions are minimised (mechanism)
	"In these hospitals, there has been changes when it comes to Med Sups, that turnover when it comes just the hospital management generally. And even with the nurses, there has been those turnovers but at least of course, at the newborn unit, we've been able to, you know, once we've had this job aids

	and all that. So, the knowledge is transferred within the unit. But of course, of course, with the management, we have to go to each and every facility. Whenever there's a change, you have to put these people to speed and remind them that there is an MoU and you know, so that whenever a study's happened whereas as you continue with the study and something comes up, we don't have to start from square one that how did you even enter in this hospital? Blah, blah, blah. Yeah, so of course, there's that challenge. And maybe the support need here is, of course from the NEST leadership in Kenya." (FI 20) *"I think it's what I said that at the hospital level, because of, you know, this teamwork that had started, you know, way before NEST came in, at the hospital level, there was less of disruptions, it's more at a more senior, much more higher administrative logistics issue to get things done. But having said that, there's the, I would say, the boots on the ground didn't change in a big way. So even when we had a lot of administrative changes, the guys who were responsible for making things run, remained relatively the same. So, you the learning curve was not issue because these people knew what needed to be done. And had, you know, were part of the original NEST plans, were consistently updated through them, meetings, both national and international meeting. So, they were pretty familiar with the implementation processes. So, I would say its the administrative logistic hiccups that would end up slowing things down, rather than the this team, this middle level team that knew what they needed to do. That changed. And I think that played a very huge role to make to still get NEST to where it is. And there was a lot of dedication and commitment from that team. That you know you cannot take away that I, I it's a pretty slim team, looking at the amount of work that needed to be done. And they did a fantastic job. But it's important to add that there was a lot of effort to build capacity beyond the team, the NEST team. So, a good example is with the clinical training. So, when it all started there was a lot of efforts to involve paediatricians at the hospital, but also residents or doctors who were in paediatric training, to learn the skills, the materials, the training, and all that. So that created a bigger pool of people to draw on. And therefore, even if the team leading the clinical education mentorship team was maybe three people, they had a big team to draw on. And those were not linked to any institution but were mainly ministry, government. People who were not affected by these institutional changes. So, if you move from one institution to another it's not now you couldn't use this group of people it's telling them now come for the training. But this the organisation that paid you last time will not pay you, you'll be paid by organisation B." (FI 32)*
5S	When there is a change of leadership within the network and new network leadership puts in efforts to maintain network functioning (context), network members feel that it is still worthwhile to be part of the network (outcome) because they feel the leaders value the network (mechanism)
	"NEST360 Kenya completed the health facilities progress review and introduction of data for action visits at Thika on September 7, Machakos on September 8, Kerugoya on September 13, and Nyeri and Embu on September 14. Facilities were receptive to the new NEST360 Kenya leadership and discussions around data led to action points to help the facilities tackle challenges and promote success." (documents – Q3-Q4 2022 NEST360 quarterly newsletter)
5T	When hospital/facility leadership sees the effort that the network is making and the changes that have resulted (context), this encourages them to take action to work towards the collective vision (outcome) because they understand the value of the work (mechanism)
	"And even the hospital management has, after seeing that the NEST has come in, is supporting many things these days. If you ask for things, even from the hospital store, the supplies are limited. But you find even from the administration they try. They try to make sure that they provide whatever we need. It's not always enough, but you can see goodwill from the administration, which was not there initially. It's as if they are saying if these others have come in and have done such a good work, how can how can we fail them? Or how can we fail those a newborns or even the nurses who are in the or the workers in the newborn unit? So, you'll find even from the administration that they're really trying whenever we ask them for some things, you find they might not have the resources... But you can see their efforts." (FI 22)

	"I think NEST has shown that you can actually make a difference. It has shown that it doesn't have to be the very expensive machines, you need to make a difference. So, I remember initially, the discussion we need a NICU here to make a difference. But then we should just need simple machines, you don't even require ventilators to make a difference, remember the management, I think they have shifted, they have realised you don't require very expensive things to make a difference. And they have seen what NEST has done." (FI 23)

Champions

11A	When a network provides a platform for members who are passionate and believe in the collective vision (context), they are willing to be champions (outcome) because doing so enables them to initiate change (mechanism)
	"I can say the team leader, actually, who is our Med Sup is like the role model when it comes to all this…And it's like the champion, right, rather than the patron of the whole issue." (FI 09) *"I think the last bit is could be a bit controversial is also networks and and teams really depend on champions. And the success of a lot of this implementation work and and how thing take up and taken up and successful in some of the environments is who the champions are on the ground. I think part of the success for NEST to some degree is because of the champions that NEST had when it started, there were passionate people, there were people who were respected had a good knowledge of the terrain, engaged very well with people at the hospital level. And that played a very huge role in creating this collegial partnership and network of people who were willing to work together. And I think that's something maybe is as can't be quantified or can't be it's not tangible, per se, but it's it's a software component that we might overlook that sort of played quite a role because of the champions behind CIN the champions so to come in NEST initially and created all these other and mentored other people to actually be champions and advocates for NEST." (FI 32)*
11B	When network leaders identify and nurture influential and capable network members and support their leadership capabilities (context), this creates network champions (outcome) because they have the support to enact their skills and passions (mechanism)
	"And so far, we've been able to train a number of biomed engineers and a number of clinical staff and they were also taken through what we call Generic Instructors Course. So, we have GICs, yeah, they're instructors who are able now from the Ministry of Health, they are from those facilities and expose that we we involve all these levels from from national to county level to facility level. And, you know, we have all these people who are now champions and are able to they're well equipped to be able to now even continue training." (FI 20) *"We were able to identify some key, my opinion, people who would carry forth that training. So, in [redacted], we I identified one person, the ward in-charge was not very wanting to teach. So, I had to identify somebody else who I felt would be left behind to teach. So that happened in [redacted] and actually it was a difficult time for me because the first baby we put on CPAP I think we we chose the baby had other complications but we still put the baby on CPAP and then the baby died. So now people are like ahhh I'm not so sure about this CPAP thing. And also, for me, it was very heart-breaking. Because I'm like I know this thing works. Probably we didn't choose the right candidate. So, what we did to help correct that we had a specialised nurse in [redacted] because I had to move on to [redacted]. So, she was one of my students. So, I trusted her and she knows about CPAP and what it can do. So, we left her there for a whole week for the for and she was able to be present, work with the people, and put a baby on CPAP and see the baby actually thrive. So at least that really, really helped. That neonatal nurse actually really helped. And she was able to now quote unquote mentor. That side because she I left her behind for a week. And then after she stayed away for a week, then she came back again for another week. And now several, like six or seven people are comfortable and then now we left them for some time, after a month, we sent her back again, like that. And they were, I think now they*

	were okay to start CPAP and their own newborn champions, were able not to oh these things this thing can do this. So, all those lessons we took to [redacted]." (FI 29)
11C	When network champions are capable and willing to take on additional responsibilities within the network (context), they will train and mentor network members (outcome) because they see the value and have the skills and passion to do so (mechanism)
	"It is very difficult for me to dissociate myself from NEST because I think I am NEST. As in when NEST started we were the first people to be trained to become the trainer of trainees you see. I have trained about five county personnel on the NEST bundle, the ETAT+... [redacted], [redacted]. I've done those ones [redacted] and then [redacted]. There's [redacted] so I've trained those ones. Now, when we go to train, you know, you train your colleagues. You participate in the training of the biomedical engineering, the mentorship processes, you know, you visit, go see what are they doing there. They also visit, you see what you are doing here. So, for us NEST is not foreign. In [redacted] County, we are part of NEST. Yes, yeah. So, whenever we have visitors coming to [redacted], it's very difficult as a medical superintendent to say we have visitors simply say our team is here. Yeah, because we have worked with them. And we have seen the improvements in terms of the knowledge base among my medical officer interns clinical officer interns, my nurses, and nurses interns, and all that we have really worked with them. So, we feel like we are part of the programme for NEST." (FI 04) *"And so far, we've been able to train a number of biomed engineers and a number of clinical staff and they were also taken through what we call Generic Instructors Course. So, we have GICs, yeah, they're instructors, who are able now from the Ministry of Health, they are from those facilities and expose that we we involve all these levels, from from national to county level to facility level. And, you know, we have all these people who are now champions and are able to they're well equipped to be able to now even continue training." (FI 20)*
11D	When network champions are capable and willing to take on additional responsibilities within the network (context), they will help change practices (outcome) because they see the value and have the skills and passion to do so (mechanism)
	"So that is what we have been working on and then having a champion champion who will bring whatever you want. She is always there keeping the records telling me no [redacted] this is what happened. It has really helped [redacted] to achieve a lot on CPAP." (FI 05) *"For example, one of the challenges we have had is the issue of we have not been doing very well with the CPAP uptake, despite the fact that we got the machines. So, one of the meetings or in some of the meetings, we've tried to compare with other facilities which are doing better and so, we learned that some facilities were doing what they really invested in CPAP champions. So, these are people who are the ones who are running that idea. And because what we noticed is that after the initial training, over time, the confidence levels went down. But when we got now those sharings and the issue of champions, you know, we've tried to get one champion here. And we have seen that that has helped us quite quite a lot. Unfortunately, one of our champions has also been transferred to another facility, that was our medical officer, but we still have one nurse who is still working as a key champion especially CPAP." (FI 25)*
11E	When network champions have pre-existing relationships that they bring to the network (context), this helps the network take action (outcome) because these relationships bring with them extra resources (e.g. access to people, lending legitimacy to the network) (mechanism)
	"The champions also bring something that's easily visible, like relationships they have with people in Ministry, relationships they have with people at hospital. So those relationships, despite, you know, the mentorship to other people, those relationships that champions have to make things happen cannot be passed on because it was individual things it was something created." (FI 32)
11F	When network champions leave the network (context), this may result in a loss of relationships important to the network (outcome) because these are personal to the champion (mechanism)

	"I wouldn't say the Kenyan one is perfect but I think there was a lot of effort when NEST started that the champion mentored very many a couple of other people around them that even when they reduced their time and contribution towards NEST, it pretty much hasn't fallen apart. There are bits and pieces that are not as enthusiastic as they would be but it's still holding together. And it's one piece and I wouldn't say it would fall apart if they left but it would be great to still have them. And and the champions also bring something that's easily visible, like relationships they have with people in Ministry, relationships they have with people at hospital. So those relationships, despite, you know, the mentorship to other people, those relationships that champions have to make things happen cannot be passed on because it was individual things it was something created." (FI 32)
11G	When network champions leave the network (context), this may result in a loss of energy to take action in the network (outcome) because network members feel less motivated and encouraged (mechanism)
	"Like I said previously, when when [redacted] was handling this, I think she was more how do you call it, she was she was more hands on, which she was more involved. And so, it's made you feel better. And I think when when her influenced stopped, I don't know what exactly happened, I don't so now, it's a bit like the touch somehow, the energy, like it went away, don't necessarily know what happened when the energy went away something from so now I think the activities are just been done without even then used to have I think the clinical services manager that is [redacted] will come around." (FI 10) *"I wouldn't say the Kenyan one is perfect but I think there was a lot of effort when NEST started that the champion mentored very many a couple of other people around them that even when they reduced their time and contribution towards NEST, it pretty much hasn't fallen apart. There are bits and pieces that are not as enthusiastic as they would be but it's still holding together. And it's one piece and I wouldn't say it would fall apart if they left but it would be great to still have them. And and the champions also bring something that's easily visible, like relationships they have with people in Ministry, relationships they have with people at hospital. So those relationships, despite, you know, the mentorship to other people, those relationships that champions have to make things happen cannot be passed on because it was individual things it was something created." (FI 32)*

