TECHNOLOGY INTEGRATION IN NEWBORN CARE: EXAMINING COMMUNICATION AND DECISION-MAKING AMONG HEALTH PROFESSIONALS IN KENYAN HOSPITALS.

UNIVERSITY OF OXFORD

GLORIA KARUNGO NGAIZA

GREEN TEMPLETON COLLEGE

NUFFIELD DEPARTMENT OF MEDICINE

UNIVERSITY OF OXFORD

A thesis submitted for the degree of

Doctor of Philosophy

Trinity 2024

ABSTRACT

Neonatal deaths remain a significant challenge in many Low-and Middle-Income Countries, including Kenya. Affordable technologies such as Comprehensive Positive Airway Pumps (CPAP) and phototherapy can effectively reduce neonatal mortality and are being utilised across Africa. However, their introduction and implementation in resource-constrained health systems are poorly understood. This study explores the communication and decision-making processes among health professionals regarding CPAP and phototherapy use in Kenyan newborn units and their impact on the technology implementation.

Using a focused ethnographic approach, I conducted unstructured non-participatory observations, in-depth interviews, and document reviews in two newborn units in level-five Kenyan hospitals. Data collection occurred in two phases, six months apart. My conceptual framework, developed from a scoping review and the Non-Adoption, Abandonment, Scale-Up, Spread, and Sustainability (NASSS) framework, guided data collection, analysis, and presentation. Combining inductive and deductive coding, the thematic data analysis identified key themes and built explanations.

Findings reveal that physical context elements, such as adequate staffing, patient rooms in close proximity and health professionals’ communal congregation area promote more frequent and in-depth communication among health professionals using CPAP and phototherapy. A positive socio-organisational context, characterised by teamwork, supportive networks, a common language, and practical rewards, fosters more friendly communication and inclusive decision-making among health professionals. Moreover, when health professionals perceive technology features and functions as complicated, as with CPAP, communication increases significantly, prompting detailed discussions and thorough documentation during its use. Wider system factors, such as inadequate financial support hindered evidence-informed decisions and communication by impacting the availability of clinical tests and documentation materials. These interconnected factors shape health

professionals' communication and decision-making processes, ultimately influencing technology implementation from initiation to maintenance, discontinuation, and repair.

Stakeholders, including funders, policymakers, local governments, and health professionals, must recognise how physical, organisational, and technological contexts shape communication among health professionals during decision-making in newborn care. These factors directly affect the use of life-saving technologies. A tailored approach that considers these variables, rather than a one-size-fits-all approach, will ensure better integration and sustainability of these technologies, leading to improved outcomes in newborn care.

TABLE OF CONTENTS

ACKNOWLEDGEMENT

I express my deepest gratitude to God for granting me the opportunity to pursue my dreams and for surrounding me with the support of His people throughout this challenging and rewarding journey. Thank you to the National Institute of Health and Care Research (NIHR) and the Nuffield Department of Medicine for the studentship that made this research possible.

I extend heartfelt appreciation to my esteemed supervisors, Prof Caroline Jones, Dr Dorothy Oluoch, Prof Sassy Molyneux and Prof Catherine Pope, for their unwavering guidance and great kindness. They have gone above and beyond their responsibilities to show me support, and I feel very privileged to be under their supervision. Your mentorship has been invaluable, and I am truly grateful for the impact you have had on my academic and personal growth.

I thank the Health System Collaborative, Nuffield Department of Medicine team, especially Prof Mike English, for trusting me to be a student in the Harnessing Innovation in Global Health for Quality Care (HIGH-Q) programme. I appreciate HIGH-Q colleagues, including the administration, DPhil students and research teams in Oxford and at KEMRI Wellcome Trust in Kenya, for their invaluable research support. I appreciate the Initiative to Develop African Research Leaders (IDEAL) for facilitating my DPhil placement and the guidance during data collection in Kenya. Special thanks to Green Templeton College and my college adviser, Prof Derek Jewel, for their support.

I thank the Government of Kenya and the two county hospitals for the permission to collect data in their hospitals. I appreciate all research participants for their willingness to contribute to my research. Your collaboration has been instrumental in the success of this study.

To my partner and best friend, Dr Roy Alex Tinguely, I sincerely thank you for your constant love and resolute support. Your presence has been a pillar of strength for me, and I consider myself incredibly fortunate to have you by my side. In loving memory of my late parents, Mr Edward Medard Ngaiza and Mrs Teofilda Kokulingila Wenceslaus, who instilled in me the importance of education and encouraged me to strive for excellence. Thank you for over two decades of heavenly love. I acknowledge the support of my brothers Gerald, Edmund, Raymond, Edwin and Medard Ngaiza. My dearest sister Dr Cecilia Ngaiza has walked with me throughout this journey, and I am blessed to do this PhD at the same time as hers.

I extend my gratitude to all my friends for their friendship and encouragement. I appreciate my support system in Oxford, represented by Marwa Elbasheer, Sandra Adele, Dr Naomi Mburu, Dr Melvin Obadha, Dr Natasha Ali, and Prof Kevin Marsh for being here for me. Sincere appreciation goes to my former advisers, Prof Jolene Skordis, Prof Tim Colbourn, Prof Audrey Prost at University College London (UCL) and Prof Emmanuel Balandya at the Muhimbili University of Health and Allied Science, for supporting my PhD application.

This journey would not have been possible without the collective support of these individuals and organisations. I am truly grateful for the privilege to undertake this research and contribute to the field of knowledge.

DEDICATION

I dedicate this thesis to all women and men denied the opportunity to reach their full potential in life.

DECLARATION

I declare that this thesis is a presentation of my original research work and has not previously been submitted for a degree from any other university. To the best of my knowledge, this thesis does not contain any material previously published or written by another person except where duly acknowledged in the text.

LIST OF FIGURES, TABLES AND ANNEXES

Chapter One

Chapter Two

Chapter Three

Chapter Four

Chapter Five

Chapter Seven

Chapter Eight

ABBREVIATIONS

ANT	Actor-Network Theory
COI	Clinical Officer Intern
COVID-19	Coronavirus Disease 2019
CPAP	Continuous Positive Airway Pump
DSF	Dynamic Sustainability Framework
HIGH-Q	Learn to Harness Innovation in Global Health for Quality Care Programme
HTA	Health Technology Assessment
IV	Intravenous
KEMRI	Kenya Medical Research Institute
LMIC	Low-and Middle-Income Countries
MOI	Medical Officer Intern
MO	Medical Officer
NASSS Framework	Non-Adoption, Abandonment, Scale Up, Spread and Sustainability Framework
NEST360	Newborn Essential Solutions and Technologies (360)
NBU	Newborn Unit
OPD	Outpatient Department
OxTREC	Oxford Tropical Research Ethical Committee
SDG	Sustainable Development Goals
SERU	Scientific Ethics Review Unit
TOT	Training of Trainers
WHO	World Health Organisation

DEFINITION OF TERMS

Amniotic Fluid	The clear, slightly yellowish liquid that surrounds the fetus within the amniotic sac during pregnancy.
Bilirubin	(Also called total serum bilirubin) It is a yellow substance that forms when red blood cells break down. It is processed by the liver and then excreted in bile. High bilirubin levels can cause jaundice, where the skin and eyes turn yellow.
Bilirubinometers	(Also called transcutaneous bilirubinometers) A quick device for assessing and detecting bilirubin levels in the blood.
Birth Asphyxia	Lack of oxygen and blood flow to the brain and other organs, during or right after birth. One of the primary causes of early neonatal deaths.
Cardex	Also known as “Kardex”, is a hard copy form that nurses use to document decisions they make in babies’ management.
Chlorhexidine	A liquid antiseptic that reduces the number of germs and, in the newborn care context, cleans the babies’ umbilicus.
Medical Investigations	A range of systematic studies and diagnostic procedures conducted to analyse, diagnose, and monitor health conditions, encompassing laboratory tests, imaging studies and physical examinations.
Comprehensive Newborn Monitoring Chart	A hard copy form that health professionals use to document babies’ management and progress.
Convulsions	A sudden, violent, irregular movement of the body, caused by involuntary contraction of muscles. It is associated with brain disorders such as epilepsy, toxins in the blood, or fever in children.
Continuous Medical Education	Educational activities in the medical field to improve or learn about new and developing areas. In this research, activities involve in-person presentations.

Croc Shoes	Rubber-clog shoes that health professionals wear in the hospital setting.
Cyanosis	Lack of oxygen in the blood leads to skin, lips or nails turning blue.
Dextrose	The solution contains 5% or 10% sugar and is given to a patient through blood vessels.
Express Milk	Squeezing milk from the breast for feeding the baby or storage.
Haemolysis	(Adjective: Haemolytic) Red blood cells break down, leading to the release of their contents into the surrounding fluid such as plasma. This can occur due to infections, autoimmune disorders, certain medications, toxins, or physical damage to the red blood cells.
Hypothermia	Body temperature lower than normal, typically below 35°C.
Infection	The invasion and multiplication of foreign micro-organisms like bacteria, viruses, fungi and parasites in the body.
Intrapartum Related Complications	Complication to the mother or baby during childbirth, from the beginning of labour to the placenta delivery.
JIK Solution	A type of liquid for stain removal and germ killing.
Major Ward Round	(Also called grand round) is the activity that a wide audience of health professionals do in inpatient care, including the presention of patient medical conditions and the treatment plan.
Meconium Aspiration Syndrome	The newborn baby's first faeces are called meconium. Meconium aspiration syndrome happens when a baby breathes meconium and amniotic fluid into the lungs during delivery.
Nasogastric Tube	A catheter passing through the nose into the stomach to deliver food and medication and draw substances out.
Neonatal Sepsis	Bloodstream infections in babies younger than 28 days old.
Normal Saline	A solution that contains sodium chloride and is given to patients as a source of water and electrolytes.

Nomogram	(Also called Bhutani Nomogram) is a chart for assessing the risk of severe hyperbilirubinemia (jaundice) in newborn babies. It helps to determine whether phototherapy treatment is needed based on gestational age and the presence of other risk factors such as Rhesus incompatibility.
Ophthalmoscope	A medical instruments used by healthcare professionals to examine the interior structures of the eyes, including the retina, optic disc, and blood vessels. This tool allows for detailed inspection of the eye to diagnose and monitor various eye conditions and diseases.
Oxygen Saturation Pressure	The percentage of haemoglobin in the blood that is saturated with oxygen and is measured using a pulse oximeter and expressed as a percentage.
Premature	(Also called preterm) refers to babies born alive before 37 weeks of pregnancy.
Pulse Oximeter	A medical device used to measure the oxygen saturation level (SPO2) in a patient's blood.
Respiratory Rate Level	The number of breaths a person takes per minute and is an essential indicator of respiratory health. Normal respiratory rates for newborn babies range from 30 to 60 breaths per minute.
Ringer's Lactate	A solution containing water and electrolytes and helps to improve a patient's blood volume, pressure and alkaline.
Rhesus Incompatibility	Discordant pairing of maternal and fetal rhesus (Rh-) types which can be a concern if a Rh-negative mother is carrying a Rh-positive fetus which may cause complications to the baby including anaemia.
Short Message Service (SMS)	A communication protocol that allows users to send and receive text messages over mobile networks.
Scrubs	Attire worn by health professionals, consisting of a loose-fitting shirt and pant.

Spina Bifida	A gap in the baby's spine caused by the poor development of the spine and spinal cord.
Stethoscopes	A medical device for listening to the heart sounds or breathing.
Surfactants	(Also called lung surfactant) A complex mixture of lipids and proteins that coat the inner surface of the lungs, reducing surface tension, maintaining lung elasticity and facilitating efficient gas exchange.
Talipes	Also known as clubfoot, is a congenital condition characterised by an abnormal positioning of the foot, typically with the foot turned inward and downward.
WhatsApp	A messaging application that allows users to send text messages, voice messages, make voice and video calls, share media, and engage in group chats over the internet.

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

In this chapter, I discuss the global burden of neonatal mortality, focusing on Low-and Middle-Income Countries (LMICs), including Kenya. I highlight the potential of innovative technologies in newborn care to reduce these deaths and review evidence on their implementation, particularly in LMICs. The crucial role of communication among health professionals in ensuring the successful use of these technologies is also examined, highlighting current knowledge and identifying gaps in the research literature. I explain why this research is necessary and outline its aims and objectives. I reflect on my background and interests, showing how they align with this research. Finally, an overview of the upcoming chapters in this thesis is provided, setting the stage for the detailed discussions that follow.

1.2 THE BURDEN OF NEONATAL MORTALITY

Neonatal mortality is the death of children within the first 28 days of life (UNICEF 2023; WHO 2024a). It is a global health challenge, with 2.3 million neonatal deaths reported in 2022 alone despite a significant reduction from 5.0 million in 1990 (WHO 2022b). Although there has been some progress in reducing neonatal mortality, this has been slower than for children beyond the post-neonatal period. Between 1990 and 2020, the average annual reduction rate in neonatal mortality was 2.4 per cent, compared to a 3.3 per cent reduction among children aged 1–59 months, in the same period (UNICEF 2023).

The neonatal mortality rate is calculated as the number of deaths during the first 28 completed days of life per 1000 live births in a given period (WHO 2024a). Neonatal mortality rates show that children continue to face different chances of survival based on where they are born (Figure 1.1). Most neonatal deaths occur in LMICs. In 2022, Sub-Saharan Africa had the highest neonatal mortality rate at 27 deaths per 1000 live births, followed by central and southern Asia with 21 deaths per 1000 live births. That year, a baby born in Sub-Saharan Africa was at eleven times greater risk of dying than one born in the lowest-mortality region (WHO 2022b). According to a study that used 245 Demographic and Health Surveys from 64 LMICs conducted between 1986 and 2018, including over 2 million children under five years old, 53.1% of children dying below five years old are in the neonatal period. This is followed by 28.4% during the postneonatal period (one month to one year old) and 18.5% in childhood (one to five years old) (Li et al. 2021).

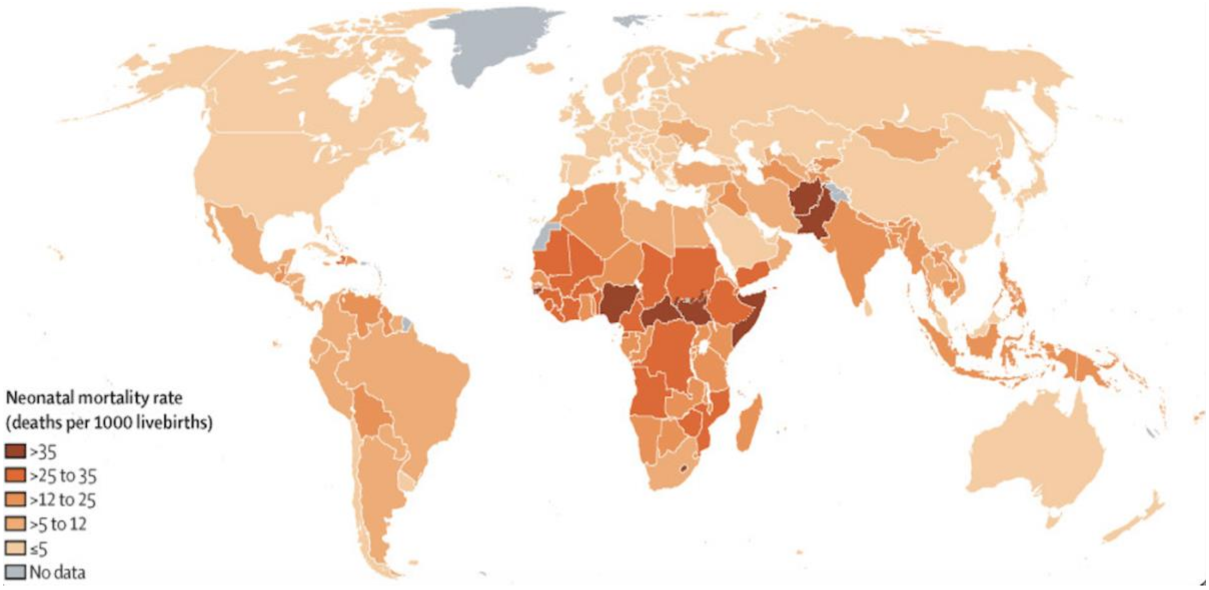


Figure 1.1 Global Distribution of Neonatal Mortality. Source: (Sharrow et al. 2022)

In Kenya, neonatal mortality increased from 28 per 1000 live births in 1989 to 33 per 1000 live births in 2003. However, between 2003 and 2022, the burden was reduced by 35% to 21 per 1,000 babies born alive (KDHS 2022). While the latest mortality rate in Kenya is better than the Sub-Saharan African average of 27 deaths per 1000 live births, it is comparable to other East African countries in 2021. For instance, Tanzania's latest mortality rate in 2021 stood at 20, Rwanda's at 18, Burundi's at 21, and Uganda's at 19 deaths per 1000 live births (Bank 2024).

Recent studies have reported the leading causes of neonatal mortality in Kenya (Olack et al. 2021; Irimu et al. 2021). Verbal and social autopsy interviews conducted with caregivers of deceased newborn babies in 17 health facilities in Kenya reported *birth asphyxia, hypothermia, neonatal sepsis* and *respiratory distress syndrome* (Olack et al. 2021) as leading causes of death. Another study that examined continuously collected routine patients' data from structured paper record forms for all admissions to newborn units (NBUs) from 16 Kenyan public hospitals between January 2017 and December 2018 also reported *neonatal sepsis and respiratory distress syndrome* as leading causes of death (Irimu et al. 2021). The same study also identified *jaundice and intrapartum-related complications* as leading causes of death.

1.3 TECHNOLOGIES AND REDUCING NEONATAL MORTALITY

Efforts to reduce neonatal mortality are on the global agenda. For instance, Sustainable Development Goal 3.2.2 aims for all countries to strive to lower neonatal mortality rates to no more than 12 per 1,000 live births by 2030. This goal is part of the United Nations' 17 Sustainable Development Goals, which provide a blueprint for a better and more sustainable future for all. The goals were adopted by Member States in 2015 as part of the 2030 Agenda for Sustainable Development (UN 2015). Neonatal mortality rates suggest that an accelerated effort is needed in each country to reach the target of Sustainable Development Goal 3.2.2. For example, a systematic analysis of national, regional, and global levels and trends in neonatal mortality between 1990 and 2017, with scenario-based projections to 2030, has estimated 1.8 million neonatal deaths in 2030 with the current effort. With an acceleration in the pace of reduction of neonatal mortality, this number could reduce to 1.2 million neonatal deaths in 2030 (Hug et al. 2019).

Recent reports focusing on the prevention of neonatal deaths have underscored the importance of technologies in accelerating progress to improve the outcomes of newborn care. For instance, the *WHO report "Born Too Soon: The Global Action Report on Preterm*

Birth highlights newborn technologies such as phototherapy, mechanical ventilation, and surfactants as pivotal tools in combination with medications and increased staffing in reducing deaths of premature babies through enhancing the quality of care (Lawn, Bhutta, et al. 2023). The Lancet Newborn Interventions Review Group and The Lancet Every Newborn Study Group, which include specialists in neonatal care with substantial experience in LMICs, highlight the potential of technologies such as neonatal resuscitation, phototherapy, and Continuous Positive Airway Pump (CPAP) to alleviate the burden of newborn death (Bhutta et al. 2014). These authors observe that potential gains are particularly high in LMICs, where most neonatal deaths are preventable.

In 2022, Rosa-Mangeret and colleagues published a review of the leading causes of neonatal illness and death and analysed vital interventions to reduce them. The review used a bottom-up approach, starting with clinicians in the field and extending to policymakers. They recommend CPAP and phototherapy as essential, cost-effective technical solutions that should become available globally (Rosa-Mangeret et al. 2022).

In 2016, the World Health Organisation published *the Interagency List of Priority Medical Devices for Essential Interventions for Reproductive, Maternal, Newborn and Child Health Guide* to improve access to these devices in LMICs and support quality of care. The guide has an elaborate list of recommended newborn devices for use in health facilities, including CPAP and phototherapy (WHO 2016). The 2023 *New World Health Organisation Recommendations for Care of Preterm or Low Birth Weight Infants:* Health Policy includes CPAP as a recommended intervention for preterm babies alongside kangaroo mother care, breastfeeding, and nutrient supplements (Darmstadt et al. 2023)**.** Ten years ago, Bhutta et al. highlighted that technologies already implemented in high-income countries significantly contributed to reducing neonatal mortality rates, drawing from their review of newborn interventions across the continuum of care in 75 countries (Bhutta et al. 2014).

CPAP supports a baby's respiration by stabilising chest walls, supporting airways, and enhancing surfactant release. It is vital for infants with birth asphyxia and respiratory distress syndrome (Polin and Sahni 2002; Gupta and Donn 2016; Ho et al. 2020). Phototherapy treats jaundice manifesting with skin and eye yellowing, itching, abdominal pain, and, in severe cases, sepsis and brain damage (Joseph A 2024). Treatment relies on clinical presentation and serum bilirubin levels (Bratlid 2001; Porter and Dennis 2002). CPAP and phototherapy are potentially crucial in addressing the leading causes of neonatal mortality in Kenya.

1.4 TECHNOLOGY IMPLEMENTATION IN HEALTH SYSTEMS.

Studies have identified a range of failures and challenges to the implementation, uptake and sustained use of medical devices such as CPAP and phototherapy in LMICs. A systematic review of 35 studies from grey literature and published papers examined the availability of 48 devices, including infant warmers, neonatal resuscitators, phototherapy devices and tools for diagnosing infectious diseases, monitoring oxygen saturation, providing assisted ventilation, preventing mother-to-child transmission of HIV, assisting childbirth, and assessing weight or temperature in health facilities in LMICs (Thairu, Wirth, and Lunze 2013). The review found that many of these technologies were not used as they were unsuitable for the local environment. The authors concluded that most technologies are developed in wealthier nations and need to withstand harsh conditions or be adapted to be implemented in LMICs.

Other studies have suggested that the health system may be a barrier to technology use. For example, a study conducted between 1986 and 2010 analysing inventory reports from hospitals in four continents in 16 LMICs involving over 100,000 medical devices found that approximately 40% were out of service (Perry and Malkin 2011). The reasons cited for this included lack of training and poor technology management. The authors of the study concluded that technologies may promise benefits in patient outcomes. Still, the cost of acquisition, maintenance, and ongoing training may strain already stretched resources and mean their use is not sustainable. Similarly, a review of the literature and guidelines for surgery and anaesthesia published between 1980 and 2018 found that poor planning, inadequate collaboration, and a lack of understanding of healthcare systems can lead to the underutilisation of critical medical equipment, creating what is often referred to as an "equipment graveyard" in LMIC settings (Isobel et al. 2019).

Studies have found similar challenges in using CPAP and phototherapy. For example, a review of clinical trials in Ghana and other countries in LMICs found that although CPAP has positive results when used in children, there are challenges to scaling up its use (Baiden and Wilson 2021). The authors of the review attribute this challenge to the lack of evidence on CPAP implementation that could address operational challenges and facilitate learning-by-doing across health facilities. Another review of 23 LMIC papers on the use of CPAP in children aged 28 days to 4 years with pneumonia aimed to understand patient selection and contextual factors that influence the effectiveness and safety of CPAP for children with severe respiratory infection (Wilkes et al. 2022). Findings highlight the importance of contextual health system factors such as staffing and clinical practice context, equipment and training, health professionals' comfortability and cost in implementation. As for phototherapy, a recent review of published studies examined management challenges in phototherapy use(Satrom, Farouk, and Slusher 2023). The authors identified fragmented medical care, traditional birth and postpartum practices, and the lack of locally specific and culturally appropriate management guidelines contributing to the implementation challenges.

These studies all point to the challenges of implementing an intervention into existing systems that are dynamic and complex. Cohn and colleagues define complexity as a dynamic and constantly emerging set of processes and objects that not only interact with each other but come to be defined by those interactions (Cohn et al. 2013). Moreover, complex systems have indistinct boundaries; their agents follow unpredictable internal rules, leading to adaptation, interaction, and co-evolution with other systems (Greenhalgh and Papoutsi 2018).

The health system and its complexity have been defined in many ways, but the broad World Health Organisation definition is an organisation, institutions, resources, and individuals dedicated to enhancing health, addressing health determinants, and directing health improvement efforts (WHO 2010). This includes a range of interventions spanning preventive, promotive, curative, and rehabilitative measures delivered through public health initiatives and a network of healthcare facilities. This framework has six core components, or "building blocks," of health systems: service delivery, health workforce, health information systems, access to essential medicines, financing, and leadership/governance.

In response to this definition of the health system and its functioning, Sheikh and colleagues argue that although the WHO building block framework is valuable in describing and understanding health systems, it conceptualises health systems in the functional or instrumental terms of its constituent “hardware” such as finance, medical products, information systems, human resources, forms of service delivery, and governance. They suggest that besides these concrete and tangible expressions of health systems, the ideas and interests, values and norms, and affinities and power that guide actions and underpin the relationships among system actors and elements (designated as system “software”) are also critical to overall health systems performance (Sheikh et al. 2011). As such, local cultural practices, political dynamics, and community preferences are all key contextual factors likely to influence the introduction and use of interventions.

The *Lancet's High-Quality Health Systems in Sustainable Development Era: Time for a Revolution Commission* highlights the importance of understanding the context of technology use, particularly in resource-limited settings. The commission, involving the review of evidence by over 30 academics, policymakers, and health system experts from 18 countries, highlights that understanding the context, including service design and developing tools for measurement, is essential for health service improvement.

Over recent years, several studies have investigated how health system 'software' can influence intervention implementation. For example, Rogers et al. examined how team-level contextual factors influence change in healthcare practice in the Irish health system, using observations of two multidisciplinary healthcare teams and interviews with 25 multidisciplinary surgical and medical personnel. They highlight various factors at the local level to consider when delivering an intervention, such as timing and mode of delivery, the stability of each team member, and staff enjoyment of implementation. The authors recommend a flexible and adaptive approach to implementation (Rogers et al. 2021). Another study to understand contextual influences was conducted in Australia, where researchers reviewed the application of new standards nationwide and the adoption of medical emergency teams in over 200 hospitals (Braithwaite, Churruca, et al. 2018). The authors found that change in emergency care practice can be stimulated in many ways but needs an internal and external triggering mechanism, such as legislation or collaboration with wider stakeholders. They, too, recommend viewing implementation as iterative and taking a systems-informed approach to existing networks, considering social and technical characteristics.

1.5 COMMUNICATION IN NEWBORN TECHNOLOGY USE.

Effective communication is essential in delivering newborn interventions in complex health systems, and in the *2020 WHO Standards for Improving the Quality of Care for Small and Sick Newborns in Health Facilities,* effective communication was listed as one of the eight components of the standards (WHO 2020). Other newborn care guidelines have highlighted communication among health professionals as essential to implementing interventions. For example, the implementation guide for national, district, and facility levels to enhance the quality of care for maternal, newborn, and child health highlights the importance of teamwork and communication among health professionals (WHO 2022a). This guidance builds on the earlier *WHO Standards for Improving Quality of Maternal and Newborn Care in Health Facilities* (2016) and recommends communication systems within health facilities to facilitate information exchange among relevant service providers (WHO 2016a). It also encourages the establishment of feedback mechanisms with referral centres to deliver quality health interventions successfully.

Several studies have addressed the use of CPAP and phototherapy and identified specific communication challenges that affect their use (Aneji et al. 2020; Kinshella, Salimu, et al. 2022; Nabwera et al. 2020; Kinshella et al. 2020), but there is a lack of focus on communication in newborn units in LMICs per se. Without an adequate understanding of the contextual factors that influence communication, the success or failure of the intervention—and its subsequent uptake and use—cannot be adequately assessed. One possible explanation is that existing studies often have broad foci, such as understanding the implementation of technologies or examining barriers to implementation, where communication emerges as one among many themes without receiving in-depth examination. A comprehensive understanding of communication among health professionals engaging with newborn technologies is crucial to informing their successful implementation.

In this thesis, I adopt a broad definition of communication among health professionals, encompassing learning and information exchange, clinical management of patients, documentation, monitoring, and other interactions related to the use of CPAP and phototherapy. My focus is on how communication shapes the implementation of these technologies. To explore this, I examine communication at key decision-making points made by health professionals.

1.6 JUSTIFICATION FOR THE STUDY

The alarming burden of newborn mortality, particularly in LMICs, is a global public health concern (WHO 2022b). Despite evidence indicating the positive impact of medical technologies in improving neonatal outcomes, their use in routine practice in LMICs remains inconsistent and unreliable, and there is a limited understanding of strategies that could be employed to ensure their effective and sustainable use. Effective communication is integral to intervention implementation, uptake and successful use. However, little is known about communication in newborn units in LMICs, how technologies shape this communication or how communication shapes technology use.

Understanding communication at key decision-making points in newborn units and how the physical context, organisational context and technology as an intervention shape communication and decisions around technology use (or non-use) is a key step in identifying strategies to enhance the use of life-saving technologies. In this research, I focus on understanding technology-associated communication among health professionals in Kenya, focusing on their key decision-making points.

1.7 AIM AND OBJECTIVES

1.7.1 AIM

To explore communication and decision-making among health professionals regarding CPAP and phototherapy use in newborn units and how it affects their implementation.

1.7.2 SPECIFIC OBJECTIVES

1. To describe communication and decisions associated with CPAP and phototherapy use among health professionals in two newborn units in Kenya.

2. To examine the physical contexts in which health professionals communicate and make decisions about using CPAP and phototherapy.

3. To explore the organisational contexts in which communication and decision-making regarding CPAP and phototherapy occur among health professionals.

4. To examine how the type of technology shapes the interactions and decision-making among health professionals in the two newborn units.

My study has been facilitated by its linkage with The Newborn Essential Solutions and Technologies (NEST360) programme, illustrated in Figure 1.2. The programme supports the implementation of a comprehensive care package that includes 23 affordable technologies, training for health professionals, and using locally owned data to deliver high-quality care for newborn babies in the health system in Kenya, Malawi, Tanzania and Nigeria. Since 2020, the NEST360 has supported the scaling up of newborn technologies in Kenya, including CPAP and phototherapy. With a close partnership with the Kenyan Ministry of Health, the programme has reached 13 out of 47 newborn units (NBUs) in county referral hospitals.

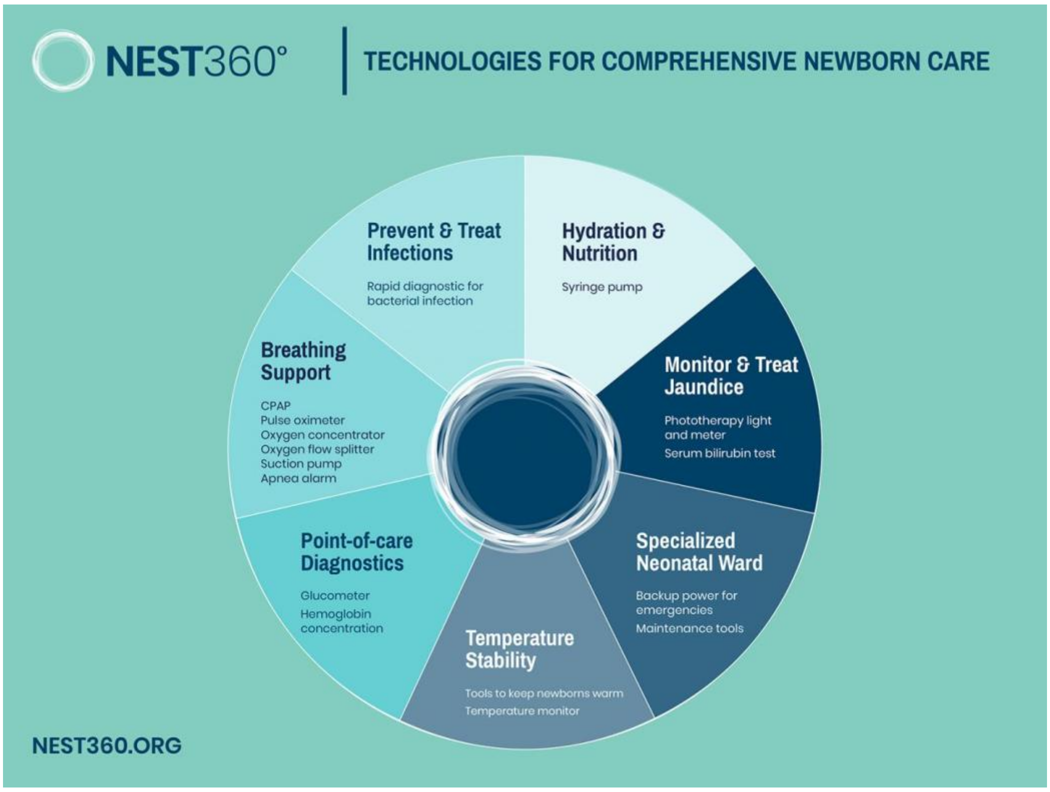


Figure 1.2 NEST360 Technology Support Areas.

To meet the research aim and objectives, I used the qualitative methodology, adopting an ethnographic approach to collect data in two level-five newborn units in Kenyan hospitals. I employed unstructured, non-participatory observations, in-depth interviews, and document reviews. This allowed me to spend extended time in the field, providing an understanding of the context of newborn units, where technology-associated communication and decision-making among health professionals occur.

1.8 RESEARCHER'S BACKGROUND AND INTEREST

My experiences as a black Tanzanian female doctor and global health specialist built my interest in researching the use of medical technologies among LMIC health professionals. The use of medical technologies started to interest me when I joined the medical field 15 years ago. I was accepted into the oldest medical school in the national hospital in Dar es Salaam, Tanzania, where I was born and went to school. Before then, my experience with the hospital setting was minimal. One of the things that first frustrated me when we rotated in the national hospital was the limitation in practising what we read in medical books. Large class sizes meant we had to take turns observing or engaging with medical technologies. It was common to miss such opportunities because a particular medical device was not working, a supervisor was absent, or they did not inform us of the procedure.

After medical school, I spent the first two years of my medical career as a medical doctor in a regional government hospital in Arusha, Tanzania. Financial and human resources were even more constrained since the hospital was smaller than the national hospital where I trained. The paediatric department where I worked had several medical technologies – CPAP and phototherapy being part of them. However, most were locked in a storeroom and only used when the paediatricians were around or had a supervisory visit from the Ministry of Health. I received no orientation to use medical technologies and relied on other health professionals.

I left the hospital to pursue a Master of Science in Global Health and Development in the United Kingdom. After the degree, I joined the UK's Department for International Development as a Health Adviser. For four years, I worked with teams in LMIC, including Tanzania, Rwanda, Burundi, Sierra Leone, and Nepal. One of the areas that my role included was endorsing budgets for millions of pounds to support medical innovations. I have experienced many projects, from piloted medical devices to innovations with proven efficacy. However, we knew little about implementing those technologies once they reach the healthcare setting, including factors shaping adoption and sustainability.

With personal experience in health professionals' interactions and decisions in using technologies, I was interested in exploring this area further. I considered these types of technology because I saw health professionals have a unique way of engaging with each of them. Working in various hospitals and seeing differences in the context and managerial style, I was keen to learn what plays a role in health professionals' communication and decision-making. My previous research training and experience primarily involved quantitative methodologies. My thesis research has introduced me to new social theories and qualitative methods for collecting, analysing, interpreting and presenting data.

1.9 THESIS OUTLINE

The thesis has eight chapters. Information about each chapter is below:

Chapter One	**Introduction.** An overview that comprises the research background, research context, the study justification, objectives, researcher's background, and thesis outline.
Chapter Two	**Literature Review.** I start the chapter by discussing communication among health professionals in health facilities, its importance, characteristics, influencing factors, and critiques of communication frameworks. I then provide an overview of technology-associated communication among health professionals in newborn care and present findings of my scoping review and the implications for my thesis research.
Chapter Three	**Methodology.** I explain the research design and methods, including the study setting, population, ethical considerations, and familiarisation with the research context. I also describe methods of data collection, analysis, and results presentation.