Adaptability

15A	When passionate, innovative, and committed network members face circumstances in the network's operating environment that are out of the network's control and affect the network forming (context), the network adapts its activities to be able to continue to work towards the collective vision (outcome) because the network members believe in the value of the network and its collective vision (mechanism)
	"I think maybe as it comes or maybe how it was conceived is not how it turned out. Cause of course, it was the plan for NEST was there just before COVID. Then COVID came in, of course, a lot of dynamics changed. Starting from how training was envisioned because they had planned that we'll have five-day physical training on the sites. We know that then now with COVID, people had to shift. Of course, there were no plans for webinars, but webinars came. There were no plans for hybrid trainings, hybrid trainings had to come in. Then, of course, other things that were not planned for. So that to facilitate the like the hybrid trainings, the hospitals actually got television sets just to facilitate the hybrid training, because now you'd have to put the people in a room and then have the lectures presented. There was only say like one facilitator just to coordinate the team on the ground and then have the training running." (FI 14) *"I'm grateful because I was a teacher. And so, I use my my students and I knew where they were and I knew them and I had their contacts. And then I literally went back to my record and looked for everybody's phone number because I knew wherever they were, they were like an in-charge or somebody who is respected, so people listen to them. I literally called them one by one and…have you had have you heard about Zoom and they're like, 'what's,'*

	they were like. So, I realised, people have no idea about Zoom. So, I had the brilliant idea of creating a WhatsApp group. And I had to write down step-by-step, how do you download Zoom. And then I realised, you need an email address to use Zoom. Then I realised nurses don't have email addresses. So now let's start how to how to create an email address. So that's how it started. And I did steps step one, step... because...I already had experience with creating the SOPs for using the machines, so I used same concept. So, break it down, how you prepare, how you create an email, how you download on on your phone. When you download it on your phone, how to join a meeting...next step. When you're in a meeting, this is what you do. Yeah. And for two weeks, that's all I did. Called Everyone sent everybody. Then I also learned about WhatsApp broadcasts, not just groups, you can create a broadcast list with everyone. And you can send them a message as long as they have your contact on their phone, send them a message at once. So, I would have like 300 contacts and my request to them, I would call them and request, please save my number on your phone. So that took so that meant I had to buy the the programme had to buy me a phone, fill it with airtime, so they could save my phone number. So that I could do I didn't tell them about why I needed them to save it. But I was doing that so I could have a broadcast list. That meant I could be able on a click of a button to send to 1000 people a Zoom link, right sharing the code. And that's how we had an overflow. And people now started to get comfortable in using Zoom. And then when we finished the COVID lectures, we thought we could do the newborn series. So again, went back, redid all the lectures, so that they were uniform, again, worked with the postgraduate students. And we would teach we would do the deep scientific dive to the postgraduates like on a Monday and was it Monday or Tuesday, early in the morning. Friday evening we would do the whole country. So, we would test the material with the postgraduates. And then we see how it's flowing. Correct anything any science that is wrong, and then on Friday teach the whole country. So, we started by having the Zoom link which has which was basic, which would get up 100 people. And then we'd lock people out. Then we went to 250 locked people out, we went to 500 we were locking people out, we had to pay for the 1000, and we still were locking people out. And so, it became a thing. Yeah, for like 12, 14 weeks. Every Friday. We had discussions would have a lecture presented the same way. Nurse... a doctor the the science nurse to the practice. And now we started recruiting people to help because now it was too much for me. So now I started getting the neonatal...requirements we had three so they would alternate so we don't get too tired. The postgraduates also they alternate so we don't get too tired. So, Friday we had something going on those 14 weeks. I don't think I slept at the end of it one every hour of lack of sleep, I think. And we were able now to do teach everything the whole content or the priority areas. And then in October so we did that Between April all the way to October and then still COVID was there, we couldn't teach. So, we figured, now we've become masters of Zoom. Let's try, can we get teachers to teach and then just two days and practicals. And we approached, we were in a CIN meeting online, oh yea we also started having online monthly meetings with the CIN sites. And we pitched about NEST and what we want to do and people would give us ideas, people would attend, people people apparently it was a real need and people would listen. And then we finally because everybody was so engaged, always if it's not a Zoom meeting or webinar or something it was a meeting about something, everybody was always informed about what's happening. And because I already had this broadcast, it was very easy to share information, share the slides, share videos, you know. So, it made it so much easier to do that. So, we had all that going on. Again, we figured we can run the course on Zoom. But we need video conference. So, we said 'who's willing, anybody willing to be a guinea pig?' And then Kakamega team the [redacted] she was the one in charge then. She said, yeah, come try with us. And try we did. And we had 12 lectures with demonstrations video on, we taught. And we did the two days of mentorship. No two days of, we did three days, three days online, two days hands on, onsite. And when we did the three days online, I was present in [redacted], so that if anybody had an issue, I could read the room and see people are not understanding or if they're not, if they're feeling sleepy, then I'll tell the guys online maybe we need an energiser or please repeat that topic again, we didn't hear you. So, it made it easier. And by the time when we were done. We were done with the three days, two days people came for hands-on. So, we just had stations. And we use the same model neonatologist was the head of the training but we had neonatal nurses and we had paediatricians. And then they would demonstrate the skill use the first stage approach the GIC, you know, so we did all that. And it really helped. When we finished [redacted], we did [redacted], we improved." (FI 29)

15B	When network members are reflexive and seek out input from others on network activity implementation (context), the network can adapt its functioning (outcome) because the network members develop a better understanding of the actions they need to take to work towards solving the identified problem (mechanism)
	"I think the major changes is modification of the working process in terms of implementation. Right now, I think there is a lot of monitoring and evaluation of what we are doing. We are not doing things as routine, so I think there are those, we are evaluating what we are doing, you can see QI we are modifying. You look at the mentorship for clinical, it is being modified. You look at the technical team; they are thinking of coming up with webinars. So, I think there is a lot of modification in terms of the implementation of the programme and trying to see. We are not doing everything across, like maybe you want to implement something, let's say we will do it in 13 facilities, you know? I think it is being done at context specific, like this facility is struggling with this, how do we go about this? This facility has these issues, how do we go by? So, it is not a one-man thing but it is very specific in terms of what are our facilities experiencing. And then that now informs the interventions that we are supposed to do at the facility level." (FI 16) *"And even the facilities, the staff that we are working with taking into account their feedback, the feedback that they share with us upon, you know, once we do a few … it was just a matter of doing it. It's a matter of how like when we come up as a team from the hospital and NEST then we discuss. We will have a debrief after the visit then of course they share their their aspect of some of the things that should be probably omitted or should be improved or should be added things like that. And with that we've been able to improve a lot by now from the time we started." (FI 20)*
15C	When skilled and capable network members leave network facilities (e.g. move to non-network facilities) (context), network members work to restore those same competencies within the network (outcome) because they recognise the value and importance of those skills in the network (mechanism)
	"Now they we have only been able to do on-job training so that these onsite mentors now are the ones that train them. Because again, I think, as part of the plan may be, in fact, as part of the MoU it was that people who had been trained were not supposed to be transferred from the newborn unit, for at least I think was it two or three years, without unless it was on their requests. But that has not been honoured. Because hospitals will tell you, sometimes, facilities have been opened, governments are not employing, and we need staff, so we have to pinch for here and there or sometimes, yeah. Others just see it is routine for them. But actually, we were able to establish, even from the nursing council that there is no rule that requires that nurses are rotated and all that. So, there are some who have not rotated. But for those ones who have been rotated again, we have to work with what we have. So unfortunately, we didn't have budgets for the training. We only just had to we've only just had to use the onsite mentors just to trains these ones who come in." (FI 14) *"What we try to do and what to try to hope that happens in the field, should there be such a case that some mentorship needs to be done, we hope that amongst the team in the field that already attended the skills training, at least there should be one or two that are still there, because, again, within our system, their county health system, rotations and transfers are always there. So, you'll find that in most cases, and currently, we will face to be the one that ideally all NEST, all five NEST trained biomeds, all got transferred. So, a new team was brought all of them. And the new team came in and then we were like, 'Hey, okay, so we are starting from square one.' So, we normally hope that amongst those that we will be transferred, at least one or two should be left behind. So that this one or two, I am able to organise for some sort of tele-mentorship that you could either do on the phone or in the during our webinars. It makes it easier for them because already they have a clue of what we'll be talking about they'd already attended the physical training the onsite training." (FI 15)*
15D	When there are changes in network organisers or leadership that influence network activity operations and financing (context), network members will adapt to continue implementing network activities (outcome) because of their resilience and commitment to the network (mechanism)

	"Let me say, it has had an impact on the programme as such that the implementation slowed down at some point. Yeah. As a programme manager, I think I can say for any programme manager something that can be frustrating is when you lack systems to do something to to implement, to be able to implement, you know. So like, for example, when we move from CPHD, of course, there is a way, there was a system on how, you know, you are running a programme, and then move to the next, let me say stage, where we are out of CPHD and we have to continuously maintain the programme. And then just as when we are getting the momentum and coming up with systems to be able to implement smoothly, then another transitioning comes onboard where we moved now to, I don't know Strathmore University. And then of course, then they have their own policies, they have, you know, everywhere you go with a partner, they have their policies and system on how they're doing things. So, when you have a programme that is running, that has to continue running, and on the other side, you have to start abiding afresh to the other partners, policies, and system of how they're doing things you're used to doing. You know, it's not an emergency programme, yes. But it's that kind of a programme where we are managing technologies and if a technology breaks down today, we have to wait for its up time. Yeah, from down time. So, you see like maybe, initially, maybe, let me say now after CPHD, we are transition to our own kind of a system with Rice, where we were doing ... And then now once we had established that and we were having a momentum, it's when now we moved to Strathmore. So, you realise, when when you're having that momentum, where there's flexibility on how you're implementing something, you have just established that there is a downtime of equipment. And the biomed engineer, the NEST biomed engineer needs to rush the facility and ensure that because he has received a call from the hospital biomed engineers that are then unable to repair the equipment. So, within that 24 hours at least, we have to send out the biomed, the NEST biomed engineer, to go because remember these babies are relying on these technologies for their life support. So, and ours is to ensure the survival. And for these babies to also try as a programme. So you realise, we have established a mechanism where and that flexibility where the NEST biomed can quickly rush to the facility and ensure the uptime. But now, when you move when we moved to, I'm just giving specific examples, this journey just to show how transition can actually affect a programme. Yeah. So then when you when you move, when you move now to Strathmore, they have their own system of how they do things. So, if someone had has to travel, you have to give a notice, have about 10 days for that to be planned and that to happen. So, it becomes frustrating, because now we can't give 10 days in the baby cannot wait for 10 days. I mean, that's a mortality yeah. For you to be able to give a go ahead and organise transport for biomedical engineer to travel and, you know, prepare the equipment. So those are the kinds of frustrations that were coming along with implementation of this programme. So as a programme manager, I need to coordinate, I have a work plan in place with the team and the country director. And we know very well, from the work plan in the month of say January, we have these four activities that needs to happen. So in between the activities, if anything comes up with any programme implementation there has to the flexibility. So, you realize when something comes in between the planned activities in that particular month, now, having moved to having joined another partnership here, it becomes difficult to manage anything else that comes in between. So that was quite frustrating, especially the one that you're given restriction when it comes to timelines, you cannot do this at this time, we are time bound we cannot organise a training. In for instance, a training that maybe we could have organised within a span of a week and well-coordinated. No, I'm not talking about planning in terms of I'm talking about now, executing the training. Planning of course has to happen probably a month back, but now you want to execute it and because you've moved to the new partnership, and they feel like no we are time bound we are not able to book a conference space. For you, we are not able to organise transport for you, I mean it becomes frustrating. Then just as we are settling, again, another transitioning happens now from Strathmore to now having to partner with a consultant, you know, to support us with the finance systems, the operation system, basically when it comes to logistics and you know finance, and then just as we are also picking up that momentum, now we have to transition again. Now we are currently in Aga Khan. I mean, it can be frustrating for any programme implementation because even now at Aga Khan they now have, of course, even that consultant had his own system and ways of doing things. This affects a lot the flexibility on how they programme activities can be implemented. And of course, now getting into Aga Khan. Now fully transitioning to Aga Khan, where now finance has to be, of course, operated by them, logistics and when you want something to be to be done, there's a lot of bureaucracy of how things are going to be improved, approved. Sorry. And so that for that particular activity to take place. I mean, it's when you start settling down, you have to start over again. I mean, it's that kind of a

	cycle. So, we've been oscillating around transitioning more than how focusing on, you know, programming implementation and ensuring quality of what we desire to achieve. Yeah, so I think that has also affected a little bit of the quality, but even so with that I can say, I can tap our backs. I mean, as the NEST Kenya team that we've actually managed to push through a lot of activities. I mean, just just becoming flexible ourselves, putting the frustrations aside, and, you know, trying to keep that focus and, and yeah, moving on. And now I think we actually transitioned fully including the staff like, you know, now settling in under Aga Khan completely. So, I think after we settled in Aga Khan just a few months, I went on my maternity leave so. Yeah, now that I'm back. I'm sure the staff might my fellow, I mean, Kenyan team, I think, then they've now been able to, they're sort of getting a momentum. Rather, they're settling down in Aga Khan, and be able to continue with this implementation of the program. Yeah. So basically, the transitioning has had an effect big an impact big time on programme implementation. Yeah. And it can be very frustrating." (FI 20)
15E	As the network becomes more established and responsibilities shift to different network members (context), this helps the network adapt to support network sustainability (outcome) because it creates network resilience (mechanism)
	"We can also have those exchange, I call them exchange lessons and all that. And of course, because there is high turnover of staff, we are thinking of a coaching model. Like how do we come up with not a full training kind of but just have coachers at the regional level. Supporting them with transport may not be a big deal even for the programme and even at the county level. But see calling out people training now and then will not make sense. So, we are thinking of a coaching model where we have coachers for the QI at regional levels. Then they can, and you know the good thing with this is, even those facilities that refer babies, these coachers will go there. So, it is not a one man show of NEST sites, but it is all over. So, if we have county QI coordinator, he is overseer of the whole county, he can be our coacher, we capacity build. He can identify who has been moved to where, who do I need to coach, and all that especially for facilities that struggle with QI and those that are, don't have active QI teams, they can have the coachers." (FI 16) *"The other thing that we've done is around making sure that we have a large pool of trainers, a large pool of trainers. In phase two, we are going to set up regional teams. So, as we scale up in the new counties, when it's not going to be my team running around to do the training. It's going to be looking into our database and saying that we have trained three or four people in [redacted], [redacted], can they go and facilitate the training?" (FI 18)*

Teamwork

12A	When network members have opportunities to learn and work together (context), this improves multidisciplinary teamwork (outcome) because they get to know each other better (mechanism)
	"Teamwork has improved. And maybe largely because most of the meetings when we meet for reviews, they they are multidisciplinary. So that helps. So is not a case, where for example, is only the clinician who's attending a meeting, you will … see a meeting, where clinician is there, a nurse is there, a biomed is there, a manager there. So that kind of teamwork, I mean, that kind of multidisciplinary discussions and meetings, they have promoted that whole issue of teamwork within here. And yes, we can confirm that now we are more working more as a team than maybe before." (FI 25) *"So, you know, where people sit around a table during a group work meeting and people actually appreciate that they they know. The hierarchical structures between cadres do not exist in all these other places. So, these these are a lot of teamwork. So, I think that is something that people can quickly learn and benefit from and the spirit of partnership and learning from one another. Because I think there's a lot of that where people have come to recognise that there's something to learn from another hospital, be it how they navigate the administrate the administration to get things done in the newborn unit, be it how they crack the whip on students who are probably not doing their end of the bargain. Yeah, so yeah, so there is always something to learn from that." (FI 32)*

12B	When the training provided to network members is multidisciplinary (context), this enables interprofessional teamwork among network members (outcome) because they understand each other's roles and capabilities (mechanism)
	"I normally interact with the focal person, the nurse in-charge of the unit. Yeah. Because in the first place, I've given him my programme, my schedule for service. So, in the event the event there is any need for for service and maybe I might have forgotten she's there to remind me. And whenever there is breakdown of equipment, she instantly would call me because she has my contact, she will call me whenever there is any emergencies, we'll be in touch each and every time. And whenever even I when I do a repair or a service. I normally I normally present after doing the documentation, there is a part where she's supposed to sign to sign yes after the work is completed." (FI 13) *"I wouldn't call it a change, let me call it a transformation because it's a very big change about the the nurses and the biomeds and the clinicians working together for a patient. That's when you have maybe if they want to fix a patient, they are not very sure of the settings or how we are being, told they include you there. We want to fix this patient. We want this is not coming on the way, we want assistance, that big, big collaboration. And that one, maybe on the department we are seeing of it. But in NBU it's a big, big transformation there. Yes. Yes. And I think maybe if the Minister or in other partners, maybe they upgrade that cooperation, it works very well, even assisting with the patient. And then machine usage. You minimize those minor breakdowns. Yes. When the nurses and the clinician are that confidence about the machine." (FI 24)*
12C	When network members feel they are part of a well-functioning team (context), they support each other and do not feel alone in their job (outcome) because they feel responsible and accountable to each other (mechanism)
	"And there is need for teamwork. So, this teamwork, everyone feels obliged to contribute in one way or the other to the overall best outcome. So, then you find the biomedical engineers coming in strongly. You find the nurses coming in strongly. You find that administration, the management weighing in strongly, 'How can we help? Where is the problem?'… So, for me, teamwork has just been the best." (FI 04) *"Yeah, I think it's part of is a very positive programme. And one of the things I like about NEST is the teamwork spirit. Because when you look at how it has made us involved, I know we have started before we had other partners. We have I have been involved in several newborn studies in the unit. Initially, we had a Rotary Rotary grant that we were doing on CPAP. At the same time, we also had the ACTION trial the … ACTION trial, which is looking at steroids and newborn outcomes. So, the way NEST works is different. It is more of teamwork. So, you feel all of you, the nurses, the biomed, even including the cleaner, you have a team so that now you're able to call somebody and say no, this is what I think we should do. So even when you are sitting down and making a decision it will become much easier. Then when like you are dictating what to be done, everyone has a knowledge, they know what is expected. So, they are able to listen to any of us. So, to me that you think that was the most positive thing about what NEST is doing." (FI 05)*
12D	When network members feel they are part of a well-functioning team (context), network members feel that they can take the initiative to provide care (outcome) because they feel empowered and understand each other's roles and capabilities (mechanism)
	"The teamwork here is so amazing. Starting with the paediatrician, when the doctor says students, biomed there is no specific job or specific person you do everything teamly. You don't wait for that this work conditions for for doctari. No, we also canulate, take samples, yes even calculate the fields. Even if a baby comes twitching, don't have to wait for a doctor to come and collect clinical it within and administer the carrier, the loading those administer. When the doctor come now we can prescribe but at times also allowed to prescribe by our consultant. Yes, you don't. But now that we've been in the drug and the doctor is maybe attending to another question exclusively, like at night we only have one doctor who works in two wards. So do not wait wait wait to prescribe and give the drug." (FI 06)

	"It's the teamwork before you find a nurse will wait until the clinician assesses the patient but this is different. Where a patient gets to the newborn, even the nurse is able to assess and assesses decides this patient maybe has suspected this just requires oxygen or requires CPAP. They don't have to wait for the clinician, they actually initiate, they will say this baby needs a random blood sugar, you need to be the one to do it. And then they'll give a give it a plasma, they will even manage before, they then wait for the clinician, presumably because they have been empowered, before they didn't know what to do. Now they know what to do. So doing that improved outcome because now if you've got to wait for that means for the clinician to come maybe the outcome of this baby would have been different. So I've seen a lot of teamwork." (FI 23)
12E	When network members feel they are part of a well-functioning team (context), network members feel that they can take action to change practices (outcome) because they feel responsible and accountable to each other (mechanism)
	"It is the the same I know even the other year our unit was get the cleanest and the best organised and it's amazing because one you go to the other units you find the doctor will just write and go away. But here there is a lot of teamwork. For all of us the cleaners, the nurses, the nutritionist because actually one of the other things that is...being that teamwork has really helped us to identify the problem and be able to ask yourself, 'Who should solve this problem? How can we solve as a team?' So, like one of the problem, one time we discovered was our babies were not gaining weight and they were taking very long in the unit. We did a a small study. And the next question was, who should we include in this? So, when we sat down with our team, we discovered we only have two nurses in the unit per shift. Sometime this shift has 75 babies. So you've got imagine if there are 75, you may be having 20 or 15 that are critical in CPAP or...so when we looked at it, we were like, no, we need more staff. So, then we asked ourselves, with ... with a team. We have a WhatsApp group now for the newborn unit. So, in the WhatsApp, we asked ourselves, who do you think we can add in this group? And we decided we need a nutritionist. So, we work with the administration and we are given a nutritionist, just for the newborn who has been very instrumental in helping mothers helping calculate feeds, observing babies who are not feeding, gaining weight well, which has also really helped us." (FI 05) *"So, you will find that even the way people talk, you know, that teamwork. Yeah, has brought in the the relationship that the way they communicate when you go to that unit and just stand somewhere and see how people are relating with each other." (FI 09)*
12F	In an externally initiated network when there is teamwork among network organisers (context), this will enable better network activity implementation (outcome) because they support each other in their work (mechanism)
	"And then the other thing is teamwork. I think there is more stronger teamwork unlike before. We didn't have an office clinical, biomed, QI, and he is the Covid person. I think right now there is that coordination, there is that teamwork, like what am doing is building on what [redacted] *is doing and what* [redacted] *is doing is building on what I am doing. I can tell* [redacted] *what is happening and he can tell me '*[redacted] *I need your assistance here or we need to work on this.' Yeah. So, it is a matter of a lot of teamwork and coordination which again I think leads to better implementation of the program." (FI 16)* *"But there were other areas which hadn't been as successful, most of them is like, you know, the the relation, the teamwork, so to speak, within the country of the different players. Because you had the roles can be a little bit conflicting. And getting to know, you know, where do you draw the line of who does what, who doesn't do what, I think there's a bit of people may be feeling like, you know, their roles and budgets weren't very clear that stage. So, when I came in that was at least, you know, one of the things that we needed to do like streamline, you know, those things. Like there were situations before that like the trainings on biomeds and the clinical teams would happen separately with very different schedules for no good reason yet. We are supposed to be promoting as NEST interprofessional working and trainings. So, we had to get at least those ones streamline. Then we said there is no need of having a parallel planning and trainings. So that was a call to streamline that we got the teams working on those to work at the unit, run logistics together and deliver the trainings jointly and that was useful in getting teamwork built…Team, you know, teamwork issue, and that means working in facilities together with the Ministry of Health with counties. So that's what was our priority." (FI 28)*

Psychological Safety

9A	When network leadership/organisers are available and approachable, invite input and feedback, and model openness, fallibility, and non-judgmental behaviour (context), then this promotes a network's psychological safety (outcome) because network members feel empowered and not threatened when they speak up or make a mistake (mechanism)
	No supporting data
9B	When network members form trusting and respectful horizontal relationships (leading to flattened hierarchy) (context), then this promotes a network's psychological safety (outcome) because network members feel equal (mechanism)
	"So, you know, where people sit around a table during a group work meeting, and people actually appreciate that they they know, the hierarchical structures between cadres do not exist in all these other places. So, these these are a lot of teamwork. So, I think that is something that people can quickly learn and benefit from and the spirit of partnership and learning from one another. Because I think there's a lot of that where people have come to recognise that there's something to learn from another hospital, be it how they navigate the administrate the administration to get things done in the newborn unit, be it how they crack the whip on students who are probably not doing their end of the bargain. Yeah, so yeah, so there is always something to learn from that." (FI 32)
9C	When a network has a shared network identity and culture that promotes a psychological safe space (context), then network members are more likely able to learn, improve, and seek feedback (outcome) because they feel empowered and a reduced fear of negative consequences (mechanism)
	"What we do for other hospitals is when we are doing our mortality audit and it comes up that we get quite a few bad outcomes or poor outcomes from a particular hospital, we try and invite them for some of those mortality audits, not as not in a vindictive way, but to understand what they're working with. And we've learnt a lot, we've learned that some centres, the staff are doing what they can, but they're not equipped or trained. And when you create that safe environment, like they can be tell you some of the things they do like what they do for resuscitation and then that becomes like a point of, okay, we probably need to reach out to them. So, when we have trainings, we make a point of trying to invite some of those centres to come in or to also tell them what they need to advocate for from the hospital administration, some lack things as basic as oxygen. And he's just sent in an empty van at the back. So yeah, it helps to contextualise some of those things. But going down, that's like part of the plan, that we have like to actually go there and see what they have, instead of blaming them for poor outcomes to go and see what they have, what are they dealing with, and how we can help them." (FI 03) *"Of course, how can I leave an action plan that I was told in March to leave it up to December it can't happen. So, for them when they come you just put on toes to add on whatever you are given. And it has really brought change. You know at first when we were told of the QI visits, we were we were thinking of it was something like fault finding, yeah. But when we when we get to where when I got used to them, I've just seen that the something that just brings change, it's not about about faults. It's how you actually it's just, it helps you to understand how things are done and how they're done based not just doing them." (FI 11)*
9D	When a network is a psychological safe space for network members (context), it enables members to openly raise concerns or problems (outcome) because they know they will be supported and there will not be negative repercussions (mechanism)
	"In the beginning, you can you can tell it's the they might not be but we really try to moderate the tone of the meeting. So that it's not fault-finding, about blaming, we just want to understand the process they went through. And we've seen, like some cases, we thought were cut and dried that this maybe it wasn't so easy. And they you realise that the staff might be trained and experienced. But what's available in terms of equipment and monitoring