Chapter Four	**Objective One: Communication and Decision-making among Health Professionals.** I describe health professionals' communication characteristics, including the contents, ways of communicating and space for communication. I discuss the differences in the two newborn units and implications for subsequent results chapters.
Chapter Five	**Objective Two: The Role of the Newborn Unit's Physical Context in Shaping Health Professionals' Communication and Decision-Making.** I explore the physical structure, layout, and the number of health professionals in newborn units. I examine their role in shaping the communication and decision-making processes of health professionals.
Chapter Six	**Objective Three: The Role of the Organisational Context on Health Professionals' Communication and Decision-Making.** I investigate how the organisational context shapes communication and decision-making of health professionals. I explore the skills and relationships among health professionals, examining the management style and norms within the newborn units as well as the wider context.
Chapter Seven	**Objective Four: The Role of Technology Type in Shaping Health Professionals' Communication and Decision-Making.** I compare how the use of CPAP and phototherapy shapes interactions and decisions among health professionals. I highlight how the structure and functionality of each technology plays a role in health professionals' interactions and decisions. I compare knowledge produced from interacting with each technology and explore how the specific illnesses or conditions that prompt using these technologies shape communication and decision-making among healthcare professionals
Chapter Eight	**Discussion and Conclusion.** I provide a recap of my research and critically discuss my findings. I highlight implications of my research and provide recommendations for various groups of stakeholders and propose future research opportunities.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, I examine key areas in the literature relevant to my DPhil research aims and objectives. I begin with an overview of the importance of communication among health professionals in health facilities. I then discuss what is known about who, what, and how information is communicated among health professionals in health facilities. This is followed by a discussion of factors influencing communication and a critique of relevant communication frameworks found in the literature. Subsequently, I narrow the focus to the literature on communication among health professionals related to technology use in newborn care, presenting it in two categories based on the nature of the technology. The first category addresses communication among health professionals in newborn care involving information and communication technologies (ICT) aiming to facilitate information exchange. The second category covers communication among health professionals associated with technologies that support other aspects of newborn care, such as CPAP and phototherapy. I expand on the second category, central to my research, by discussing the scoping review I conducted to identify existing knowledge and gaps in communication practices among health professionals using non-ICT technologies in newborn care. Following the scoping review, I propose a framework for empirical studies examining technology-associated communication among health professionals in newborn care. I conclude with a discussion of the implications of these findings to my research objectives.

2.2 COMMUNICATION AMONG HEALTH PROFESSIONALS IN HEALTH FACILITIES.

2.2.1 IMPORTANCE OF EFFECTIVE COMMUNICATION AMONG HEALTH PROFESSIONALS IN HEALTH FACILITIES.

The *World Health Organisation (WHO) Principles for Effective Communication* acknowledges the importance of effective communication among healthcare colleagues as vital for enhancing health outcomes (WHO 2024b). According to WHO, effective communication is accessible, understandable, credible, timely, relevant, and actionable. Similarly, other organisations, such as the independent nonprofit organisation (Emergency Care Research Institute), which focuses on improving the safety, quality, and cost-effectiveness of healthcare globally, define effective communication as complete, clear, concise, and timely (ECRI 2023).

The book on newborn innovation, "*Insights from Uncertainty in Medical Innovation Experienced Pioneers in Neonatal Care"* (Mesman 2008), argues that given the vulnerability of newborn babies due to unstable and life-threatening conditions, effective communication among health professionals is paramount, especially during constant monitoring, shift changes, and ward rounds. The fragile state of newborn babies necessitates these interactions, and well-organised relevant information is needed to ensure accurate communication and understanding of that information.

The role of effective communication in facilitating teamwork was discussed in the secondary analysis of a randomised controlled trial of a study of neonatal resuscitation training in one hospital in the United States. One hundred intern doctors received a standard curriculum. At the same time, the second group had a supplemental team training curriculum comprising a two-hour team training session focused on communication skills and team behaviours. The group that received supplemental communication training to improve effectiveness shared information among themselves, which improved their performance, including reducing the resuscitation period of babies to make it faster (Katakam, Trickey, and Thomas 2012). In their opinion paper, Vanderbilt and colleagues from the United States argue that training in effective handoff communication among interprofessional teams from obstetrics, gynaecology, and neonatology ensures collaborative working that improves the safety of newborn babies upon birth (Vanderbilt et al. 2017).

In addition to facilitating teamwork, some authors have suggested that effective communication among health professionals helps health professionals cope with the emotionally stressful environment of a Newborn Intensive Care Unit (NICU). Mills and Cortezzo reviewed the literature on moral distress in neonatal units. They suggested effective communication is vital for reducing moral distress among professionals and fostering positive interactions with families and the care team. They advocate for including health professionals in team discussions to mitigate conflicts (Mills and Cortezzo 2020). Similarly, Miles et al. conducted a study involving a range of health professionals (17 individual interviews with doctors and eight focus groups comprising a total of 61 nurses, rehabilitation therapists, pharmacists, and social workers) across two hospitals in Canada regarding the impact of interprofessional relationships, identity, and power (Miles et al. 2021). Their findings underscore the importance of receiving and providing feedback in fostering positive interprofessional relationships and a good work environment for health professionals as a coping mechanism.

Another way that communication helps with an emotionally stressful environment is by facilitating trust and respect among health professionals. For example, in LMICs, Busari and colleagues conducted focus six group discussions with 61 nurses, interns, and medical specialists using the ethnographic approach to explore the views and perspectives of the key health professionals from various adult and children departments on the quality of care in a hospital in the Dutch Caribbean island of Curaçao (Busari, Moll, and Duits 2017). Their findings highlight that communication, which observes professional respect for all team members, allows a safe environment for asking questions and helps facilitate uniformity in sharing information. A recent scoping review of 29 papers from high-income countries examined communication in interprofessional rehabilitation teams (Paxino et al. 2020). They found that open, honest, continuous, and timely communication positively ensured trust and respect within a team. It allowed team members to openly express opinions during clinical discussions, contributing to health facilities meeting their goals, such as reducing length of stay and hospital readmission.

Studies examining health professional burnout have emphasised the importance of effective communication in mitigating burnout in an emotionally stressful environment. A scoping review on paediatric nurse burnout, encompassing 78 papers, 20 papers from LMICs and 58 from high-income countries, found that frequent and adequate communication was associated with lower burnout rates and improved work relationships among health professionals (Buckley et al. 2020). Additionally, Bry and Wigert conducted interviews with 13 nurses in a NICU in Sweden, providing insight into the organisational climate and interpersonal interactions among registered nurses (Bry and Wigert 2022b). Their study found that communication skills are crucial for nurses to cope with the NICU environment. Based on their results, they stress the need to boost nurses' confidence in communication and address feelings of inadequacy or anxiety in challenging communication scenarios. They argue it helps to alleviate stress and prevent burnout.

The literature has underscored the significance of effective communication in engaging patients and their families in care provision. A systematic review and meta-synthesis examining the functions of adequate communication in neonatal care units, involving 43 studies (38 from high-income countries and five from LMICs), reports that building and maintaining positive relationships with parents entails responding to their emotions, addressing their supportive needs, and assisting them in managing uncertainties in their care for babies (Wreesmann et al., 2021). The authors argue that information exchange involves continuously sharing knowledge between parents and providers throughout the baby's admission, covering topics such as medical conditions, treatment plans, and possible outcomes. Similar findings in their review paper by Mills and Coretzzo also found that clear and consistent communication among health professionals regarding rationale, expected outcomes, and options provided to parents may alleviate distress stemming from information gaps that parents have (Mills and Cortezzo 2020). Furthermore, Braunack-Mayer and Mulligan, in their paper discussing confidentiality and ethics, argue that effective communication among health professionals may uphold medical ethics by establishing agreements with families on steps to be taken before sharing patient information, including identifying the recipients of health information (Braunack-Mayer and Mulligan 2003).

2.2.2 WHO PARTICIPATES IN COMMUNICATION, WHAT IS COMMUNICATED, AND HOW IS IT COMMUNICATED IN HEALTH FACILITIES?

Communication among health professionals in health facilities has been reported to involve various groups of health professionals and communicated in different ways and spaces, as shown in the studies below.

Several studies have shown that written information, such as the recording of tasks undertaken and patient monitoring, plays a crucial role in communication among nurses within newborn units. For example, an ethnography conducted in three newborn units in Nairobi, Kenya, used semi-structured interviews with 32 nurses and 250 hours of non-participatory observation to explore how nurses conducted their activities in a challenging environment (McKnight et al. 2020). The study reported that one of the important forms of communication for the nurses was through written information using a form known as the Kardex. This hand-written form provided information about the treatment nurses gave to each patient, and it was updated at the end of each shift. The form was one of the ways of written communication that kept medical records for other health professionals working in the newborn unit. A second ethnographic study in three newborn units in Kenyan hospitals that used 29 in-depth interviews with nurses and 150 hours of non-participatory observation to understand their perspective on what is required to provide quality care within newborn units also found that written handover at the end of each shift was used to communicate information about patient management (Nyikuri 2020). The nurses in the study reported doing the handover either at the nurse station or bed-to-bed handover, with varieties depending on the time available for handover, familiarity with babies and medical emergencies. In addition to written handover, the availability of written and pictorial standards or guidelines of practice on the walls of the newborn units provided information for new nurses on how to perform different tasks, such as calculating feeds, fluids and medication.

In the 1990s, in the United States, Froehlich reported that as part of a continuous quality improvement project, a task force developed a paper-based written communication involving an interdisciplinary system to document the progress of babies admitted to a newborn intensive care unit (NICU) in a hospital in the United States. The author reported on the hospital's plan to improve documentation quality, reduce duplication, improve communication and enhance team participation (Froehlich 1996). However, there could be improvement in the reporting system since then.

Besides hard-copy written communication, health professionals have also been found to communicate increasingly using online text-based communication. For example, a recent exploratory qualitative study using an ethnographic approach to examine intra-and inter-personal teamwork in three newborn units in hospitals in Kenya employed 250 hours of observation and in-depth interviews with 17 nurses, nursing students, doctors, and trainee doctors and reported the use of messaging involving applications such as WhatsApp for official communication (Jepkosgei et al. 2022). The paper did not clarify whether there are specific WhatsApp groups for specific cadres of health professionals. However, the authors reported that some information shared between doctors and nurses through this method was duty rosters and meeting plans. Doctors use WhatsApp to request medical advice from their colleagues and seniors not in the ward when they need assistance. Nurses used WhatsApp to discuss and provide informal feedback to their colleagues on missed care or errors.
The use of written online platforms in high-income countries was also reported in a study involving 739 interdisciplinary health professionals working in newborn units in 54 hospitals

in the United States to assess the use of an internet-based reporting system for medical errors in neonatal intensive care (Suresh et al. 2004). The authors reported that health professionals embraced the platform for self-reporting various medical errors and adverse events, such as wrong doses, medication, and schedules. Reporting these errors allowed them to learn from their mistakes and make amendments.

Besides written communication, papers have reported in-person verbal communication between various groups of health professionals. There is communication between nurses and doctors, as reported by Nyikuri et al. Based on the same study mentioned earlier, this paper aims to understand the state of nurses in three newborn units in Kenya (Nyikuri et al. 2019). It reports that nurses and doctors communicated verbally during activities such as the ward rounds. Nurses reported that the availability of senior nurses and doctors in the ward round facilitated teamwork by allowing junior nurses to ask questions. Another paper that reported on communication between nurses and doctors is from an ethnographic study undertaken using unspecified semi-structured interviews, observations, and focus groups in three clinical areas of an Australian tertiary paediatric hospital. Nurses and doctors communicated regarding patients' medication, including pain relief doses and medication changes when required (Borrott et al. 2016).

More papers have reported on in-person verbal communication among various groups of health professionals (Ntinga and van Aswegen 2020; Tan, Zhou, and Kelly 2017a; Allen 2002). In his book, *The Changing Shape of Nursing Practice: The Role of Nurses in the Hospital Division of Labour,* Allen argue that verbal communication among paediatricians, doctors and clinical officers happens during the medical rounds (Allen 2002). Sometimes, this team included nurses in their discussion, mainly when there were inquiries about the patient’s progress or a medical emergency. Furthermore, a study was conducted to establish physiotherapists’ perceptions of interactions with other team members. Data was collected in four private and four public intensive care units (ICU) in South Africa, involving 39 physiotherapists in semi-structured group discussions. Physiotherapists had both positive and negative interactions with doctors and nurses. This experience was based on the mood and attitude of other health professionals and their willingness to interact and engage with them (Ntinga and van Aswegen 2020). A review of 22 papers on nurse-physician communication, all from high-income countries except one, shows the differences in the communication styles between nurses and doctors referred to as physicians. Nurses' communication included making self-introductions, humour, listening, empathy and immediate response. Physicians were found to communicate 1.46 longer than nurses, articulating their opinions significantly more than nurses who tended to agree with physicians.

In-person verbal communication is also reported within one group of health professionals, such as among nurses, as discussed in a study conducted in the NICU of a hospital in Sweden (Bry and Wigert 2022a). Through semistructured interviews with 13 nurses, they reported communicating verbally with each other. Their communication had positive experiences involving talking and laughing. However, sometimes, nurses acknowledged challenges involving colleagues communicating negative messages about what was done wrong without saying anything positive.

Another way health professionals communicate verbally is through virtual platforms, as reported in a study conducted in the United States, to understand the communication between resident doctors and nurses in the setting of a new communication tool created within electronic medical records (Haykal et al. 2020). The survey was conducted in an internal medicine department in a hospital, involving 77 nurses and 31 resident doctors. Findings show nurses and resident doctors used and agreed that phone calls for communication were faster and safer for urgent and non-urgent matters such as insomnia, pain and diet. Electronic medical records and new communication tools, such as e-messaging for non-urgent issues, substituting a certain number of phone calls. However, the e-messages had limitations, such as delays in providing answers to nurses and disruption of the nursing workflow.

Some studies have reported on verbal and written communication among health professionals in health facilities. For example, this was observed in a study to examine interprofessional communication and collaboration in caring for children with chronic conditions such as neurological conditions and type 1 diabetes mellitus in Brazil (Schimith et al. 2021). Interviews with 34 physicians and 45 nurses revealed that they used verbal in-person communication, virtual verbal communication (such as telephone), and written communication. Due to the complexity of patients' health problems, diverse professional knowledge was required, necessitating interprofessional collaboration among various health professionals, including doctors, nurses, psychologists, nutritionists, physical educators, physiotherapists, social workers, and dentists. Furthermore, a mixed-method study employing cross-sectional and phenomenological approaches was conducted in four public hospitals in Ethiopia to assess nurse-physician communication in patient care (Jemal et al. 2021). A total of 440 nurses and physicians participated in the study. The findings showed varied written and verbal communication between nurses and physicians, ranging from "never" to "always" when discussing patient management, such as treatment and discharge plans. The lack of communication was attributed to the negative attitudes of some health professionals and a challenging working environment.

Besides verbal and written communication, numerous studies have examined non-verbal communication. For example, a study to analyse verbal and non-verbal communication in an operating room used ethnographic observations of health professionals such as surgeons, registrar doctors, scrub nurses, scouts, anaesthetists and anaesthetic nurses in an operating room in a hospital in Australia (Moore et al. 2010). The authors reported that non-verbal communication, including posture and orientation, played a vital role during a challenging rectal tumour procedure. The registrar doctor’s body alignment and head movements signalled their primary surgical role and reluctance for verbal exchange. In contrast, the specialist's shifting body position and gaze indicated frustration and a desire to reconfigure roles. Authors argue that non-verbal communication is crucial in the operating room yet often overlooked, and this paper shows it can be measured. Another study on the silence discourse in an operating room in the United States used semi-structured interviews with eight attending surgeons, nurse anaesthetists, anesthesiologists, and medical students reporting silence as non-verbal communication. Findings showed that silence in the operating room is meaningful, signalling team actions and responses. It fosters focus and communication but can also create tension. Brommelsiek and colleagues argue that homogeneous silence indicates team agreement. Disparate silence is defined as an individualised silence, occurring as a solitary phenomenon in response to another team member's actions, which reflects individual disagreement or defiance (Brommelsiek et al. 2021).

Another form of non-verbal communication among health professionals in health facilities reported in the literature is using traces – non-verbal cues left in the environment that others perceive and respond to. This was reported, for example, in a study to explore how health professionals conceptualise trace-based communication, employing 25 semi-structured interviews with multiple disciplines, including surgery, anesthesiology, psychiatry, internal medicine, geriatrics, neonatology, paramedics, nursing, intensive care, neurology and emergency medicine in an acute care hospital in Canada (Cristancho and Field 2020). Some of the traces respondents reported are nurses leaving *ophthalmoscopes* by patients' bedsides to signal doctors to expedite discharge. Another example is doctors leave medical tools to indicate to occupational therapists that it is not a good time to take the patient.

2.2.3 FACTORS AFFECTING EFFECTIVE COMMUNICATION AMONG HEALTH PROFESSIONALS IN HEALTH FACILITIES.

The study to understand how nurses cope in stressful situations in Kenya, which I have discussed in the previous section, reported that a high workload can cause poor communication among health professionals because of a lack of time to engage. The high workload was attributed to inadequate financing, resulting in too few staff (Nzinga et al. 2019). Similarly, a systematic review of 65 articles on burnout among healthcare professionals in Sub-Saharan Africa, including physicians, nurses, midwives, and medical and nursing students, reported that low staffing levels led to high workloads (Dubale et al. 2019). This contributed to burnout and poor emotional well-being, leading to poor communication. Crowding and lack of privacy were also mentioned to contribute to inadequate communication among health professionals.

A cross-sectional study in seven African countries to examine provider pre-service education and training in integrated management of childhood illness used data from Service Provision Assessment (SPA) surveys and interviews with caretakers of sick children in 3898 facilities (Larson, Leslie, and Kruk 2017). The findings showed that health professionals' training in child care and a support supervision visit enabled them to score higher on communication among themselves. Similarly, an integrated review of 22 studies, all from high-income countries except one from LMIC, examined current evidence on factors impacting nurse-physician communication and interventions developed to improve it (Tan, Zhou, and Kelly 2017b). The findings revealed that current interventions only address the information needs of nurses and physicians in limited situations and specific settings, failing to address the interprofessional communication skills lacking in practice adequately. For meaningful change, the authors recommended interprofessional education programmes focusing on effective communication strategies to begin at the undergraduate level and continue into practice.

Another factor affecting communication mentioned in the literature is cultural diversity. For example, in the chapter on professional communication and team collaboration in their still widely used handbook for nurses on Patient Safety and Quality in the United States, O'Daniel and Rosenstein say that because the United States has health professionals from various cultural backgrounds, this may create barriers to communication (O'Daniel and Rosenstein 2008). They suggest that in some cultures, being assertive or speaking up is inappropriate behaviour, and health professionals may be afraid to communicate their opinions. They may communicate them indirectly in ways that make sense to them but not to those receiving the message. They argue that cultural barriers can also hinder non-verbal communication where there are differences in the meaning of gestures, such as eye contact and nods of the head.

Several papers have mentioned hierarchy as affecting communication among health professionals. For example, a study examined how the hierarchy in health organisations is perpetuated through communication and negotiated through group interaction. It used a qualitative approach that included both observation and interviews with 49 physicians, nurses, pharmacists, clinical care coordinators, nutritionists, social workers, translators, child life specialists, speech-language pathologists, physical therapists, occupational therapists and respiratory care managers in a children's hospital in the United States (Noyes 2021). The study found that group hierarchical power dynamics reinforced conversations in medical settings, with senior doctors dominating teaching and research roles. Non-physicians were often excluded from educational activities and authorship, highlighting the perceived expertise and authority disparity. Senior doctors asserted decision-making power, usually overriding other groups of health professionals and marginalising non-medical staff in communication.

Similarly, a mixed-method study undertaken to identify health professionals' perceptions towards interprofessional collaborative practice used a validated Collaborative Practice Assessment Tool to survey 290 health professionals and subsequently conducted nine focus group discussions with health professionals in primary healthcare facilities in Indonesia (Findyartini et al. 2019). Their findings showed that hierarchy in a team based on seniority, experience, and culture led to ineffective communication among health professionals. In the Curacao Hospital case report discussed earlier, the authors described the negative effect of hierarchy on communication (Busari, Moll, and Duits 2017). The authors recommend addressing hierarchy to support mutual respect and interdisciplinary collaboration.

The hierarchy was also mentioned as a communication barrier in a study investigating the impacts of work relationships on clinical outcomes with a focus on assessing disruptive behaviours. Disruptive behaviour was defined as any inappropriate behaviour, confrontation, or conflict, ranging from verbal abuse to physical and sexual harassment during care provision. This study surveyed 50 hospitals in the United States to reach over 1500 health professionals from various disciplines (Rosenstein and O'Daniel 2005). Participants reported disruptive behaviours such as physicians' lack of respect for nurses due to hierarchy. This contributed to inadequate communication because the nurses were scared to communicate with those physicians they perceived rude.

Newborn care takes place in a dynamic environment characterised by the presence of various health professionals. The American Academy of Paediatrics' technical report reviewed the education, training, competency requirements, and scopes of practice of different neonatal care providers working in NICUs (Keels et al. 2019). They argued that the NICU provider workforce comprises various professionals at different stages of their careers with a wide range of degrees, training, experience, skills, and competencies. In addition to multiple groups of health professionals, there is a call to increase the engagement of families in caring for babies. An integrative review examining parental empowerment through active participation in NICUs included 13 studies, eight from high-income countries and five from LMICs (Gómez-Cantarino et al. 2020). Findings also stress the application of family-centred care to enhance the involvement of parents in care, favouring family attachment by integrating them into the health team and, in turn, empowering them to achieve more humanised attention.

The newborn unit setting is often described as busy and sometimes loud, with significant activity and interaction. For example, a review of sound reduction management for preterm or very low birth weight infants in NICUs included one eligible study conducted in the United States (Almadhoob and Ohlsson 2020). This study found that sound levels in NICUs are louder than in most home or office environments, including disturbing noises of short duration and irregular intervals. Competing sound signals frequently challenge preterm infants, staff, and parents, indicating the need for interventions such as the use of earplugs. Additionally, a descriptive, quantitative study using observational and sound level measurements was conducted over 21 different periods: seven days, seven evenings, and seven nights. This study took place in the NICU in a perinatal centre in Canada, with a total capacity of 24 infants. The author reported that, on average, sound levels were 14 times louder than recommended, roughly equivalent to the sound of a constantly running vacuum cleaner. As the number of neonates and healthcare professionals in the NICU increased, so did the sound levels (Mayhew et al. 2022).

2.2.4 RELEVANT COMMUNICATION FRAMEWORKS IN HEALTH FACILITIES

Several frameworks have been used to study communication in health facilities. I will discuss the strengths and weaknesses of the relevant framework below. The first framework was developed to assess communication between parents and health professionals in NICU using a review of 43 documents and a thematic analysis of findings (Wreesmann et al. 2020). Following the analysis of findings, the authors proposed a NICU Communication Framework, which categorises communication functions into four parts: building/maintaining relationships, exchanging information, sharing decision-making, and enabling parent self-management. The framework also proposes five factors contributing to adequate communication across these functions: topic, aims, location, route and design. While this framework informs the categorisation of functions of communication and factors affecting them, its focus is on communication in NICUs in general, without particular consideration for technology-associated communication. Additionally, the framework focuses on the communication between parents and health professionals without including communication among health professionals.

The second framework was developed following 17 semi-structured interviews with senior neonatologists of six perinatal centres of the highest level of care in Germany, focusing on breaking bad news to families in neonatology (Seifart et al. 2022). The authors proposed eight determinants of breaking bad news, which informed the development of a conceptual framework called NEO-SPEAK. The first three determinants, Neonatal prognostic uncertainty, Encounter in partnerships and Organisation and teamwork (NEO), relate to the specific care situation in neonatology. The remaining five determinants, Situational stress, Processuality, Emotional burden, Attention to individuality, Knowledge and experience (SPEAK), relate to difficult conversations and can be modified based on the situation. This framework helps examine the context in the newborn units and the effects of individuals and teams on breaking bad news. However, this framework is specific for bad news sharing with parents and does not include communication among health professionals or those who specifically use technology.

The third is the patient-provider communication framework by Feldman-Stewart and Brundage, which was developed following the integration of other communication frameworks, such as the communication process (Berlo 1960) and clinical communication models (Riccardi and Kurtz 1983; Ross 1977). This framework applies to in-person interactions between health professionals and competent adult patients, with potential extensions to include family and caregivers. It builds on classic communication models and emphasises participant goals, individual attributes (needs, beliefs, values, skills, and emotions), the dynamic communication process (including verbal, non-verbal, and silent messages), and the complex environment influencing communication. This framework aims to enhance understanding and improve clinical use of patient-reported outcomes (PROs)

(Feldman-Stewart and Brundage 2009). The strength of this framework lies in its comprehensive approach to patient-provider communication, integrating key elements from existing models and emphasising participant goals, individual attributes, and the iterative nature of communication. It considers the complexity of the communication environment and includes various message types. However, this framework primarily focuses on communication between health professionals and patients. The framework does not address the challenges and dynamics of technology-mediated communication among health professionals.

Following a scoping review of 138 articles on the strategies to improve interpersonal communication in maternal and newborn care, Olde Loohuis and de Kok updated Feldman-Stewart and Brundage's framework to make it more inclusive (Olde Loohuis et al. 2023). Some updates include changing the "patient" title to "women and partners" to show that the communication involves women and their partners. The authors also reformulated the communication process as the interaction between health professionals, women and partners to emphasise its bidirectional nature. This bidirectional nature was already acknowledged in the paper by Feldman-Stewart and Brundage, and the updated framework used a double arrow. The revised framework included three communication goals: to facilitate information exchange, create a good interpersonal relationship, and enable the inclusion of women and partners in decision-making.

2.2.5 COMMUNICATION VERSUS DECISION-MAKING AMONG HEALTH PROFESSIONALS

Various authors have reported that communication is important for decision-making among health professionals in health facilities. For example, a book chapter on decision-making in clinical practice provides an overview of the decision-making among health professionals during the diagnosis, assessment of the severity of patient condition and management (Hardy and Smith 2008). The authors argue that communication among doctors, nurses, specialists, and other health professionals, based on their expertise, evidence, and patient data, typically facilitates decisions such as diagnosing medical conditions, selecting treatment options, and adjusting treatment plans.

More than 20 years ago, Christensen and Larson (1993) analysed collaborative medical decision-making across multiple settings and argued that communication enhances collaboration, which helps in better decision-making. Through communication, health professionals such as physicians and nurses become aware of each team member's expertise and talents, which enhances collaboration and leads to better decision-making and improved communication. Another study investigating communication and decision-making examined the ethical implications of three cases in Australia where health professionals disclosed patient information without consent, arguing it was in the patient's best interest (Braunack-Mayer and Mulligan 2003). The authors noted that a lack of communication between health professionals in decision-making could lead to ethical and legal issues. This underscores the importance of communication in decision-making as health professionals collaborate on patient confidentiality, informed consent, and adherence to healthcare laws and regulations.

On the other hand, decision-making has been highlighted as important in communication among health professionals. For example, fifteen years later, O'Daniel and Rosenstein (2008) highlighted the relationship between communication and decision-making among health professionals in their widely used handbook for nurses in the United States, focusing on patient safety and quality. They underscore that the right decisions foster communication and team collaboration, forming a continuous loop where each reinforces the other (O'Daniel and Rosenstein 2008). In neonatal care, a recent survey conducted at a NICU in the United States involving 113 health professionals and parents underscores the interconnectedness of decision-making and communication (Masten et al. 2019). Decision-making processes in this context facilitated communication among health professionals, pivotal in mitigating frustrations and conflicts among team members. The study highlights the importance of feedback loops involving superiors, nurses, and physicians to foster collaborative decision-making and ultimately enhance the quality of care provided in NICU settings.

Evidence shows that communication among health professionals can influence decision-making processes in healthcare, while decision-making can also shape communication. In this thesis, I focus on how communication among health professionals contributes to shaping decision-making in the use of CPAP and phototherapy.

2.3 COMMUNICATION IN TECHNOLOGY USE AMONG HEALTH PROFESSIONALS IN NEWBORN CARE.

There is a growing literature on communication among health professionals using newborn technologies. In this thesis context, technologies are discussed in two main categories: one focused on information and communication technology (ICT) and the second on all the remaining technologies supporting other care aspects (such as CPAP and phototherapy).

I first discuss communication among health professionals associated with Information and Communication Technology (ICT). In the literature, ICT has been referred to using various terminologies or categorised in many ways. For example, the widely cited paper by Aceto et al. that discusses the role of ICT in healthcare through the study of more than 300 papers argues that there is inconsistent use of terminologies and grouping of ICT in the literature (Aceto, Persico, and Pescapè 2018). Authors of the paper provide an understanding of a wide range of ICT, which they have grouped into e-health (electronic communication and information technology in the health sector, including the Internet), mobile health (including smartphones, mobile applications and integrated mobile telemedical monitoring systems), and personalised health (including technologies that provide care according to user needs of medication, monitoring or any other service). Other groups are smart health (including smart cards, robots, sensors, and telehealth systems via the Internet), ubiquitous health (such as wireless monitoring devices), and pervasive health (such as the Internet of Things (IoT), which is based on intelligent and self-configuring nodes that makes available virtually unlimited storage and processing power).

The World Health Organisation (WHO) has interchangeably used ICT and eHealth terminologies in discussing a wide range of technologies to improve health information systems, patient engagement, and interactions (WHO 2005, 2013). WHO argues that it becomes digital health when eHealth encompasses other developing areas, such as advanced computing sciences, data analytics, artificial intelligence, machine learning, and robotics (WHO 2020b). In this research, I have flexibly used different terminologies referring to ICT to allow the inclusion of a wide range of technologies that aim to facilitate communication and information among health professionals.

Information and communication technologies are gaining global policy attention. In 2005, 194 member states made the first ICT resolution, WHA58.28, at the World Health Assembly, which is the decision-making body of WHO. They agreed to include eHealth in a long-term strategic plan, including infrastructure development (WHO 2005). This resolution was further developed in the 2013 World Health Assembly when resolution WHA66.24 was adopted to encourage the standardisation of eHealth strategies at the national level. Standardisation ensured that policies and legislation were linked to the eHealth strategy (WHO 2013). In 2018, member states in the World Health Assembly recognised the need to strengthen digital health implementation. They adopted resolution WHA71.7 on digital health, which led to consultations with stakeholders and countries to develop a global strategy for digital health (WHO 2018). The WHO launched the Global Strategy on Digital Health 2020-2025 to support equitable and universal access to digital health services for quality health services. This strategy aims to enhance the efficiency and sustainability of health systems in delivering quality, affordable, and equitable care (WHO 2020b).

The role of ICT in improving communication among health professionals is discussed in the literature. This was reported, for example, in a review of 45 articles, with ten articles from

LMICs, 33 from high-income, and two from the global level, which aimed to describe the evidence about digital health tools (Castiglia et al. 2023). Technologies included were digital tools such as social media, mobile applications and websites. Communication improved through services such as digitalising electronic medical records, patient appointment booking, raising awareness, providing health education, and patient involvement in medication. Digital technology was also used to analyse patient satisfaction and evaluate vaccination interventions for quality of care improvement. There were similar findings from a review assessing the evidence for the impact of mobile technologies on communication, including 38 papers, with 35 from high-income and three from LMICs (Martin et al. 2019). The authors report that mobile technology involving mobile applications, WhatsApp messenger, and generic smartphones can improve workflow, strengthen the quality and efficiency of communication, and enhance accessibility and inter-team relationships.

Literature on newborn care also shows that ICTs improve communication among health professionals. For instance, a review of 11 papers, all from high-income countries with five quantitative, two qualitative, and four mixed methods, was conducted to understand health professionals' perceptions regarding the use of technologies in newborn intensive care units (Epstein Eg Fau - Arechiga et al. 2017). It reviewed technologies such as videoconferencing, videophone, and commercially available modalities such as Skype and FaceTime web cameras. The paper reports that health professionals perceived the interventions to positively improve communication in newborn care. However, the authors suggested that this area has limited research and called for more research to understand the area further. Similar positive findings were from a scoping review of 141 articles, all from LMICs, to understand the current state of health care and information and communication technologies for maternal and child health in LMICs. The technologies included were mobile apps, SMS text messaging, voice messaging, web-based applications, social media, movies and videos, and wearable or sensor-based devices. The technologies provided care to patients through health education, empowering people to participate in health activities and ensure follow-up and patient care (Till et al. 2023).

The literature shows that mobile technologies, telemedicine, and other digital tools support clinical decisions, reduce emotional stress among health professionals, and improve health workers' performance (Borges do Nascimento et al. 2023). This was reported in the first systematic review to interpret the effect of digital technologies on the competency and performance of health professionals. It included 123 published studies using qualitative, quantitative, and mixed methods and data from 298,000 health professionals globally, conducted in partnerships between researchers and World Health Organisation experts. The study included 32 studies from Africa, 71 from Asia and the rest from Europe, North America and Australia. Technologies of focus in the review were (i) telemedicine, telehealth, telemonitoring, and remote monitoring technologies, (ii) mobile health technologies, electronic medical records or electronic health systems, (iii) clinical decision support systems,(iv) artificial intelligence system and (v) miscellaneous such as clinical reminders and alert systems. Authors argue that digital technologies improve care delivery and access to care. Another mentioned advantage of digital health is decreased communication gaps and improved inter-professional networking and relationships (Borges do Nascimento et al. 2023). The World Health Organisation endorsed those findings in their internal publication as a call to the government and other stakeholders to support the adoption and use of digital technologies among health professionals (WHO 2023a).

Another systematic review of 10 articles (seven from high-income countries and three from LMICs) also supports the idea that some ICTs can support health services. The study aimed to identify scientific evidence on the use and results of information and communication technologies (ICTs) for improving neonatal health (Duran et al. 2020). The authors categorised these technologies into telemedicine, mHealth (involving videoconferencing and telephone contact), and eLearning technologies, which leverage information and communication technologies for educational purposes. There were variations in the outcome of using various technologies. For example, the use of telemedicine helped with the adherence of visits from women during postnatal care and pregnant women with diabetes. At the same time, tele-education training showed no difference compared to classroom neonatal resuscitation training.

In this section, I have presented some literature to help understand communication in ICTs. However, there are still gaps in evidence, including studies in LMICs.

The second category of literature on communication among health professionals using newborn technologies discusses technologies which are not ICTs. The primary focus of these technologies is not to facilitate information and communication. Instead, they provide other care aspects, such as CPAP and phototherapy. Communication in using these technologies has less attention, including the lack of policy to support implementation. This is contrary to ICTs, which have relatively more evidence and policy support. There is also little understanding of the topic, particularly in LMICs. My research focuses on this category of technologies. I conducted a scoping review of the literature involving these technologies to examine what is known and the gaps in understanding communication among health professionals in newborn care. I discuss the findings from the scoping review in the following sections.

2.4 A SCOPING REVIEW OF COMMUNICATION IN TECHNOLOGY USE AMONG HEALTH PROFESSIONALS IN NEWBORN CARE.

A scoping review is a knowledge synthesis method that employs a systematic and iterative process to identify and synthesise the existing or emerging literature on a specific topic (Thomas et al. 2017). The approach focuses on identifying the quantity and variety of available studies and literature, providing an overview of their subject matter. This review is beneficial for determining the range of evidence within a field, clarifying essential concepts and definitions found in the literature, scrutinising the research methods utilised in a particular topic or area, and showing areas where further research is needed (Munn et al.