	for them to use is...by inviting like, there's a case where we realised we didn't have the answers, even after talking to them because the person who came was an experienced midwife. And we felt if we had post-mortems, for example, for some of these babies, if it's acceptable to the family, which is a different discussion, we might have learnt a bit more about why they presented the way they did. So, we try to make the tone of the meeting one where we are meeting as colleagues to discuss our our the things that we are grappling with and what we also try to inverse it. So, when they tell us their challenges, we tell them our challenges, too. We say like see, we have issues with documentation, we also did not do this. And we asked for their feedback. Like how were you handled when you came? Did you feel victimised? So, that we can go back to the team and tell them to be careful how we handled them. Because we're one team and we need to make people comfortable talking, voicing their concerns." (FI 03) *"They will be defensive initially, 'oh no, we have we have shortage of staff.' We told them it's not about shortage of staff it's about how do you reorganise your work to do to ensure, yes. So, they they took it.... So they were a bit ambivalent but and we told them but we used to tell them we have come here to do a soul searching for you to help you grow before somebody else externally comes, identify your gaps, before something wrong goes goes up, comes in comes out, and then you are exposed to media before so we'd rather you know it now. And you will say this is what we are doing. Yes, we have a shortage of staff. But this may have happened because of an oversight of this. And you can, you can link it to a root cause which you are you have already been communicating with the county, we've been telling you about this one. So, it helps in them knowing things in advance, be able to escalate it to their senior. So, their seniors when things go wrong, their seniors are able to say 'no no, but I've been told of this.' So, they'll take things seriously. So that's what I can say on my participation on governance. On clinical teams, I don't know whether they have been maybe you and get people who have. But but but there have been receptive over time, they have accepted and since after every they've seen they saw that there was nothing punitive. And it was helping them do their work better. So, I can say when I go, when we go to visit to now the there is like, we are friends now they don't. They're not defensive. They accept and they say what, then they say what they will do." (FI 27)*
9E	When a network is a psychological safe space for network members (context), it encourages innovation and innovative behaviour (outcome) because members know they will be supported and there won't be negative repercussions (mechanism)
	"And I think the net should I say, the network that we have that involves bringing people together in the programme review meetings, the quality improvement initiatives that we have, the mentorship that they have, those are things that are very unique. And to give you an example, in [redacted] County recently invited us to their QI Technical Working Group. And they really love their QI model, one approach that is used by NEST and the team that visited of course they made a presentation. So, they've requested that we support them to develop their team, the QI county specific QI that is just not specific to the newborn, but cuts across the entire the entire hospital. The same thing we are hearing from the Ministry, so the Directorate of Quality Standards, they recognise that the approach that we're using for QI is something that is also very unique. And the the the process of integrating or trying to embed that approach. Because they've been leading our QI into the national you know within the routine system. So I think I would say yes, that is something you people people know that NEST it's a programme, it has its unique characteristics. Of course, some are good, some might not be good. But they do know that. Yeah, that this is something that is definitely their part of, should I say, a programme or a project or an organisation that is really keen on improving quality of care." (FI 18) *"I know there was an improvement when it comes to management of neonatal jaundice and when it comes to CPAP use, so looking at neonatal jaundice, the staff were well trained and after the training, they continued with on-job trainings within the unit. And of course, and of course also with the unit that is referring to them, but that's now the maternity. And this way other than jaundice, they were able to also improve on hypothermia. Right from the time the baby is being transferred to the newborn unit from maternity, they from the training, it helps them even to become more innovative around keeping that warm chain of the … babies especially from referred to from maternity, all the way to the newborn unit. Some of them came up with you*

	know, the wrapping, they using the wrapping bags, and you know, ensuring that they warm chain is kept until the baby is admitted in the newborn unit and is in the unit newborn unit, neonatal unit staff hands." (FI 20)
9F	When a network creates a psychological safe space for network members (context), it enables them to more easily communicate and collaborate across the network's facilities, levels, and sectors of care (outcome) because they already have a common ground and understanding (mechanism)
	"It has been very positive because it is not really it depends with how you do the audits. If you do an audit like a blame, you may not achieve much. But if you do an audit, ask ourself where did we go wrong as a team, so it will become much easier for them to be receptive. So, they have been fairly receptive. Even when they refer, I know the other week one referred and I told her, you will have to bag this baby until we stabilise, and that is what we did. We bagged with her and we tell her no, that is not how you hold the … bag you do it like this. They were very they are very it depends on the communication you communicate to them." (FI 05) *"And then yes, and then communication in advance. Yes... when they see us national team when they are seen on the ground, they tend to panic what did they come to do. We have a senior officer coming from the Ministry. Could there be something wrong? Something like that? Yeah. So so that there was that so so maybe it's a communication so but now communication later on went when they were all brought to the other centre with 13 hospitals that all the bosses saw us. And you are the ones also facilitating they now even when we go there, we don't need that a letter from the ministry that you have now. Yes... like now if I go to the county, like now I'm going to for that county I had to show them a letter. And we had to communicate them in advance. But for NEST now, you can come now that we have bonded we don't we will just say we're coming to your organisation. This one what I need is only a release letter from the Ministry." (FI 27)*

Commitment

7A	When network members identify with the network's collective vision, identity, and culture (context), they are more likely to be committed to the network (outcome), because they believe in and value the vision, identity, and culture (mechanism)
	"It's just, it's an important initiative. I think it's a very it's it's it's made a difference. And I wish that difference that it has made can be highlighted. So that it's important to see. And it's not discussed as at policy levels as something that might be done. It's essential. Like what we were doing before, it's not safe. We can only wish that it will scale up and go farther, maybe in the future, if they're thinking about innovation for other types of equipment. That would be something exciting would be like to hear and contribute to things. There are still things that we grappled with things like monitoring, continuous monitoring, things that we would like to have and a technology to allow that would be good." (FI 03) *"It is very difficult for me to dissociate myself from NEST because I think I am NEST as in when NEST started we were the first people to be trained to become the trainer of trainees you see. I have trained about five county personnel on the NEST bundle, the ETAT+... [redacted], [redacted]. I've done those ones [redacted] and then [redacted]. There's [redacted], so I've trained those ones. Now when we go to train, you know, you train your colleagues. You participate in the training of the biomedical engineering, the mentorship processes, you know, you visit, go see what are they doing there. They also visit you see what you are doing here. So, for us NEST is not foreign. In [redacted] County, we are part of NEST. Yes, yeah. So, whenever we have visitors coming to [redacted], it's very difficult as a medical superintendent to say we have visitors simply say our team is here. Yeah, because we have worked with them. And we have seen the improvements in terms of the knowledge base among my medical officer interns, clinical officer interns, my nurses, and nurses interns and all that we have really worked with them. So, we feel like we are part of the programme for NEST." (FI 04)*

7B	When network members' professional identity/calling align with the network vision (context), they are more likely to be committed to the network and enact affective commitment (outcome) because they professionally value/find importance in the network vision (mechanism)
	"The nurses that come for neonatal training they're passionate, really into newborn care. And it really helps because at that point, I'm not pushing anybody just working with people who want to work and want to be there. Yes, and even our registrar's who come in not necessarily, want be wanting to wanting to be a part of newborn care, they inevitably catch on and even they go out there and make changes to some extent. So, I suppose those neonates change you, neonates have a way of changing." (FI 02)
7C	When networks members have support from network leadership/organisers (context), they are more likely to be committed to the network (outcome), because they feel valued (mechanism)
	"And I can say that one of the things that I've learned, because we've had quite a number of programmes are running across the health sector, with the NEST is a very unique programme. Why could, why should I say it's unique? With NEST actually, it goes back to the users or the clients or to a point the facility. And it narrows down not just at the facility management, because some programmes will work with the managers, then you're just given these what you're supposed to do and all that. But with NEST it's narrowed down to the people that are hands on, for our case, the devices, the people that are really with the devices on a day-to-day basis. And with that, we feel we are part of the programme because you're able to contact a technical person in the programme that is readily available to assist in terms of selling as well as in terms of assisting even troubleshooting in terms of diagnosis in terms of repairing, and even at some point they can even be able to come and physically support." (FI 08)
7D	When networks enable members to achieve professional norms (that are part of their professional identity) (context), they will be committed to the network (outcome) because of affective commitment (i.e. the alignment between their professional and the network's norms) (mechanism)
	"We have also seen people now interested in practicing neonatal medicine or going back to school to study to specialise. Whether it be it's nurses, be it doctors, and no one now is afraid in terms of taking care of a neonate. I think we better placed." (FI 12)
7E	When a network member gets 'emotional' benefits (positive feelings) or feel a sense of purpose from being part of the network (context), they are likely to be highly committed (outcome) because it is fulfilling for them (mechanism)
	"I'm actually proud of NEST. Why am I saying like that is because when they came on board, they actually involved the the that management of the hospital. I'm one of the people, I'm the nursing manager, and I was involved in the training, they trained me. And, you know, once the training was done, most of the things, whatever is happening on the ground, I am actually part of the that activities that are being implemented on the ground. And the thing that actually motivates me more is that I'm able to look at this journey, how we started and where we are heading to. Or that's just a motivating factor. Because, okay, initially, we had a small room, and with so many patients, and you know, we didn't know how to go about it. Yeah, there is, there are so many patients, we are few nurses there, we don't have resources to use. So, most of those babies were dying, and it was very demotivating. So, looking at this journey, it's a motivating factor, because now we can look back and see where we've come from." (FI 09) *"So, I'm really happy for this programme, it has made us to be up to the task of just not doing things, you are doing things knowing that at the end of this month, I'm being monitored, what have I done right? What have I done wrong? You see and it was good to have… know when you go to meetings and you see that glucose monitoring [redacted] you at number 10 here, but [redacted] is number one. You want to see I'm going to [redacted] that the nurse there but that you're doing right so that I can reach you on. NEST has opened up our minds as a programme." (FI 11)*
7F	When a network shows network hospital/facility leadership it can improve care practices (context), this can generate commitment from them (outcome) because they see its value (mechanism)
	"Also, something else, so that I feel have impacted on the changes is the goodwill of the management. Yeah, because the NEST programme, we able to track our performance every quarter, because they're able to generate our reports, every quarter. And through these reports, we are able to tell where

	our challenges are. And once this is shared with the management, the management now becomes supportive, because we are able to make decisions based on data. That now decision is quite informative. And we feel like if there is a problem with the usage of CPAP, 'Do you need more training? Is the equipment the problem?' And we're able now to address those specific gaps. So, I feel the main use of data is quite quite important, and has really impacted on some of these changes that you're seeing within the facility." (FI 08) *"The newborns, the premature babies, yes, there was really a problem, because we didn't have the CPAP machines. And so, we used to lose many of them, we use to lose many. But at least with the the CPAP machines, we can see that we are saving many. Yeah, and it's not a procedure for a specific person to do. Anyone with a baby will always admitted respiratory distress syndrome, the nurse that is found there, it just starts CPAP. So, the newborn care has actually improve. And even the hospital management has, after seeing that the NEST has come in, is supporting many things. These days, if you ask for things, even from the hospital store, the supplies are limited. But you find even from the administration they try. They try to make sure that they provide whatever we need. It's not always enough, but you can see goodwill from the administration, which was not there initially. It's as if they are saying if these others have come in and have done such a good work, how can how can we fail them? Or how can we fail those a newborns or even the nurses who are in the or the workers in the newborn unit? So, you'll find even from the administration that they're really trying whenever we ask them for some things, you find they might not have the resources... But you can see their efforts." (FI 22)*
7G	In an externally initiated network, when the network initiators promote the efforts and accomplishments of the network to donors and the interested global community (context), this increases network member commitment to the network (outcome) because network members feel their efforts are acknowledged and valued (mechanism)
	"Significant progress was made, despite the challenges of a global pandemic. In 2020, NEST360° faced the challenge of confronting and responding to a global pandemic, which demonstrated the resilience and commitment of the whole NEST team — a network of doers with enthusiasm and zest, who show up to do the work each day." (document - annual impact report 2020) *"NEST360 continued to exceed expectations in Q1 of 2022! NEST is installed in 64 facilities across Malawi, Kenya, Nigeria, and Tanzania. We offer our sincere gratitude to all the NEST360 partners, Ministries of Health, clinicians, nurses, biomedical technicians, mothers, and babies who are part of this successful milestone. We are excited to share our First Quarter 2022 accomplishments!* *Country-led change is underway in all four NEST implementing countries. The teams have accomplished incredible work that will support progress towards sustainability and institutionalization efforts." (document – Q1 2022 newsletter)*
7H	If a network has committed and proud members (context), then they are more likely to act on the identified problem and collective vision (outcome) because members are willing to put in the energy, effort, and passion (mechanism)
	"I do and they see it. I see it in our nurses like they do things that it's above and beyond she doesn't have to do it, she can do her core duties like my my charge nurse or my nurse in-charge of NBU. They really do a lot of extra to to to improve how the services are being done, you know, like advocacy or even just getting a bit of data. Some maybe, like we she we compile our own monthly reports. It's a bit different from what we get with CIN because it's for inpatient. Talking about the things we need, what what we're missing, we get a lot of support also from our obstetric department, we meet in the MPDSRs, like the head of department herself will come or one of the other consultants. So, I do feel people are passionate because those children in that NBU, even if it is in Eastlands, which I know is a low economic status area, they deserve as good a chance as anybody to survive intact not just survive, because some survival there are issues, they have issues that will be lifelong or long term. They deserve a chance to survive intact and pursue their dreams and their lives. This you don't know what they will become. And I think it's a really fundamental thing for a country to protect its weakest.

	And its most vulnerable. And for me, those children represent that to most families represent that. And I think most of us we look at it that way, we want to tide them over that that period so that we can they can grow and thrive. So, I feel it." (FI 03) *"Actually, you can feel it, I think that one of the challenges we have would be, first of all, let's talk about the passion. You know, passion is there, you find people come report to us very early, they will leave very late, you know, we have that shortage by and large. Our NBU you know sometimes it goes up to 65, 70 neonates, but then that's on some shifts actually can be against three nurses. But then it becomes really difficult you know, but you will see them work. And, you know, sometimes you sit down and say, 'God, this is just great.' If you don't have that push that commitment, believe me, you will not, you will give up. And they're so passionate and they feel bad. You say doctor, we've lost this baby. We did our best, but it is very sad. You know, you can read it. Yeah. So that passion is there. The passion is there. We just need now at the county level to motivate these people. Motivating means, for example, increase the number of workforce, yes, we need a fairly good ratio between the healthcare workers and the patients to have that one on one attention. Yes, as I say, you can see them you can read a bit of frustration because if you're in a room where you have 25 neonates and like some of the rooms, the acute rooms and you will find three or four babies are on CPAP. You know, CPAP really needs close monitoring, like initially, you know, quarter hourly and all that. So, you have like three or four on a CPAP. There are others on oxygen, they need the SPO monitoring that these ones who need fluids adjustment, they need that and that. So, they become a bit overwhelmed. So, if it were not for the passion, they would just give up." (FI 04)*
7I	When committed network members take action to disseminate knowledge to network members and others outside the network (context), this extends network benefits to network members and others outside the network (outcome) because of a greater availability of knowledge and skills (mechanism)
	"The clinical training team did not give up and went on a campaign to train everyone (especially nurses) how to download and use Zoom. Three nurses played a key role, using existing WhatsApp groups. They took time to list out the steps to download Zoom and then and explain how to use the software. This extra effort bore so much fruit, and it was evident with the number of people who wanted to join in the webinars. The clinical team had to increase their Zoom account maximum capacity numbers from 100, to 300, then 500. Registrations for the webinars would go up to 2,000 sometimes. In addition, the audience evolved to not only Kenyan, but also health workers from Uganda, Nigeria, Cameroon, Ethiopia, Rwanda, and Mauritius. The webinars were held from April to July 2020 every Friday evening and during this time, the clinical training team became masters of using Zoom to run trainings. Building on this experience, the training team was able to transform the face-to-face newborn care trainings into a three-day virtual training for specific facilities, and sometimes they were able to combine up to three facilities at the same time." (documents – annual impact report 2020) *"And then when we finished the COVID Lectures, we thought we could do the newborn series. So again, went back, redid all the lectures, so that they were uniform, again, worked with the postgraduate students. And we would teach we would do the deep scientific dive to the postgraduates like on a Monday, and was it Monday or Tuesday, early in the morning, Friday evening we would do the whole country. So, we would test the material with the postgraduates. And then we see how it's flowing. Correct anything any science that is wrong, and then on Friday teach the whole country. So, we started by having the Zoom link which has which was basic which would get up 100 people. And then we'd lock people out. Then we went to 250 locked people out we went to 500 we were locking people out we had to pay for the 1000 and we still were locking people out. And so, it became a thing. Yeah, for like 12, 14 weeks every Friday. We had discussions would have a lecture presented the same way. Nurse... a doctor the the science nurse to the practice. And now we started recruiting people to help because now it was too much for me. So now I started getting the neonatal…requirements. We had three so they would alternate so we don't get too tired. The postgraduates also they alternate so we don't get too tired. So, Friday we had something going on those 14 weeks I don't think I slept. At the end of it one every hour of lack of sleep, I think and we were able now to do teach everything the whole content or the priority areas." (FI 29)*
7J	When influential outside stakeholders are actively engaged in network processes (context), then they are more likely to be committed to the network (outcome) because they can be helped to understand the collective vision of the network (mechanism)

	See CMOCs 16B and 16E
7K	When influential outside stakeholders (often specific individuals within an organisation) are committed to the network and actively engaged in participating (context), then it may be easier for the network to achieve its aims (outcome) because network members feel empowered (mechanism)
	"If I'm honest, I don't see that sort of commitment and things in big organisations, but I see it in the people who work for it. So, you know, the big organisation like USAID may, I mean, it's sort of a nebulous, big, as far as most people consider money providing donor. But within it, there are some very highly motivated people. And I think it's those people that are attracted to what NEST is trying to do. And those are the people who can drive their own donor units. So yeah, I mean, some of the big donors can just appear a bit tired, can't they? But that's, that's the overall image, I think you need to look at the individuals who work in it. And they differ in different countries." (FI 01) *"We have got our division of Paediatrics called a Child Paediatric and Child Health, so we haven't involve them a 100%. So, they're still especially on QI. So, I would loved to have them. That's one. And then when you would have loved to use their officers, NEST what they did is they asked people to apply, can you apply to be a quality improvement facilitator. So, we have got quality improvement facilitators from different places, who may not necessarily be government, they are in other counties, but they may not necessarily be staff, who will ensure sustainability. On my part, I remember I had three officers, but later on, they became busy and I became the only one supporting. Again, as a result of the issue of you have you had to apply. Right? So that is, so so recent. So, I do I would want so so that that was a challenge." (FI 27)*

Engaged and motivated network members

8A	When network leadership provides opportunities for network members to be supported, recognised, and learn through training, equipment provision and support, and facility renovations (context), this creates engaged and motivated network members (outcome) because they derive direct benefits and feel like they belong to the network (mechanism)
	"And I can say that one of the things that I've learned because we've had quite a number of programmes are running across the health sector with the NEST is a very unique programme. Why could why should I say it's unique with NEST actually, it goes back to the users or the clients or to appoint the facility. And it narrows down not just at the facility management, because some programmes will work with the managers, then you're just given these what you're supposed to do and all that. But with NEST it's narrowed down to the people that are hands on, for our case, the devices, the people that are really with the devices on a day-to-day basis. And with that, we feel we are part of the programme because you're able to contact a technical person in the programme that is readily available to assist in terms of selling as well as in terms of assisting, even troubleshooting in terms of diagnosis, in terms of repairing, and even at some point they can even be able to come and physically support. Then in terms of training again, the kinds of training that NEST has been offering is quite different from so many trainings that have been able to attend because the kind of training that NEST is offering it's not just a training to understand the equipment but they're gauging 'Do you have the necessary skills to handle this piece of device?' I speak that because I'm also a trainer with them. So, I'm also a trainer with them. And this was really assisted us to feel to be part of NEST. And also, we're able to give those monthly reports to them. So, every time we share the reports, they're able to gauge the weakest points we are having. And from there they are now to support." (FI 08) *"I do feel do feel because given the technology and the technology and the training I've gone through now, but with some of the equipment, we never had a good idea about. Actually, my interests I've really been on the CPAP..... This is a machine, I never learned it in other training. I got it the first time when I was introduced to it by NEST through that I'm now in a position now even to train others on how to use and how to how to operate, how to*

	handle, how to repair in the event of a breakdown. So, I really feel to be part and parcel of NEST because of this. Being involved and being given a free a free will to handle the the equipment in the under NEST program. So, I feel really part and parcel of the programme." (FI 13)
8B	When network members' personal identity strongly aligns with a network's identity and culture (context), then this will result in engaged and motivated network members (outcome) because they feel they belong (mechanism)
	"Actually, you can feel it, I think that one of the challenges we have would be, first of all, let's talk about the passion. You know, passion is there, you find people come report to us very early, they will leave very late, you know. We have that shortage by and large our NBU you know sometimes it goes up to 65, 70 neonates but then that's on some shifts actually can be against three nurses. But then it becomes really difficult you know, but you will see them work. And, you know, sometimes you sit down and say, 'God, this is just great.' If you don't have that push that commitment, believe me, you will not you will give up and they're so passionate and they feel bad. You say doctor, we've lost this baby. We did our best, but it is very sad. You know, you can read it. Yeah. So that passion is there. The passion is there. We just need now at the county level, to motivate these people. Motivating means, for example, increase the number of workforce. Yes, we need a fairly good ratio between the healthcare workers and the patients to have that one on one attention. Yes, as I say, you can see them you can read a bit of frustration because if you're in a room where you have 25 neonates and like some of the rooms, the acute rooms, and you will find three or four babies are on CPAP a, you know, CPAP really needs close monitoring, like initially, you know, quarter hourly and all that. So, you have like three or four on a CPAP. There are others on oxygen, they need the SPO monitoring that these ones who need fluids adjustment, they need that and that. So, they become a bit overwhelmed. So, if it were not for the passion, they would just give up." (FI 04) *"I think there's just something special about people who work in maternal and newborn care. Most of them, it's it's from the heart, sometimes somebody will tell you, I was just, maybe they might just be a nurse. They're not as specialists, they're not a neonatal nurse or whatever. But the moment they get into that space, somehow, it's just some positive energy that comes with it, yeah I think. I think I have not seen somebody who didn't like working with newborns. I haven't seen one. You never know, there could be. I haven't met one. Everybody it was either, 'Oh, I was so scared.' 'Or I didn't know I don't think I was I'm passionate about kids.' But when I got there or my all these changes." (FI 14)*
8C	When network members actively participate in network change practices that align with the professional values they live by (context), this creates engaged and motivated network members (outcome) because it helps them to fulfil their moral obligation or vocational calling (mechanism)
	"Because when they come, they're telling you this week this month we are doing mentorship. Next month, we are doing quality assurance, so whatever you are giving you up to the standards, right, right, right. So, I'm really happy for this programme, it has made us to be up to the task of just not doing things, you are doing things knowing that at the end of this month, I'm being monitored, what have I done right? What have I done wrong? You see and it was good to have … know when you go to meetings, and you see that glucose monitoring [redacted] *you at number 10 here, but* [redacted] *is number one, you want to see I'm going to* [redacted] *that the nurse there but that you're doing right so that I can reach you on NEST as opened up our minds as a programme." (FI 11)* *"A good part of that because when you have something wishes streamlined has a focus as a progress. It's easier. And you see, you are part of that. NBUs it's NBUs, this machine is not working. You see in you you are part and parcel of that. And when everything goes well, you know that everything is okay, today we are okay. You feel good. Because you know that newborn that premature baby will be there maybe for one week, two weeks, and if they are, okay, now with that. You see now, in your profession, you are something you are proud proud of." (FI 24)*
8D	When a network can show its members that it can affect some change (context), members are more likely to continue their engagement with it (outcome) because they can see its value and a sense of satisfaction with the positive changes (mechanism)
	"Because when you see that when they come here, they're just saying that they have that attitude, they change when they meant for nurses how are most aged, you see that was the perspective. But now you see now the young nurses are coming out. And if this if these babies can, if someone nurse

	these babies, tiny babies and go home I can also manage so people are not isolated in the NBU. Now if you talk to people they are now willing to come to work in the NBU, unlike the past, when they could only see the aged who are working in NBU. So, it has really brought up a very big change. And when you see when people from periphery come and see how you're handling these machines, how you're handling patients, they feel the change." (FI 11) *"But once I think from the onset of the programme might have caused some of these changes is one the attitude. Because before, even from our end, I think we need to have that really positive attitude towards the newborn unit. Yeah, because you're categorising it just as the larger the maternal unit. Yeah. But today, I think of that we feel like that's preterm is equally a human being is equally important and needs to live. And with that, now, it changes our attitude. And we feel like we really need to take care of these devices, the newborn unit and have them functional." (FI 08)*
8E	If a network can leverage the affective or normative professional commitment of its members to work towards achieving network goals (context), then they can become more engaged with the network (outcome) because of a sense of shared purpose (mechanism)
	No supporting data
8F	When engaged and motivated network members are provided with the resources and opportunity to act (context), then they will attempt to enact changes in practices (outcome) because they feel empowered to change practice or work towards solving the problem (mechanism)
	"And also showing us whether we're using our equipment because they monitor how machines are used. So, when we talk about like we have unmet needs for some things, like getting data to support that, this machine has this number of hours of use, it's dramatic because before like the basic things, some of them you bring them in yourself, like buy your own pulse oximeter is not necessarily for newborns to finding this equipment or CPAP. There was a form of CPAP that we'd used but we'd use a bottle and put like measure the for the amount of the water level that you wanted to put in there. We couldn't really calculate your FI02. So to find all these technologies that can take the kind of use you're putting them through, it was a game changer, it really was. CPAP has given us like another layer of management before calling, like some of the Level 6 referral hospitals to give the babies a chance. Like with the non-invasive form of ventilation, which is what the world is moving towards, like if you can avoid invasive ventilation, that is what is behind it. So, to have that, as a resource, I think has been a really... And even other hospitals are hearing about some of our referrals are sent so that they say they have come for CPAP. So, it's I think it has changed a lot of things, you're doing more responsive medicine from data, you have like things you have collected physiologic data you're collecting from the patient, so you can tailor make your management to that patient. And you're wondering how you were doing it before, without some... like even another example, a recent one, which found me there is just a Bilirubinometer. Because there are times our lab does not cannot process those samples, either the machine has broken down or we don't have the reagents. So, you keep babies for days longer than they should have stayed because you're trying to be careful. And they get phototherapy they don't need, then the numbers go up because you're still admitting. And now now that we can measure it at the bedside, you can make a medical decision for a baby immediately that is sound and supported by something. So that has also really helped a lot." (FI 03) *"See, we were able to able to renovate the newborn unit and repainting. We're proud of that. Okay, it is been NEST who did for us. And you think that the repainting and the renovations…when you're working in a clean environment in a beautiful place It motivates you to work... in a clean environment, beautiful place it motivates you to work." (FI 26)*
8G	When network members are committed to the collective vision that is strongly associated with their professional identity and are faced with issues that are beyond their control (context), they will not be deterred from continuing to engage with the network (outcome) because they believe what they are doing is worthwhile and feel accountable to other network members (mechanism)
	"So, I think it's what I said that at the hospital level, because of, you know, this teamwork that had started, you know, way before NEST came in at the hospital level, there was less of disruptions. It's more at a more senior much more higher administrative logistics issue to get things done. But having