2018; Mak and Thomas 2022; Arksey and O'Malley 2005). In this study, the scoping review approach helped identify what research had been undertaken on communication among health professionals around the use of newborn technologies and the outputs or knowledge produced by this research. This information helped refine my research questions and develop an initial conceptual framework to guide the study.

2.4.1 METHODS

I developed a protocol (Annexe 2.1) to guide the scoping review. My scoping review was informed by the methods described in two publications. The first is the Joanna Briggs Institute Manual for Evidence Synthesis. It guides various methodological aspects, including determining when a scoping review is suitable and how to extract, analyse, and present findings. It offers insights into the implications for both practice and research (Peters et al. 2020). The second is the Preferred Reporting Items for Systematic Review and Meta-Analysis Extension for Scoping Reviews (PRISMA-ScR). The PRISMA-ScR aims to offer direction on how to report scoping reviews effectively. The original Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement were adjusted to create this extension. Five items from the original PRISMA checklist were deemed irrelevant for scoping reviews. These items are 13 (summary measures), 15 (risk of bias across studies), 16 (additional analyses), 22 (risk of bias across study results), and 23 (additional analysis results). Scoping reviews may include various evidence types (documents, blogs, websites, studies, interviews, opinions) and do not assess the risk of bias of included sources. Unlike systematic reviews, scoping reviews aim to provide an overview of existing evidence without critically appraising the sources. Critical appraising the proof of quality in scoping reviews is optional. This reporting guideline aligns with the Joanna Briggs Institute guidance for scoping reviews, emphasising the significance of methodological rigour (Tricco et al. 2018). A copy of the PRISMA-ScR is in Annexe 2.2.

My review was designed to answer two questions:

1. How do health professionals using technologies communicate in the newborn care setting? (Consider who is involved, the content of the communication, and the space where communication occurs).
2. What factors shape communication among health professionals using technologies in newborn care within hospital settings, and how do they impact this communication?

SEARCH STRATEGY AND SOURCE OF LITERATURE

I conducted the first round of literature searches between June and August 2021 and updated the list in October 2023 to add any new papers published since August 2021. I searched relevant websites and seven databases: PubMed, Web of Science, Scopus, Embase, ERIC, Cochrane Library, and Google Scholar.

I identified five keywords to guide the search for papers and the inclusion and exclusion criteria. These were communication, technology, health professionals, neonates, and health facilities. The search terms used to identify articles on PubMed were: (((("communication" OR "interaction*") AND ("Health professional*" OR "Health worker*" OR "workforce*" OR "human resource for health" OR "Healthcare worker*" OR "nurse*")) AND ("Technolog*" OR "innovation*" OR "medical?device*")) AND ("Neonat*" OR "new?born*" OR "bab?*" OR "below 28 days" OR "less than 28 days")) AND ("Hospital*" OR "ward*" OR "health cent?*" OR "neonatal unit" OR "new?born unit" OR facilit*")

ELIGIBILITY CRITERIA

For this scoping review, I adopted the definition of communication used by the World Health Organisation, which refers to providing information, guidance, and advice to protect the health of individuals (WHO 2017). I defined technology as an innovation, a device, or a process introduced to change the existing practice or improve newborn care (Lunze et al. 2015; WHO 2016b, 2023b). I excluded studies on information and communication technology (ICT) because, as noted above, I wanted to focus on examining the communication process concerning technology rather than examining how technology serves as a communication medium.

I included the literature about all disciplines of health professionals working in neonatal care. I adopted the neonate definition of a baby from the day of delivery up to 28 days of life (WHO 2023c). I included literature on health facilities at all levels, including primary health care centres, district or first referral, and specialised and general hospitals as defined by the World Health Organisation (WHO 2009). I have highlighted in Table 2.1 below further criteria for including studies in the scoping review:

ARTICLES SELECTION CRITERIA	
Period	• I did not put a time limit on the research data collection or article publication.
Document type and location	• Unpublished and published literature including empirical studies, commentaries and viewpoints. • Articles that discuss the use of one or multiple technologies in newborn care regardless of the geographical location.
Language	• I included only articles published in English.
Research method	• Studies that used qualitative, quantitative, and mixed methods.
Quality	• Since the review aim was to scope the available evidence, I did not consider the quality of the articles.

Table 2.1 The Criteria for Including Studies in the Scoping Review.

DATA CHARTING AND SYNTHESIS

I screened the article titles to include studies that met the screening criteria and removed duplicates. The abstract review followed this to determine the eligibility of articles. I read the full texts of articles that met the inclusion criteria and the references of key articles to scan for other eligible articles. I presented data to my supervisors for quality assurance throughout the review process.

I developed a data extraction management tool on Microsoft Excel, which captured information on included studies, including the author (s), year of publication, geographical location, methodology, technology type, and limitations. Informed by previous studies, columns in my tool also documented findings based on identified essential areas in healthcare communication: groups of health professionals involved in the communication (Oliveros, Brailovsky, and Shah 2019), ways of communicating (Vermeir et al. 2015; Chichirez and Purcărea 2018; Oliveros, Brailovsky, and Shah 2019), information content (Vermeir et al. 2015; Schroeder et al. 1999), time the communication took place and the quality (Chichirez and Purcărea 2018) and factors affecting communication (Vermeir et al. 2015; Chichirez and Purcărea 2018; Oliveros, Brailovsky, and Shah 2019).

2.4.2 RESULTS

CHARACTERISTICS OF PAPERS

The first search yielded 7771 articles. After reading the titles, I excluded 7619 papers, including duplicates. I had 152 articles for abstract review. After reviewing 152 abstracts, ten articles passed to the final stage of full-length review. I also included three articles from the relevant article references to make the final list of papers 13. These 13 papers reported 12 studies with publication years between 2015 and 2023. Figure 2.1 summarises the process of choosing scoping review articles.

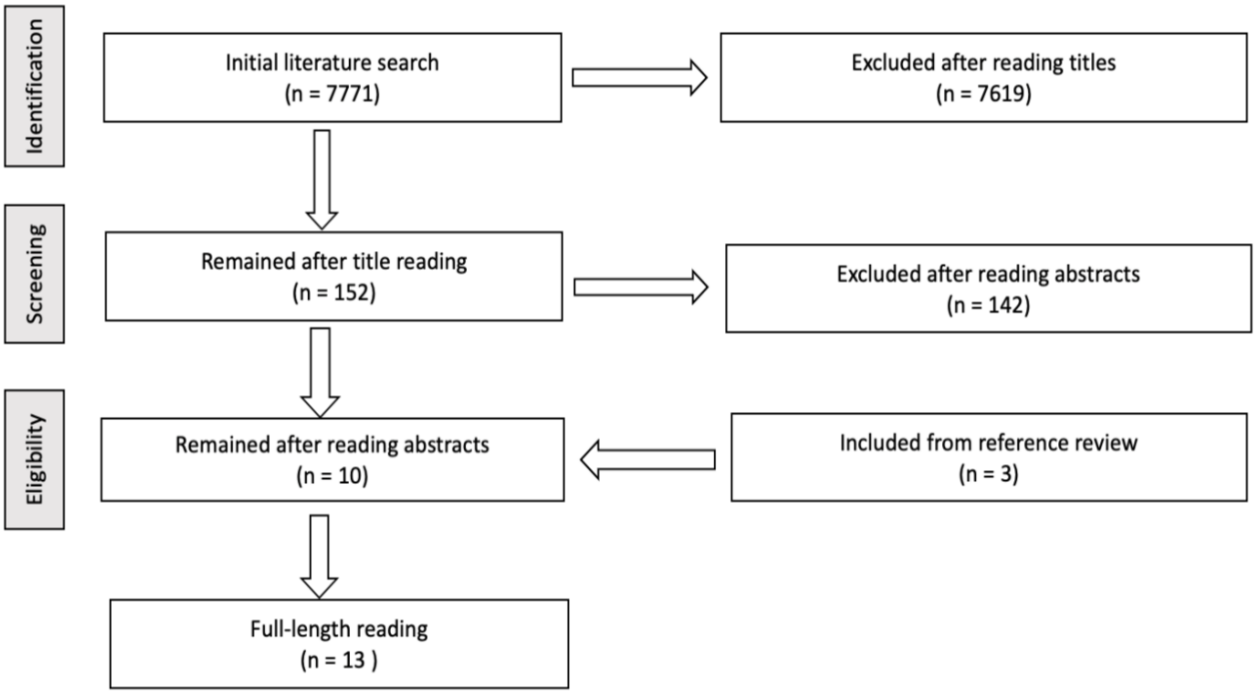


Figure 2.1: Scoping Review Chart Highlighting the Screening and Selection Process.

Of the 13 articles in the scoping review, there were 12 studies, with one having two papers (Nyondo-Mipando, Kinshella, et al. 2020; Kinshella et al. 2020). Eight studies were from low- and middle-income countries, while four were from high-income countries. As shown in Table 2.2, these studies reported on various technologies: Continuous Positive Airway Pump (CPAP) in six studies, reported in seven papers, and one study each reported on phototherapy, pulse oximeter, SaferBirths Bundle of Care, non-invasive neonatal heart rate monitoring device, paediatric extracorporeal membrane oxygenation and oxygen therapy. Most studies examined a single technology, except for one, which discusses a bundle of technologies in Tanzania (Mdoe et al. 2023). While one study focuses explicitly on CPAP, participants also mentioned a ventilator in their responses (Dewez et al. 2018).

Regarding the health facility levels where the studies were conducted, one study focused on primary health care (Agarwal et al. 2023), while the rest reported on health professionals in the newborn units in secondary and tertiary hospitals. Qualitative methods and single-country studies were predominant. Nine of the twelve studies employed in-depth interviews with the number of participants and facilities involved varying between 12 and 46 participants and covering staff working in one to 21 health facilities. Four of these qualitative studies reported using focus group discussions and in-depth interviews. Two studies used quantitative methods: one was an observational and online survey with 121 participants from a hospital in the United States (Nater et al. 2023); the second involved a self-assessment checklist completed by 113 health professionals across 11 hospitals in Malawi (Asibon et al. 2020). The study in Malawi used mixed methods comprising a facility assessment and 31 qualitative interviews in three hospitals (Kinshella, Salimu, et al. 2022). None of the studies included in the review reported using an ethnographic approach.

While communication was not the primary focus in any of the studies, it arose as a key issue for the participants and the authors in investigating issues such as functionality, acceptability, feasibility and perceptions. For example, communication emerged as a challenge in a study to examine the feasibility and acceptability of the paediatric pulse oximeter in the integrated management of neonatal and childhood illnesses services across six primary health facilities in India (Agarwal et al. 2023). Similarly, a study by Anton et al. examining the functionality and acceptability of a novel non-invasive neonatal heart rate monitoring device in three NICUs and one labour ward in the United Kingdom through 21 semi-structured interviews with health professionals reported communication among health professionals (Anton et al. 2020).

AUTHOR, YEAR	TITLE AND PUBLICATION YEAR	COUNTRY	TECHNOLOGY	METHODS
Dewez et al. 2018	Healthcare workers' views on the use of continuous positive airway pressure (CPAP) in neonates: a qualitative study in Andhra Pradesh, India.	India	Continuous Positive Airway Pump (CPAP)	• 18 in-depth interviews with doctors. • 8 focus group discussions with 51 nurses • 15 neonatal units in district and college hospitals.
Kinshella et al. 2020	Scaling up newborn care technologies from tertiary- to secondary-level hospitals in Malawi: an implementation case study of health professional perspectives on bubble CPAP.	Malawi	CPAP	• A secondary analysis of interviews with 46 health professionals (nurse, clinician, district health management). • 1 tertiary and 3 secondary-level hospitals.
Nabwera et al. 2020	Sometimes you are forced to play God horizontal ellipsis : a qualitative study of healthcare worker experiences of using continuous positive airway pressure in newborn care in Kenya.	Kenya	CPAP	• 16 key informant interviews and 15 focus group discussions among 100 healthcare workers in Kenya. • 19 Secondary and tertiary hospitals (15 public, 2 private and 2 mission).
Nyondo-Mipando et al. 2020	Barriers and enablers of implementing bubble Continuous Positive Airway Pressure (CPAP): Perspectives of health professionals in Malawi.	Malawi	CPAP	• 46 in-depth interviews with nurses, clinicians and district health managers. • 3 district hospitals and 1 tertiary hospital.
Aneji et al. 2020	Implementing bubble continuous positive airway pressure in a lower middle-income country: a Nigerian experience.	Nigeria	CPAP	• In-depth interviews and Focus Group Discussions with healthcare workers and hospital administrators (unspecified number). • 7 established hospitals.
Asibon et al. 2020	Using a peer mentorship approach improved the use of neonatal continuous positive airway pressure and related outcomes in Malawi.	Malawi	CPAP	• Assessment and self-evaluation checklist of 113 nurses. • 10 secondary and one tertiary hospital.

Agarwal et al. 2023	Feasibility and acceptability of the paediatric pulse oximeter in integrated management of neonatal and childhood illnesses (IMNCI) services by public health facilities: A qualitative study in rural Western India.	India	Pulse oximeter	• In-depth interview with Medical Officers (n=6) and Auxiliary nurse midwives (n=6). • 6 Primary Healthcare Centres .
Kinshella et al. 2022	Challenges and recommendations to improve implementation of phototherapy among neonates in Malawian hospitals.	Malawi	Phototherapy	• Mixed-method study comprised of a facility assessment and 31 qualitative interviews with nurses, clinicians, pediatric physicians and district health managers and caregivers. • 3 secondary-level hospitals.
Mdoe et al. 2023	Healthcare Workers' Perceptions on the "SaferBirths Bundle of Care": A Qualitative Study.	Tanzania	SaferBirths Bundle of Care Moyo (Fetal Heart rate), NeoBeat (Fetal heart rate meter) and upright bag mask.	• 21 focus group discussion with 106 midwives and doctors and 43 individual interviews midwives, doctors and staff in leadership role. • 4 Regional hospitals, 15 district hospitals, and 2 health centres.
Peeler et al. 2015	The experiences of parents and nurses of hospitalised infants requiring oxygen therapy for severe bronchiolitis: A phenomenological study.	Australia	Oxygen therapy	• A descriptive phenomenological approach to interview 12 Parents and 12 nurses • 1 tertiary paediatric hospital.
Lu and Li 2020	Action research on neonatal nursing staff: Experiences caring for bubble continuous positive airway pressure patients.	Taiwan	CPAP	• Interviews with 20 special care paediatric nurses. • 1 children's hospital.
Anton et al. 2019	Functionality and acceptability of a novel non-invasive neonatal heart rate monitoring device: a qualitative study of healthcare professionals.	United Kingdom (UK)	Non-invasive neonatal heart rate monitoring device	• Semi-structure interview with 21 paediatricians, midwives and neonatal nurses. • 3 Newborn Intensive Care Unit (NICU) and a labour ward.
Nater et al. 2022	Development of pediatric multidisciplinary extracorporeal membrane oxygenation simulations: A novel educational program to enhance team communication and emergency preparedness.	United States (US)	Pediatric extracorporeal membrane oxygenation	• Prospective, observational study and an online survey with 8 Paediatric Cardiac Intensive Care Unit attendings, 4 Advance Practice Nurses, 54 paediatric intensive care unit registered nurses, and 55 paediatric respiratory therapists. • 1 tertiary children hospital.

Table 2.2: Studies Involved in the Scoping Review

1. WHO IS INVOLVED IN COMMUNICATION?

Studies included in the review reported communication issues among health professionals in the newborn unit. While two studies did not specify the disciplines of health professionals investigated (Nabwera et al. 2020; Aneji et al. 2020), ten studies provided specific details. Two studies (presented in three papers) reported on health administrators or leaders as well as nurses and doctors (Nyondo-Mipando, et al. 2020; Kinshella, et al. 2020; Mdoe et al. 2023); one included communication between doctors, nurses, and paediatric therapists (Nater et al. 2023). Three studies reported on both nurses and doctors (Dewez et al. 2018; Agarwal et al. 2023; Anton et al. 2020). Two studies focused solely on nurses (Asibon et al. 2020; Lu and Li 2020). Another two papers described studies involving health professionals and parents (Kinshella et al. 2022; Peeler, Fulbrook, and Kildea 2015). This summary highlights nurses and doctors as the health professionals most frequently included. Nurses were reported in all ten studies that specified health professionals involved and doctors in 8 out of 10.

2. WHAT IS THE CONTENT OF COMMUNICATION AND HOW WAS IT COMMUNICATED?

Based on the information I have analysed from the scoping review, I have categorised what health professionals communicated into three groups: knowledge sharing, patient management, and patient monitoring and documentation. Decision-making cuts across all three categories, as I will discuss throughout the chapter.

KNOWLEDGE SHARING

Knowledge sharing on technology use through training is is a key component of communication about technology use. Various approaches to training on medical technologies were reported in the studies included in this review. One training approach involved using trained health professionals to cascade knowledge transfer from the centre to peripheral facilities (Training of Trainers). For instance, in their secondary analysis of data from the study to understand the implementation of CPAP in one tertiary and three secondary hospitals in Malawi,

Kinshella et al. reported that the training of trainers' model was adopted, whereby nurses from district hospitals received training at the tertiary hospital nursery and then cascaded this knowledge to their colleagues. They include a quote from a district nurse in their paper:

> *"I went to Queens, Chatinkha Nursery, where peers taught us about bubble CPAP. We were there for 5 days… When I went there, I had no knowledge about CPAP, so when I went there, I was taught a lot so that when I was coming, I was not the same as when I was going." District 3 hospital nurse, F, 26. (Kinshella et al. 2020, p 4).*

Similarly, a qualitative study examining the utilisation of CPAP in newborn care across 19 hospitals in Kenya documented that senior staff members underwent comprehensive training sessions. Subsequently, they disseminated their knowledge and skills to other health professionals during in-house educational meetings. A lack of training for some health professionals adversely impacted their decision-making regarding CPAP use. Consequently, there were instances where CPAP treatment was prematurely discontinued when patients were transferred to different staff members for care (Nabwera et al. 2020). There were instances when the training did not align with the decision-making practices in the trainees' facilities. This reportedly led to disagreement among health professionals regarding the decisions on the eligibility for CPAP treatment among premature newborn babies with birth asphyxia (Kinshella et al. 2020).

Another formal training approach documented in the paper by Mdoe et al. was simulation exercises. This study investigated health professionals' perceptions of the "SaferBirths Bundle of Care" in Tanzania and described the integration of simulation-based training in routine training in 21 hospitals. This training was informed by local data and feedback loops with simulation training tools such as manikins and a training manual incorporated into learning activities. Written communication was also used to help facilitate improvements in practice. Health professionals documented and used the information to plan simulation scenario sessions to enhance clinical skills (Mdoe et al. 2023). Similarly, within a tertiary children's hospital in the United States, simulation exercises for paediatric multidisciplinary extracorporeal membrane oxygenation were designed to address circuit and patient emergencies and foster confidence, teamwork and effective communication behaviours (Nater et al. 2023).

A study conducted in Nigeria investigated the implementation of CPAP in seven hospitals, where the training involved designated champions within each hospital facilitating hands-on interpersonal training sessions (Aneji et al. 2020). These champions played a crucial role in delivering peer mentoring and tailored training sessions to meet the specific needs of their respective hospitals. There were efforts to establish an online group for virtual written communication via *WhatsApp* among the champions during the initial stages of CPAP implementation. However, these efforts were unsuccessful. This failure was attributed to the staff under-utilisation of the platform across all sites. Only one champion from a single site actively used the platform for the programme communication. Aneji et al. argue that in addition to such training initiatives, written documents such as guidelines and protocols with visual aids should also be available so that health professionals and hospital administrators can refer to the standard practice of using CPAP in Nigeria. They recommend that "*effective communication and messaging for staff and caregivers with visual aids and scripting to improve ready acceptance of new technology is essential"* (Aneji et al. 2020, p 6).

The nature and duration of the formal training varied considerably across the studies, from a few hours a day to a week. In the Nigerian study, the training of trainers was reported to be just two hours long (Aneji et al. 2020), while the longest training was in four hospitals in Malawi, which lasted between five and seven days (Nyondo-Mipando, Kinshella, et al. 2020).

Some studies reported training led to positive outcomes. For instance, a study investigating the feasibility and acceptability of the paediatric pulse oximeter in six primary healthcare facilities in India found that training for auxiliary midwives and medical officers significantly boosted their confidence and contributed to positive decisions to use a pulse oximeter. The participants reported gaining comprehensive knowledge about symptoms, clinical presentation, severity grades, and appropriate medical treatments for affected children (Agarwal et al. 2023).

Another way of sharing knowledge reported in two of the studies was by using guidelines. In the Malawian research study undertaken in three secondary-level hospitals, written guidelines were available to assist health professionals in phototherapy. However, their use was reported to be inconsistent (Kinshella, Naanyu, et al. 2022).

> *"I have seen a coding guideline in the nursery where they have documented the values if you are using whether a bilibrinometer or bilirubin levels from the lab and also… where you can check. [For example,] maybe if you see that this patient is more jaundiced… If you ask most people… they don't understand most of it… I don't think they (the guidelines) are really used." Tertiary hospital physician (Kinshella et al. 2022, p 5).*

Similarly, in the study conducted in NICUs and a labour ward in the UK, participants were reported as recommending printed visual aids such as instruction sheets on resuscitation or pre-attached instructions on the non-invasive neonatal heart rate monitoring device as a means of communication (Anton et al. 2020).

In the study in Taiwan, a lack of experience with technology use was found to affect the willingness of nurses to accommodate babies who required CPAP. This, combined with inadequate communication, led to considerable stress. The nurses in the special care nursery expressed low confidence in a new care model because they had not been adequately warned or prepared for the change with the significant challenges it would bring. They expressed that babies on CPAP should be cared for in the NICU (Lu and Li 2020).

> *"The head nurse mentioned they only had less than a week of notice before the admission of CPAP patients. Our opinions were not taken into account. We were asked to care for these patients before we were psychologically prepared for it. No one agreed that these patients should be admitted to our unit. Isn't CPAP the ICU's job?" [Focus Group] (Lu and Li 2020, p 373).*

PATIENT MANAGEMENT

Another communication content among health professionals is information exchange on patient management. In a study to assess the peer mentorship approach to improve the use of CPAP in 11 hospitals in Malawi, health professionals discussed and made decisions to initiate CPAP for eligible newborn babies (Asibon et al. 2020).

In the studies included in this review, participation in decisions regarding technology use varied across health professionals involved in the review and the study context. In four hospitals in Malawi, nurses in secondary-level hospitals contributed to the decision-making process regarding CPAP usage. In contrast, in the tertiary hospital, autonomy in decision-making was primarily accorded only to doctors (Kinshella et al. 2020).

PATIENT MONITORING AND DOCUMENTATION

Health professionals communicated concerning monitoring and documenting the progress of babies who used technologies. For example, in the Malawian study examining the implementation of CPAP in one tertiary and three secondary hospitals, it was found that nurses, clinicians, and the district health management discussed the regular monitoring of breathing required for CPAP patients. This monitoring commenced within the first 15 minutes of CPAP initiation and was supposed to be followed by hourly checks and subsequently every four to six hours (Asibon et al. 2020).

3. IN WHICH SPACES DID HEALTH PROFESSIONALS COMMUNICATE?

Few data on the time or location of interactions and decision-making among health professionals regarding technology were available in the studies included in the review. However, one Malawian study on understanding the implementation of CPAP in one tertiary and three secondary hospitals reported that interactions among health professionals were more challenging at night because of fewer staff and increased workload (Nyondo-Mipando, Kinshella, et al. 2020).

4. WHAT FACTORS SHAPE COMMUNICATION QUALITY AMONG HEALTH PROFESSIONALS USING TECHNOLOGIES IN NEWBORN CARE WITHIN HOSPITAL SETTINGS, AND HOW DO THEY IMPACT THIS COMMUNICATION?

PHYSICAL CONTEXT

The availability of electricity to power the machines plays a role in health professionals' decisions and communication. In the Nigerian study, none of the seven hospitals had a consistent electricity supply. Before implementing CPAP, only one hospital had nearly continuous power availability. However, this hospital encountered significant disruptions when its neonatal intensive care unit underwent renovations without proper coordination, leading to a 50% decrease in electricity availability and reliability. As a result, health professionals extended their communication to involve people responsible for managing the hospital’s power. The constant disruption also led to the decision not to use CPAP (Aneji et al. 2020).

The study also reported power outages in three secondary-level hospitals in Malawi. The challenge of the inconsistency of electricity supply was a significant issue that altered health professionals’ communication on decisions to use or not use phototherapy. Lack of power led to health professionals deciding not to start phototherapy in newborn care (Kinshella, Salimu, et al. 2022). Similarly, in the other study from Malawi, nurses and clinicians reported communicating on the decisions to use CPAP, which was affected by the daily electricity outages, often lasting for several hours. Even with a generator, there were delays and challenges due to fuel shortages (Kinshella et al. 2020). In a study in Kenya, a similar challenge with electricity in Kenya led health professionals to engage with people outside the newborn unit to discuss what decisions to make based on the available power alternative from a generator:

> *"At times, our electricity is on and off; I remember a time a baby was on CPAP, and our generator had a problem, and we were told to wait for around 35 minutes for them to fuel the generator. So, it interfered with that process." (Nabwera et al. 2020, p 5).*

Several studies reported an inadequate number of health professionals to shape communication and decisions about using technologies. For instance, health professionals in the Malawi study conducted in one tertiary and three secondary hospitals described how the low number of health professionals led to nurses being reassigned to labour and post-natal wards. The small number of health professionals contributed to the reluctance to make decision to initiate CPAP treatment because of the high interactions and documentation needed during its use (Kinshella et al. 2020). Similarly, in the Kenyan study, health professional shortages and strikes contributed to discussions on decisions not to use CPAP. This was because nurses linked CPAP to the additional interactions and documentation needed to monitor babies receiving CPAP that they could not perform. However, the authors acknowledged that this perspective primarily represented the experiences of nurses, emphasising the importance of exploring the viewpoints of other disciplines within the health professionals:

> "*Unfortunately, we were unable to compare the differing perspectives of doctors and nurses to highlight any differences in staff experience in line with their professional background. It would have been useful to interview doctors and nurses independently to identify any potential team working challenges that might have*

influenced decision-making and the delivery of CPAP in newborn care in the Kenyan health system." (Nabwera et al. 2020, p 8).

In the Malawian phototherapy study, shortages of nursing staff and clinicians were reported to affect the decisions among health professionals on the level of monitoring and documentation of babies on CPAP needed (Kinshella et al. 2020).

> *"The standard ratio of nurse to patient is supposed to be one-to-one for a patient to be well looked after …but here, because of shortage, you would find that on duty, we will be three nurses against sixty patients…So, it just requires you to prioritise… …The areas that children are on CPAP…they are the sick babies. Your priority should be towards the sick babies; whether the babies are ten or more, you can divide your time." Tertiary hospital nurse, F, 38 (Kinshella et al. 2020, p 6).*

ORGANISATIONAL CONTEXT

Data from the studies in the review suggests that the organisational context of newborn units, including the support provided to health professionals to enhance their expertise, played a role in health professionals' communication and decision-making regarding technology. For instance, in the Malawi study on CPAP implementation, the hierarchical culture contributed to clinicians holding greater authority in technology-associated discussions and decision-making than nurses. During critical situations, trained nurses could initiate CPAP, but they would subsequently consult a clinician for follow-up (Nyondo-Mipando, Kinshella, et al. 2020; Kinshella et al. 2020).

> *"We said that the child was not supposed to be put on CPAP because of the cardiac problem… so we discussed [it] with doctors, but they insisted on putting the baby on CPAP, so the baby was put on CPAP, and the condition was still worsening… [and] eventually the baby died…. It becomes so hard for us to argue with them since they are doctors and they are above us because the moment you say we do not do these things like that, they think that we are underrating them, so these doctors need to be*

trained more… for example, the registrars and consultants." Tertiary hospital nurse (Nyondo Mipando, et al. 2020, p 7)

In the Tanzanian study on safe births, the authors documented how a friendly atmosphere that allowed health professionals to learn from mistakes without criticism encouraged them to use technology. The presence of champions among the health professionals who provided instruction on technology use was pivotal in encouraging health professionals to communicate and engage with the Safe Birth Bundle of Care technologies (Mdoe et al. 2023).

By contrast, a lack of comprehensive skills and the absence of a strategy to sustain the technology-related skills of health professionals had a detrimental impact on decisions regarding the use of CPAP in the Kenyan hospital study (Nabwera et al. 2020). Similarly, in the Malawian study on phototherapy, inadequate skills contributed to the insufficient use of phototherapy protocols to improve communication and inform decision-making. In the Malawian CPAP study, the lack of a systematic plan to disseminate training to all staff members resulted in inadequate skills among health professionals; the health professionals who had received CPAP training were reassigned to different departments before they had a chance to pass on their expertise, leaving behind replacements who lacked proper orientation in CPAP use (Nabwera et al. 2020).

> *"Just after the training, I think our paediatrician left the facility, and from that time, utilisation and prescription of CPAP was very, very minimal and kept deteriorating until now. It is like nobody is thinking about CPAP." Focus group discussion, newborn unit 6, senior nurse, public hospital." (Nabwera et al. 2020, p 5)*

A study aimed at understanding the implementation of CPAP in four hospitals in Malawi found that the lack of clear roles and responsibilities among different groups of health professionals sometimes complicated decision-making processes. Despite nurses often receiving training, clinicians held greater authority in decision-making (Nyondo-Mipando, Woo Kinshella, et al. 2020). This challenge of disagreement among health professionals regarding CPAP use was also reported in a paper that conducted a secondary analysis of data from the study by Nyondo-Mipando et al. (Kinshella et al. 2020).

The lack of essential equipment and supplies was reported to affect decisions about technology use in two of the 12 studies. In the Malawian phototherapy study, a lack of Transcutaneous Bilirubinometers, a non-invasive point-of-care device that estimates serum bilirubin levels, was found to influence health professionals to make decisions to use phototherapy without being aware of *serum bilirubin level*s (Kinshella, Salimu, et al. 2022). In the Indian study on the feasibility and acceptability of the paediatric pulse oximeter in six primary healthcare facilities, the authors found that none of the six primary healthcare centres had a paediatric pulse oximeter. Consequently, adult equipment was used for paediatric patients, posing challenges in obtaining and communicating accurate readings from the technology for monitoring babies (Agarwal et al. 2023).

TECHNOLOGY CHARACTERISTICS

The review data suggests that health professionals' communication and decision-making associated with technologies depended on their perceptions of those technologies. Health professionals in neonatal units in Kenya believed that CPAP improved neonatal care when used appropriately. Positive personal experiences with CPAP boosted staff morale and confidence in communicating with colleagues, and they decided to use it (Nabwera et al. 2020). In a study conducted in one hospital in Australia, nurses discussed and made decisions to use oxygen therapy when they perceived it was safe for them and their patients (Peeler, Fulbrook, and Kildea 2015).

Studies in India and the United Kingdom reported that perceptions of the difficulty of using a particular technology played a role in communication and decision-making about its use among health professionals. In the Indian study, health professionals perceive CPAP as a less complicated technology than a ventilator, and, due to the perceived technical simplicity of using CPAP, most nurses and some doctors felt trained nurses could independently decide to initiate CPAP without discussions with doctors for approval (Dewez et al. 2018). In the UK, paediatricians, midwives, and neonatal nurses using a non-invasive neonatal heart rate monitoring device in three NICUs and one labour ward expressed a preference for a device that is "easy to use," "easy to attach," "self-explanatory," and "easy to maintain" for them to communicate and decide to use technology (Anton et al. 2020).

2.4.3 DISCUSSION

Despite the crucial role of communication among health professionals who use newborn technologies to support care, my review found limited articles explicitly addressing this topic. Communication emerged as a recurring theme across various studies; however, the depth of information provided was insufficient. Many studies only included a few sentences on communication or focused on limited aspects associated with it. Consequently, there is a gap in achieving a comprehensive understanding of the role communication plays in technology implementation. Most studies were conducted in Low-and Middle-Income Countries (LMICs), with over half focusing on Continuous Positive Airway Pressure (CPAP) technology, leaving other technologies less explored.

This review sheds light on communication among diverse health professionals, including nurses, doctors, respiratory therapists, and healthcare managers involved in newborn technologies. Other groups of health professionals playing a pivotal role in newborn care, such as dieticians (Sneve et al. 2008; Olsen et al. 2005) and occupational therapists, (Rubio-Grillo 2019; Nightlinger 2011) were not reported in the evidence on technology-associated communication among health professionals in newborn care. Communication across geographical settings includes knowledge sharing, patient management and monitoring, and documentation. I have highlighted decision-making regarding technology use as a crucial part of communication among health professionals who use newborn technologies. The extent of the involvement of health professionals in communication varies based on their availability and autonomy. However, the literature on the timing and spatial aspects of these interactions is limited. Communication modalities range from verbal to written, both in-person and virtually.

Within the physical context, technology integration has amplified the demand for an adequate number of health professionals. While studies on general communication among health professionals report on issues typically involving interactions among health professionals, this review reveals that technology use requires extra work, including documentation and procedural tasks. This additional work can affect the communication and decision-making in the newborn unit. This finding echoes reports from other newborn care research that acknowledge the challenge of inadequate staffing levels (Kolié et al. 2022; Silveira et al. 2022; Tubbs-Cooley et al. 2019).

Another physical context factor is the challenging infrastructure, such as unreliable electricity, which led to negative decisions not to use CPAP and phototherapy. This challenge also led to increased communication between health professionals in newborn units and those outside the newborn unit who facilitated the availability of alternative energy, such as a generator. Further understanding of the physical environment of the newborn unit and its role in health professionals' communication and decision-making around technology use is needed. For example, evidence from the office setting shows that architectural design, such as workspace size, layout of windows, walls and cubicles and spatial proximity of co-workers, affect their interactions in an office setting (Amadi et al. 2023). Hospitals with fewer wards, beds, and buildings shortened distances between health professionals, improving communication and information flow (Pachilova and Sailer 2015; Pachilova and Sailer 2019). Understanding how the layout and physical structure affect communication and decision-making among health professionals in newborn care is crucial.

In the organisational context, communication associated with technology use necessitates an additional layer of training and skills. This dual requirement underscores the complexity and additional burden placed on health professionals. Other factors, such as hierarchy, also influence communication, consistent with findings from general communication studies. While these studies did not provide an in-depth explanation, they are a beginning of understanding the culture and power dynamics and how they shape communication associated with technology. However, the scoping review highlighted a notable gap in the literature regarding the role of other organisational factors on communication in technology use, suggesting a need for further research.

In the scoping review, I have identified some information on how technology itself can shape communication and decision-making. While the perceived difficulty of using technology deters health professionals from deciding to use it or fully participate in communication around its use, positive patient outcomes from it encourage them. However, evidence on the role of technology-specific factors in communication and decision-making among health professionals, such as documentation, is limited. Documentation in newborn care is crucial (Adane et al. 2021; Diaz and Requejo 2021; Lundin et al. 2022), and understanding similarities and differences across two technologies will inform technology implementation for quality care.

STRENGTHS AND LIMITATIONS OF THE SCOPING REVIEW

The review strategy provided a comprehensive search of articles discussing communication in the newborn technology use context regardless of their quality. The limitation of the study is that it included only studies published in English, which excluded articles in other languages. Although the search strategies included varied terminologies, there was a possibility of missing technological studies that mentioned technical names of technologies.