	said that, there's the, I would say, the boots on the ground didn't change in a big way. So even when we had a lot of administrative changes, the guys who were responsible for making things run, remained relatively the same. So, you the learning curve was not issue because these people knew what needed to be done. And had, you know, where part of the original NEST plans, were consistently updated through them meetings, both national and international meeting. So, they were pretty familiar with the implementation processes. So, I would say it's the administrative logistic hiccups that would end up slowing things down, rather than the this team, this middle level team that knew what they needed to do that changed. And I think that played a very huge role to make to still get NEST to where it is. And there was a lot of dedication and commitment from that team. That you know you cannot take away that I I it's a pretty slim team, looking at the amount of work that needed to be done. And they did a fantastic job." (FI 32)
8H	When network members are transferred to facilities out of the network or out of the network unit (context), this leaves a gap in trained, engaged, and motivated network members (outcome) because their skills and knowledge are lost (mechanism)
	"The only challenge now we've been having is the fact that those who have been trained again, sometimes because of political reasons, they're moved to other units. So, you find that it's maybe have an issue, maybe it's even a personnel issue. So instead of me looking at it like you you've trained this nurse in the newborn unit which knows everything about newborn care, but since I have an issue with you, I take you to maternity or I take you to surgical units and bring in a new nurse who's not trained. So, it becomes like, lost lost resource. This person is highly knowledgeable, they know what to do. But the new one is coming in again, you have to start again afresh." (FI 10) *"One of our biggest problems has been staff rotations. We make every effort to make sure we train you, one month later. Yeah. You're not there. Yeah. So, we the that has not gone well. We've struggled and I don't know whether it's us or it's the system, right? Or what we should do about it? How do we keep people in the unit? So, we've had that problem in all the countries. Okay, all the countries we're struggling with keeping people in the unit. Right, right. Yeah. No matter how much you talk with management, management is still moving people. Even when you … they're still moving people, so that has not gone well. I don't know. Actually, we don't know how to do that. So, we've tried to come up with ways to solve it with simple orientation programs. Still lobbying with the management, please stop moving people. We've we've now realised that if we get people specialised, people will not be moved. Yeah. So, if we can have like neonatal nurse in training, right? neonatologist...Mostly nurses are the ones who are moved. So, if you can have many of these, whoever wants if they can go and do the course. Yeah. And we didn't have any funding for that. Right. So, we are not able to take people for those courses. But their while we … up there who are willing to, so we are encouraging people if you can do neonatal nursing go and do, this is where you can go and also participating in creating curriculums for different programmes. So, we've done that separately. I've been involved with so many like last week, all this in an effort to keep it going in the unit as much as possible and not give them the skill but keep them right right there where we need them." (FI 29)*
8I	When networks engage with non-network stakeholders in network activities (e.g. quality improvement) and deliberately seek out feedback and advice (context), this can improve network activity implementation (outcome) because non-network stakeholders provide a broader understanding of relevant issues (mechanism)
	"For the QI facilitators, mostly clinical and biomed are from NEST sites and even HRIOs. The gap is the ones that are from non-NEST sites, its governance. So, you find these people from governance they are not necessarily clinicians or biomed, it can be somebody in an NGO. We have one, I think it is only one who is a clinician. The other one is working in an NGO. So, yes, what they tell us is it has impacted them as individuals. Especially the clinicians in terms of what they do at their facilities. But you can't really measure in terms of has the process influenced you as an individual and what you are doing at wherever you are working. But I think the major is, we have learnt a lot, the training, and then we give them certificates. So, like last year if we did two rounds of QI. We gave them certificates mentioning the rounds of QI. Then this year, of course now with the transition and trying to pick the new model, of course we will now remove all those that are from non-NEST and we give them certificates for one round that they have done. So, I think they also appreciate that bit that 'I was in NEST.' And then they also mention a lot of impact in terms of the programme. The one thing, one good thing with

	people from non-NEST, they give feedback without bias. 'We went to [redacted] last QI and this is what we were told and this is not working, you should do this.' So unlike people who are from NEST side, they might only give the positive, because you know they are also being supported. But people form non-NEST are not attached to a facility, so it's no biasness in terms of the debrief. So, we always have a debrief when, maybe after two weeks virtually just to share their thoughts including the QI. So, for the county coordinators, they had an observation form and you will also notice the gap of data. They were saying "these people were not able to access data" So, you see it is a problem out there. So, we usually have a debrief and they say, most of the feedback is impact of the programmes to the facilities rather than to the individuals but as individuals they are usually happy like even through the WhatsApp chats and all that you could realise they are also impacted especially because of the trainings and the certificates." (FI 16) However, because they are not part of the network, they may be less engaged. *"We had on my part, I would say that we have division of we have got our division of Paediatrics called a Child Paediatric and Child Health. So, we haven't involve them a 100%. So, they're still, especially on QI. So, I would loved to have them. That's one. And then when you would have loved to use their officers NEST, what they did is they asked people to apply, can you apply to be a quality improvement facilitator, so we have got quality improvement facilitators from different places, who may not necessarily be government, they are in other counties, but they may not necessarily be staff, who will ensure sustainability. On my part, I remember I had three officers, but later on, they became busy and I became the only one supporting again, as a result of the issue of, you have you had to apply." (FI 27)*

Empowered and confident network members

10A	When a network acknowledges the capabilities of network members by selecting them to be network trainers and mentors (context), they become confident and empowered in their skills (outcome) because they develop the capacity to teach them (mechanism)
	"I think that was quite a bit of a rigorous process but it took time to get to that point. I remember it since the very first training that we all went. The initial training, the refresher training on the devices is out of that. That NEST there are facilitators who are able to point out specific people, according to how they performed in the training and they recommended them to undergo what we call training of trainers, TOT training, of which I attended the TOT training. I was able to attend that training in Nairobi for one week and out of that training again because, you know, you have the pre-test and post-test whereby they're able to gauge your performance and also during the training you do the presentations, they're able to gauge how you perform out of that. Again, I was picked up to undergo another training that is called Generic Instructor Course, the GIC, of which I was also able to do the training. I think I performed well because out of that, again, I was picked now as an instructor candidate. Yeah. So, I went through the instructor candidate, of which, that team of instructors, they were able to assess us, they have to now recommend if you really fit or rather if you qualify to get trainer with them. So, it was among those that were picked to be a trainer with them. So out of that now, we are able now to start support in terms of training. So, when they organise any technical trainings, we are called upon out to support the NEST and train our biomeds and all that. And to me, that is a benefit because once I come back home, I'm able to train my biomeds here, I'm able to train the students that are coming on attachment because having now that knowledge, having gone through the training, what it entails, and all that I'm able to conduct all that." (FI 08) *"I'm very very happy because it builds people confidence. For some people, I know one of the nurses that we talk about it with him. He was so quiet teacher. I was saying, [redacted] if it's not this now taking so much of my time because we had to rehearse the thing four times for him to present something during the webinar. Today, that man is our best trainer. He is so good so and also others who you could feel now, you know, for my students. It's*

	something because they're I'm going to train them. But now when it comes to the other people are spending now this is now yeah. But I learned now to have the patience. Those people, the ones especially the ones who are not very good trainers, today, they're good trainers, because I will tell them, you have not read the reference that's why you don't have confidence. And they go read a lot until they come and even talk things which I tell them now now you are really an expert, you have mastered the subject. Yeah, so that's how we now generated a group of newborn unit people who were very good mentors, because they knew their subject, they were trainers, they have read the references. They had the confidence. Yeah, so right now the people, if you go to these facilities, they talk proudly about how they used to train, how they learned a lot, but they're learned a lot, because they also went a lot to read right, to prepare for training. So, in each facility, we had trainers which facilitate, we had a nurse, a paediatrician who were trained as trainers through the training for trainers. And then now we'd have very many rehearsals with them. So, they're quite polished." (FI 30)
10B	When network members receive support (e.g. training, mentorship) to help them improve and expand their skill set (context), they become more confident in their previously learned and newly acquired skills (outcome) because they develop the capacity to perform them (mechanism)
	"Also, the use of CPAP, most of this stuff, when we started the programme, most of the clinical staff have been lacking the confidence let me say that to use CPAP. Because to them, it it has been like a complex device to use given the mortality around the use of device, of course, and it sort of brought about some negative attitude around using it. So, with time with the trainings with the mentorship, this builds so much on their capacity and their skills and and boosted their confidence. And speaking of hospital like [redacted] they've been doing well when it comes to use of CPAP and and then in one or two other facilities." (FI 20) *"They're more confidence and not only using the machine even in resuscitation, they are more confident let me say in everything they do unlike before, and I believe the training is has brought has brought all this." (FI 23)*
10C	When network members receive support (e.g. training, mentorship) to help them improve and expand their skill set (context), they feel empowered in their role and motivated to proactively apply their skills beyond the network (outcome) because they have greater confidence in their abilities (mechanism)
	"For our case in terms of biomedical engineers, you feel there's so much that you've learnt out of the NEST programme, you in terms of support, in terms of tools, in terms of how we work that you've been able to carry that to these other departments. Yes, yes, yes. Because today you go to laboratory, we have a file there for devices, the same case, we are having in the the newborn, you have a file there. So that once the biomed visits, anything they do, they're able to record and file there. So today, we are able because you've seen the good things that have come out of this. So, we've been able just to try and adapt the same to these other areas. And also, by assigning the biomedical officers in other areas, today, we are able to try and push for trainings, so that if somebody is in theatre, they can be able to become the best in theatre, attend as many trainings as possible under the theatre category, so that they can come back and be the best in that unit. So, we've been able to learn a lot out of these NEST programme." (FI 08) *"So, people never knew what the biomed does, yeah, but NEST has brought the biomed out. And now they are doing what they're supposed to be doing. Right, because I love what one of them said in [redacted]. The biomed were taught about the device. They were not just taught about clinical use, they were taught like opening the device, right? Like an engineer, like look into them. This is what if it breaks down this is the spare part to look for. So, they know how to repair those machines without NEST. They know they can ask for help. They can do videos, they can do take pictures, and they can be somebody can advise them because we have our biomed experts. So, the biomed role has been improved. Biomeds never used to go to newborn units. Now they go. And I like what one of them said that they know if this machine is not working a baby could die. So, they make it a priority to pass through the newborn unit and make sure all the devices are working the way they should. Then another biomed from [redacted] said we took these concepts, we learn about newborn technology. And we are doing the same thing in ICU, in medicine. So, the other departments in the hospital are benefiting from the things because the biomed takes care of the whole hospital, right? There are not many, right? So, one or two are located in the newborn unit but*

	they also take care of. So, what we are learning here, they are taking to, they have a path. So that for me, it reassures me that we won't have a graveyard because they will ask questions, they will try and look for a solution." (FI 29)
10D	When a network brings in previously neglected cadres/positions into the network and capacitates them to do their role (context), they feel empowered to enact their role in the network (outcome) because they feel their skills and abilities are valued by the network (mechanism)
	"I think the programme has has trained the biomeds in terms of how to take care of the equipment, the bundle of equipment to make sure that they serve the purpose that has been set out. So, it has created that responsibility on the biomed, so that he doesn't say I'll wait for me to be called. Now, they're able to do PPM, planed preventive maintenance for the unit, they have also been able to train the users on how to use the equipment. And even though the users are more knowledgeable, when they see things are not working, they're able to call up and the biomeds are readily available to offer the service. So, I think it is a it is a lesson that even the other service delivery points can utilise the policymakers, can utilise in terms of knowing that the biomed as important as the people who are offering the end care to the patient." (FI 12) *"Even the other teams because you will find some facilities do have sessions whereby it's quote unquote, some competition interdependent interdepartmental. So, if like this month maybe the NBU won, last time it was the biomeds, or different areas, maybe cleanliness, maybe workspace organisation, maybe service delivery. So especially in the service delivery part. If a problem will be reported on a NEST device that is installed, and that problem the biomeds are able to address it within the quickest time possible, nobody will fail to appreciate them. They'll see these guys are really working, spares have been ordered, they are able to take it up, they're able to escalate it to the NEST team in Nairobi, the NEST team was able to organise proper … to reach us, they do this work the machines back working, they feel it nice when they get appreciated because of the work done." (FI 15)*
10E	When network members (e.g. nurses) are given the freedom to use their clinical skills and role (context), they can take action to address problems/provide care without waiting for a more highly trained network member (e.g. doctor) (outcome) because they feel permitted to do so (mechanism)
	"What we've empowered ourselves with, like now the nursing team, you look at it's very different from how, you know, we started, they are empowered, they are confident, they're able to to to link up with the consultants, the medical officers in a very good way, focusing on quality of services. So that I feel especially the nursing team, we feel proud when we walk down there in the NBU unit, we feel proud of what we are able to do. Yeah, initially, it was like the baby has complicated, call the consultant, call the medical officer, but nowadays, yes, we are calling that consultant or the medical officer, but it's something we are already doing. So that we are able to stabilise the patient, the doctor is coming in and finding us doing something. Yeah, so I feel the NEST team has been good. It has involved all of us. It has not many times you may find a programme just focusing on the doctor only. So yes, we are there supporting them but we don't know exactly what to do, we are waiting to be instructed by so um, so. But here we are put together that class was one. They didn't isolate doctors, consultants in a different corner. We had one class and whatever we were able to be empowered with knowledge, skills, even the machines knowing how to operate them." (FI 09) *"The other change I've seen is that the nurses are able to embrace the new technology...you find that a preterm has come, you're not on duty do you want to know how to take the...to do this the preterm the syringe pump, people really have embraced that technology because it is to use a syringe pump or that Bilidx those. You find a nurse has taken the the … using the Bilidx so you find that the nurse had already started the baby on phototherapy. Previously, you have to had to it for the lab but sometimes the reagents there are no reagents." (FI 26)*
10F	When providers in the network are well trained, mentored, or coached (context), this positively changes their attitudes around performing the skills/providing care (outcome) because they feel empowered and confident (mechanism)

	"Before NEST come in if you can, just starting up from that background, where we are before NEST came in even here as a department, we considered a newborn unit as the larger maternity unit. Yeah, we were not so specific and so much good not giving it so much attention as the newborn neonates but to because we assigned biomedical engineers to every key department within the facility. And we had just assigned a biomedical engineer in maternity unit. And we're not so much concerned or rather, we're not so much on point in the newborn unit. And this now made us just to do the general works, whatever we can do in the labour ward, whatever we can do in the post-natal. That's what we actually also did in the newborn unit. But when NEST now came in, we realised we need to give more attention to the newborn units. And with the trainings that followed, the subsequent trainings, and all of that that's it now engagement, the newborn unit now became even more closer and even more passionate with the newborn units." (FI 08) *"Let's say we feel proud to be part of NEST, we feel we refer ourselves as the NEST hospitals. And because it came and changed how we do things. It's changed how we you know, we perceive things, it's changed our outcomes. So, we are very proud to be part of it. I must say, it's like, yeah, it's like a movement sort of. So first of all, you are always motivated to do the best you can, you're motivated to make a difference for that child. And, you know, you stop doing things just the way you were doing them before because now you know better. So, I think it's more than just adding the group of people but from within, they found it changed in you. And then when you come together as a group, I think it's more of a movement. We want to make a difference for the children. So, I hope that can continue." (FI 23)*

Purposeful relationships, linkages, and partnerships

4A	When network members believe in the network's collective vision (context), then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because they are more willing to work with and value working with people whom they identify as being likeminded (mechanism)
	No supporting data
4B	When network members are open to and able to invest time in developing relationships and linkages through the network (context),then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because they have a better understanding of each other (mechanism)
	"Now, because, again, I said, what everybody wants to see is that the statistics are improving, you know, perform quality performance within health facilities, we decided our first mission was actually first to coordinate, introduce ourselves with health to the health facilities, and then find out what the issues are. And then we can work with individual health facilities to see how to rectify this to strengthen where things were working well and then overcome barriers where, you know, there were barriers." (FI 28) *"The other thing that we discovered was that was not enough. So, we had to do mentorship. So, after the training, and then the assessment, then two days mentorship. I found that to be better. So, in [redacted], we did two days. And I did the mentorship myself. And it was interesting I would say because I had to make first of all, I had to make friends with the nurses in the newborn unit. Because not all of them were able to attend the training. So, kind of like do a training for them. So that they don't say oh, that CPAP belongs to the guys went for the training. So, the two days were very useful to …now everybody to oh, this is a CPAP machine, this is what it looks like, this is how it works. And I was there with the biomed. So, it made it easier. And now the people who had been trained also also helped with the ... So that's where I learned that if you want anything to work, it helps if people trust you. It helps when people see that you're one of them. So, I would wear scrubs and just be with them, work with them. And then bring in the issue and for that they didn't know in fact they have been doing wrong, suctioning procedures people have been doing wrong. So, it was time to refine those. We*

	discovered some students who are in that unit also had never seen these things before so also teaching them. And so, in the end, I had to make friends with everyone, and we were able to identify some key, my opinion, people who would carry forth that training." (FI 29)
4C	If network members have strong pre-existing relationships (context), then this helps ensure that network members have purposeful and co-operative working relationships (outcome) because they are already familiar with each other (mechanism)
	"There is already a network here formed by KEPRECON and KPA, you must have heard about the Clinical Information Network. So, most of those hospitals were already part of you know a community of practice, so to speak. So, they already had that comradery going on. And NEST was more of an addition complementary into what they do. So, for that kind of network, I would see them feeling the value of being part of that network and the strong data that coming out. For others, again, it was more of a mixed results. And they would see just how do I improve things in my own facility but not necessarily as a network, the were efforts made though to try and bring these hospitals together." (FI 31) *"And I think there was also that it was much easier because a lot of the people who ended up within NEST, quite a number of them, were familiar to one another. So, they were part of the broader CIN. So, these are paediatricians, a lot of them either knew each other through CIN or through previous networks or having trained together. And so I wouldn't say there were, the challenges of setting up the network were much easier, in terms of a network of professionals and and people involved in implementing NEST. I think was easier here than in other countries, because they also have some sort of some sort of existing platform." (FI 32)*
4D	When network members share a professional identity (context), this supports forming purposeful and co-operative working relationships (outcome) because they share common socialised perspectives (mechanism)
	No supporting data
4E	If there are artefacts in place that outline the roles and responsibilities of network members (context), then this can help ensure that network members have purposeful and co-operative working relationships (outcome) because there is a common understanding among network members about what they are expected to do (mechanism)
	"So, there is that clarification there is that clarity of each cadres has role in how they should go about things but also help them to plan on may be making arrangements of which devices need to go for maintenance. So that they are kept free for that kind of work to be done. Yeah, so that is those are some meaningful strides that I want to say have happened, again, coming back to the biomedical department." (FI 15) *"Then I think after that, at some point, we signed a memorandum of understanding with the facilities, all these facilities, because it's very key in ensuring that it's just a binding document, because you see that NEST programme is also a programme that is on a research basis. Yeah. So, involving them and all that there has to be a binding document for this." (FI 20)*
4F	When a common baseline understanding is created among network members of what is expected of them (context), this helps to develop purposeful relationships (outcome) because the network members have the same level of understanding about each other and their roles and responsibilities (mechanism)
	No supporting data
4G	When a network creates opportunities for relationship building between network members within and across facilities (context), this may help in the creation of purposeful and co-operative working relationships and improve existing working relationships (outcome) because they get to know each other's personality, skills, ways of working, and motivations better (mechanism)
	"I would say that that relationship wasn't there initially. In fact, whenever a machine would fail to would develop a problem. Even the nursing team would be like, maybe let it just stay here because if you call them it will just be taken away. So, the biomed team was in another world and the clinical

	team in other worlds. Now, after this training, the clinical team realised they need the biomedical team to have their babies taken care of very well. So now, like in [redacted], we have two biomedical engineers stationed in the newborn unit, attached to it. Yes, newborn unit is covered 24/7 by my biomedical engineer, they come in the morning, check the incubators, adjust those fluids and do everything, then in the evening, they will again come and do that. They will be called upon wherever there is any problem. And all that. So, I will say the relationship is quite good. At the moment, they appreciate each other, each other's role. They both some of them will even join my ward round. Yes. And especially if I'm teaching things like phototherapy, and all that they would be in. And I would ask them, yeah, well, what's your take on this and that, so they have just realised all of us have realised our role is to ensure that baby that neonate both receive the best of care. Yeah, so it wasn't there. That relationship was not there before it was bad. I will say, Yeah, but now people appreciate each other strength and the role. Yeah, in the overall outcome of our neonates." (FI 04) *"I think NEST has played a very big role particularly to harmonise our working relationship between the biomeds and the staff. Because whenever they have taken us to be part and parcel of the unit and through that, they have gone further, even to to empower us. So that you have the capacity to support the newborn by giving us the training through that alone, the user or the sub in the newborn unit at the moment, they have confidence in our working ability, as a result of being being quick to be maintained. So, they have confidence we have created confidence in them towards us. Yes, because initially that confidence was not there. But through the empowering of NEST at least, they're able to allow us to get to work on their on the newborn equipment without without having any, any doubt of our ability, maybe to handle them. Yes, and NEST has given us that free role. We have given us free role even to touch on the equipment to see the event maybe I'll start that is when we can conduct today, the main NEST engineer who assistance. So, they are really created a good working harmony between us biomedical engineers, and the user and the newborn unit. Yes. So, we now have got the working relationship and given that has also advanced our frequent interaction with them. Because through our programme, we are each and every day each and every day, there is no day I can't miss going to the newborn unit. Because weekly maintenance I normally do because of the how frequently machines are used to monitor them on a daily basis. So, it does really strengthen our ties with the with the user and the newborn unit." (FI 13)*
4H	When the network provides resources that support the network members' ways of working (context), this may help in the creation of purposeful and co-operative working relationships and improve existing working relationships across professions (outcome) because they are better able to collaborate and do their job (mechanism)
	"Actually, it change them greatly. Before before NEST came. We never used to have to have the phototherapy light, so that you make sure that your baby is about on jaundice, when it comes to procurement, sometimes it could take a lot of time. And again, also that pile part of maintenance, it could take a lot of time. But when when when NEST came, actually it improved our services. And because the equipment were very simple to use, you could also find we used to very we used to have very few concentrators, but when the NEST came and brought those bundles even the nurses who were who are in that department in the newborn unit, staying abreast of the technologies and also they became very active because the output was very very within was it was within a very short time. And they could they could become friendly, more friendly to maintenance biomeds, because when they have a breakdown, they call us. We could also network with the NEST personnel in case of any problem and they will be sort with they could be sorted within within a very short time. And that meant the whole thing to become at least enjoyable. And we could we could we could have a kind of good relationship with the nurses." (FI 21) *"Initially before NEST you do it until the machine has broken down, then you're trying to fix it yourself. You're not able, then I'd say let me call the biomed. Sometimes they're not even available. But after NEST, we were supposed to have one of the biomeds like based in the newborn unit we have one, basically in newborn unit. So, because of that, is able to do the servicing of the machine, the ones which are programmed like it doesn't have to attend to the machine has broken down to service the machine. So, because of that we have many more breakdowns of the machine. And then even the ones that tend to break is always available to repair. And because of NEST, again, we're able to get those um those whatever they are call that*