ADDRESSING THE IDENTIFIED GAPS

In my empirical research, I aim to address the gaps in existing studies by comprehensively investigating communication among health professionals in newborn care. Recognising the interconnectedness of communication and decision-making, I will consider decision-making as an integral part of communication. My research will examine the context of the newborn unit to explore the characteristics of communication and decision-making among health professionals using technology. This study will complement the findings of the scoping review by providing more detailed information on the individuals involved in communication, the ways health professionals communicate, and the spaces where communication occurs.

I will also investigate how the context shapes or can be shaped by communication and decision-making among health professionals in newborn care. I will explore how the physical context, including the layout and structure of environments where newborn technologies are used, affects communication and decision-making. I will also examine organisational contexts, such as hierarchy and resources, which were briefly mentioned in the scoping review, to understand their role in technology-related communication and decision-making in newborn care settings. Furthermore, I will analyse various aspects of technology, including its design and functionality, to determine its impact on communication and decision-making among health professionals. By comparing communication and decision-making between CPAP and phototherapy, this research aims to distinguish technology-specific issues from broader contextual challenges affecting health professionals' communication and decision-making.

CONCEPTUAL FRAMEWORK FOR STUDYING TECHNOLOGY-ASSOCIATED COMMUNICATION AND DECISION-MAKING AMONG HEALTH PROFESSIONALS.

The findings of the scoping review informed the development of a conceptual framework (Figure 2.2) to guide data collection, analysis and presentation in examining communication among health professionals who use newborn technologies. Drawing on the NICU Communication Framework Field (Wreesmann et al. 2020) discussed in section 2.2.4, I developed this framework.

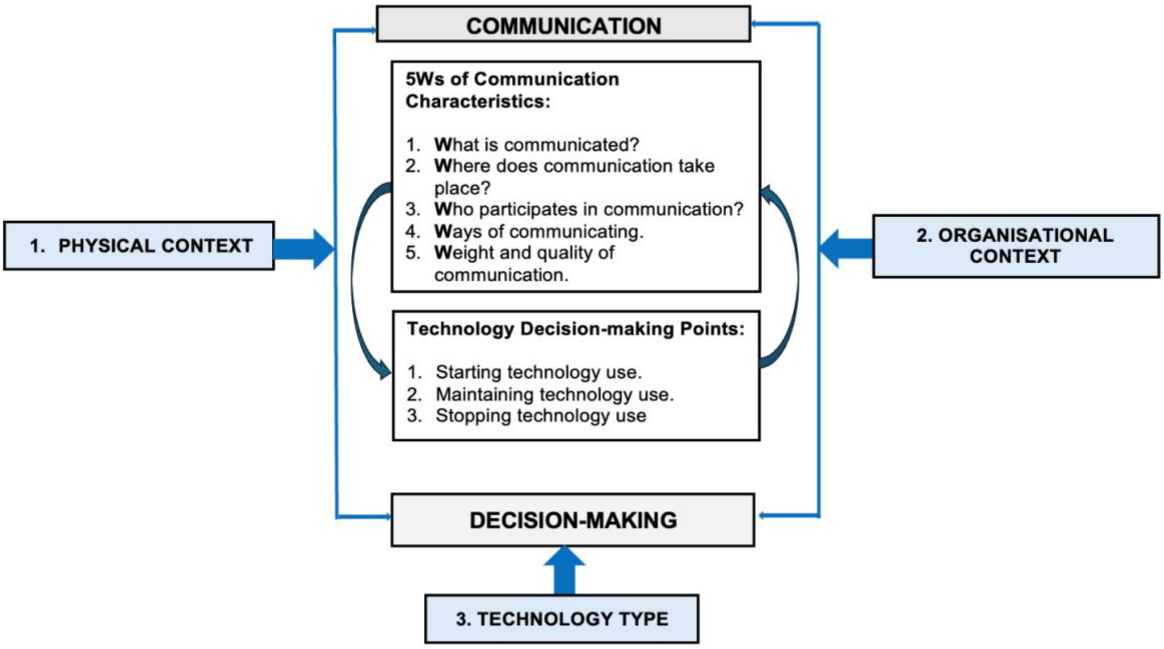


Figure 2.2: A Conceptual Framework to Research Communication and Decision-making in Health Professionals Using Newborn Technologies.

The framework shows communication and decision-making as interrelated processes that influence each other. The framework also provides the following:

(a) A guide to examine technology-associated communication in newborn care, presented in 5Ws:

- *What is communication*? Investigating the contents of the interactions that health professionals using technologies in newborn care have. This may vary depending on the context.
- *Where does communication take place*? This question addresses both the time and place interactions happen. It can be at a specific time of day, such as in the morning, or during a particular routine, such as during the ward round or patient handover.
- *Ways of communicating:* This characteristic focuses on how health professionals receive and send information through various methods, such as written and verbal communication.

- *Who participates in communication?* This question examines which health professionals engage in communication and decision-making and their capacity and level of engagement.
- *Weight and quality* of communication area seeks to understand aspects of information shared and perceived fairness or adequacy. It includes but is not limited to the interaction duration, tone, appropriateness, clearness, timing, and people involved.

(b) A guide to understanding various points of decision-making in newborn technology use:

- Starting technology use: Initial steps taken by health professionals to incorporate new technological tools into patient care.
- Maintaining technology use involves continuously providing technology care to patients.
- Stopping technology use: Discontinuing the use of technology, whether temporarily or permanently.

(c) The framework helps examine factors that shape communication and decision-making among health professionals engaging with newborn technology.

I have grouped them into three sections: physical context, organisational context, and technology.

- *Physical context*: The role of the physical context of the newborn unit, including the availability of power and the number of health professionals (quantity) in their communication and decision-making.
- *Organisational context*: This section examines the organisational culture and support, including measures to reinforce technology use, such as accountability and champions. It also informs the investigations of the availability of supplies and the "quality" of health professionals, including measures to ensure knowledge sharing through training and mentorship.

- *Technology type*: The role of the condition and the number of patients who use a particular technology in communication and decision-making among health professionals. The section includes information about the patient's clinical outcome and its effect on interactions and decisions among health professionals. It also consists of the perceived technology design in communication and decision-making among health professionals.

2.5 CONCLUSION

The findings of the scoping review offer an overview of communication and decision-making among health professionals involved in using newborn technologies. It identifies notable gaps in the existing literature on the interactions and decision-making in some groups of health professionals, such as dieticians, and interprofessional communication dynamics. The literature highlights the significance of physical and organisational contexts on communication and decision-making among health professionals. However, there remains a gap in information on additional contextual factors, such as the structure and layout of newborn facilities, and a comprehensive understanding of the impact of organisational culture and support on communication and decision-making among health professionals. Given the limited empirical research on how technology type affects communication and decision-making among health professionals, examination of structural and functional aspects of technology and comparative analyses within similar contexts to distinguish technology-specific issues from broader systemic factors is crucial. To address these gaps, I propose a conceptual framework employed in this thesis to facilitate understanding communication and decision-making among health professionals in newborn units using CPAP and phototherapy. My research is the first study in LMICs to comprehensively examine the physical and organisational context and compare types of newborn technologies and their roles in communication and decision-making among health professionals engaging with newborn technology.

CHAPTER 3: METHODOLOGY

3.1 INTRODUCTION

In this chapter, I discuss my research methodology. I begin by outlining the philosophical standpoint of social constructionism and the relevant theories that informed this study. I detail the research design, providing insight into the Kenyan context, the two newborn units where data was gathered, and the reasoning behind selecting CPAP and phototherapy technologies. I discuss data collection, analysis, and positionality and reflexivity. I conclude by discussing ethical considerations and the challenges of carrying out this research amid the COVID-19 pandemic.

3.2 RESEARCH PARADIGM: SOCIAL CONSTRUCTIONISM

A paradigm can be defined as “the set of common beliefs and agreements shared between scientists about how problems should be understood and addressed” (Thomas 2021). Each paradigm operates with its own set of ontological and epistemological assumptions, and these philosophical differences are evident in the methodology and methods employed by each paradigm (Scotland 2012). I considered the following core paradigms at the outset of my research: positivism and interpretivism (Fazlıoğulları 2012; Grant and Giddings 2002).

The positivism paradigm views reality as objective and independent of individual perspectives and thus emphasises objective observation and measurement to answer research questions (Guba and Lincoln 2000; Creswell and Creswell 2018; Creswell and Poth 2018; Merriam and Tisdell 2016). Positivists seek to minimise the researcher’s influence on the research process (Liamputtong 2013) and use a deductive approach to test theory rather than generate one (Park et al. 2019). Given the complicated dynamics of technology-associated communication and decision-making in the newborn unit, I chose not to employ a positivist approach. I did not have a pre-existing hypothesis or theory to test, but instead, I sought to understand the complexities of social interactions, organisational structures, and contextual factors in the newborn unit setting.

Interpretivism is a research paradigm that emphasises the understanding of the social world through the subjective experiences of individuals. Unlike positivism, which seeks to uncover objective truths through quantifiable data and empirical evidence, interpretivism is rooted in the belief that reality is socially constructed and can only be understood through the meanings and interpretations individuals ascribe to their experiences. This approach prioritises participants' perspectives, acknowledging that each person’s view is shaped by their unique context, history, and interactions (Orlikowski and Baroudi 1991).

Interpretivism believes in the subjectivity of human experience, and researchers aim to go deeply into the lived experiences of individuals, seeking to understand their thoughts, feelings, and actions from their point of view. This requires a high degree of empathy and openness from the researcher, who must be willing to engage with participants' stories without imposing their biases or preconceptions (Orlikowski and Baroudi 1991). The goal is to construct a holistic understanding of the phenomena under study. Context plays a crucial role in interpretivist research. Interpretivists argue that human behaviour cannot be fully understood without considering the social, cultural, historical, and situational contexts in which it occurs (Schwandt 1994).

Qualitative methods are central to the interpretivist approach. Techniques such as interviews, focus groups, participant observation, and case studies are commonly used to gather detailed and in-depth data. These methods allow researchers to capture the complexity of human experiences and social interactions. The data collected is often rich and descriptive, providing insights that more quantitative approaches might overlook (Creswell 2017). Its flexibility and iterative nature characterise interpretivist research. The research process is often non-linear, frequently revisiting and refining their questions and methods in response to emerging insights. This adaptability enables interpretivists to remain responsive to the dynamic and evolving nature of social phenomena, ensuring that their findings remain relevant and grounded in the lived realities of their participants (Walsham 2006).

Social constructivism and social constructionism are terms often used interchangeably (Lynch 1998). Both are linked to interpretivism and are interested in understanding social phenomena through actions, interactions, and the creation of meaning. Reality is subjective, varies from person to person (Scotland 2012), and is socially constructed (Creswell and Creswell 2018). Social construc*tivism* focuses on individual cognitive processes, while social construc*tionism* focuses on a collective understanding of social and relational processes (Crotty 1998).

My research was informed by social constructionism. Like Berger and Luckman (Berger and Luckmann 1966), I was interested in how individuals and groups shape (construct) the social reality of the newborn unit and communication and decision-making in this setting. Social constructionism highlights the influence of culture on individuals, emphasising how culture moulds our perceptions and provides us with a distinct worldview (Crotty 1998). I felt that a social constructionist approach would recognise historical and cultural influences and how knowledge and social action are intertwined (Burr 2015) and help uncover motivations, values, and beliefs impacting their decisions about technology use.

3.3 RELEVANT THEORIES AND FRAMEWORKS

I explored different social theories about technology and its implementation to prioritise the ones that would inform my research.

Actor-Network Theory (ANT) seeks to explain how social systems emerge and function by examining the relationships between humans and non-human entities, such as objects, technologies, and policies. ANT rejects the idea of "society" as a pre-existing entity and instead focuses on the interactions and networks that bring it into being (Bencherki 2017).

Bruno Latour, Michel Callon, and John Law, the key theorists of ANT, argue that social phenomena are shaped through constantly evolving associations between actors in a network.

A foundational concept in ANT is that no actor—whether human or non-human—is inherently more important than another in shaping outcomes. This approach contrasts with hierarchical models of society, where some entities (like institutions or policies) are given more weight than others. Instead, ANT treats all actors as equally capable of influencing and being influenced within a network (Callon 1981; Doolin and Lowe 2002).

Another central argument of of ANT is the agency of non-human entities. Technologies, machines, and even documents are viewed as actors within a network because they have the capacity to affect interactions and decisions. A medical device is not just a tool but an active participant in the network of healthcare, shaping how care is delivered and perceived (Prout 1996).

ANT also emphasizes the dynamic nature of networks, focusing on how associations are formed, maintained, and transformed over time. These processes are often studied through moments of change or disagreement within a network, such as the use of a new technology or the adoption of a specific policy. Such controversies help reveal the underlying mechanisms of negotiation and alignment within networks (Vicsek, Király, and Konya 2016; Cresswell, Worth, and Sheikh 2010).

In healthcare, ANT may be particularly useful for understanding how professionals, patients, and medical devices interact to shape clinical practices. For instance, decisions around the use of technologies like CPAP or phototherapy machines can be viewed as the result of negotiations within a network of doctors, nurses, patients, and the devices themselves.
I use Actor-Network Theory (ANT) in Chapter Seven to inform my analysis of the role of technology type in health professionals' communication at various decision-making point.

This theory helped me to interpret the findings that highlight the agency of both human and non-human actors and the dynamic relationships between them.

I also considered the Adaptive Structuration Theory (AST), which can be used to explain the influence of technology in an organisation. It focuses on how social structures and human agency shape or can be shaped by technology. However, it lacks a strong implementation focus (DeSanctis and Poole 1994; Rains and Bonito 2017), making it unsuitable for this research.

Several theories about innovation and implementation have been used to study health care and the use of health technologies. The diffusion of innovation theory provides an understanding of innovation adoption and spread and has been used to explore potential adopters' perceptions of innovation, the adopters' innovativeness, the social system around the adopter, the diffusion system, and the individual adoption process (Dearing 2009). I did not choose this theory because empirical studies using this framework appear to look especially at individual adopters. I felt it did not comprehensively address innovation abandonment, scaling up, spread and long-term sustainability of innovations (Greenhalgh et al. 2004; Greenhalgh et al. 2005).

Normalisation Process Theory (NPT) has been used to investigate implementation by looking at the work that people and systems do to integrate interventions into the routine. It looks at four components, which are coherence (or sense-making), cognitive participation (or engagement), collective action (work done to enable the intervention to happen), and reflexive monitoring (formal and informal appraisal of the benefits and costs of the intervention) (Murray et al. 2010). NPT can explain the success or failure of the implementation project (May et al. 2018). My research did not employ NPT because I felt that the complexity of non-adoption, abandonment, scale-up, spread, and sustainability of innovations was more comprehensively understood by the NASSS framework.

The Non-Adoption, Abandonment, Scale-up, Spread, and Sustainability (NASSS) (Figure 3.1) framework provides a structured way to analyse and make sense of complex healthcare technology implementations. It considers various dimensions, such as the technology, organisation, individual users, and broader socio-political context. This broad framework was developed by reviewing 28 technology frameworks and empirical case studies. Its strength is its applicability to healthcare technology projects, focusing on improving patient care and outcomes (Greenhalgh et al. 2017; Greenhalgh and Abimbola 2019).

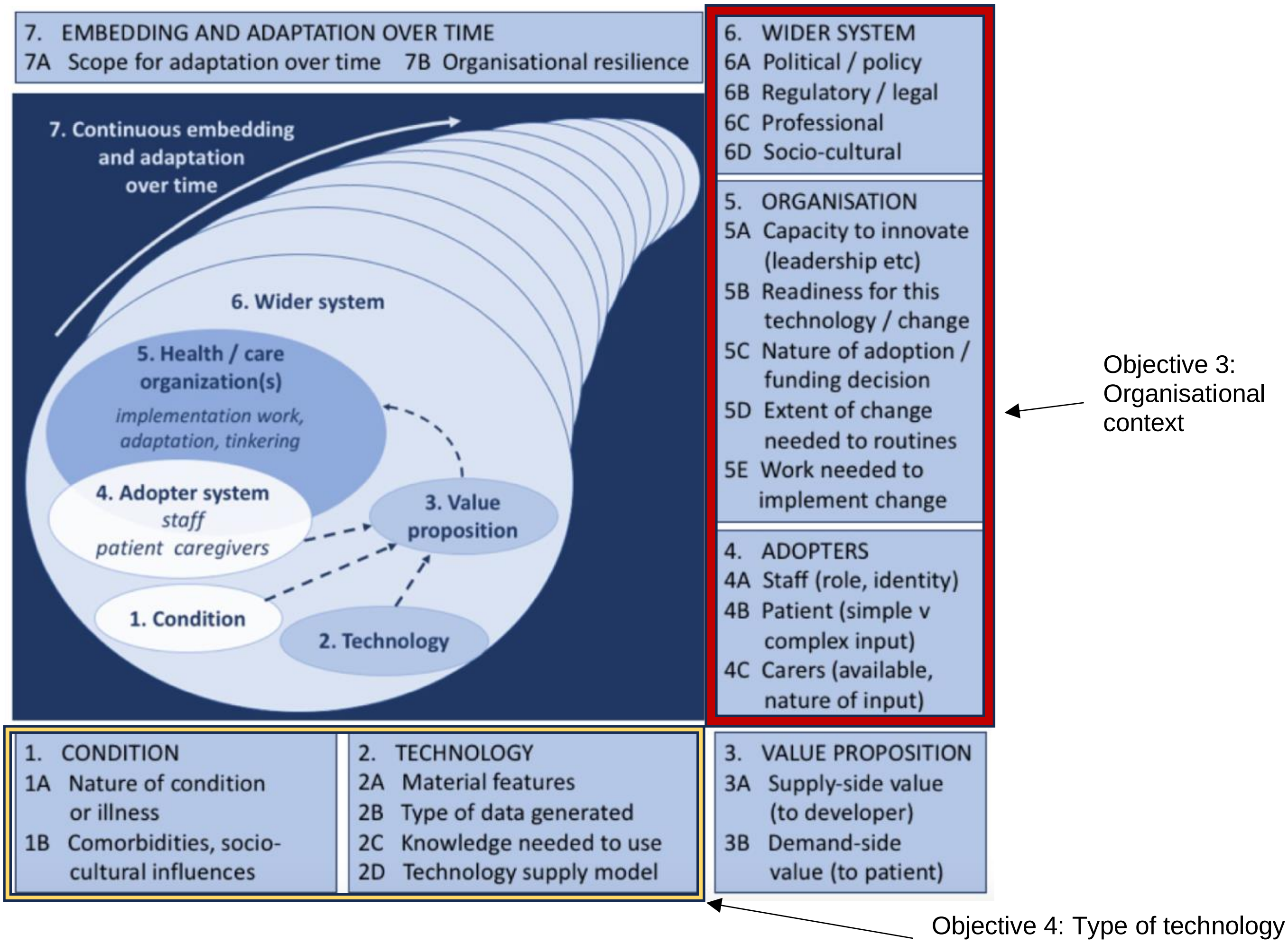


Figure 3.1: Non-Adoption, Abandonment, Scale-up, Spread, and Sustainability (NASSS)NASSS Framework (Greenhalgh et al. 2017).

The framework has seven domains:

Domain 1: **The condition or illness**: The nature of the condition or illness and relevant sociocultural factors and comorbidities.

Domain 2: **The technology**: Key features of the technology, knowledge the technology brings into play, knowledge and support required to use the technology and the technology supply model.

Domain 3: **The value proposition**: The developer's business case for the technology (supply-side value), as well as its desirability, efficacy, safety, and cost-effectiveness (demand-side value).

Domain 4: **The adopter system**: Changes in staff roles, practices, and identities. The patient's (and immediate caregiver's) expectations and whether they are achievable and acceptable. Assumptions about the extended network of lay caregivers.

Domain 5: **The organisation**: The organisation's capacity to innovate and readiness for technology-supported change. Easiness of adoption and funding decisions, changes needed in team interactions and routines. Work involved in the implementation and who will do it.

Domain 6: **The wider context**: The political, economic, regulatory, professional (For example, medico-legal), and sociocultural context for programme rollout.

Domain 7: Embedding and adaptation over time: Scope for adapting and coevolving the technology and service.The organisation's resilience in handling critical events and adapting to unforeseen eventualities.

In the NASSS framework, each domain is classified into three categories: "simple," "complicated," and "complex." "Simple" refers to interventions that are straightforward, predictable, and comprised of few components. "Complicated" describes interventions involving multiple interacting components or issues. "Complex" is used for dynamic and unpredictable interventions and is not easily disaggregated into constituent components (Greenhalgh et al. 2017; Greenhalgh and Abimbola 2019). A key benefit of the NASSS framework is that it is very flexible, and the authors encourage researchers to explore and adapt it for different purposes. NASSS was developed using case studies from developed countries (Greenhalgh et al. 2017), for example, in a United Kingdom study of remote video consultations across three large hospitals and a technology-supported new service model (Greenhalgh et al. 2018). In Australia, NASSS was used to evaluate a multi-faceted computerised quality improvement intervention for cardiovascular disease prevention in general practice using a HealthTracker (Abimbola et al. 2019).

I chose NASSS to inform my data collection, analysis, and presentation of findings, but I modified the framework to align with my objectives. I did not include Domain 3 (value proposition) as a standalone component, as its elements were already covered in other domains (for example, desirability in Domain 2). I merged Domain 5A (on capacity) with 5C (on funding). I omitted Domain 5D, which focused on changes in team interactions and routines following technology use because I started data collection after the technology introduction and had no data before technology use. I discuss Domain 7 (embedding and adaptation over time) as a cross-cutting agenda across all domains. I refrained from applying the weighting of domains as “simple”, “complicated”, or “complex”, choosing instead to focus on studying the broader dynamics in the newborn units.

HOW THE CONCEPTUAL FRAMEWORK COMPLEMENTS THE NASSS FRAMEWORK

I employed the conceptual framework (developed in Chapter Two) and the NASSS framework to guide data collection, analysis, and presentation of findings. The conceptual framework helped identify specific issues related to technology-associated communication and decision-making among health professionals, while the NASSS framework focused on implementing technologies. In Table 3.1, I demonstrate the integration of these two frameworks, highlighting how they complement each other and contribute to achieving my research objectives.

NASSS FRAMEWORK DOMAINS	CONCEPTUAL FRAMEWORK DOMAINS	CONTRIBUTION	RESEARCH OBJECTIVE
1. Condition **2. Technology**	**1. Technology** • Patient factors (Clinical outcomes and number) • Technology (features and functionality)	The NASSS framework treats health issues and technology as separate domains. The conceptual framework combines them. In the conceptual framework, technology does not just mean gadgets and tools. It also includes how they work and how they are used by patients with health conditions and illnesses.	**Objective 4:** To examine how the type of technology shapes the interactions and decision-making among health professionals in the two newborn units.
3. Value Proposition		Part of this domain in NASSS framework was excluded because it focuses on supply and demand efficiency and cost-effectiveness, which is beyond my research focus. It also considers safety and desirability which I included in the technology domain.	
4. Adopters **5. Organisation** **6. Wider System**	**2. Organisational context** • Health professionals' skills • Management • Culture	The NASSS framework has three separate domains that I considered in the conceptual framework as organisational context. This includes health professionals' skills, management roles and how organisations are run (their culture).	**Objective 3**: To explore the organisational contexts in which communication and decision making about the use of CPAP and phototherapy occur among health professionals.
7. Embedding and Adaptation over Time		This is a cross-cutting NASSS domain which focuses on how technologies are altered and adapted.	
	3. Physical context	The NASSS framework has no domain focusing on the physical context, but the conceptual framework includes consideration of the number of health professionals and physical cirumstances such as power availability where communication and decision-making about the use of CPAP and phototherapy takes place.	**Objective 2**: To examine the physical contexts in which health professionals communicate and make decisions about using CPAP and phototherapy

Table 3:1 How the Conceptual Framework Complements the Nonadoption, Abandonment, and Challenges to the Scale-Up, Spread, and Sustainability (NASSS) Framework.

3.4 RESEARCH DESIGN

3.4.1 RESEARCH APPROACH

I employed a qualitative research approach, using ethnographic methods that allowed me to spend time in the "field" to understand the meanings that health professionals construct in their communication and decision-making around technologies. This allowed me to explore how individuals interpret and construct their realities within social contexts (Creswell and Creswell 2018; Liamputtong 2019; Creswell and Poth 2018). Ethnography is well-suited for interrogating complex problems (LeCompte, Schensul, and LeCompte 2010) and understanding experiences, routines, and interactions in the hospital setting (Chenhall and Senior 2023). It can provide a rich understanding of people's culture within a specific community, including their beliefs, customs, and behaviours (Angrosino 2007).

While classic ethnography requires a researcher to spend extended periods for a prolonged field experience, focused ethnography is shorter and more intensive (Müller and Brailovsky 2020). I used the focused ethnographic approach that enabled an immersive exploration of health professionals' engagement with CPAP and phototherapy. I collected data through non-participatory observations, in-depth interviews, and document reviews. Section 3.6 elaborates on the specifics of data collection methods.

3.4.2 STUDY SETTING

THE KENYAN CONTEXT

I conducted my data collection in Kenya. Kenya is one of the Low-and Middle-Income countries in East Africa, with a population of 47.6 million (Statistics 2019). The annual population growth rate is 1.9 per cent, with 36% of people living below $2.15, according to the 2017 Purchase Power Parity[1] (PPP) (Bank 2023). Since 2013, Kenya has transitioned into a devolved governance system comprising the national government and 47 semiautonomous county governments (Masaba et al. 2020). Since this transition, health service delivery has become the county government's responsibility. The national government maintained the policy and regulatory functions.

The healthcare system in Kenya consists of the public sector, which includes the Ministry of Health (MOH) and government-owned organisations, and the private sector, which encompasses non-governmental organisations (NGOs), for-profit private facilities, and faith-based organisations (FBOs) (Phares Mugo 2018; Bank 2022). The health service delivery system is organised into four levels:

a) Community services: Level 1 community units focus on community-based initiatives to stimulate demand for healthcare services.

b) Primary health services: This level encompasses Level 2 dispensaries and Level 3 health centres, serving as the primary access points for basic healthcare needs.

c) County referral services: These include Level 4 and Level 5 hospitals, functioning as referral hubs within the county for specialised medical care.

d) National referral services: Level 6 hospitals are designated national referral centres, offering highly specialised medical services at the national level.

[11] Purchasing power parities (PPPs) are the rates of currency conversion that try to equalise the purchasing power of different currencies by eliminating the differences in price levels between countries.

County authorities provide services at levels (a) to (c), covering community, primary health, and county referral services. The national government offers national referral services (McCollum et al. 2018). A summary of services provided at each level of the health facility is in Table 3.2.

Level of care	County/National	Type of services
National Referal Hospitals **Level 6:** Teriary care hospitals	National	Tertiary/highly specialized services, including high-level specialist medical care, reference laboratory support, blood transfusion services, and research have defined level of self-autonomy
Secondary Hospitals **Level 5:** Secondary care hospitals Level 4: Primary care hospitals	County	Comprehensive inpatient diagnostic, medical, surgical and rehabilitative care, including reproductive health services Specialized outpatient services Hospitals managed by a county
Primary health care Level 3: Health centers **Level 2:** Dispensaries and clinics	County	Disease prevention and health promotion services Inpatient services for emergency clients awaiting referral, clients for observation, and normal delivery Services
Level 1: Community	County	Community-based health services

Table 3.2 A Summary of Services Provided at each Level of the Health Facility (Source: World Bank 2022)

Health services are delivered through a network of over 12,600 facilities nationwide. As of 2020, the public sector system represents just under 50% of these facilities. Over 60% of level five health facilities are publicly owned, while all level six health facilities are under public sector ownership (Bank 2022). Figure 3.2 displays the percentage distribution of health facilities from levels two to six based on ownership type.

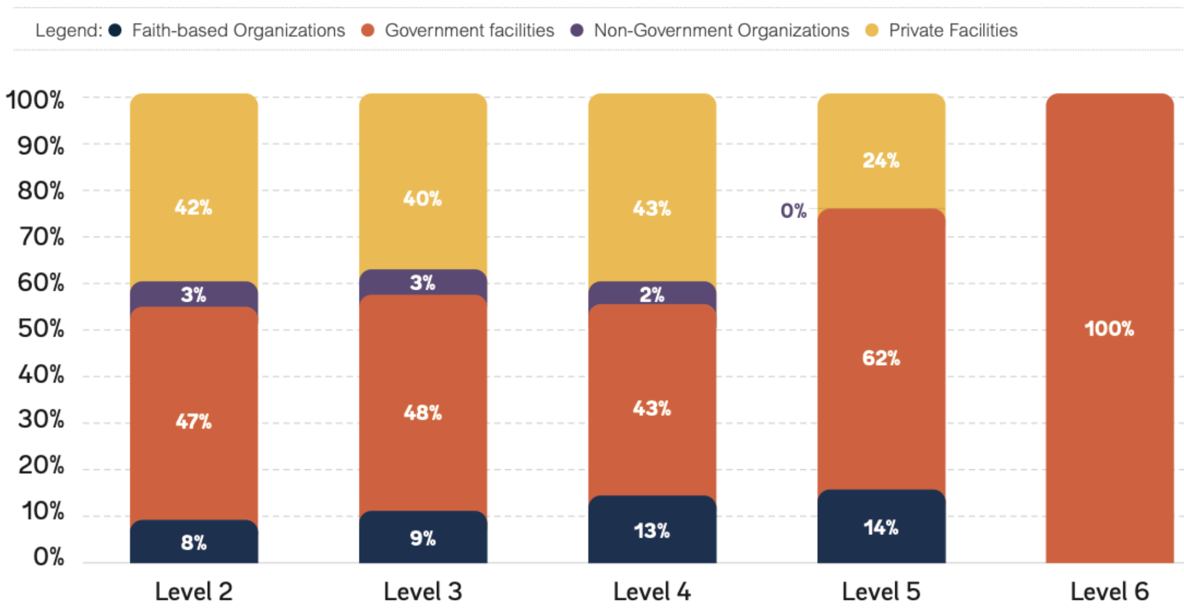


Figure 3.2 The Percentage Distribution of Health Facilities from Levels Two to Six Based on Ownership Type (Source: World Bank 2022).

The large cities in Kenya have a higher presence of private health facilities, whereas, in the more remote rural areas with a low population, public health facilities are often the only healthcare providers (Agency 2016). Kenya is working towards universal health coverage to provide all Kenyans access to quality health services without financial hardship. One of the priorities is access to prioritised health technologies. The Ministry of Health is working towards health benefits packages and an improved health financing strategy (MOH 2020). As of early 2023, one million households had registered and benefited from social health insurance (Treasury 2023).

In the past 20 years, the percentage of women who seek hospital delivery has doubled (Figure 3.3), with over 80% of women receiving care from a skilled provider (KDHS 2022).

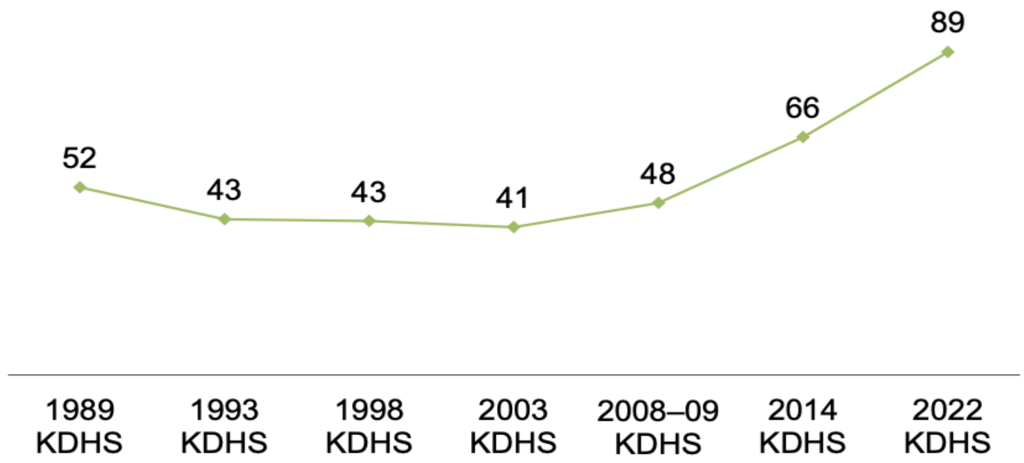


Figure 3.3: Percentage of Live Births in the Two Years Preceding the Survey Delivered by a Skilled Provider in Kenya (Source: Kenya Demographic and Health Survey 2022).

As discussed in Chapter One, despite progress made over the years, neonatal mortality in Kenya is at 21 deaths per 1,000 live births (Figure 3.4). According to the 2022 Kenya Demographic and Health Survey (KDHS), neonatal deaths account for 66% of infant deaths and 51% of under-five deaths (KDHS 2022).

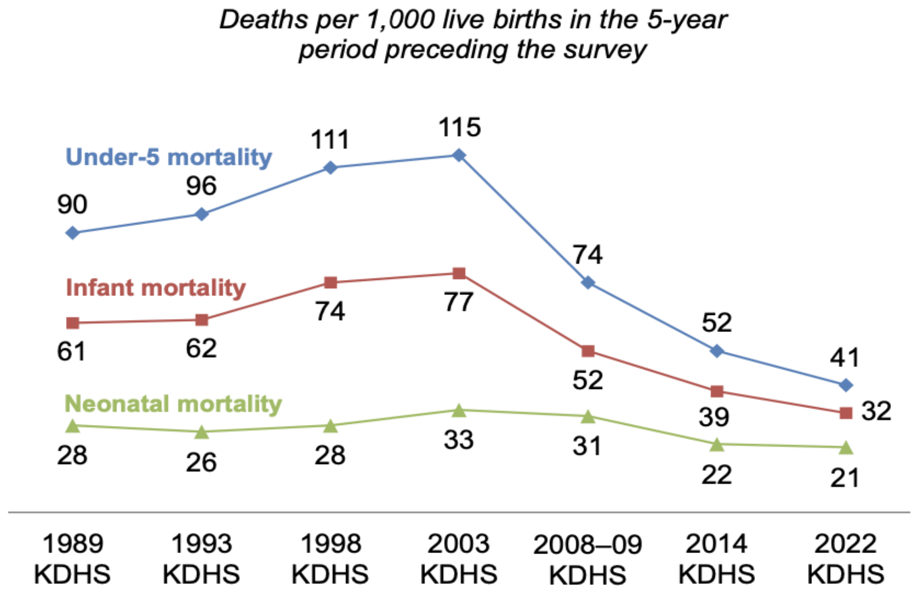


Figure 3.4: Trends in Early Childhood Mortality (Source: Kenya Demographic and Health Survey 2022).

CPAP has been used in Kenyan private hospitals since the early 2000s (Myhre et al. 2016), but its introduction in public hospitals started between 2013 and 2015, and health professionals have increasingly received training in technology use (Olayo et al. 2019; University 2023). Phototherapy has been used in Kenyan hospitals since around 2000 (English et al. 2014; Jalemba et al. 2015; Magai et al. 2019).

The Kenyan Ministry of Health has made some progress in supporting the integration of newborn technologies, including CPAP and phototherapy, into newborn care via the 2020 Comprehensive Newborn Care Protocol (MOH 2022) and the Health Technology Assessment (HTA) plan (Mbau et al. 2023).

NEWBORN UNITS

I collected data in two Newborn Units (NBUs) in two level-five county referral hospitals in Kenya with pseudonyms Amani and Upendo. These hospitals served the majority of the people in their respective counties.