	whatever the parts, we need to repair the machine. So that helps. But the fact that he's available, I think it really has made it possible that our machines are able to function longer and more efficiently, because they're being serviced every other and then before we do that until they're broken down then we realise has never been serviced before. So, I think being this in the newborn unit, and always being available, it has really improved the shelf life of this machines, and us being able to use them. Because there's no point of having a machine if you're not using." (FI 23)
4I	When network leadership creates a psychological safe space that enables cross-learning between network members (context), this may help in the creation of purposeful and co-operative working relationships and improve existing working relationships (outcome) because network members are able to openly share their experiences (mechanism)
	"I think they they go out of their way to also make you feel like that like with the meetings they they regularly call us for where they I asked us to present or present, like discuss our points of view, and they bring different centres together, and you realise that what I'm grappling with in my centre somebody else in another part of the country is grappling with the same thing or they have approached it in a different way that has worked. So, I feel so, I feel like we are part of a group and just listening to what other hospitals are saying that they they can see it and they want to join NEST also. So, yeah, so I think we do not just because of the innovations, but also the meetings that make you try and think about some of the interventions and how to get better." (FI 03) *"We both have meetings and those meetings are quite, they're quite nice in terms of meet your colleagues, because it's good to meet your colleagues have not seen them for a long time. But again, you tend to learn what they're doing well. Because you have oh, like I remember the last meeting we had some they say they don't have challenge with hypothermia. And I was like they're in [redacted], [redacted] is very cold it's one of those parts of Kenya, which is very cold, the infant would have, [redacted] is cold. Then they don't have a challenge with hypothermia, as we are here and you're struggling with hypothermia, and you know, then we kept from asking them, so how you doing different and you're able to tell us what they're doing differently. See, when you meet and you exchange information and notes, we're able to learn from one another. So, I think it's actually good for us. Whenever we have these forums, we always learn from one another. And they make them quite regular, which is good." (FI 23)*
4J	When network members have established purposeful relationships within and across network facilities (context), this helps to improve communication between network members (outcome) because they are familiar with each other (mechanism)
	"I think what NEST strengthened within the hospital was biomedical engineering. Like before, I forgot to mention them as well. But I feel since NEST, that interaction has been strengthened, because it was a very technical kind of interaction we used to have before, like when machines have completely broken down. But I feel that has been … since because we do a lot of they do pre-emptive maintenance. And it's now more of a discussion, not just us telling them it's broken down, but also them feeding back how we're using equipment and whether we are using it the right way." (FI 03) *"It is very important, I will say, prior to NEST, [redacted] County and [redacted] County are just about 50 kilometres away. But trust me, I had never even visited that newborn unit. I didn't even know whatever was happening there. Currently, it's very easy, you know, you when you have a case, you can call your colleague say, we have this business or that, have you seen this before? How are you handling this scenario? How are you handling this, this, and that? So, it's very it's very good. It's and I'm even called by the nursing team, nurses from other hospitals, you know, they'll be like, 'Oh, Doc, we have this scenario. We've done A-B-C-D and probably, we're not getting anywhere, what would be the best thing to do?' When it comes to consumables the various things, you know, in the lab and all that I'm able to ask my colleagues 'Anyway, do you have this in excess? Could you give me this for some time?,' you know, and all that." (FI 04)*
4K	When purposeful linkages and strong working relationships are established between network members (context), this improves network members ownership of the network (outcome) because they feel connected to each other and to the vision (mechanism)

	"We also have learned our lessons in terms of how to provide quality care within our contexts, comparing to other facilities, and also we also have had an opportunity to compare with not just with the facilities within the country, but within also the other participating countries, countries within the the NEST, the NEST programme. So, as our facility, we feel more confident, we feel more connected, even with the interventions that are ongoing with the NEST consortium." (FI 12) *"Well, I think I can say yes, because I think what is very special or what is very unique about how the NEST implementation has been done is that there is always that constant contact to the people and it is not just like any other project where people just come in it's train and donate equipment and that's the end of it. We are in constant touch with these people. Currently, I think we've been able to do like two programme review meetings where we want to get everybody involved, hear from them, listen to what they have to say. They give us their thoughts on how they're implementing this. So, I think there is that there is that ownership that I think is is is unique for in the NEST programme." (FI 14)*
4L	When purposeful linkages and strong working relationships are established between network members (context), this helps to build trust among network members (outcome) because network members have confidence in each other (mechanism)
	"So, after the training and then the assessment, then two days mentorship, I found that to be better. So, in [redacted], we did two days. And I did the mentorship myself. And it was interesting I would say because I had to make first of all, I had to make friends with the nurses in the newborn unit. Because not all of them were able to attend the training. So, kind of like do a training for them. So that they don't say 'oh, that CPAP belongs to the guys went for the training.' So, the two days were very useful to … Now everybody to oh, this is a CPAP machine, this is what it looks like, this is how it works. And I was there with the biomed. So, it made it easier. And now the people who had been trained also also helped with the ... So that's where I learned that if you want anything to work, it helps if people trust you. It helps when people see that you're one of them. So, I would wear scrubs and just be with them, work with them. And then bring in the issue and for that they didn't know in fact they have been doing wrong, suctioning procedures people have been doing wrong. So, it was time to refine those. We discovered some students who are in that unit also had never seen these things before. So also teaching them. And so, in the end, I had to make friends with everyone." (FI 29) Constant change in relationships makes the creation of trust difficult. *"So, the honest truth is it has had I'm looking for a bet... so I don't want to say it's significant because, you know, NEST is still functional, still goes on, but it actually did have impacts on implementation. Mainly, because transitioning. So, each organisation had its roles and responsibilities and there was very little duplication across those organisations. So, then moving from one organisation to another creates like a vacuum, sort of impact stream of work. So, if say CPHD was responsible for looking after the biomedical side of things, then transitioning that to another organisation or figuring how that will work in the absence of CPHD, then that means a lot and the institutional arrangements, therefore, of how, say, colleagues in KEMRI, would reach out to CPHD to get devices for training, then that has now to go to another partner who has to understand why should we give you devices for training. How does that work? How do we loan them? How can we trust that you take care of them? Because the also at an institutional level, there is some amount of time that takes before you can you can establish like a working relationship, trust, and all that. And that's not just at the beginning, because we transitioned from CPHD, then, I think, had a gap where the team in Kenya tried to run the show, then it was quickly realised that there is a lot of logistics that CPHD would run in terms of coordinating trainings and couriering things to sites that needed an institutional base, so we then transition to another institution, which also took a bit of time." (FI 32)*
4M	When purposeful linkages and strong working relationships are established between network members (context), this supports the creation of a psychological safe space (outcome) because network members feel they can speak freely without fear of negative consequences (mechanism)

	"Not officially, what we do for other hospitals is when we are doing our mortality audit, and it comes up that we get quite a few bad outcomes or poor outcomes from a particular hospital, we try and invite them for some of those mortality audits, not as not in a vindictive way, but to understand what they're working with. And we've learnt a lot, we've learned that some centres, the staff are doing what they can, but they're not equipped or trained. And when you create that safe environment, like they can be tell you some of the things they do like what they do for resuscitation, and then that becomes like a point of, okay, we probably need to reach out to them. So, when we have trainings, we make a point of trying to invite some of those centres to come in or to also tell them what they need to advocate for from the hospital administration, some lack things as basic as oxygen and he's just sent in an empty van at the back. So yeah, it helps to contextualise some of those things. But going down, that's like part of the plan, that we have like to actually go there and see what they have, instead of blaming them for poor outcomes to go and see what they have, what are they dealing with, and how we can help them at…So we're trying to identify a few facilities that if they are agreeable with it, but through the county." (FI 03) *"So, you know, where people sit around a table during a group work meeting, and people actually appreciate that they, they know, the hierarchical structures between cadres do not exist in all these other places. So, these these are a lot of teamwork." (FI 32)*
4N	When purposeful linkages and strong working relationships are established between network members/organisers (context), this enables network members/organisers to provide support in enacting the collective vision (outcome) because they can develop a mutual understanding of the identified problem and potential solutions (mechanism)
	"Sometimes we don't have a problem or maybe managing a sick neonate, it's just a matter of making an inquiry with them. I've seen they've really assisted us in so many ways. I can give an example. There was a time, had a problem with CPAP machine. It is not that our CPAP machines were not working, they were working. But there was just a problem because babies are not big which on CPAP. As an in-charge, I really tried, I really tried to talk to my staff, to just to encourage them. So, what I did, I talked to [redacted] *and* [redacted] *came on the ground, and you see when she came on the ground it started working, it started working. So, my assumption was that you see someone you know, someone from outside and someone from in it, you know, someone from outside can convince you much better than someone from there. It works. It really works so well. You know when you have like 15 babies on CPAP in a month, so that is a…Yeah, anytime you come in the morning, all the CPAPs are working and the bed are full. So, there's there's good interaction, there's good communication with the NEST group." (FI 07)* *"Can you tell your story and your journey and what do you think and they're they're they're very emotional about it because they said we've never seen anything like the approach that NEST has used. They they say this is the only programme that came over here and it was long term. It wasn't it didn't come in and out. And you know, it has a follow-up when they bring like equipment so they ensure that they they train enough on the equipment not just purchase and do that initial, you know, one day trading and then you know, leave people alone. They said equipment is put in place, you are trained, you are followed up you are given ways on how to monitor performance of the equipment and reporting, how to troubleshoot when there are issues. The NEST people are available to work with you on getting the equipment back to work. The clinical teams are not abandoned. Also he they got your phototherapy machines, your CPAPs there. Then we have shown you how to use them and then we disappear we don't we walk the journey with them. With the trainings with the training of trainers though GIC courses for the teams. And, you know, all those things including mentorship. So so so they really they literally feel like, you know, they shed tears at the imagination that NEST would actually be out of the they say this is this is the best story they've they've ever said they can tell about the programmes that we have encountered, because ours is not about the research, as you know, it's about real, you know, making a real change on the ground." (FI 28)*
4O	When purposeful linkages and strong working relationships are established between network members (context), this helps them to be in agreement (outcome) because they can more easily develop a shared conceptualisation of the identified problem and potential solutions (mechanism)

	"So, it has really interlinked us. The various hospitals say that we feel like we are almost somewhere, yes. We can always consult and compare ourselves with them, learn from each other. So, knowledge flows quite freely. Yes and we always, we are concerned about the service provision in our neighbouring hospitals or counties and this apparently has been quite easy. If we have a baby who needs a specific like surgical intervention through our interactions here, I will be able to know that he's a paediatric surgeon in [redacted], for example, so that I don't have to refer that patient to [redacted], which is probably over 140 kilometres away, you know, when I have [redacted] that is 50 kilometres away. So, it has enabled us to assess the strength of the various hospitals and know how we can then tap into this strengths here and there." (FI 04)
4P	When different professions within the network (e.g. clinical and technical) develop strong working relationships (context), their attitudes toward the other profession changes (outcome) because they understand each other's value (mechanism)
	"Now at first, we were used to see them like this is just a person to handle the machines after one all he knows is the machine but when NEST came up, and they send both of us on how to use the machine, you see. So, to give them it gives us power also to see the biomedical people as also as part of the medical team. Because without them our machines will be failing regularly. But when they came up and they even they have a CMEs on how this machine is working for the when it fails when it is faulty, how, what what is done. It has brought us it has been that relationship to really build the relationship." (FI 11) *"My colleagues would be very much willing to go to see how the babies are doing there because of the improved improved equipment or the bundles which we have we are brought to us. So that is that kind of improvement over there is that kind of that kind of positive attitude towards towards visiting the place and like sometimes back when up when when we never used to have that positive. Because when I go there, I will just tell the attendant that 'oh, the nurse there I'm going to work out your problem or which will take a lot of time.' Because now, I'm now I'm trained and I'm able to to assist. The person in that department at least have developed a positive attitude towards going to help then, yes. At least that is what I've seen. Yes, that is what I've noted. Yes and also, the nurses in that department are very happy because they used to have a very big, big mortality rate. But when the bundles came, their mortality dropped. Actually, too, it is only left in labour ward. Yes. Whereby I remember there is a month when we never we used to when we are the zero-mortality rate, from from from newborn unit. Yes. So, when the working in that kind of condition, you become very happy." (FI 21)*

Appendix 6A. List of journal publications and conference abstracts

Realist Review

Kalaris K, English M, Wong G. Developing an understanding of networks with a focus on LMIC health systems: How and why clinical and programmatic networks form and function to be able to change practices: A realist review. SSM – Health Systems. 2023; 1:100001. doi: 10.1016/j.ssmhs.2023.100001.

Kalaris K, English M, Wong G. Understanding how and why networks improve and provide high-quality healthcare and services in LMIC health systems: a realist review. The Global Health Network Collections. 2023. doi: 10.21428/3d48c34a.6ce8f242.

Scoping Review

Kalaris K, Wong G, English M. Understanding networks in low-and middle-income countries' health systems: A scoping review. PLOS Global Public Health. 2023; 3(1): e0001387. doi: 10.1371/journal.pgph.0001387.

Other publications during my DPhil

Agyekum EO and Kalaris K,* Maliqi B, Moran AC, Ayim A, Roder-DeWan S. Networks of care to strengthen primary healthcare in resource constrained settings. BMJ. 2023; 380: e071833. doi: 10.1136/bmj-2022-071833.
*Co-first authors

Kalaris K, Radovich E, Carmone AE, et al. Networks of Care: an approach to improving maternal and newborn health. Global Health Science and Practice. 2022; 10(6): e2200162. doi:10.9745/GHSP-D-22-00162.