When choosing hospitals to conduct my research, I considered hospitals with CPAP and phototherapy specifically hospitals involved in the NEST360 implementation project and those involved in the HIGH-Q project. I identified 13 level four and five government which were recipients of the NEST360 technology bundle within the year before I started my research. Among the 13 hospitals I considered four hospitals which were part of the Learning to Harness Innovation in Global Health (HIGH-Q) programme (HIGH-Q) that received funding from the National Institute of Health and Care Research (NIHR) to conduct multidisciplinary research in shown in Table 3.3 below:

	AMANI HOSPITAL	UPENDO HOSPITAL	UA HOSPITAL	NYOTA HOSPITAL
Type of facility	Government county hospital	Government county hospital	Government county hospital	Government county hospital
Geographical location	Metropolitan urban area, near the capital city	Semi-urban	Semi-urban	Semi-urban
Catchment area	120,000 population	78,807	N/A, No specific catchment area.	Unknown population
Admission and referrals annually	• 9865 deliveries, • 2514 admission to the newborn unit, • 32 referrals out of the hospital	• 6000 deliveries, • 1296 admission, • 7 referrals out of the facility.	• 7200 deliveries, • 1800 admissions, • 20 referrals out of the hospital	• 5678 deliveries, • 2357 admission to the newborn unit, • 57 referrals out of the facility
Neonatal unit capacity	Up to 45 cots and incubators, frequently more than one baby in each.	Up to 30 cots and incubators, frequently one baby in each.	Up to 45 cots and incubators, frequently one baby in each.	46 cots and incubator, frequently one baby in each.
Power availability	The facility is connected to the power grid, two generators as backup power, and both function.	The facility is connected to the power grid. A backup generator is available.	The facility is connected to the national grid. 7 functional generators, 14 functional solar panels.	The facility is connected to a power grid, five generators,
Policies and working conditions	Staff have a job description document. Staff rotate outside the newborn unit.	Staff have a job description document. Staff rotate outside the newborn unit.	Staff have a job description and a shared copy. Staff rotate outside the newborn unit.	Staff have no job description. Staff rotate outside the newborn unit.

Table 3.3 Four Hospitals Considered for This Research (Source: NEST360 programme facility assessment).

The HIGH-Q programme (Figure 3.5) is a five-year multi-disciplinary evaluation programme that centres around the existing NEST360 technology programme (NIHR, 2023). The programme traces processes to promote technology adoption and monitors a set of quality-of-care indicators that may be affected by the introduction of newborn technologies. Additionally, it includes a specific workforce enhancement intervention and conducts research involving health professionals and family members to explore how technology adoption and workforce capacity together influence care quality and technology use. The research extends into the post-discharge care for newborns and their families.

My research is embedded within the HIGH-Q programme and aligns with programme objective 1b: Implementing technologies in Kenyan hospitals.

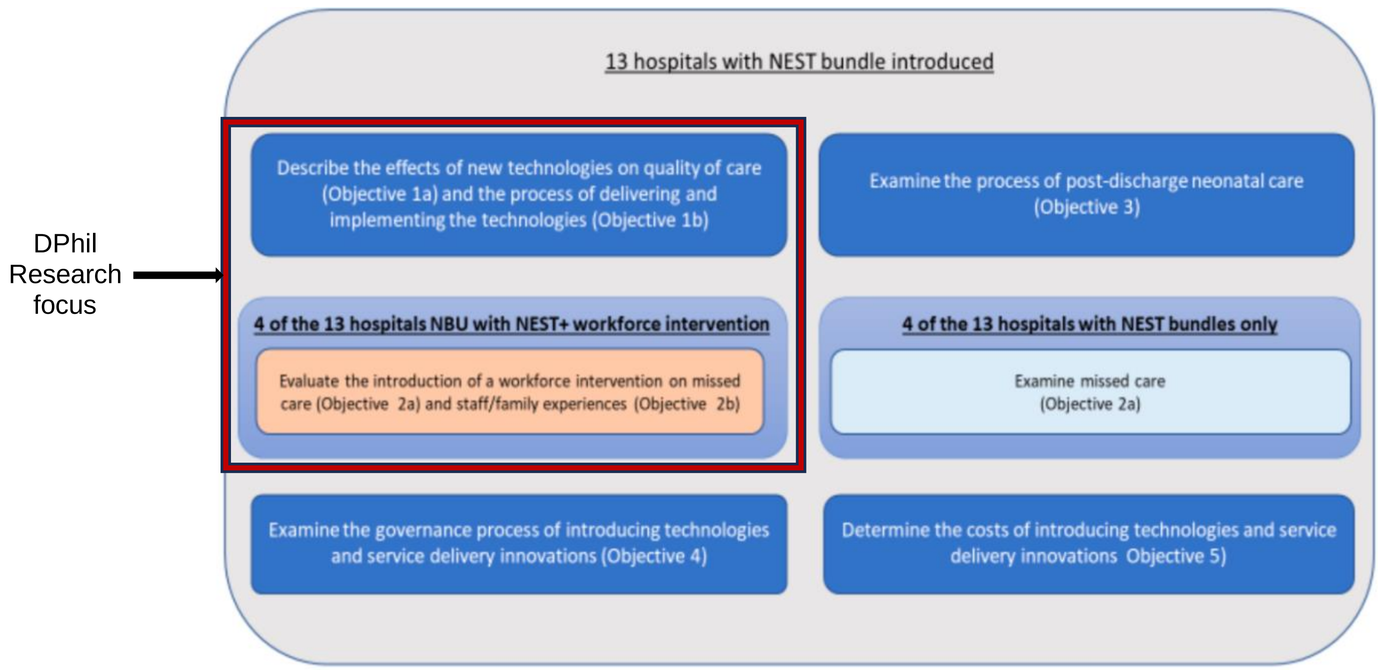


Figure 3.5 HIGH-Q Programme Objectives and DPhil Research Focus.

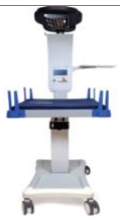
Following a familiarisation visit to the four HIGH-Q hospitals, I narrowed my choice to two newborn units: Amani and Upendo. This decision was pragmatic regarding the time available for the research and was informed by geographical diversity and population served. The decision to focus on two Newborn Units (NBU) in two hospitals also considered factors such as the need to obtain research permits. Amani NBU is located near the capital city of Kenya, catering to the largest population. Upendo NBU is situated in a smaller town city, approximately three hours away from the capital, serving the second smallest population among the four hospitals. Other important factors influenced my choice of sites. Amani NBU is the busiest, admitting the highest number of babies, while Upendo NBU is comparatively less busy, with the smallest number of babies admitted per year in the NBU. Both hospitals are level five facilities with reliable power supply through electricity or a generator, and they have designated job descriptions for health professionals in the NBU.

STUDY PARTICIPANTS

Health professionals in the two newborn units were the focus of my research, and I also observed family members and babies in the newborn units as secondary participants. Information about the health professionals involved in the research is in section 3.6 of this chapter and Chapter Five.

TECHNOLOGIES

The newborn units featured a diverse range of newborn technologies, ranging from CPAP to phototherapy. I have detailed the function and quantity of technologies in each newborn unit in Table 3.4.

	Technology	Newborn Unit		Information
		Amani	Upendo	
1.	 Light Meter	1	1	It measures the intensity of phototherapy light.
2.	 Oxygen Flow Splitters	35	17	It directs one supply of therapeutic supplemental oxygen to multiple babies through nasal masks and prongs.
3	 Oxygen concentrators	3	3	It creates supplemental oxygen from the surroundings for babies who need it.
4.	 Suction Pump	3	2	It clears secretions from the babies' oral and nasal cavities.
4.	 Glucometer	1	1	It monitors babies' glucose levels at the bedside.
5.	 Radiant Warmer	4	4	It keeps the babie warm.

6.	 Ambu bags	2	3	It helps to deliver positive ventilation in babies, used during resuscitation.
7.	 Pulse oximeter	2	6	It monitors oxygen levels in patients' blood.
8.	 Weighing scale	1	2	It measures babies' weight.
	 Radiator	4	4	It warms the room to maintain high temperatures.
9	 Incubator	9	5	It keeps premature babies warm.
10	 Digital Thermometer	2	2	It measures patients' temperature.
	 Syringe Pump	0	2	It calculates and dispenses intravenous nutrition, fluids and medication.

	 Bilirubinometer	0	1	It measures bilirubin levels at the bedside.

Table 3.4 Technologies in Amani and Upendo Newborn Units

While these technologies are not the primary focus of my research, they contribute to understanding the NBU environment. The technologies of focus in this research are CPAP and phototherapy. Informed by my literature review, I chose to focus on CPAP and phototherapy because they address the four leading causes of newborn mortality in Kenya; CPAP supports babies with respiratory distress syndrome and low birth weight, while phototherapy can benefit babies with jaundice and neonatal sepsis. My interest in these two technologies was also informed by my earlier experiences working in a newborn unit in Tanzania and my appreciation of the difference it makes in babies' lives. Both technologies are commercially available in Kenya, and the Ministry of Health is keen to scale them up in county referral and national hospitals.

Amani NBU has eight CPAP machines (Figure 3.6). Three of these machines are of "Diamedica design"; a donor provided them to NBU five years before I conducted the research. This CPAP design has an in-built oxygen source. A year before I commenced the study, the NEST360 programme supplied the unit with five additional "Pumani design" CPAP machines. This machine does not have an in-built oxygen source; health professionals connect it to an external oxygen supply.

CPAP, Diamedica design CPAP, Pumani design

Figure 3.6 CPAP Designs

Amani NBU has seven phototherapy machines (Figure 3.7). A donor donated four “older versions” of the machine four years before this research. The NEST360 programme provided the NBU with three additional phototherapy machines a year before my study commenced. While the older machines provided only one option for regular phototherapy intensity, the latter model had two options for phototherapy intensity – regular and intense.

Phototherapy, older version Phototherapy, new version

Figure 3.7 Phototherapy Machines

Before the NEST360 programme, the Upendo NBU had no CPAP machines available. A year before I started my research, the NEST360 programme supplied the NBU with four "Pumani" CPAP machines. Additionally, health professionals used five phototherapy machines. One was "the older version" and had been in NBU for about five years. The rest of the phototherapy machines were new versions from the NEST360 programme and were in the NBU for a year.

3.5 ACCESS TO THE SITES

I obtained a placement with Kenya Medical Research Institute (KEMRI) Wellcome-Trust as a visiting PhD student for eleven months. I visited the sites from November 2021 to April 2022 and October 2022 to February 2023. I spent the first month familiarising myself with the context of Kenya and the hospitals. I met key stakeholders to learn how the health system operated and gained insight into related research. From the experience, I updated the Field Visit Manual (Annexe 3.7) which was developed before data collection.

I attended regular health services delivery meetings, such as sessions organised by the weekly Clinical Information Network and bi-weekly KEMRI Social Science meetings. I also participated in HIGH-Q-programme meetings, which brought together different groups of researchers with similar interests in the same geographical area to share data collection plans. I visited the hospitals to ensure the hospital administrations knew about the research and to brief health professionals about the study. Before commencing data collection, I spent the first week of data collection building rapport and gaining people's confidence in the newborn unit. I also identified where to stand or sit when observing, the necessary documents in the newborn unit and the right time to talk to health professionals and families of newborn babies without interfering with the provision of care.

3.6 DATA COLLECTION METHODS

I had two rounds of data collection, six months apart (Figure 3.8). In the first round, I spent ten weeks in NBUs– five weeks in each hospital. I spent the first four weeks observing and reviewing documents and used the fifth week to interview health professionals. In the second round of data collection, conducted after introducing additional nursing staff, I used the same data collection methods but also paid attention to the extra staffing, spending four weeks in each hospital.

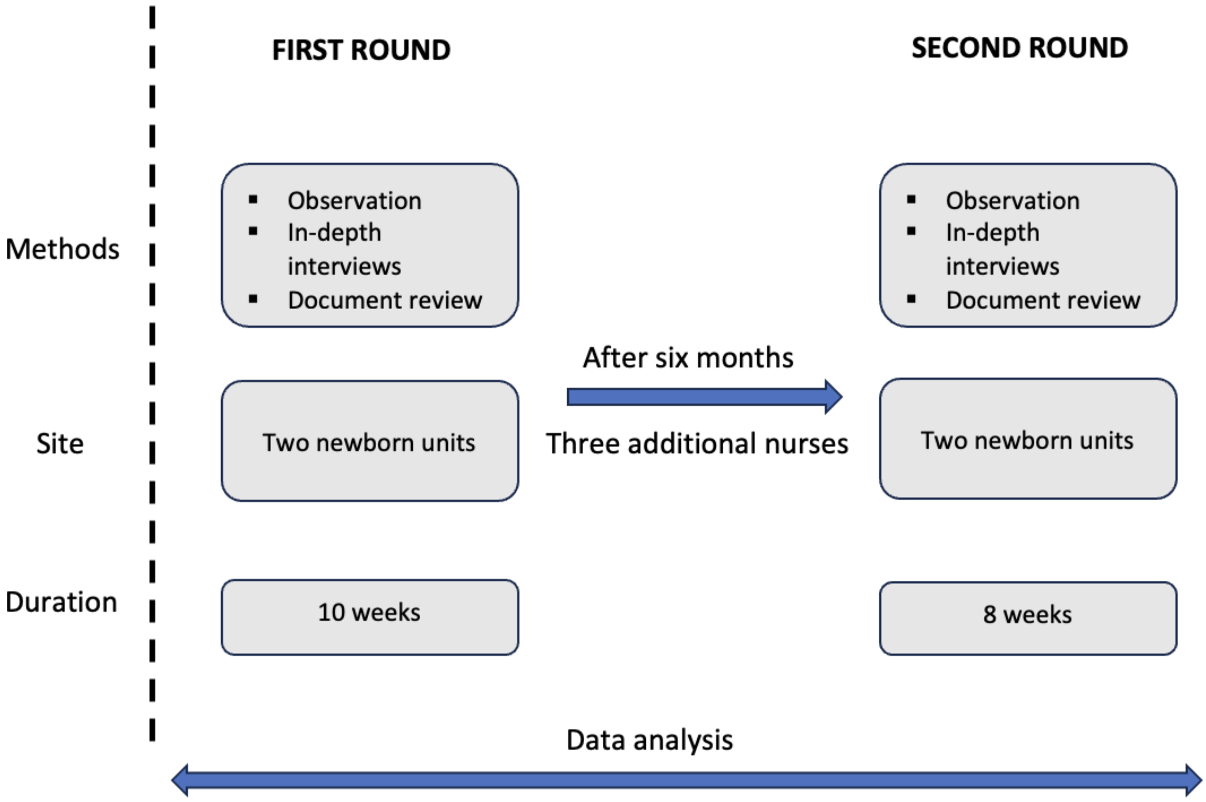


Figure 3.8 Data Collection Plan

i. Observation

I performed unstructured, non-participatory observations in both hospitals. Consent for observation was ongoing due to the frequent rotation and shift changes of health professionals. The nature of the environment in the newborn units made it impossible to obtain written consent for everyone observed without disrupting the natural occurrence of activities, but verbal consent was obtained guided by the non-participatory observation consent form in Annexe 3.2. Informed by Spradley (Spradley 1980) (Table 3.5), my observation considered the following:

1.	**Space**	The physical place.
2.	**Actor**	The people involved.
3.	**Activity**	A set of various actions.
4.	**Object**	The physical things.
5.	**Act**	Individual acts carried out by the people.
6.	**Event**	A set of activities carried out by the people.
7.	**Time**	The chronological sequence.
8.	**Goal**	The aims people wish to accomplish.
9.	**Feeling**	The emotions that are expressed.

Table 3.5: Observation Parameters (Spradley 1980)

The non-participatory observation was also informed by a guide I developed in Annexe 3.4. I observed the NBUs for 9-and 12-hour-long daily shifts alternating on weekdays and weekends, as well as day and nighttime and collected 650 hours of observation in each hospital. While my primary focus was on health professionals, I also observed sick newborn babies and their families. In a notebook, I made notes on activities, conversations, personal reflections, ideas, initial interpretations, and other interesting findings. Then, I typed them up on a computer at the end of each shift. I reviewed this information continuously as the research progressed, using the data to refine my focus as observations developed. Information from these observations was used to refine the interview guide.

I had informal conversations with health professionals and family members of babies admitted to the newborn unit to get more information about their experiences and clarify what I observed. I also had weekly debrief meetings with supervisors to discuss my observations and challenge my assumptions. During some of my observations, other HIGH-Q team members also observed the mothers' experiences. We held bi-weekly meetings with the HIGH-Q team to discuss operational and ethical challenges encountered during the observations. With consent from the NBU administration, I took photographs of the NBUs and commissioned illustrations by a Kenyan artist depicting four scenarios to show the conditions within the newborn units. These portraits are in Chapter Five.

Interviews

I conducted formal, individual, in-depth interviews with health professionals, including nurses, doctors, and nutritionists, in the newborn unit. I obtained written informed consent (See form in Annexe 3.1.) and used an interview guide (in Annexe 3.3). During the observation weeks, I identified a suitable time for an interview with individual health professionals and made an appointment. Most of them preferred the end of the shift before they went home.

Since health professionals were busy and worked in shifts, it was challenging to bring them together to discuss the issues without disrupting the provision of services. Individual interviews enabled health professionals to participate at a time convenient to them. Each interview lasted between 45 minutes and one hour. I requested participants to use a language they were comfortable with between Kiswahili and English.

I used a stratified purposeful sampling technique to identify frontline health workers from different groups of health professionals and their experiences and responsibilities. I also considered the duration of health professionals working in NBU. I interviewed 19 health professionals in the Amani newborn unit and 23 in the Upendo newborn unit (Table 3.6). I interviewed 9 and 16 health professionals in Amani and Upendo newborn units in the first round, respectively. In the second round, I interviewed 10 and 7 health professionals in the Amani and Upendo newborn units until information saturation. I re-interviewed one nurse-in-charge from each NBU; the rest of the participants were not re-interviewed. No health professional declined to be interviewed in both health facilities.

	HEALTH PROFESSIONALS	NUMBER		DURATION IN NBU	
		AMANI NBU	UPENDO NBU	AMANI NBU	UPENDO NBU
1	Paediatricians	1	1	5 years	4 years
2	Medical Officer Interns	3	3	4 to 10 weeks	5 to 10 weeks
3	Clinical Officer Interns	4	2	2 to 3 weeks	2 to 3 weeks
4	Nurses	9	12	6 months to 8 years	6 months to 15 years
5	Ward assistants	2	3	2 years	6 months
6	Nutritionists	0	1	N/A	2 years
7	Nutrition interns	0	1	N/A	2 weeks

Table 3.6 Characteristics of Health Professionals Participating in In-depth Interviews in the Amani and Upendo Newborn Units.

I recorded the interviews and stored them on a password-protected digital recorder. At the end of each interview, I transferred the recorded file from the digital recorder to a password-protected OneDrive folder, which was accessible only to HIGH-Q researchers. Subsequently, I deleted the recording from the digital recorder. With assistance from a research assistant, I transcribed the anonymised interviews verbatim and translated two interviews from Kiswahili into English for data analysis. After transcription, I reviewed the transcripts for quality assurance.

Document review

Both NBUs used a paper-based system for documenting, storing, and sharing information, as neither had an electronic health information system. During my observation shifts, I reviewed documents. When there were relatively few activities in the NBU, I examined all hard-copy documents on the walls, regardless of their content, and summarised their intended purpose in my observation field notes.

With assistance from the nurses in charge in each NBU, I examined handwritten clinical notebooks, including handover books and discharge notes, to understand their purpose, content, frequency of communication, and the extent to which health professionals were required to document. For instance, I reviewed documents such as the nurses' *Cardex* sheets to assess the recorded patient information on CPAP and phototherapy from admission to discharge, including frequency, intensity, and completeness.

I compared files of babies on CPAP and phototherapy with those of babies not on these treatments to evaluate the documentation practices, the individuals involved, and how health professionals interacted with the information. For example, I examined patient files to determine what the medical team documented after observing patients on CPAP and phototherapy and whether other health professionals, such as nurses, required subsequent actions. I also observed the nurses' responses to documented instructions from the medical team, including their promptness.

I adapted my document review process based on information emerging during observations. For instance, when I suspected that some nurses were documenting patient progress without taking clinical measurements, I reviewed patient files immediately after the nurse completed documentation to verify this. This approach was also used to monitor whether doctors reviewed nurses' documented information during their ward rounds or if they contradicted the nurses' notes.

While most documents were in English, some were in Kiswahili. A complete list of the documents reviewed can be found in Annexe 5.1 for Amani NBU and Annexe 5.2 for Upendo NBU.

3.7 DATA ANALYSIS

I used NVIVO 13 to manage my data. I analysed data alongside data collection, reviewing the field notes, transcripts, and documents to note short phrases, ideas and fundamental concepts to explore in further data collection. I developed a draft coding frame in the first round of data collection that I updated as I analysed more data.

Some codes (Figure 3.9) were deductive, derived from reading the research literature, for example, from the NASSS domains. An example of these codes is technology functionality and the nature of the patient's condition. Some codes were words used by participants and new information I did not expect to find (inductive coding). These codes are, for example, language and technology repair.

Adopting from Ziebland and McPherson, I used the One Sheet of Paper (OSOP) method to mind-map ideas. This process entails systematically reviewing each section of coded data and documenting all the issues raised on a single sheet of paper (Ziebland and McPherson 2006). Each issue identified in the coded extracts and the relevant respondent identification was noted on the OSOP. For instance, the first extract might highlight a positive response a nurse got from the paediatrician, with the corresponding identification of a respondent noted next to it. Subsequent extracts may explore the topic further or introduce new issues, such as poor orientation of rotating doctors or inadequate documentation of the progress of babies on CPAP.

The OSOP serves as a comprehensive summary of all the issues linked to each code. The subsequent step involves considering how these issues may be grouped into broader themes and beginning to explain what is happening in the data. The goal was to encompass all the issues raised by the extracts rather than focusing solely on the most prevalent ones.

I explored the type of technology used, the groups of health professionals involved, the organisational and physical environment and the characteristics of babies using technology. I examined underlying patterns and themes that provide deeper insights into technology-associated communication and decision-making among health professionals. Figure 3.9 shows 21 codes I developed. After reviewing the codes several times, I grouped codes to form six themes associated with communication and decision-making among health professionals.

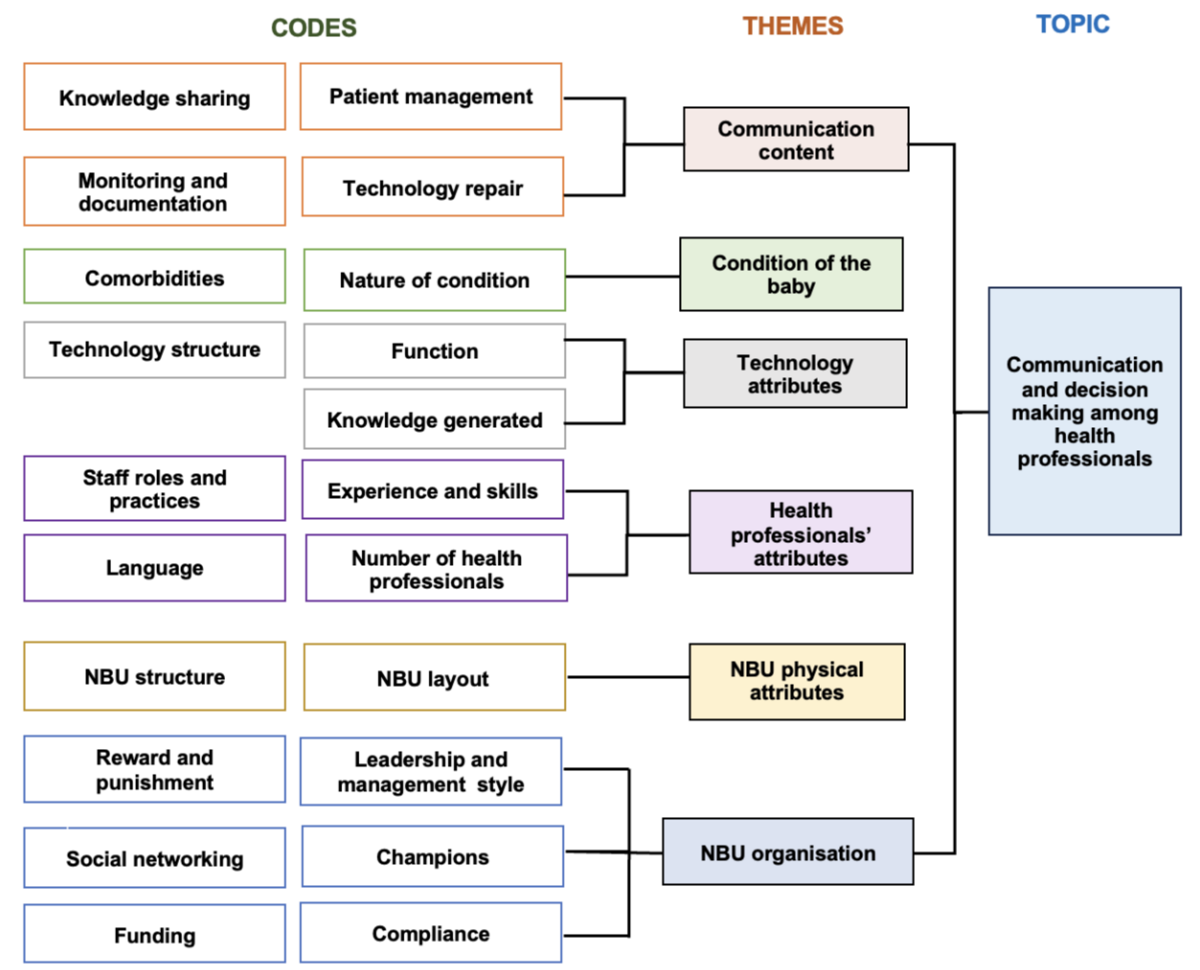


Figure 3.9 Coding Framework

3.8 REFLEXIVITY

In Chapter One, I presented my background before starting this DPhil research. In this section, I expand on my experience in the hospital as a medical doctor and my role in the development sector to explain how this influenced my research. Before starting on my academic research path, I worked in a busy newborn unit in a referral hospital in Tanzania as a medical doctor for two years. This was my first job after medical school. It was a busy environment with many patients and activities in the daily routine. The NBU had various technologies, including CPAP and phototherapy, which were kept in the NBU store and rarely used except when the paediatrician, who was the head of NBU, decided to use them.

Besides theoretical knowledge in medical school, I did not receive orientation or training in using the technologies. I wondered why I, and other junior doctors and health professionals, did not engage with these technologies – were they broken, or did the paediatrician think we did not have the capability? All these questions remained unanswered because I felt I could not question my superiors as a junior doctor.

When I left the medical practice, I worked in the development sector as a health adviser. Health innovation and technologies were a priority of many development partners. While it was encouraging to invest in the area, I remembered all the technologies in the hospitals that we did not use. It intrigued me to research the implementation of these technologies once they reach the newborn unit. Acknowledging the role health professionals play, I was interested in their interactions and decision-making associated with technology use.

These experiences meant I had a general understanding of the newborn unit, including patient conditions and routines such as admission, discharge and handovers. My medical background also allowed me to understand verbal and written medical conversations. However, when I worked as a doctor, I was busy and paid less attention to the environment. During the research, I spent significant time observing, interacting, and asking questions to health professionals and caregivers of newborn babies, and I gained new perspectives. I appreciated the work that other health professionals, such as nurses and nutritionists, did that I had not previously noticed.

My knowledge of the local language – Kiswahili, allowed me to understand conversations that were not in English. Although I had experienced challenging newborn outcomes before, such as deterioration or death, it was hard to watch medical emergencies without assisting in the management. Sometimes, it was hard to watch medical decisions without interfering to help or correct when there was a mistake or misunderstanding.

I observed that most nurses were women, while other groups of health professionals were varied. The age distribution was between 20 and 60 without apparent dominance of a specific age group. I am a black woman in her 30s who went into an environment where most health professionals were black, with a few Asian staff. I perceived and did not notice any different reactions because of my age, race, and gender.

The newborn unit administration in the Amani newborn unit advised me to wear no additional hospital clothes to cover my non-uniform clothes. While some health professionals, such as nurses and medical and clinical officer interns, wore uniforms, paediatricians and visitors did not wear any. It was easy to spot me among health professionals. While some caregivers mistook me for paediatricians or visitors, health professionals knew I was a researcher. On the other hand, I wore the hospital-provided uniform in the Upendo newborn unit, just like all health professionals. It took a few days for new rotating health professionals, such as medical and clinical officer interns, to understand my role at the newborn unit.

The nurses who spent the most time in the ward started social conversations with me, especially during the night. They were open with me about how they felt without considering me an external person, which provided an honest understanding of their experience. Most health professionals in both hospitals thought I appeared younger than I am – like a recently graduated junior doctor. They appeared to view me as a colleague, which may have led to receiving information and responses in more medical terminology and with more detailed explanations compared to the research assistants collecting data on mothers' experiences in the NBU. The research assistants reported and I observed that they received responses in simpler language and in a more summarised form. Sometimes, paediatricians in Amani Hospital asked me to answer questions in ward rounds because they considered me part of their team. I had weekly debriefing meetings with supervisors to reflect on my position and how I viewed information based on my background. I regularly reminded myself of my position and the importance of focusing on the participants' views, while also recognising that the perspectives I received were influenced by their perceptions of me.

I spent a prolonged time in the field to understand the context and had time to get clarification when required. When the information was unclear, I requested participants to provide more information or clarify where I did not understand to ensure I captured their intended meaning. When I needed clarification, I presented ideas or thoughts to the participants for their feedback. After completing the data collection, I discussed the findings with both newborn unit health professionals, who agreed with the interpretation of what I heard and saw. The discussion also generated more information, which I have included in the data analysis.

3.9 ETHICAL APPROVAL AND CONSIDERATIONS

Before beginning data collection, the HIGH-Q study, which my DPhil research falls under, received ethical approval from the Scientific Ethics Review Unit (SERU). The approval number is KEMRI/SERU/CGMR-C/229/4203. A copy of the approval is in Annexe 3.5. I ensured the Ministry of Health, local county government, and hospital administration were aware of the research and happy for it to proceed. Before data collection, the Oxford Tropical Research Ethical Committee (OxTREC) approved the HIGH-Q study. The OxTREC reference number is 26-21; a copy is in Annexe 3.6.

During data collection, I was aware of my position as a medical doctor. I avoided using it to influence health professionals, especially those who would feel inferior (such as Clinical Officer Interns), to give me their time. I engaged with them only when they were available and comfortable. I avoided expressing my opinion on how I thought of communication and decision-making; instead, I gave them priority to express their views. I treated the shared information with confidentiality through anonymising personal data. Interview participants were reimbursed for their time. I spent time understanding the newborn units' culture to respect how they operated. I was aware of being around vulnerable newborn babies and observed respect and privacy.

With my medical background, I faced some ethical dilemmas in the newborn unit. In some moments, I witnessed medical errors, emergencies, delayed decisions or situations that put patients in danger. I attended bi-weekly meetings with other researchers in the HIGH-Q programme. We discussed ethical and operational challenges and how to deal with them. We categorised how to deal with the situation into three groups, as shown in the Table 3.7 below:

	Action	**Example (s)**
1.	Feedback to health professionals immediately.	▪ The CPAP machine is out of the baby's nose. ▪ Eye masks were out of the baby on phototherapy.
2.	Feedback to health professionals later, for example, after data collection.	▪ Health professionals were forging data documented. ▪ Health professionals sleep during the night shift.
3.	Do nothing	▪ Congested newborn unit with many babies.

Table 3.7: Dealing with Ethical Dilemmas.

CHAPTER 4: COMMUNICATION AND DECISION-MAKING IN THE NEWBORN UNITS.

4.1 INTRODUCTION

In this chapter, I provide a summary of the different disciplines of health professionals in two newborn units and compare how they communicate about technologies. I discuss differences in communication content among health professionals in Amani and Upendo NBU and group them into four categories: patient management, knowledge sharing, technology repair and monitoring, and documentation.

Potential similarities and differences in ways of communicating among different groups of health professionals within and across the newborn units are highlighted. The space where communication happens among health professionals associated with technologies is also compared. I conclude the chapter by discussing the findings and their implications for the following chapters.

4.2 HEALTH PROFESSIONALS IN THE NEWBORN UNITS

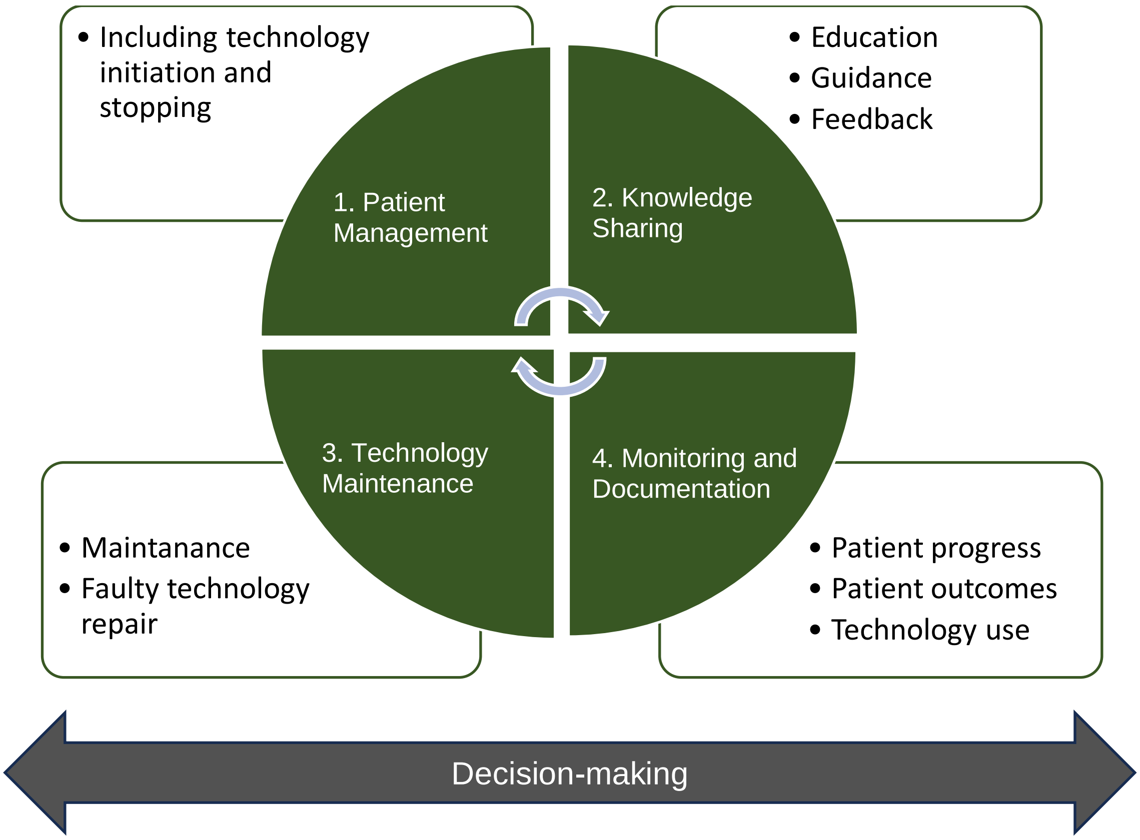
Various disciplines of health professionals were involved in different activities in the two NBUs, as summarised in Table 4.1.

Health Professionals	Number in each research round				Summary of Health Professionals' Roles
	Amani NBU		Upendo NBU		
	First	Second	First	Second	
Nurses	10	13	10	11	Provided direct patient care, administered medications, and monitored patient progress.
Paediatricians	2	3	2	2	Diagnosed and treated illnesses in babies and oversaw the medical care in the NBU.
Medical Officers	0	0	1	2	Provided general medical care, performed procedures, and supported the paediatricians in managing patient care.
Medical Officer Interns	5	4	2	2	Assisted in patient care under supervision, performed routine medical procedures, and gained practical experience.
Clinical Officer Interns	4	4	4	4	Supported clinical officers in patient care, performed basic medical tasks, and learned through hands-on experience.
Ward Assistants	3	3	2	2	Assisted with non-medical tasks such as cleaning, patient transport, and ensuring the ward environment is safe and clean.
Nutritionists	2	2	1	1	Monitored weight and oversaw nutritional plans for patients.
Nutrition interns	0	0	1	2	Supported nutritionists in assessing and planning patient diets, and assisted with nutritional education.
Biomedical Engineers	4	4	3	3	Maintained and repaired medical equipment, ensuring that all devices were functioning correctly and safely.
Vaccination Team	3	3	3	3	Administered vaccines to babies.
Medical Students	20	20	0	0	Observed and assisted in patient care, learn clinical skills, and gained practical medical knowledge.
Nursing Students	6	6	10	10	Assisted nurses in patient care, performed basic nursing tasks, and learned through clinical practice.
Occupational Therapist	1	1	2	2	Assessed and supported the developmental needs of babies, and provided therapeutic interventions.

Table 4.1 Health Professionals in Amani and Upendo Newborn Units

4.3 CONTENT OF COMMUNICATION

Figure 4.1 shows the categories of technology-associated communication contents in both NBUs. Decision-making is a cross-cutting factor across the four categories and plays a significant role in health professionals' communication.



Patient management

Health professionals in Amani NBU interacted regarding patient clinical management, including the decisions to start, maintain and stop technology use. Paediatricians, who were senior team members, verbally made most decisions to start and stop babies on CPAP and phototherapy machines. In contrast, other team members, like nurses and medical and clinical interns, implemented orders from paediatricians.

Paediatricians also made other decisions, such as clinical investigations and the baby's feeding mode (breastfeeding, nasogastric tube or cup feeding). They documented the information in the patient file, which contained clinical details and was kept next to the patient for other health professionals to access and act upon. I noted that health professionals had more lengthy discussions and documented more when dealing with babies on CPAP compared to phototherapy machines. I observed that the nutritionists and occupational therapists did not interact verbally with other health professionals, such as nurses and paediatricians. For example, the nutritionists posted handwritten summaries of babies' weights on the wall to inform other health professionals.

In Upendo NBU, health professionals also discussed patient management. Unlike in Amani NBU, other health professionals, such as nurses and clinical and medical officer interns, made independent decisions to start and stop babies on CPAP and phototherapy machines without direct input from the paediatricians.

The nutritionists planned the babies' feeding plan (breastfeeding, *nasogastric tube* or cup feeding) with the paediatrician and other health professionals like nurses and medical officers. Like Amani NBU, I observed that health professionals engaged in more extensive discussions and documentation when managing babies on CPAP more than those receiving phototherapy treatment. The occupational therapist also verbally interacted with other health professionals when discussing joint plans for babies who needed physiotherapy, such as those on CPAP.

Knowledge sharing

From interviews and informal conversations with health professionals, I learned that some nurses and paediatricians in the Amani NBU had received formal training on technology use (further details are provided in Chapter Six). Health professionals exchanged information on how to operate technology, the criteria for starting or stopping, and other aspects of patient management during technology use, such as feeding and cleaning babies. I observed paediatricians teaching medical and clinical officer interns how and when to use various technologies during ward rounds. Some nurses informally inducted their fellow nurses on initiating or stopping technology. Paediatricians also expressed their frustrations to other health professionals when there was patient mismanagement, such as delays in initiating patients on phototherapy after the prescription. Nurses and clinical and medical officer interns reported feeling uncomfortable giving feedback to paediatricians because they were superior to them, even when they were unhappy with their decisions.

Similar to Amani NBU, some nurses and paediatricians in the Upendo NBU reported receiving formal training on technology. However, unlike Amani NBU, health professionals provided induction and mentorship to their colleagues, regardless of their background and position. I observed the paediatrician teaching nursing students, nurses, and clinical and medical officer interns about using CPAP and phototherapy during ward rounds. Nurses also oriented clinical and medical officer interns on using CPAP and phototherapy. The NBU also offered special sessions to orient NBU health professionals on technology use, which I did not observe in Amani NBU.

Technology maintenance

The nurses in charge of Amani and Upendo NBU contacted the biomedical team to inspect and repair technologies in the NBU that were not functioning correctly. Health professionals in Upendo NBU reported feeling more comfortable verbally reporting faulty technologies to the nurse in charge than those in Amani NBU.

Monitoring and documentation

In Amani NBU, health professionals, including medical officer interns, nutritionists, and nurses, documented information regarding babies on CPAP and phototherapy. This included details on patient progress, medical requests such as consultations, criteria for treatment, dosage, and actions like medical investigations and referrals. Nurses played a crucial role in monitoring and recording the progress of babies on CPAP and phototherapy. I observed that sometimes there were gaps in the documentation, such as missing three-hourly temperature levels for patients on phototherapy.

Similarly to Amani NBU, health professionals in Upendo NBU, including nurses and medical officer interns, documented information on patients receiving CPAP and phototherapy. However, unlike in Amani NBU, monitoring patient progress was more inclusive and involved various groups of health professionals, including occupational therapists and paediatricians, rather than relying predominantly on nurses. Additionally, documentation in Upendo NBU was more complete and accurate, with more consistent recording of patient progress, such as three-hourly temperature and breathing measurements.

4.4 WAYS OF COMMUNICATING

Health professionals communicated among themselves through verbal, non-verbal and written methods.

Verbal communication in Amani NBU involved in-person and virtual interactions. I observed health professionals talking to each other in the NBU during formal duties, such as doctors exchanging ideas during the ward rounds and nurses interacting during patient handovers at the end of each shift. I noticed that in-person interactions were more common among health professionals from the same group, such as across nurses, than among different groups, such as nurses and doctors. When health professionals interacted across disciplines, I observed that their conversations were formal, and sometimes, there was a noticeable tension between them.

Virtual verbal communication was through mobile and landline phones. I observed, and health professionals reported, that virtual interactions were commonly used when consulting senior staff members, coordinating with professionals from other departments, and managing patient referrals to or from different hospitals. I observed frequent calls, particularly in the evening, between nurses and the doctor on call, as well as intern doctors and paediatricians.

Health professionals in Upendo NBU also participated in in-person and virtual verbal interactions. While I observed health professionals' interactions in formal spaces like admissions and ward rounds, I noticed more informal interactions than in Amani NBU. For example, after the ward round, I observed nurses chatting with a paediatrician about plans for patients. Several times, I observed nurses sharing their weekend plans with other nurses during their lunch or evening breaks. In contrast to Amani NBU, I noticed more frequent and prolonged in-personal verbal exchanges among health professionals from diverse groups, including nutritionists and doctors.

Like Amani NBU, virtual verbal communication in Upendo NBU comprised mobile and landline phones. Health professionals also had phone consultations with other departments and hospitals. Calls between health professionals within the NBU were fewer than in Amani NBU. There were fewer calls from intern doctors to paediatricians and nurses to the doctor on call.

I observed printed and handwritten information in various spaces in Amani NBU, such as the official patient files, handover books, clinical guidelines, and announcements on the notice board. Table 4.2 includes information about the documents that health professionals were required to fill out in the Amani and Upendo Newborn Units. A complete list of all documents reviewed in the Amani Newborn Unit is provided in Annex 5.1.

DOCUMENTS IN THE PATIENT'S FILE				
Document	**Amani NBU**	**Upendo NBU**	**Required Documentation Frequency**	**Explanation**
Continuation Form	✓	✓	Once a day	For documenting information from the medical team regarding the babies' progress and management plans.
Newborn Admission Records	✓	✓	During admission to NBU	For recording information about all babies on admission to NBU, including their condition on delivery, weight, temperature and skin colour.
Comprehensive Newborn Monitoring Chart	✓	✓	Every eight hours	For recording information about babies' progress such as the temperature, heart rate, breathing rate, and *oxygen saturation pressure*. It also recorded CPAP and phototherapy-related information such as the time of starting and progress.
Nursing Cards	✓	X	Once per shift and during an emergency in Amani NBU 12 times per day in Upendo NBU	For documenting the management nurses gave a baby from admission to discharge such as medical procedures, medication and calling the doctor to review.
CPAP Monitoring Sheet	✓	X	Every six hours	For recorded the progress of babies on CPAP, including the machine's status.
Neobac	✓	X	Before each test	For documenting information about babies who needed a blood culture and sensitivity test
Lab Requisition Form	X	✓	Before each test	For documenting information about babies who needed other laboratory tests apart from blood culture and sensitivity.
Paediatric Treatment Chart	✓	✓	Two to three times per day	For recording information about the treatment babies receive while in NBU.
Referral Forms	✓	✓	During every referral	For documenting information about babies who are referred from other facilities such as their name, date of admission, date of referral, referring facility, the reason for referral and the referring clinician.
Paediatric Referral Form	X	✓	During every referral	For recoding facility-level details of babies who were referred, including the condition at referral and interventions given.
Radiology Request Form	✓	✓	Before each investigation	For documenting information about babies who needed radiology services.
OTHER DOCUMENTS OUTSIDE THE PATIENT'S FILE				
The Admission Book	✓	✓	During admission of babies from other departments within the same hospital.	For recording information about the babies received in the unit, including mother's name and condition, admission reason, baby's weight, mode of delivery and diagnosis.

The Nurse Report Book	✓	✓	Two times per day in Amani NBU Three times per day in Upendo NBU	For documenting information useful for handovers and briefing doctors from other departments requested to review the baby. It included the baby's mother's name, incubator/cot number, days in the ward, diagnosis, and management.
The Report Book for the Matron	✓	X	Twice per day	For including information about new admissions and very sick babies.
Patient Referral Book	✓	✓	During every referral	For recording information about babies who arrived in the NBU from other hospitals including the date of birth, time, the reason for referral, date of birth, HIV status, and who received the baby.
The Unpleasant Event Book/ Patient Report Book	✓	✓	Two to three times per day	For documenting unpleasant events such as birth asphyxia and severe respiratory distress.
CPAP Book	✓	✓	During every start of CPAP treatment	For documenting information regarding babies on CPAP, including their date of birth, birth weight, the day started CPAP, the day completed CPAP, gestation age, and the outcome.
Death Book	✓	X	After every death	For recording information about babies who died in NBU, including the cause of death and number of admission days.
Duties Book	✓	✓	Once per week	For documenting nurses' rota.
Random Blood Sugar (RBS) Book	✓	✓	After every investigation	For writing information about babies who were tested sugar levels, including the time, sugar level and the number of sticks used when doing the test.
Continuous Medical Education	✓	X	Once per week	Included a summary of topics nurses choose to present to their colleagues and students.
Round book for major ward round	X	✓	Once per week	For documenting information about the medical team decisions during the *major ward round* including the diagnosis, and the management plan.
Temperature monitoring book	X	✓	Two to three times per day	containing information about the temperature of every cube, adequate or not,
Nutrition support	X	✓	Once per day	For recording information about the nutritional support babies receive from the nutritionist and the medical team, such as the feeding mode and the number of feeds.
Equipment documentation book	X	✓	Once per day	For reporting information about the number and condition of medical equipment in the ward.
Non-pharmaceutical commodities book	X	✓	Once per week	For reporting information about the medical supplies, including the date received, quantity used,reference number and signature.

Table 4.2: Documents Completed by Health Professionals in Amani and Upendo Newborn Units

I observed inconsistent references to documents such as guidelines for using CPAP and phototherapy in routine patient care. I saw health professionals using mobile phone messages *(Short Message Service)* to communicate virtually. They also used online platforms such as individual *WhatsApp* messages and *WhatsApp* groups on their private mobile phones. Health professionals informed me that there was a *WhatsApp* group for nurses and a separate one for doctors. The NBU did not have an electronic health information system. Instead, they used a paper-based system for documentation and communication.

Like Amani NBU, there were printed and handwritten documents in various newborn unit spaces in Upendo NBU. A complete list of documents reviewed in the Upendo Newborn Unit is in Annex 5.2. Sample documents filled out by health professionals in the Amani and Upendo Newborn Units are in Annex 5.3. I observed more frequent documentation and the use of guidelines to inform technology use than in Amani NBU. Health professionals used the *Short Message Service (SMS) and* individual and *WhatsApp* groups to exchange messages. Unlike Amani NBU, which had several WhatsApp groups, Upendo NBU had one *WhatsApp* group for all health professionals.

In Amani NBU, I observed nonverbal communication through health professionals' body language, such as body movements. I observed some handshakes and facial expressions (for example, laughter and frowning). I observed intern doctors and nurses looking tense when interacting with paediatricians. In Upendo NBU, non-verbal communication differed from Amani NBU, with health professionals having more informal and friendlier interactions. I observed hugs, whispers, and much laughter.

4.5 SPACE FOR COMMUNICATION

In Upendo NBU, I observed formal verbal conversations about baby management in patient rooms offices, such as nurses' room. This was the case for both in-person and virtual discussions. I saw informal conversations, for example, nurses gossiping about a doctor who mismanaged a patient on CPAP in spaces like the changing room—away from their office and patient rooms. Written communications were across different ward sections, including corridors and patient rooms. Nonverbal communication was in all sections of the NBU.

Unlike Amani NBU, I saw formal and informal verbal conversations in various spaces in Upendo NBU, including the corridors, patient rooms, and different tables in the ward. Like Amani NBU, written communications were in various ward sections, including corridors and patient rooms. Nonverbal communication was in all sections of the NBU.

4.6 TIME COMMUNICATION HAPPENED

In both NBUs, I observed, and health professionals reported that interactions were more frequent during the day than at night. The morning was the busiest time with activities such as handovers, ward rounds, and interdepartmental consultations. The night shift communications included patient admissions and patient monitoring. Sometimes, the intensity of communication depended on circumstances like a medical emergency or the number of admissions. For example, when a baby on CPAP worsens the condition, monitoring their progress and documentation intensifies in frequency and level of detail.

4.7 COMPARISON OF COMMUNICATION AMONG HEALTH PROFESSIONALS IN TWO NEWBORN UNITS.

SIMILARITIES

In both NBUs, health professionals communicated verbally, non-verbally, and in writing. The content of technology-related communication was similar across the NBUs, focusing on patient management, technology maintenance, knowledge exchange, and patient monitoring and documentation. I noticed more frequency and intensity of interactions among health professionals when dealing with CPAP compared to phototherapy. Communication activity in both NBUs heightened during daytime hours and exceptional circumstances such as medical emergencies, while interactions diminished during night-time.

PARAMETER	AMANI NEWBORN UNIT	UPENDO NEWBORN UNIT
Contents of communication	• Patient management: Paediatricians made most decisions regarding technology use.	• Inclusive decisions regarding technology use, involving more health professionals beyond just paediatricians, including clinical and medical officer interns and nurses.
	• Knowledge sharing: Informal training and orientation sessions were conducted within specific groups of health professionals. • No dedicated sessions for orienting new NBU health professionals – informal orientations instead.	• Informal training and orientation sessions were conducted across different groups of health professionals. • Special sessions to orient new NBU health professionals and refresher sessions for existing health professionals.
	• Patient monitoring and documentation: I observed frequent gaps in filling information in respective documents, for example, three hourly temperature levels for patients on phototherapy.	• I observed health professionals mostly completed filling in the information required in respective documents such as three hourly patient progress.
Ways of communicating	• Mostly formal interactions with fewer casual exchanges, often accompanied by some tension among health professionals.	• Health professionals engaged in both formal and informal friendly interactions with each other.
	• Verbal interactions more within the same group of health professionals, such as among nurses.	• Verbal interactions among and across groups of health professionals such as between nurses and doctors.
	• Notable frequency of consultation phone calls among NBU health professionals, for example, between paediatricians and medical officer interns.	• Fewer consultation calls among NBU health professionals.
	• Multiple *WhatsApp* groups for different groups of health professionals.	• One *WhatsApp* group for all health professionals.
Space for communication	• Formal interactions in formal spaces like patient rooms and informal interactions in more relaxed settings like the changing room.	• No space distinction in conducting formal and informal conversations. For example, health professionals used patient rooms, corridors, and offices for both interactions.

Table 4.3 Communication Differences among Health Professionals in Amani and Upendo Newborn Units.

4.8 SUMMARY

In this chapter, I report similar communication contents to those in the literature review – patient management, knowledge sharing, and monitoring and documentation. I have also reported one additional category related to technology repair. Health professionals engaging with newborn technologies use verbal and written communication. While this aligns with my scoping review findings, I also report nonverbal communication, which was reported among health professionals not associated with newborn technology use. This might be because no studies in my scoping review employed ethnographic observations, and none focused on communication.

I show the differences in health professionals' communication in various spaces. In Amani NBU, communication appeared formal in places like patient rooms and informal in areas like changing rooms. In Upendo NBU, there was no space distinction for formal and informal conversations. They all happened in spaces such as patient rooms, corridors, and offices – fostering increased interaction and collaboration among health professionals. In Chapter 5, I explore the role of the physical context in health professionals' communication and decision-making.

In Amani NBU, paediatricians were responsible for technology decisions. Interactions among health professionals in Amani NBU were predominantly formal, occasionally marked by tension between individuals. Communication tended to occur more frequently within the same professional group rather than across interdisciplinary lines. Various WhatsApp groups were utilised to communicate with different groups of health professionals. In contrast, decision-making in Upendo NBU was more inclusive, involving paediatricians and other healthcare professionals. Interactions among health professionals in Upendo NBU were formal and informal, fostering a more friendly atmosphere. There was a higher frequency of interactions across different professional groups facilitated by a single WhatsApp group, including all health professionals. In Chapter 6, I explore the differences in interactions among health professionals, focusing on the organisational context to explore relationships, organisational culture and other issues that may play a role in technology-associated communication.

I observed that there were more frequent and intense interactions among health professionals when dealing with CPAP compared to phototherapy. In Chapter 7, I discuss technology-associated factors and their role in decision-making and communication among health professionals. In the following results chapters, I examine what contributes to the differences in health professionals' communication and decision-making within the two NBUs.

CHAPTER 5: THE ROLE OF THE NEWBORN UNIT PHYSICAL CONTEXT IN SHAPING HEALTH PROFESSIONALS' COMMUNICATION AND DECISION-MAKING.

5.1 INTRODUCTION

In this chapter, I set the scene of Amani and Upendo newborn units that are the focus of my research. I highlight the physical structure and layout of the newborn units and consider their role in shaping communication and decision-making. After that, I highlight the number, disciplines and routines of health professionals as well as caregivers, and babies in the NBUs. At the end of the chapter, I present similarities and differences between the two NBUs and how they shape communication and decision-making. I conclude by discussing key findings – how they relate to the literature, the implications of findings and their relationship with the subsequent results chapters.

5.2 PHYSICAL STRUCTURE

5.2.1 AMANI NEWBORN UNIT

Amani NBU was on the ground floor in the middle of over ten one-storey hospital buildings. To reach it, I passed a busy and noisy outpatient department (OPD) waiting area, where over fifty people sat or stood throughout the day. The passage past the OPD led to a closed gate that gave access to inpatient departments such as the Maternity Ward, Paediatrics, Surgery, Orthopaedics, and the Newborn Unit. The NBU was at the end of a passage next to the Postnatal Ward. A guard near the NBU door monitored people accessing the NBU and the Postnatal Ward. The NBU was a standalone building with one main entrance. On the door was a "Newborn Unit" sign (Figure 5.1). A twenty-litre plastic tank with a tap next to the entrance acted as a handwashing point.

Figure 5.1 Amani Newborn Unit Entrance

Outside, the NBU was quiet, and the air was fresh. Upon entering the NBU, I noticed changes in temperature, air quality, and sound. The temperature was usually higher—consistently above 30 degrees Celsius—compared to the outside environment, which was generally below 20 degrees Celsius. The air inside the NBU was heavy, suffocating, and smelled like spoiled milk and sweat. Often, there were loud and continuous cries from babies.

As shown in Figure 5.2, the NBU was a rectangular structure (40 by 25 metres) with concrete floors and concrete walls that were freshly painted pink. The spacious, well-maintained glass windows on the left and right sides of the building were usually closed to maintain the temperature.

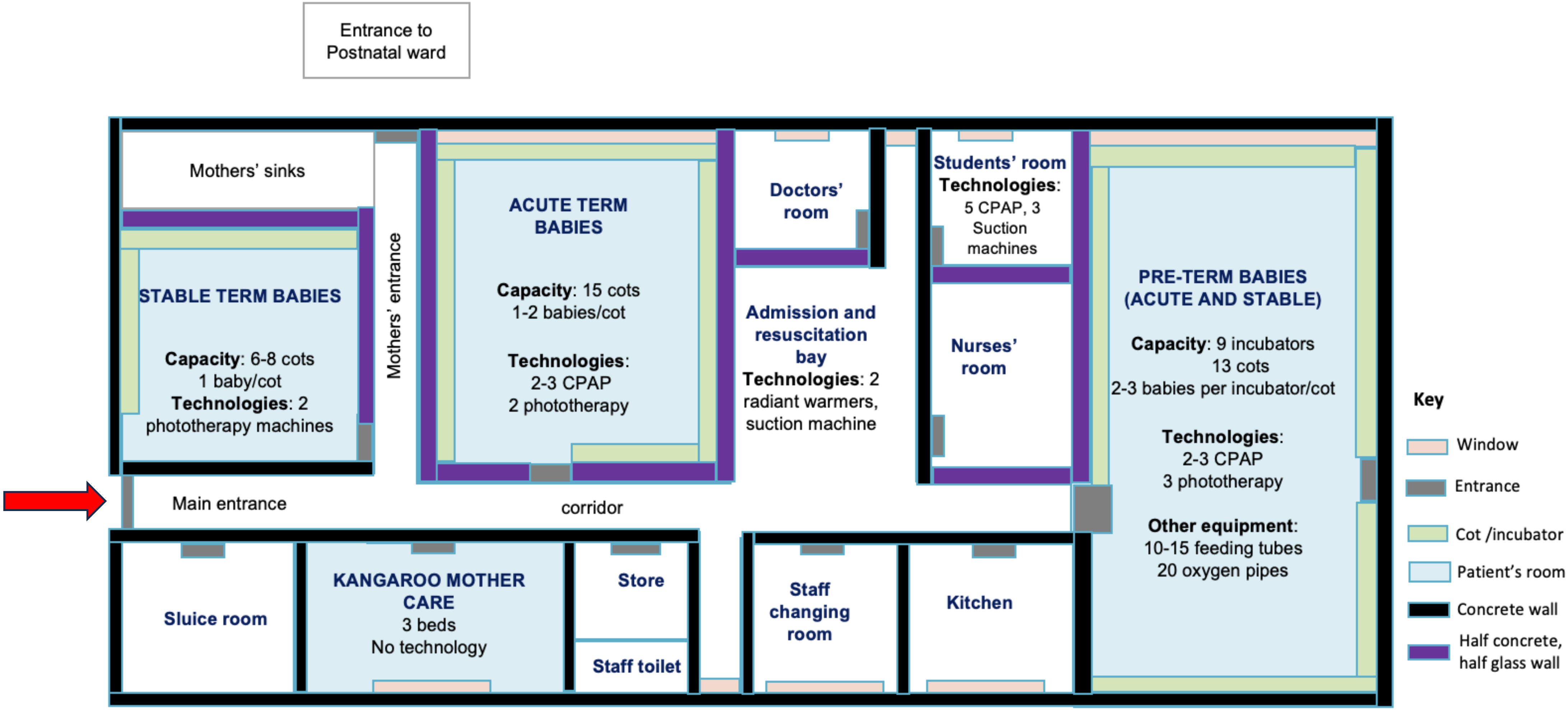


Figure 5.2 Amani Newborn Unit Layout

While whole concrete partitions demarcated the sluice, toilets, Kangaroo Mother Care, and Changing Room, other rooms had half-concrete walls at the bottom and glass walls on top. All rooms had glass doors, except for the patients' rooms—Acute Premature, Acute Term, and Stable Term Babies' rooms—which had no doors. A clean white ceiling board on the roof had about ten large and bright tube lights.

As I entered through the main entrance, there was a shoe-changing area (Figure 5.3) and coat-hanging hooks. To the left of the main entrance was the Stable Term Babies' Room, the first of four patient rooms. Babies who were doing better and born after 36 weeks of pregnancy stayed in this room while awaiting vaccination and discharge. It was a spacious room with ten multicoloured plastic cots. Babies in the room rarely shared a cot, and their mothers sat on two wooden benches placed along one wall when they visited. The room had no technology, and its walls were clear of documents. Next to the room was a corridor leading to the Postnatal Ward entrance. Mothers used this entrance to access the NBU. Adjacent to this door was a sink with two taps and washing soap.

Figure 5.3 Amani Newborn Unit Shoe Rack

To the right of the main entrance was the Sluice Room. It was a small room with a few buckets, usually full of hanging clean laundry and washed hospital devices, such as suction tubes. Next to it was the Kangaroo Mother Care Room, the second of the patients' rooms. It was a small room with three beds, providing space for mothers and stable premature babies who needed weight gain before discharge. They stayed with their mothers full-time for warmth and care, with the room typically housing two or three babies. No technology was present in this room.

As I walked further down the corridor, the newborn unit became busier. The Acute Term Babies' Room was on my left, the third of the patients' rooms. Very sick babies born after 36 weeks of pregnancy stayed in this room. It was a crowded space with fifteen cots tightly arranged around the walls to allow easy access to oxygen pipes on the wall and a small amount of floor space in the middle. The plastic cots were clean, in good condition, and multicoloured—purple, light green, and pink. This room was always full of two to three babies sharing cots on most days. Each cot had a handwritten number. Most babies wore only nappies, while those on Continuous Positive Airway Pressure (CPAP) wore nappies and a cap to secure pipe connections. Each baby had a blanket provided by their family or the hospital. About 80% of the babies in this room used oxygen most of the time.

Apart from oxygen therapy, this room had one to two CPAP machines and up to four phototherapy machines based on need. When not in use in this room, health professionals moved these machines to the Students' or Preterm Babies' Rooms. There was no specific section for babies on CPAP and phototherapy machines; instead, they were distributed across the room based on bed availability. Since the babies on these technologies were not kept together, monitoring and documenting their progress were similar to those not on technology. A printed poster on how to use phototherapy, targeted at health professionals, was on the wall, but no information on CPAP was displayed. Nurses used a wooden table with two chairs beside the room entrance for documentation or interaction with mothers.

With this arrangement, the available space was minimal, especially during ward rounds and handover activities. The congestion worsened when mothers came to feed their babies every three hours (Figure 5.4). Most of them struggled to find space on the floor to sit. During feeding times, health professionals could not move around or interact due to the noise and lack of space. They had verbal interactions only when together in one room due to the significant distance between rooms.

Figure 5.4 Mothers Feeding Babies in Acute Term Babies’ Room, Amani Newborn Unit

Between the Acute Term Babies' Room and the Pre-term Babies' Room were the Admission and Resuscitation Bay (Figure 5.5) and three rooms for the health professionals: the Nurses’ Room, Doctors' Room, and Students' Room.

Figure 5.5 Amani Newborn Unit Admission and Resuscitation Bay

The Admission and Resuscitation Bay housed documents, technologies, and other medical supplies. Medical guidelines were displayed on the glass wall, featuring a wide range of clinical information such as glucose management, oxygen therapy calculations, baby positioning during breastfeeding, and resuscitation techniques. These documents partially obstructed views of the Acute Term Babies' Room. Most documents contained general guidelines for managing babies in the NBU. Two radiant warmers and a suction machine were positioned against the wall. Miscellaneous unlabelled equipment, including gloves, suction tubes, and syringes, were often scattered on a table throughout the day. The area was busy, with at least two babies per radiant warmer and constant movement of health professionals, especially during the day. The busy nature of the section meant health professionals rarely had verbal interactions with their colleagues.

The Nurses' Room was small, featuring a medium-sized wooden table and two chairs. It contained a functional mobile phone, a broken landline phone, administration and patient files, and handwritten report books. It also stored portable technologies such as a pulse oximeter and glucometer. On the glass wall facing the Resuscitation Bay were over 20 handwritten and printed documents (Figure 5.6) focusing on the clinical management of various newborn conditions and administration announcements. Annexe 5.1 provides further details on the documents on the wall and table. Although up to four people could comfortably stay in the room, it was usually occupied by nurses and medical and nursing students, particularly during the day. When students were present, the room was noisy, smelly, and disorderly. I regularly observed some nurses and doctors wearing earphones while documenting. Interacting in this room was challenging for health professionals.

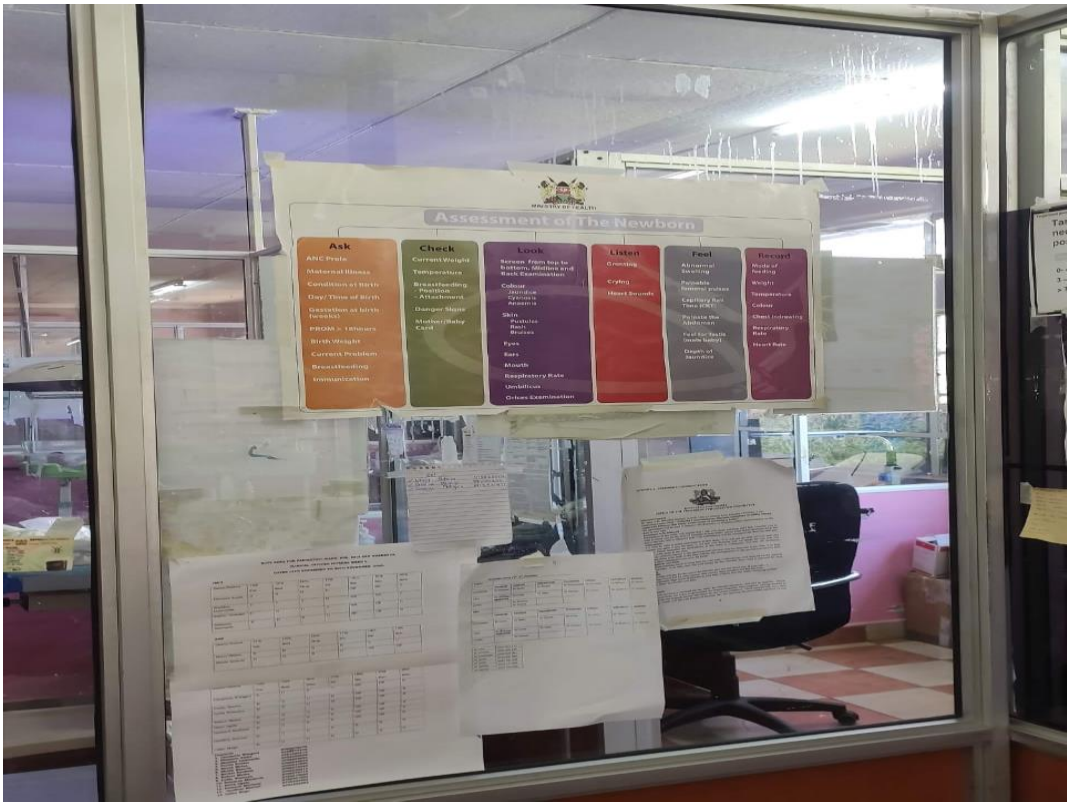


Figure 5.6 Amani Newborn Unit Documents on the Wall in Nurses' Room

Doctors used the Doctors' Room for documentation and rest. It was a small room with a wooden table, two chairs, and a small shelf with locked compartments. The room faced the Acute Term Babies' Room, allowing a view of the babies through the glass wall, but the sounds of babies' cries, mothers' conversations, and machines beeping made discussions inaudible. Since the room use was exclusively for paediatricians, Medical and Clinical Officer Interns, it was not visited by other health professionals, creating silos within the teams. The third room, the Students' Room, stored unused and broken equipment, including three unused CPAP machines.

Opposite the resuscitation area, and between the Kangaroo Care and Pre-Term Babies' Rooms, were the store, changing room, toilet, and kitchen. The Store was a small room with an old washing machine for patients' linen and a small cabinet for mothers' clean gowns. Its marble floor usually appeared dirty. The health professionals' toilet, marked with a sign stating, "Do not pee on the toilet," was a clean squat toilet with a loud flush that could be heard in the Acute Term Babies' Room.

The kitchen was used for preparing tea for health professionals and warming milk for babies whose mothers were absent due to illness or death. It featured an in-built kitchen table, a gas stove, a kettle, and cups in a dish dryer. A metallic sink with a functional tap was located below the window. The kitchen appeared clean. The Changing Room served multiple purposes providing space for tea breaks, clothes changing, private discussions, drug storage, and as a sleeping area at night. Two locked drug cabinets stored supplies like intravenous fluids and syringes, requiring approval from the nurse in charge. A three-seater old sofa placed next to the wall under the window provided seating for nurses and nursing students. A table in the middle of the room was used for keeping food, though some students and nurses placed their bags on it. Nurses hung their non-uniform clothes on hooks behind the door after changing into their uniforms. I often observed nurses gossiping about paediatricians and intern doctors in this room, such as a nurse complaining about a doctor's delay in fixing a cannula.

At the end of the corridor was the Preterm Babies' Room, the final patient room. It had babies born before 36 weeks of pregnancy and was the busiest and most crowded room. The left side accommodated babies needing critical care, while the right side was for stable babies. The left side had nine colourless rectangular plastic incubators and one radiant warmer arranged against the walls. The incubators were clean and in good condition, with each containing two to three babies on blanket-covered green mattresses. Babies wore nappies only. Below the window was a small white sink with one tap and running water.

On the right side were thirteen cots, also arranged around the walls. On most days, two babies shared cots, with rare instances of a cot being occupied by only one baby. Collated information about the progress of all premature babies' weights, documented by nutritionists on paper three times a week, was posted on the wall. Babies on technologies were spread across both sides of the room. A total of thirty-five oxygen pipes were installed on the wall across the room. Four metallic portable heaters on the floor maintained the room’s warmth. Between six and ten drip stands held intravenous fluids, such as *Normal Saline, Dextrose,* and *Ringer's Lactate*. Depending on the day, one or two babies were on CPAP, while two to four babies were on phototherapy during most of my observations (Figure 5.7). As in the Acute Term Babies' Room, there was no specific section for babies on CPAP and phototherapy.

Figure 5.7 A baby on CPAP in the Acute Premature Babies’ Room, Amani NBU

Two medium-sized wooden tables were in the middle of the room; one was used primarily for placing items, while the other was designated for documentation. The first table held four white twenty-litre buckets labelled "clean water," "soapy water," "*JIK*," and one with an unreadable label. Mothers used these buckets to place cups to *express milk* and to feed some babies who could not breastfeed. The second table was surrounded by three black, old metallic chairs. Nurses used this table to fill in the information in the patient's files, and it was typically covered with a large number of files.

Since the room has many items, people added to the congestion. It became particularly crowded every two hours when mothers came to feed their babies, spending approximately 45 minutes in the room. A few mothers used the available plastic chairs, while most sat on the floor. The room was so crowded that there was nowhere to stand. During these feeding times, the noise level increased, and health professionals faced limitations in their movement and interactions within the room.

5.2.2 UPENDO NEWBORN UNIT

As with Amani, the Upendo Newborn Unit was located in the middle of the hospital, which comprised over 15 buildings. To access it, I passed through a gate leading to the inpatient departments. To the left, a corridor extended to the Maternity Wing, which included the Labour Ward, the Post-Natal Ward, and the Newborn Unit. The Newborn Unit was adjacent to the Post-Natal Ward.

The "Newborn Unit" sign was outside the door (Figure 5.8), clearly visible as was the case with Amani NBU’s door. Upon entering the NBU, the temperature was higher (above 30 degrees Celsius) compared to the outside environment, which ranged between 15 and 20 degrees Celsius during my data collection period. Unlike Amani NBU, the air was fresher with only a mild milk smell. People entering the NBU changed their shoes at the door and placed them on a shoe rack (Figure 5.9) against the left wall near the entrance. Above the shoe rack were about ten wooden hooks used for hanging white medical coats.

Figure 5.8 Upendo Newborn Unit Entrance

Figure 5.9 Upendo Newborn Unit Shoe Rack

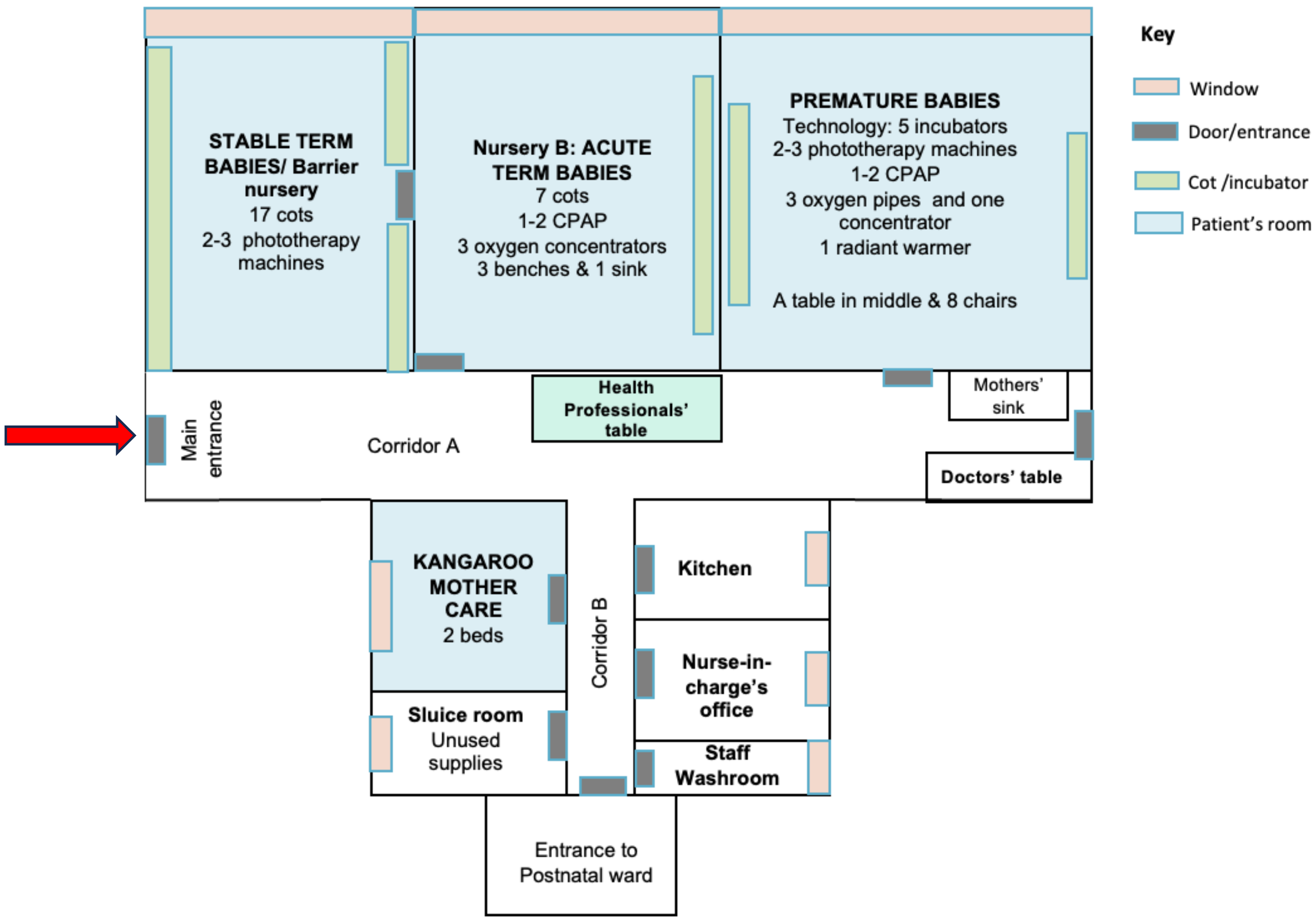


Figure 5.10 Upendo Newborn Unit Layout

As presented in Figure 5.10, the NBU was 25 x 25 square metres. It appeared older and was about half the size of Amani NBU. It had a tiled floor with grey and cream colours. The walls were painted blue and pink, with visible small holes. While the walls were made of concrete, three patient rooms had half-concrete and half-glass walls. The roof featured an old white ceiling board discoloured from rainwater and held about ten tube lights. The spacious and wide glass windows were in good condition and were usually closed. All rooms had light blue wooden doors, which were typically open.

From the main entrance, the left side of the NBU had three patient rooms next to each other. The half-glass walls made it easy to see what was happening in all three rooms. I noticed health professionals interacting across different patient rooms because the rooms were close to each other, and the doors were usually open. This differed from the arrangement in Amani NBU, where the patient rooms were farther apart, limiting interaction to health professionals within a single room or portion of a room.

The first room to the left from the entrance led to two Term Babies' Rooms. The first was the Stable Term Babies' Room, which also accommodated babies on phototherapy. It was a small room with 17 mesh-wired metallic cots arranged around the wall against oxygen pipes. The cots were unlabelled and coated with old, fading white paint. Each had a dark green-covered mattress and a hospital-provided flowery white sheet that matched the mothers' robes. An average of 12 babies occupied the room at a time and did not share cots. On the right side of the room was a Phototherapy Bay for babies who needed phototherapy (Figure 5.11). The area was labelled, and a *nomogram* on the wall provided criteria for health professionals to use phototherapy. A designated phototherapy area allowed health professionals to monitor all babies during phototherapy. This differed from Amani NBU, where there was no dedicated corner for babies undergoing phototherapy. As I had observed earlier, the lack of a dedicated area for phototherapy sometimes led to health professionals missing the prioritisation of monitoring and documenting babies' progress.

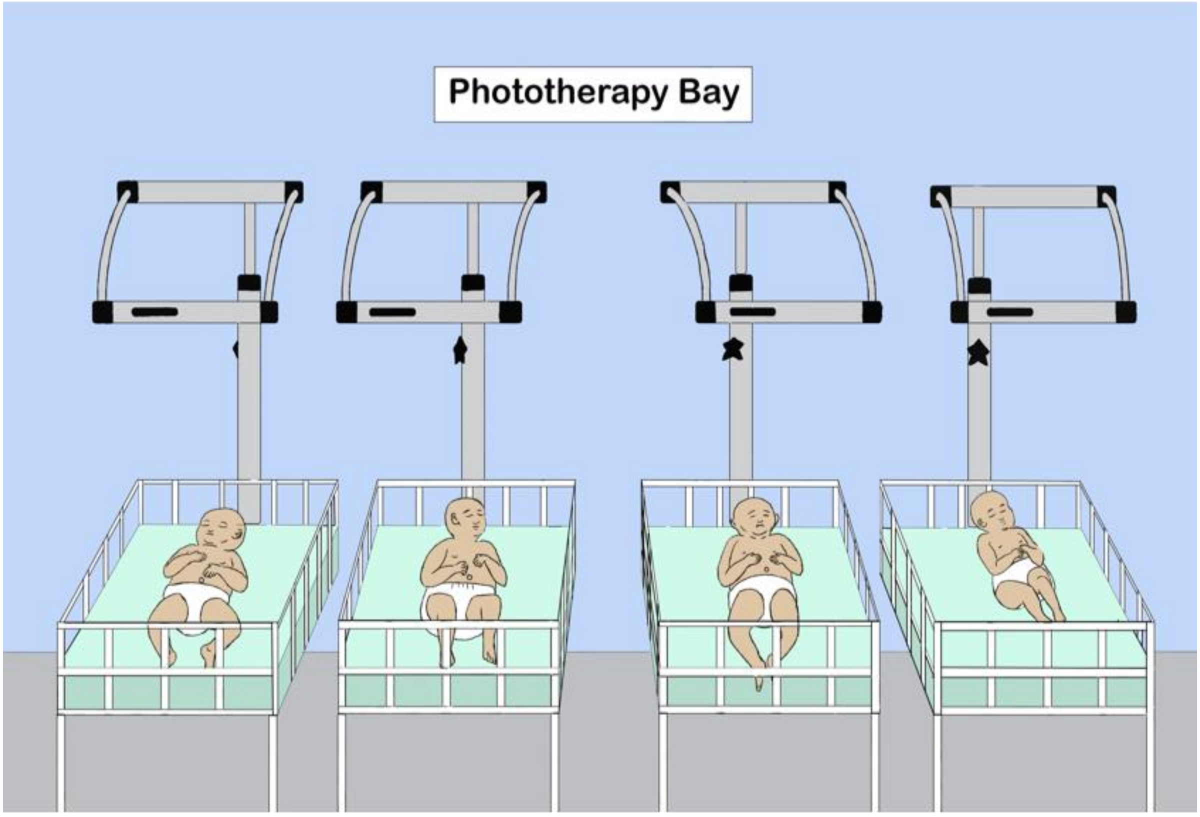


Figure 5.11 Phototherapy Bay in Stable Term Babies' Room

The next room was the Acute Term Babies' Room for sick babies born after 36 weeks. It had seven cots on the right side of the room arranged next to oxygen pipes on the wall. On a busy day, it had seven babies, but more often, just five babies. It was less than one-third of the number of babies in the Acute Term Babies' Room in Amani NBU, and babies did not share cots. This area was dedicated to term babies on CPAP for monitoring and documentation prioritisation. This was unlike Amani NBU, which had no dedicated space for babies on CPAP. One baby used CPAP on an average day, and when it was busy, up to three babies used CPAP.

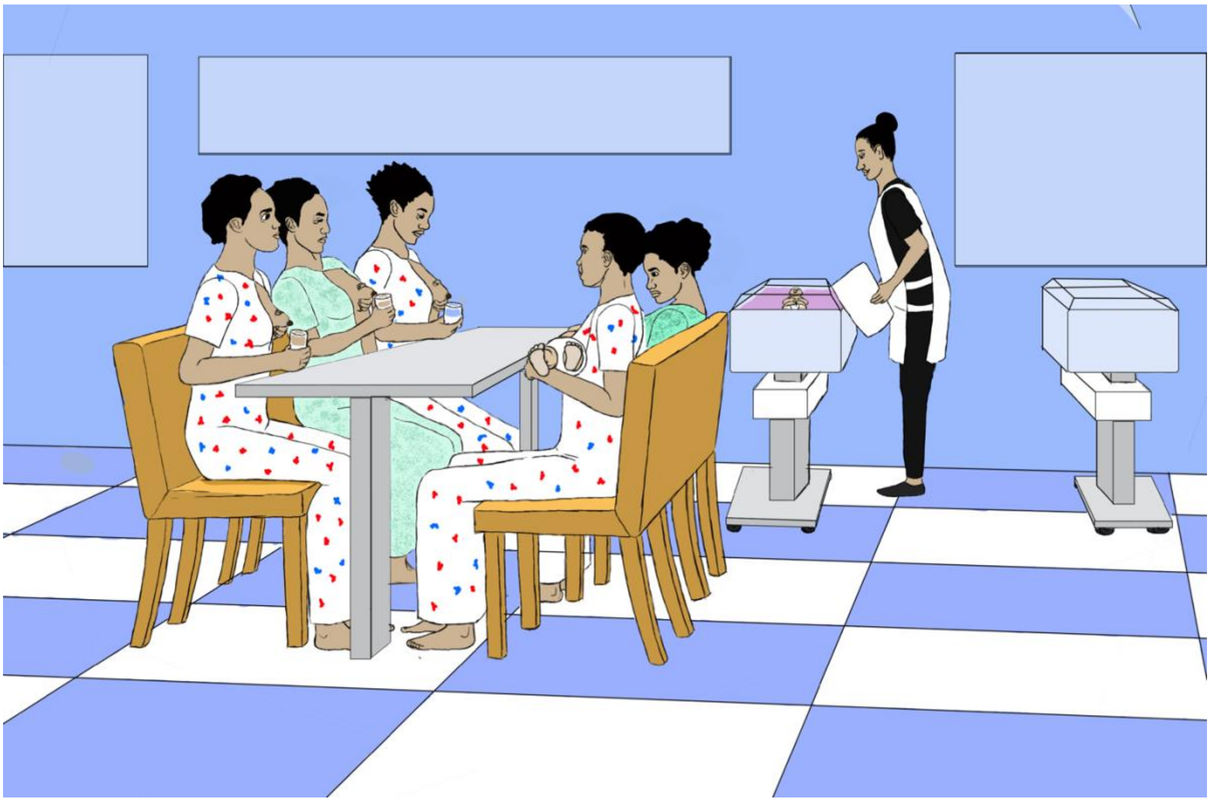
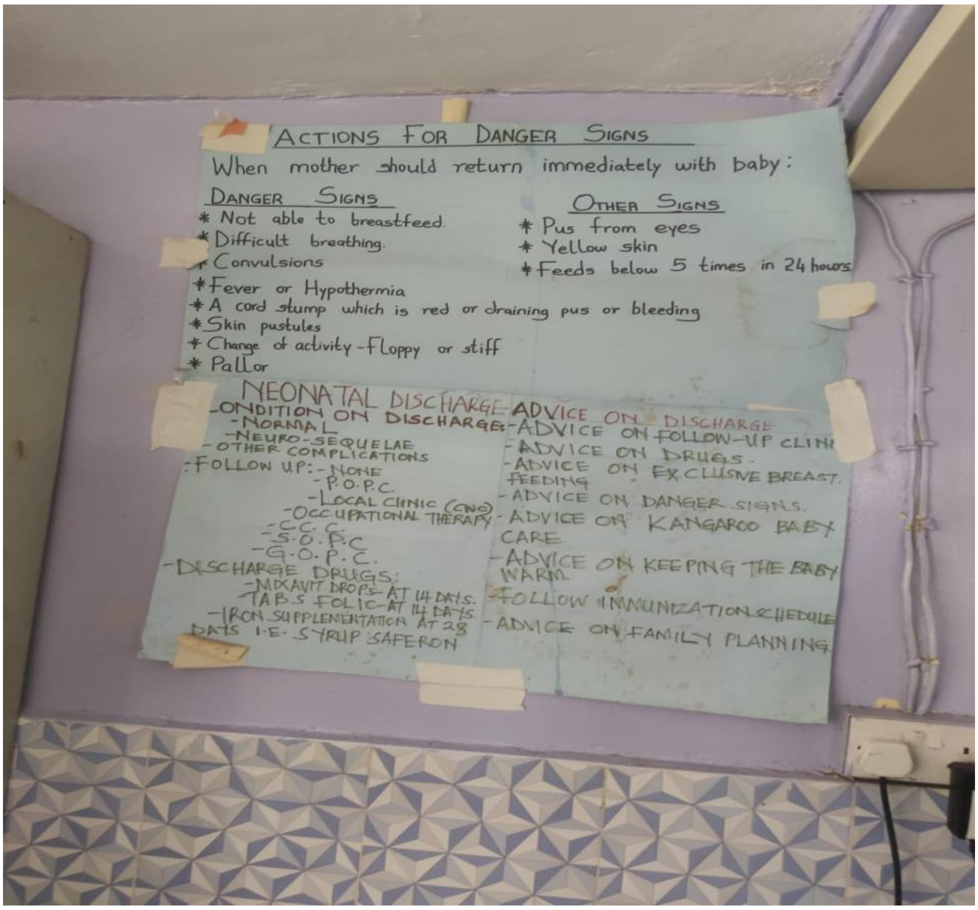


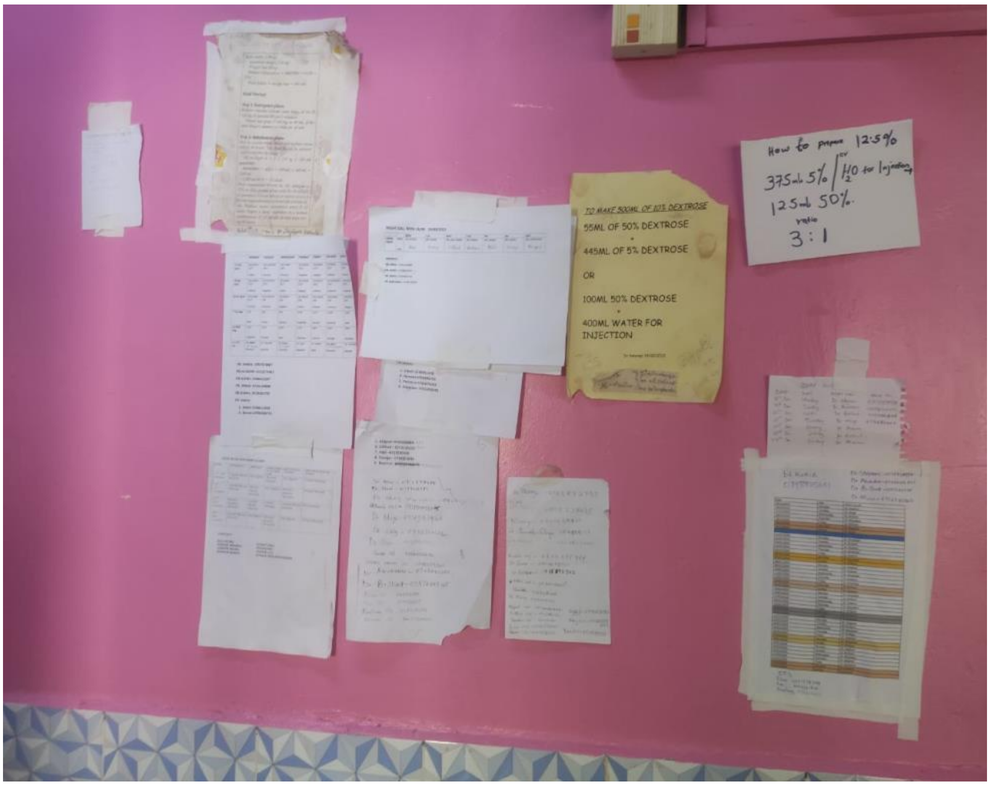
Figure 5.12 Mothers Feeding Babies in Acute Preterm Babies' Room

Comprehensive Newborn Monitoring charts containing each baby's clinical information were on each cot in all patient rooms. These charts made it easy to identify a baby before administering care and during other activities such as handover and documentation. In contrast, these charts were not attached to the cots in Amani NBU, which led health professionals to spend more time locating patient files whenever they needed to document patient progress.

Corridor A served as the unit's epicenter. A medium-sized wooden table and three wooden chairs overlooking the Acute Babies' cubicle were located close to the entrance door in the corridor. This table functioned as a Health Professionals' Station (Figure 5.13). On the table were handwritten books. It was a communal area where health professionals from all disciplines could have verbal conversations and documentation. Nurses, the medical team, and other health professionals used it for admissions, discharges, consultations, medical discussions, and social interactions. From this table, it was possible to see and interact with health professionals or family members in the patients' rooms because the doors were always open. The list of books on the table was detailed in Annexe 5.2. This arrangement differed from Amani NBU, which lacked sufficient space for bringing together different groups of health professionals for interactions. Next to the table was a landline phone and patients' files, while opposite it was a medicine cabinet. At the end of Corridor A was another table with three chairs, which I observed being used by students and occasionally by medical officers and clinical officer interns. Opposite this table was the mother's sink with three taps and liquid soap. The sink was old and leaked drops of water onto the floor. Despite regular cleaning, it had a pungent smell. Next to the table were documents on the wall (Figure 5.14).

Figure 5.13 Upendo Newborn Unit Health Professionals' Station





Figures 5.14 Upendo Newborn Unit Documents on the Wall

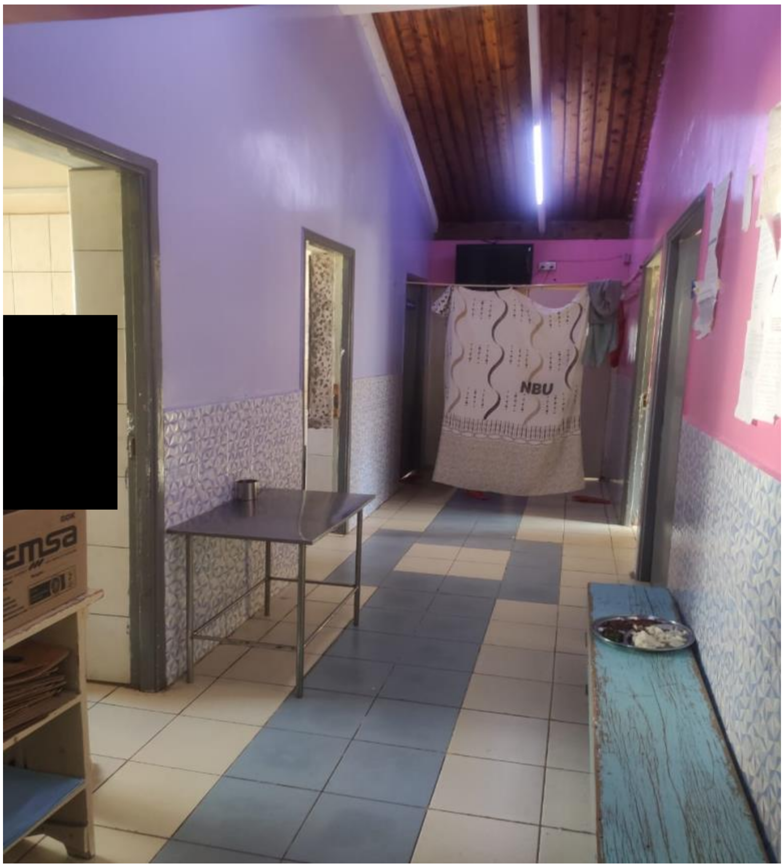


Figure 5.15 Upendo Newborn Unit Corridor B

Corridor B (Figure 5.15) extended from the Nurses' Station to the Postnatal Ward door. From the main entrance, the right side of the NBU had one patient room—the Kangaroo Mother Care room. Additionally, it had other rooms used by health professionals: the kitchen, the nurse in charge’s room, the sluice, and the toilet. The Kangaroo Mother Care (KMC) Room housed premature but stable babies who remained in the ward to gain weight. It had two beds, two radiant warmers, and a window. Mothers did not share beds. As with the similar room in Amani NBU, there were no CPAP or phototherapy machines in this room.

The kitchen was a small room opposite the Kangaroo Mother Care room. A metallic sink with a functional tap was next to the door. Three buckets labeled "clean water," "soapy water," and "*JIK* water" were under the sink. Mothers placed used feeding cups and syringes in the buckets before ward assistants cleaned them. A wooden table opposite the sink had a kettle, microwave, and gas stove. Health professionals' cups and flasks were on top of the microwave. Having washing buckets in the kitchen created space in the patient rooms—

unlike Amani NBU, which kept washing buckets in the already congested Premature Babies' Room.

Outside the kitchen, in the corridor, was a small metallic table for mothers' porridge, snacks, and cups. Sometimes, the table had food remaining for several hours. Unlike Upendo NBU, Amani NBU did not serve food in the ward; mothers ate in the Postnatal Ward. A curtain surrounded the Postnatal Ward door and served as the mothers' changing room before entering the unit. They removed their postnatal gowns and wore NBU robes, placing the changed robes on the curtain rod. Details on the information on the corridor walls are in Annexe 5.2.

The Nurse-in-Charge's Room was next to the kitchen. It was a small, disorganised, and crowded room that acted as a store and changing room. A wooden locked chest of drawers was next to a big window. Three boxes filled with documents were on the floor in the room. About ten hooks on the wall held health professionals' bags and home clothes. One old white sink with running water was next to the door. Since the room was full of medical supplies, nurses used the Health Professionals' Station for documentation, resting, and interaction with other groups of health professionals.

The Sluice was a spacious room next to the Postnatal Ward. Health professionals cleaned and stored unused equipment such as CPAP machines, incubators, and drip stands there. Bodies of deceased babies stayed in the room for up to 12 hours before being collected by the mortuary team. The Toilet Room for health professionals was next to the Postnatal Ward. It was clean and spacious, with a European-style toilet. The flushing system was malfunctioning, and an external valve controlled the water flow instead. Sometimes, the toilet flooded when the valve was left open after use.

5.3 PEOPLE AND ROUTINE IN THE NEWBORN UNIT

Both NBUs had three groups of people – health professionals, caregivers, and babies.

5.3.1 BABIES

AMANI NEWBORN UNIT

Between 40 and 80 newborn babies were in the NBU at any given time (Figure 5.16). The top three causes of admissions were *infections*, *prematurity*, and *birth asphyxia*. Cases of abandoned babies and congenital malformation cases were also common. Babies admitted to the NBU weighed between 700 grams and 5000 grams.

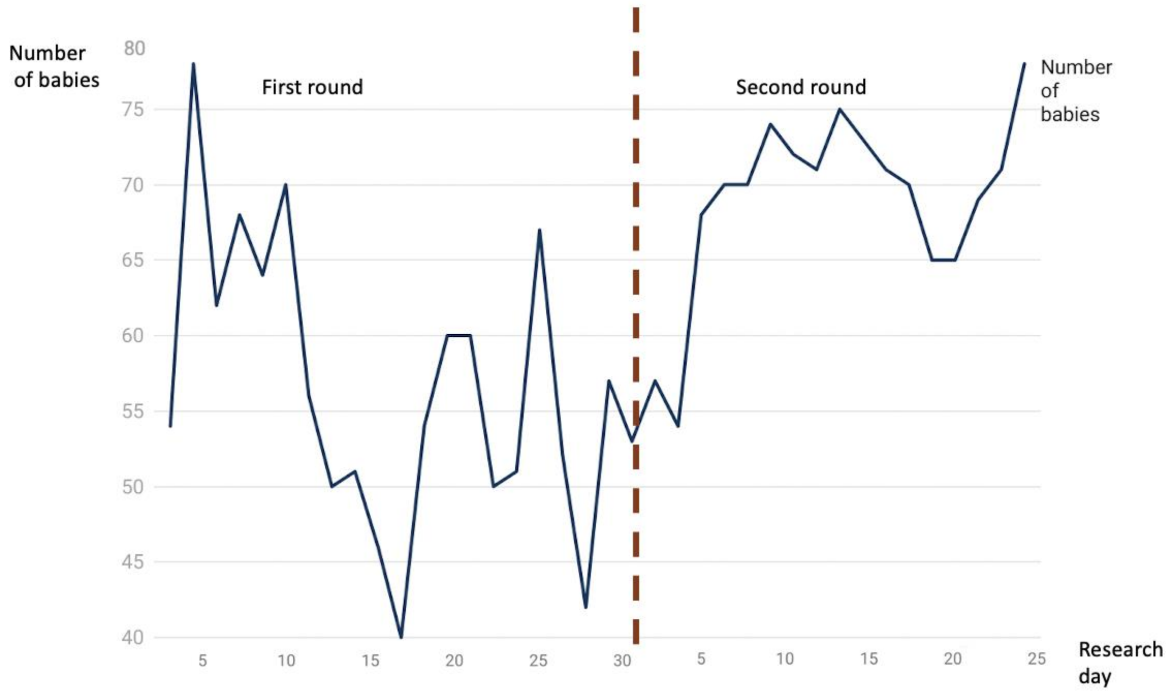


Figure 5.16 Babies in the Amani Newborn Unit

UPENDO NEWBORN UNIT

Between 15 and 30 babies were admitted to the Upendo NBU at any time (Figure 5.17), which was three times fewer than the number in Amani NBU. Their weights ranged from 700 grams to 5000 grams. Similar to Amani NBU, the top three causes of admissions were *prematurity, infection,* and *birth asphyxia*. Other conditions included congenital disabilities such as *Spina Bifida* and *Talipes*. A few abandoned babies or those with sick mothers were accommodated in the unit.

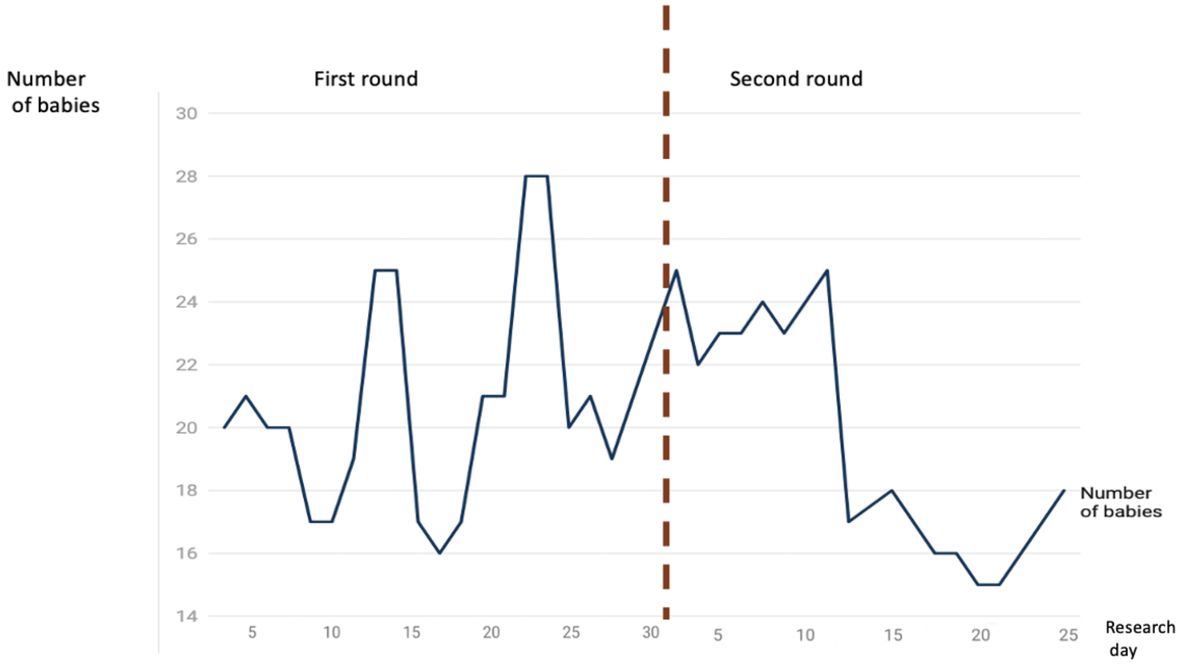


Figure 5.17 Babies in the Upendo Newborn Unit

5.3.2 HEALTH PROFESSIONALS

AMANI NEWBORN UNIT

Various health professionals worked in Amani NBU. Some health professionals were based in the NBU while others visited from other hospital departments. Health professionals comprised clinical and non-clinical groups. Table 5.1 summarises information about health professionals in the two NBUs.

Nurses

Nurses worked exclusively in the NBU. During the first round of data collection, ten female nurses worked at Amani NBU, with their experience ranging from three months to four years. Three of these nurses, including the nurse-in-charge and deputy nurse-in-charge, held postgraduate degrees in newborn and paediatric nursing, while the others had diplomas in nursing. Their ages varied between 20 and 50 years, with the nurse-in-charge and her deputy being in their 30s.

During the second round of data collection, the ten nurses were joined by three new nurses who had started work in the NBU six months before the second round of data collection. These new nurses (two male and one female), all in their 20s, had started working in the NBU six months prior. They had less than three years of nursing experience and were part of the HIGH-Q program nurses' intervention, having joined from other hospitals. All nurses working in the NBU wore *scrubs, croc* shoes, and face masks, and I observed them changing masks in the middle of their shifts.

Medical Team

This group included paediatricians, medical officer interns, and clinical officer interns. During both rounds of data collection, three female paediatricians (including the Head of the Paediatric Department) worked in the NBU on a rota. They also attended to patients in other units, such as the Paediatric Ward and Outpatient Clinic. Two of the paediatricians were in their late 40s, while one was in her 30s. Their experience in the NBU at Amani ranged from three to seven years. Additionally, one male paediatrician from a local university visited once a week to teach medical students.

Up to four clinical officer interns and five medical officer interns rotated through the NBU every six weeks. No qualified medical officer or clinical officer was employed to work in the NBU. Medical and clinical officer interns wore *scrubs* of any colour, while paediatricians wore their home clothes. None of the paediatricians, medical officer interns, or clinical officer interns wore white coats in the NBU, leaving them at the entrance. All health professionals in this group wore *croc* shoes and carried *stethoscopes*. Face masks were mandatory during the first round of data collection but became optional in the second round.

Other Health Professionals

Two female nutritionists in their 20s visited the NBU at least three times a week, wearing non-uniform clothes. A team of four biomedical engineers, also in non-uniform clothes, came to the NBU to repair technologies. Occasionally, up to four students accompanied the engineers to learn how to connect machines such as oxygen pipes. Every afternoon during weekdays, two female and one male nurse from the Outpatient Department visited the ward to vaccinate babies, wearing *scrubs, croc* shoes, and masks.

One female occupational therapist visited the NBU at least twice a week, dressed in non-uniform clothes. During my observation period, up to six nursing students rotated through the NBU for two weeks, while up to 20 medical students visited weekly during major ward rounds. Medical students wore blue *scrubs* with name tags on the left-hand side of their chests, but did not wear white coats. All health professionals, including the students, wore *croc* shoes and masks. In both rounds of data collection, three female ward assistants, aged between 30 and 50 years, worked in the unit. They wore non-uniform clothes and multicoloured aprons. Nutritionists and occupational therapists did not interact with each other or with other health professionals.

People	Gender	Health professionals in each research round				Qualification
		Amani NBU		Upendo NBU		
		First	Second	First	Second	
Nurses	Female Male	10 0	11 2	9 1	10 1	Diploma or degree in Nursing
Paediatricians	Female	2	3	2	2	Master's degree in paediatrics
Medical Officer Interns	Female Male	3 2	1 3	1 1	1 1	Doctor of Medicine degree
Medical Officers	Female	N/A	N/A	1	2	Doctor of Medicine degree
Clinical Officer Interns	Female Male	1 3	2 2	2 2	1 3	Diploma in Medicine
Ward Assistants	Female	3	3	2	2	Secondary school education
Nutritionists	Female	2	2	1	1	Diploma in Nutrition
Nutrition interns	Male			1	2	Diploma in Nutrition
Biomedical Engineers	Male	4	4	3	3	Biomedical engineering diploma
Vaccination Team	Female	3	3	3	3	Diploma in Nursing
Medical Students	Female Male	5 15	4 16	N/A	N/A	Doctor of Medicine students
Nursing Students	Female Male	5 1	4 2	8 2	6 4	Diploma in Nursing
Occupational Therapist	Female	1	1	2	2	Occupation Therapy diploma

Table 5.1 Health Professionals in Amani and Upendo Newborn Units

UPENDO NEWBORN UNIT

Nurses

In the first round of data collection, ten nurses, including one male nurse, worked in the unit. Their experience in the maternity wing[2] varied between four and twenty years, with half having worked for ten years. Both the in-charge and deputy-in-charge had 20 years of

[2] Some nurses cared for newborn babies in the maternity wing before the establishment of the Newborn Unit.

newborn care experience. Compared to the Amani NBU, most nurses in Upendo NBU had more than twice the experience. During the first rounds of data collection, both NBUs (Amani and Upendo) had a similar number of nurses. Female nurses dominated both NBUs, with just one male nurse in Upendo NBU. Nurses in Upendo NBU wore white aprons on top of their scrubs. The aprons had the words "I am an advocate for patients' safety" in front and “COVID-19 prevention” at the back.

In the second round of data collection, three nurses were added to the NBU. Despite these additions, one nurse was on sick leave and another retired, bringing the total number of nurses to 11. With that increase, Amani NBU had two more nurses than Upendo NBU. However, the workload in Amani NBU was higher due to the number of patients compared to Upendo NBU. All three new nurses in Upendo NBU joined from the Postnatal Ward within the same hospital. Since they were familiar with the environment, their orientation training focused on newborn care. This differed from the additional nurses in Amani NBU, who came from other hospitals and needed time to familiarise themselves with the hospital and NBU.

Medical Team

Two paediatricians served the NBU during both rounds of data collection. The female paediatrician, in her 50s, headed the paediatric department. The second paediatrician was a male in his 40s. Based on the number of patients in Upendo NBU, Amani NBU had up to double the number of babies per paediatrician on most days. Upendo NBU had medical officers with permanent employment in the department, which facilitated smooth transitions once medical and clinical officer interns moved to other departments. In the first round of data collection, one female medical officer served the NBU and other units within the department, such as the outpatient clinic and the paediatric ward. In the second round, a young female medical officer joined the department. Medical officers played a crucial role in providing instruction and ensuring that medical and clinical officer interns rotating in the NBU received proper orientation on how to use technologies. Amani NBU did not have medical officers, and apart from paediatricians, its medical team consisted of temporary intern doctors only.

During both rounds of data collection, an average of two medical officer interns and four clinical officer interns rotated in the NBU for up to five weeks. Upon entering the unit, the clinical team wore green robes over their home clothes. Both newborn units had a similar number of medical and clinical officer interns.

Nutritionist

With the occasional assistance of two nutrition interns, one female nutritionist in her 40s worked exclusively at the NBU. She wore green robes like the medical team. While she worked full-time at Upendo NBU, two nutritionists visited Amani NBU to provide services while also offering support to other departments in the hospital.

Other Health Professionals

Three biomedical engineers visited the NBU routinely and on demand. The vaccination team, consisting of one nurse and up to three nursing students, visited the NBU daily to vaccinate babies who were due for discharge. They wore white nurse uniforms. Up to 10 nursing students rotated in the unit for three weeks. The female students wore white aprons over their uniforms, while the male students wore green robes. Two female occupational therapists visited the unit twice a week. One therapist was in her 30s, while the second was in her 50s. They wore green robes. In the first round of data collection, all health professionals wore masks, but mask-wearing became optional in the second round. Mask-wearing remained mandatory in Amani NBU during both rounds of data collection. While the groups of other professionals were similar in both NBUs, Upendo NBU did not have medical students.

In both rounds of data collection, two female ward assistants supported the unit, compared to three in Amani NBU. One, who was in her 20s, had hospital employment. The second, in her 50s, worked through a contracted company. They wore white aprons over maroon *scrubs*.

5.3.3 CAREGIVERS

AMANI NEWBORN UNIT

Mothers of sick newborn babies between 15 and 40 years old were the only family members allowed to the ward regularly. Most had secondary school education and were involved in economic activities such as petty trade, farming, and teaching. A few mothers were students, while others reported being homemakers. Mothers wore light green robes before entering the unit and returned to their home clothes upon exiting. They walked barefoot. Some mothers had blood-stained robes. A few mothers, especially new ones, entered the ward wearing other clothes apart from the robes, particularly at night. Although mothers were required to wear masks, some did not wear them or wore them incorrectly—exposing their noses. Relatives and friends of babies were allowed in the post-natal ward during visiting hours but not in the newborn unit.

UPENDO NEWBORN UNIT

Mothers of sick newborn babies ranged between 18 and 40 years old. Most had primary school education and engaged in economic activities, including small businesses such as salons and tailoring. Some mothers were homemakers, and a few were students. They wore hospital slippers and old white flowery robes that matched the babies' linen. Mothers improvised to cover the holes from the torn and dirty robes. In the first round of data collection, mothers wore masks, but fewer did in the second round.

While mothers were the primary carers of small and sick babies, other family members were allowed to visit by permission. One baby received one or two visits during admission. During visitation, family members shared green robes with health professionals. This was contrary to Amani NBU, where other family members were not allowed to see sick babies apart from mothers.

5.3.4 ROUTINE

AMANI NEWBORN UNIT

Amani NBU was a busy place that operated 24 hours every day. It received admissions from other departments, such as the theatre, labour, gynaecological ward, and other hospitals throughout the day.

As shown in Table 5.2, while nurses had two shifts daily, other health professionals came at specific times. The morning nurses' shift ran from 8:00 a.m. to 6:00 p.m., while the evening shift started from 6:00 p.m. to 8:00 a.m. The morning shift began with the nurses' handover at 8:00 a.m., but this was often delayed by up to 15 minutes. The average number of babies one nurse handled per shift ranged between 20 and 40, with an average of 30 babies on most days. After the handover, which involved transferring responsibility and information about patient care from one health professional or team to another during shift changes, nurses focused on administering medication, monitoring patients, documenting care, initiating technologies, and supervising mothers' feeding.

Based on agreements among those on duty, work allocation sometimes involved each nurse managing a specific room. At other times, there was no specific arrangement, and nurses chose duties randomly. Nurses also worked on admission, discharge, and family engagement. These activities kept nurses busy throughout the day. Sometimes, nurses had to dedicate several hours to emergency activities such as resuscitation and preparing babies for referral to the national hospital. During the first round of data collection, two nurses covered the day shift. In the second round of data collection, this number increased to four nurses on Monday and Thursday during major ward rounds to respond to the medical team's requests. The number of nurses on the evening shift remained the same.

I observed one instance where a new nurse asked a colleague why nurses were not participating in CPAP-related decision-making. Besides that, I did not notice any significant change in how health professionals interacted with each other or made decisions after the new nurses started to work in NBU. I, however, noticed some changes in how nurses behaved during shifts with more nurses. For example, nurses took longer lunch breaks and increased the use of phones during shifts.

Time	Health Professionals	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday and Sunday
MORNING 8:00 am to 6:00 pm	Nurses	2 – 4	2 – 3	2 – 3	2 – 4	2	2
	Paediatricians	1 – 2			1 – 2		
	Medical Officer Interns	2 – 3	2 – 3	2 – 3	2 – 3	2 – 3	1
	Clinical Officer Interns	2 – 4	2 – 4	2 – 4	2 – 4	2 – 4	1
	Nutritionists	2		2		2	
	Occupational Therapist	1				1	
	Medical Students	10 – 20			10 – 20		
	Nursing Students	6 – 10	6 – 10	6 – 10	6 – 10	6 – 10	
	Ward Assistant	1	1	1	1	1	1
	Biomedical Engineers	1 – 3				1 – 3	
	Vaccination Nurses	2	2	2	2	2	
EVENING 6:00 pm to 8:00 am	Nurses	1 – 2	1 – 2	1 – 2	1 – 2	1 – 2	1 – 2
	Medical Officer Interns	1	1	1	1	1	1
	Nursing Students	2 – 4	2 – 4	2 – 4	2 – 4	2 – 4	2 – 4
	Ward Assistant	1	1	1	1	1	1

Table 5.2 Routine of Amani NBU Health Professionals

Medical and clinical officer interns varied in number according to the rotation schedule in the NBU. They started the day with a ward round at 9 a.m., attending to between 15 and 20 babies each during this time. While paediatricians attended the major ward rounds only on Monday and Thursday, medical and clinical officer interns conducted ward rounds daily. During the major ward rounds, paediatricians, clinical officer interns, and medical officer interns discussed the management of each patient in depth. They divided into two teams, with each team seeing up to 40 babies when the NBU was full. On other days of the week, paediatricians did not come to NBU; they attended to patients in the paediatric ward and outpatient clinic. Medical students were present in the NBU only during the major ward rounds on Monday and Thursday and left immediately after the rounds.

After the major ward rounds on Monday and Thursday, paediatricians left the NBU, while the medical and clinical officer interns remained. Medical officer interns admitted and discharged patients, attended to medical emergencies, and initiated technologies. Clinical officer interns focused on practical tasks such as cannulation and blood withdrawal. After 2 p.m., the medical officer intern on call responded to newborn unit requests and emergencies, while the other medical and clinical officer interns left the NBU until the following day.

Nutritionists visited three times a week in the morning. They weighed babies and recorded the information on the wall without interacting with nurses or doctors. Biomedical engineers and occupational therapists came once or twice a week. Nursing students were present every day during the data collection period but lacked a structured schedule. They often stood in the ward or sat in the changing room. Occasionally, under nurse supervision, they participated in administering patient medication, but I did not observe them actively monitoring or documenting patient progress or participating in procedures such as CPAP and phototherapy.

Ward assistants in Amani NBU were consistently present, with one assigned to each of the two 12-hour shifts. Their roles included cleaning the NBU, with the floor scheduled to be cleaned three times over 24 hours at 5:00 a.m., 1:00 p.m., and 8:00 p.m., though this schedule was not always strictly followed. They also washed cups used by mothers to express milk, provided mothers with warm water for cleaning babies in the morning, took babies for X-rays, collected supplies from the pharmacy, fed babies without carers, and cleaned equipment.

Mothers with premature babies visited the unit every two hours, while those with babies born at term visited every three hours. They were busier in the morning (8 to 9 a.m.) when they changed diapers, wiped their babies with cotton and warm water in a metallic bowl, changed blankets, and applied topical antibiotic (*Chlorhexidine*) to the baby's umbilicus. After these tasks, they fed their babies while sitting on the floor, on plastic chairs, or standing. Some mothers breastfed, while others *expressed* milk in a cup and fed babies via a *nasogastric tube.* During subsequent visits apart from the morning one, they fed their babies and changed nappies as needed. These tasks were consistent across rooms. Information about Amani NBU activities is summarised in Figure 5.18.

Every NBU health professional was welcome to join the *Continuous Medical Education* (CME) session in the hospital hall every Tuesday and the Child Mortality meeting in the Paediatric Ward every Friday. These hour-long meetings started in the morning. Occasionally, the hospital provided tea and snacks during these meetings.

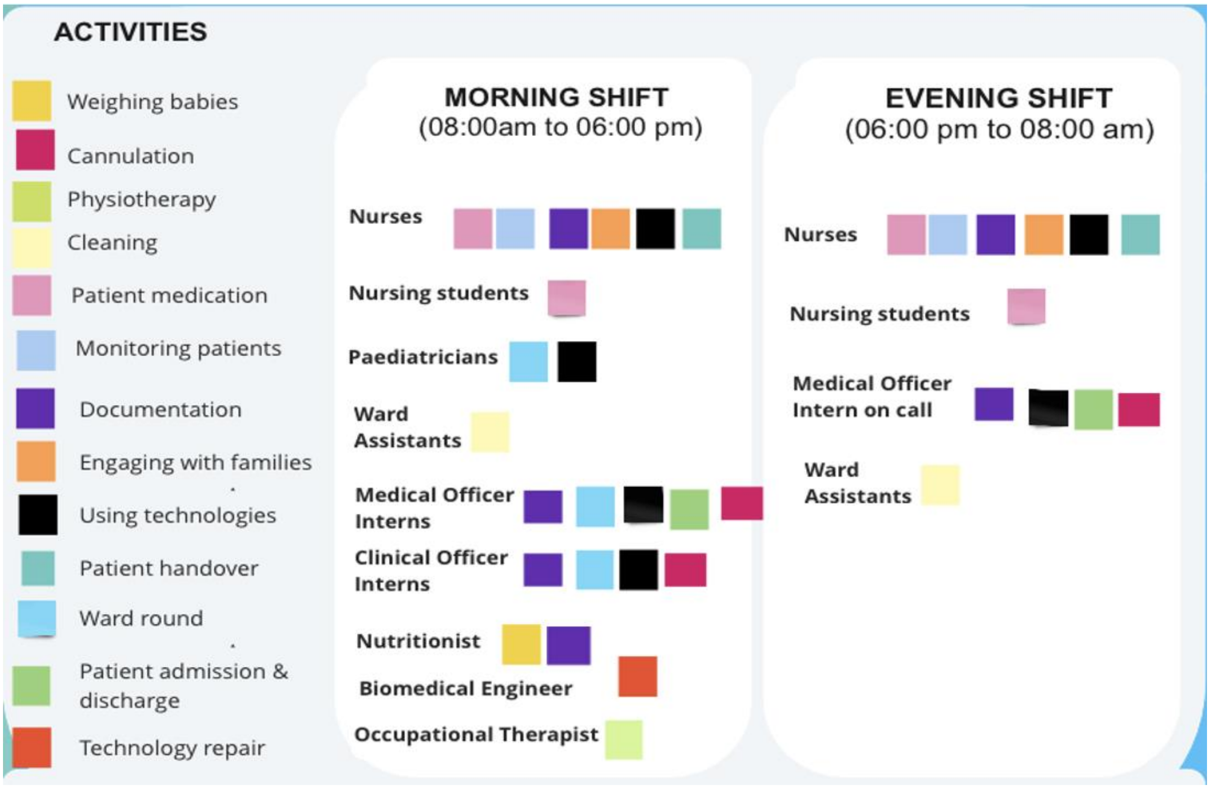


Figure 5.18 Activities in Amani Newborn Unit

UPENDO NEWBORN UNIT

Like Amani NBU, Upendo NBU operated every day for 24 hours. Despite receiving admissions from the labour ward, gynaecology ward, theatre, and other hospitals, it had a better baby-to-health professional ratio than Amani NBU. Table 5.3 shows the routine of health professionals in Upendo NBU.

Time	People	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday and Sunday
DAY 7:30 am to 12:30 pm	Nurses	2 – 3	2 – 3	2 – 3	2 – 3	2 – 3	2 – 3
	Paediatrician				1		
	Medical Officers		1 – 2		1 – 2		
	Medical Officer Interns	2	2	2	2	2	2
	Clinical Officer Interns	2 – 4	2 – 4	2 – 4	2 – 4	2 – 4	2 – 4
	Nutritionist	1	1	1	1	1	
	Occupational Therapists	1 – 2	1 – 2	1 – 2	1 – 2	1 – 2	
	Nursing Students	4 – 10	4 – 10	4 – 10	4 – 10	4 – 10	
	Ward Assistants	1 – 2	1 – 2	1 – 2	1 – 2	1 – 2	1 – 2
	Biomedical Engineers					3	
	Vaccination Nurse	1	1	1	1	1	
EVENING 12:30 – 6:30 pm AND **NIGHT** 6:30 pm –7:30 am	Nurses	1 – 2	1 – 2	1 – 2	1 – 2	1 – 2	1 – 2
	Medical /Clinical Officer Interns	1	1	1	1	1	1
	Nursing Students	2 – 6	2 – 6	2 – 6	2 – 6	2 – 6	2 – 6
	Ward Assistant	1	1	1	1	1	1

Table 5.3 Routine of Upendo Newborn Unit Health Professionals

Nurses in Upendo NBU worked on a three-shift rota, compared to the two shifts at Amani NBU. The nursing students followed a similar rotation and performed the same activities as the nurses. In Upendo NBU, the afternoon and evening shifts overlapped as follows:

- 7:30 am to 4:30 pm – The afternoon shift had two to three nurses, including the nurse in charge and her deputy.

- 12:30 p.m. to 6:30 p.m. – The evening shift had one to two nurses.
- 6:30 p.m. to 7:30 a.m. – The night shift with one to two nurses.

This arrangement meant that the day shifts for the nurses involved fewer working hours. Occasionally, one nurse took care of 30 babies during their shift, but on most days, they cared for 10 babies—three times fewer than the number at Amani NBU. When there was more than one nurse, each was allocated a room to provide care. During the first round of data collection, two nurses covered the day shift. In the second round, this increased to three nurses at least two or three times a week. The number of nurses on the evening and night shifts remained the same. I did not notice any significant change in how health professionals interacted with each other or made decisions after the new nurses joined the NBU. However, I did observe a positive change. For example, two nurses took annual leave, which they had not done for a while.

Nurses' shifts started with a handover from the nurses on the previous shift and proceeded to provide the babies with medication and monitor their progress. Like nurses in Amani NBU, they also performed other activities such as resuscitation, admission, discharge, health education for mothers, technology insertion/removal, and taking patients' vitals. In Upendo NBU, nurses spent relatively more time supervising and mentoring medical officer interns, clinical officer interns, and nursing students. On the other hand, the NBU had no medical students, which meant less work for paediatricians to teach and supervise.

Medical officer interns and clinical officer interns attended daily ward rounds. However, unlike Amani NBU, all medical and clinical officer interns remained in the ward until 5 p.m. to assist the doctor on call before leaving. Clinical and medical officer interns in Upendo NBU took night calls, unlike Amani NBU, where the ward administration allowed only medical officer interns to be on call at night. The shared workload enabled them to have time for interactions and collaborative decision-making.

The medical officers went to the NBU to do the ward rounds at least twice a week. Additionally, one paediatrician came to the unit for the major ward round on Thursday. In the major ward round, the medical team discussed patients in detail. While Amani NBU had two major ward rounds per week, which allowed clinical officer interns, medical officer interns, and medical officers more in-person access to paediatricians, Upendo NBU had one major ward round per week. Paediatricians in both NBUs communicated virtually with medical and clinical officer interns regarding patient management through mobile phone calls.

Unlike Amani NBU, nutritionists and occupational therapists spent more time in Upendo NBU and actively engaged with other health professionals, such as nurses and the medical team. The nutritionists were in the unit on weekdays. They weighed babies three times a week, provided mothers with daily feeding assistance, and attended the major ward rounds. The occupational therapists visited the ward every day for about an hour to stimulate babies with birth asphyxia and manage babies with Talipes.

Ward assistants worked two shifts—during the day and at night. While working full-time during the day, they split their time with the labour ward at night. They cleaned the unit at 9 a.m. and 2 p.m. They also washed mothers' and health professionals' robes, cups, and syringes, prepared baby-cleaning water, fed babies without carers, and served mothers five meals per day.

Some mothers of premature babies came to the unit every two hours, while the rest visited every three hours. Mothers in the Kangaroo Mother Care room stayed with their babies full-time. Mothers were busiest in the morning. They cleaned babies with warm water and cotton, applied cream to the baby's umbilicus, changed nappies, and fed babies. Every shift, they fed babies, changed nappies, and documented the progress of the baby on the Comprehensive Newborn Monitoring chart. They recorded the baby's feeding mode, feed amount, and whether the baby had stool and urine. This was different from mothers in Amani NBU, who did not have access to or document their babies’ progress in any clinical document. Health professionals handled all the documentation without sharing that responsibility with caregivers. I summarised information about the Upendo NBU activities in Figure 5.19.

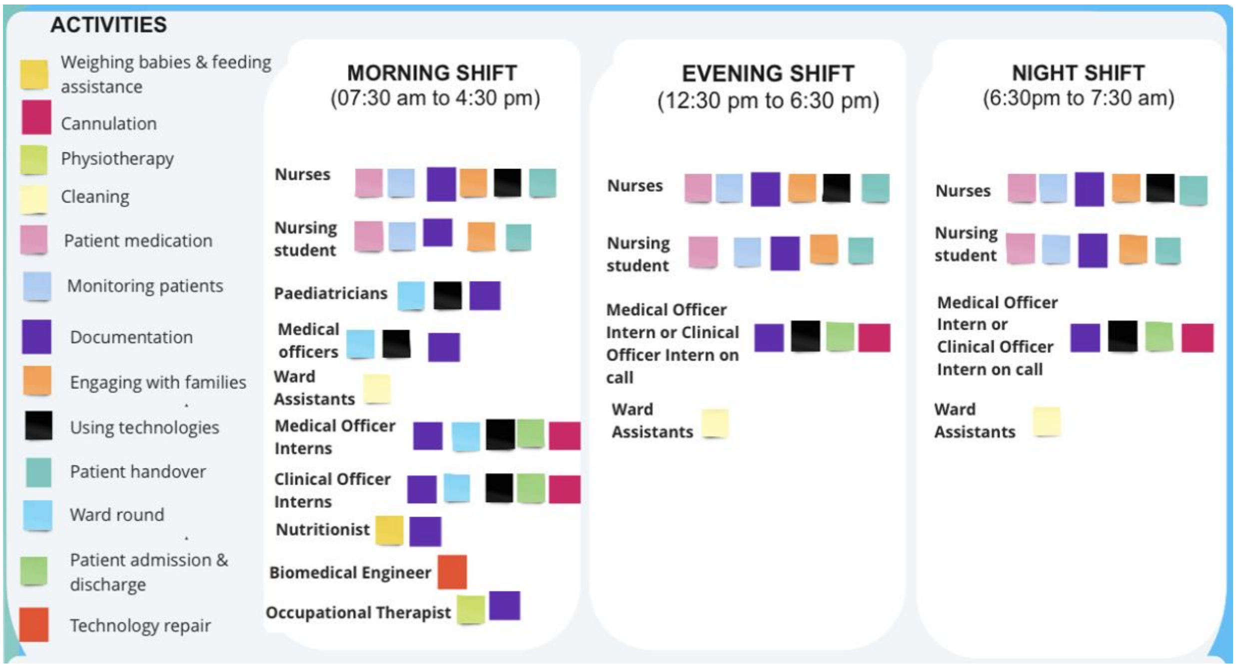


Figure 5.19 Activities in the Upendo Newborn Unit

5:4 COMPARISON OF THE TWO NEWBORN UNITS

In this section, I highlight similarities and differences between Amani and Upendo NBU.

5:4:1 MAIN SIMILARITIES

Both NBUs had similar physical structures consisting of four patient rooms – Premature Babies, Acute Term Babies, Stable Term Babies, Kangaroo Mother Care and other supporting rooms such as the sluice and kitchen. Similar groups of health professionals, for example, nurses, paediatricians, Clinical Officer Interns, Medical Officer Interns, nutritionists, occupation therapists, ward assistants and biomedical engineers, were in both NBUs. Most health professionals in both NBUs were women. Routine activities such as ward rounds, handovers, admission, discharge, and referrals were present in both NBUs. During the second round of data collection, each NBU received three new nurses.

5:4:2 MAIN DIFFERENCES BETWEEN AMANI AND UPENDO NEWBORN UNITS

	AMANI NEWBORN UNIT	UPENDO NEWBORN UNIT
Physical Structure and the Layout	• Congested and uncomfortable newborn unit offered limited space for health professionals to interact and make decisions.	• Spacious newborn unit allowed health professionals to interact and make inclusive decisions.
	• New and relatively bigger building with patient rooms far apart, hence more effort for health professionals to interact.	• Relatively old and small building. The patient rooms were close to each other and simplified interaction among health professionals.
	• Communal gathering areas, such as the nurse's and doctor's rooms, were designated for specific disciplines of health professionals, restricting interaction among members of the same discipline.	• The communal space at the health professionals' bay was open to all disciplines, facilitating interaction among different groups of health professionals. Its proximity to the patients' rooms also made it convenient for health professionals to interact both within the communal area and with those attending to patients.
	• The absence of a designated area in the patient rooms for babies receiving CPAP and phototherapy resulted in challenges in prioritising their monitoring and documentation.	• The presence of a dedicated area for babies undergoing CPAP and phototherapy facilitated the prioritisation of monitoring and documentation.
People and Routine	• Relatively higher patient-to-health professional ratio led to a heavy workload and restricted communication time among health professionals.	• Relatively lower patient-to-health professional ratio led to more time for communication time among health professionals.
	• Relatively shorter period for nurse rotations, with four years being the longest tenure. This necessitated a significant transfer of skills.	• Nurse rotations in the newborn unit had a relatively longer duration, with half of the nurses staying for ten years, more skill maintenance among health professionals.

	• No permanent medical officers were stationed in the unit, hence a lack of opportunity for them to impart knowledge to rotating medical and clinical officer interns.	• Permanent medical officers were stationed in the unit and assisted to impart knowledge to rotating medical and clinical officer interns.
	• Lack of a structure arrangement to allow nursing students to contribute to monitoring and documentation, leaving the workload on the nurses.	• Nursing students participated in all nurses' duties including participating in monitoring and documentation and allowing nurses more time for teaching and other interactions .
	• The new nurses were recruited from outside the hospital, requiring time for their induction to the hospital and training in newborn care.	• The three new nurses were from the hospital's maternity wing within the hospital, enabling their induction to concentrate on newborn care.
	• Only medical officer interns were on call without assistance from clinical officer interns, limiting their opportunities to interact with other health professionals.	• Both medical officer interns and clinical officer interns were on call, which reduced the workload and increased the time for interaction with other health professionals.

5:5 DISCUSSION

In this chapter, I have described the context of the two NBUs where my study occurred. The NBUs' physical structures, layout, people, and routines highlight similarities and differences. These settings are interesting places to explore communication and decision-making around CPAP and phototherapy.

In my observations, I saw that the close arrangement of patient rooms in Upendo NBU significantly reduces movement time for health professionals, fostering more frequent interactions compared to the distant layouts in Amani NBU. Additionally, the presence of a communal health professionals' bay in Upendo NBU promotes interdisciplinary interaction and technology-associated communication and decision-making, unlike the segregated doctors' and nurses' rooms in Amani NBU.

These findings resonate with a book chapter that explores the constraints and architectural design of newborn units in LMIC and their role in communication among health professionals (Amadi et al. 2023). It suggests that environments with features like see-through panoramic views and communication ports have enhanced communication among nurses in LMIC newborn units. An ethnographic study performed in a land-grant university in the United States found that the arrangement of the environment that allows for proximity among healthcare professionals facilitates discussion, learning, and feedback in a comfortable and private setting (Kupritz and Hillsman 2011).

Furthermore, literature reviews of studies done mainly in high-income countries have compared layouts with single-patient rooms, which separate healthcare professionals, to those with open bay arrangements and have found health professionals found it easy to communicate in an environment with an open bay where communication is facilitated (Shahheidari and Homer 2012; Doede, Trinkoff, and Gurses 2017). Centralised workstations in high and upper-middle-income countries have also been shown to enhance communication by bringing nurses together, in contrast to cross-shaped clustered stations that put health professionals far from each other (Brewer et al. 2018; Cai and Zimring 2013; O'Callaghan, Dee, and Philip 2019).

In my research, I found that having designated areas for babies needing CPAP and phototherapy in Upendo NBU facilitates easy monitoring and timely interactions, documentation, and information sharing among healthcare professionals. This setup ensures that patients requiring the same level of care are grouped together, streamlining the monitoring process. In contrast, Amani NBU lacked specific spaces for such patients, leading to missed monitoring and documentation opportunities, particularly for those on CPAP and phototherapy who required prioritised care.

This finding aligns with previous research that examined the impact of hospital building proximity on communication among health professionals in the United Kingdom. The study revealed that hospitals with fewer wards and buildings, which reduced the distance between healthcare professionals, experienced better communication and information flow (Pachilova and Sailer 2015; Pachilova and Sailer 2019). Thus, reducing distance can have a positive effect on communication dynamics.

My research builds on evidence of the importance of building design and layout in optimising communication among health professionals in hospital. In particular, my data suggest that design and layout is particularly important in the design of NBUs to optimise communications around babies needing CPAP and phototherapy. These insights from my research could contribute to informing policies and guidelines, such as the upcoming document in Kenya to propose appropriate structures for newborn units. By highlighting the importance of designated spaces for specialised care within healthcare facilities, particularly for infants requiring CPAP and phototherapy, my research contributes to the development of practical guidelines. This guide will build on similar guidelines, such as the Kenyan Norms and Standards for Health Delivery plan (MOH 2006) and the guidelines for materials to use in the construction (MOH 2021).

In my research, I found that a congested and uncomfortable newborn unit presents significant challenges for health professionals to communicate and make technology-associated decisions effectively. A spacious newborn unit allows health professionals to engage in inclusive decision-making processes. For example, in the congested Amani NBU, health professionals faced difficulties having transparent and inclusive interactions compared to the more spacious ward in Upendo NBU. Reducing congestion in NBUs improves the mood of health professionals and encourages documentation, data utilisation, and interactions among them.

Overcrowding in healthcare settings has been extensively studied and linked to reduced quality of care, particularly in emergency care scenarios (Jung et al. 2021; Miró et al. 1999; Savioli et al. 2022). Similarly, my findings align with literature highlighting the detrimental effects of overcrowding in office settings, characterised by noise, crowded spaces, poor distribution of supplies, and uncomfortable temperatures and air circulation. These factors reduce privacy and make staff uncomfortable interacting with others, ultimately impacting their performance (Kamarulzaman et al. 2011). My research contributes to the understanding that congested newborn units can negatively impact technology-associated communication among health professionals.

In my research, I found that high workload negatively affects communication and decision-making among healthcare professionals. A higher patient-to-health professional ratio results in a heavier workload and limited communication time among health professionals. Despite both NBUs having a similar number of health professionals, Amani NBU, with three times the cot capacity of Upendo NBU, experiences a heavier workload. This increases the workload in Amani NBU and makes it more challenging for health professionals to interact with each other. Additionally, the nursing staff in Upendo NBU benefited from having three shifts, reducing the number of consecutive hours spent at work and maintaining interactions compared to the two shifts in Amani NBU.

Another factor contributing to the higher workload is the lack of structured arrangements to involve nursing students in monitoring and documentation tasks, leaving the bulk of the workload on the nurses. In Upendo NBU, nursing students actively participate in all nursing duties, including monitoring and documentation, allowing nurses more time for teaching and other interactions. Furthermore, the lack of inclusivity in medical team roles exacerbates the workload. In Amani NBU, where only medical officer interns are on call without assistance from clinical officer interns, there are limited opportunities for interaction with other health professionals compared to Upendo NBU, which allows both medical and clinical officer interns to be on call.

My research findings align with existing literature from LMICs and high-income countries, highlighting workload as a significant factor contributing to poor communication among health professionals, including when engaging with technologies (Carayon and Gürses 2005; Kaddourah et al. 2013; Nyondo-Mipando, Kinshella, et al. 2020; Vermeir et al. 2017). Studies investigating workload in maternal and newborn care in Kenya have also identified burnout among health professionals as a potential consequence (Afulani et al. 2021; Getahun et al. 2023). After new nurses joined the NBUs, observations revealed that some nurses took more leave and rested more frequently, suggesting a need for burnout recovery measures.

My research highlights significant contextual variations even within government hospitals. In the subsequent chapter, I explore these contextual factors further, focusing on how the NBU organisation and the wider health system shape health professionals' communication and decision-making.

CHAPTER 6: THE ROLE OF THE ORGANISATIONAL CONTEXT IN SHAPING COMMUNICATION AND DECISION-MAKING AMONG HEALTH PROFESSIONALS.

6.1 INTRODUCTION

In this chapter, I build on what I discussed in Chapter Five about how the physical environment shapes communication and decision-making among health professionals. I examine how the organisations are set up and how the bigger picture around them shapes how health professionals use CPAP and phototherapy machines.

I draw on three domains of the NASSS framework: the adopter system (health professionals engaging with technologies), the organisation (the capacity to use technology) and the wider context (institutional and sociocultural issues). I compare what I found in the two NBUs and conclude by using relevant theories and other literature to interpret my data.

6.2 THE ADOPTER SYSTEM

6.2.1 KNOWLEDGE AND SKILL SUPPORT FOR HEALTH PROFESSIONALS.

This section covers training, orientation, and mentorship to health professionals associated with CPAP and phototherapy and how they shape communication and decision-making.

Amani Newborn Unit

At least three years before my research, a few nurses in Amani NBU received phototherapy and CPAP training when using the Diamedica CPAP model. A year before the study commenced, the NEST360 programme offered a five-day technology orientation, which included phototherapy and CPAP training to health professionals, including five nurses, two paediatricians and one biomedical engineer. Other health professionals, such as the nutritionist and the occupational therapist, were not formally trained nor did they engage in informal induction and orientation. In my second round of data collection, three new nurses received formal NEST360 training before joining the unit. The formally trained health professionals received supportive printed charts and books to share with colleagues.

Formally trained health professionals oriented others on CPAP and phototherapy use in the NBU. Informal orientation offered to medical and clinical officer interns was mainly during discussions with paediatricians during the ward rounds and virtual phone conversations. I observed paediatricians asking medical and clinical officer interns questions and correcting them. The atmosphere was usually tense, with paediatricians looking angry at them for getting answers wrong.

> *The team of two clinical officer interns, two medical officer interns, and one paediatrician were in the Major Ward Round…… When they moved to the next cot, the paediatrician was unhappy with the Medical Officer Intern who stopped the baby on phototherapy yesterday. She said in a loud and angry tone, "Who stopped phototherapy on this baby? The baby is still very yellow and should still be on therapy." (Fieldnotes, Round 2, Amani NBU)*

Formally trained nurses oriented their fellow nurses, usually during their shifts when they were required to initiate technology or monitor a baby who needed technology care.

> *"Today, we are on a shift with a colleague of mine, So if I have any questions, I would ask her if she has any. It is a learning process for everyone. So when you are feeling like you are in doubt of something, I just would ask the colleague that I am there with. If I am alone on a shift, I will probably just call one of them and inquire more." (Interview, Nurse 12, Round 1, Amani NBU)*

> *A nurse showed another nurse how to switch on and off a phototherapy machine. They were practising on the older version of the phototherapy machine. (Fieldnotes, Round 2 Amani NBU)*

I observed, and health professionals reported, a hesitation to learn from other groups of health professionals. For example, I spoke to nurses who shared why engaging medical and clinical officer interns who rotated in the NBU was uncomfortable because of a perceived lack of respect from the medical team.

"Usually, medical and clinical officer interns do not believe what we say." (Interview, Nurse 9, Round 1, Amani NBU)

"You get some doctors who still have their issues. Most of them are not trained in CPAP. When you tell them this baby needs CPAP, they feel like you are commanding them. Some will appreciate it, but others will take it negatively." (Interview, Nurse 10, Round 1, Amani NBU)

Despite formal and informal training, some health professionals needed time to familiarise themselves, especially before using CPAP independently.

"I think the training, I would say, those are a cumulative improvement over time. By the time we were given Diamedica [CPAP model name], we were so new with CPAP, completely new, and it took us so long to really get confident to use CPAP. So we did not use it a lot." (Interview, Paediatrician 1, Round 1, Amani NBU)

"The machines [CPAP] were new and were not used, so we started getting used to them now slowly slowly. Yes, and because we were there with people who had been trained earlier. They were also encouraging us." (Interview, Nurse 5, Round 1, Amani, NBU)

Upendo Newborn Unit

In the Upendo NBU, five nurses, one paediatrician, one medical officer and one biomedical engineer received the same CPAP and phototherapy training. NEST360 conducted this training a year before my research. Before this training, a few nurses had received training in phototherapy use. The NEST360 workshop was the first time health professionals in Upendo

NBU received CPAP training. In my second round of data collection, three new nurses received formal NEST360 training before joining the NBU.

Trained health professionals oriented others in the NBU. Unlike Amani NBU, health professionals learned from others regardless of their professional discipline.

> *The medical officer then showed the medical officer intern how to position the feeding tube above the nostril on top of the CPAP pipe to allow air to come out and reduce the patient's swelling. (Fieldnotes, Round 1, Upendo NBU)*

There were regular skill-building sessions to refresh knowledge and induct new staff. Paediatricians and medical officers also oriented medical and clinical officer interns, nutritionists, occupational therapists and nursing students during activities such as the ward round. Nurses inducted and gave feedback to medical and clinical medical officers. I observed that health professionals respected each other's opinions and knowledge and had friendly interactions. For example, medical and clinical officer interns I observed and interviewed reported listening to nurses because they had more experience.

> *"I can say the staff here are very helpful. For instance, at first, when you know we were being taught [how to use technologies], we had not done it in a live baby. So, sometimes you could get to ask your colleagues, and they would show me softly, and I got to understand. So, I can say that we are really helping each other. We are a good team." (Interview, New nurse/nurse 11, Round 2, Upendo NBU)*

> *"The CPAP, everybody has been trained. So, the nurses can initiate CPAP, the clinical officer interns can initiate it, the medical officers, the medical officer interns: they have been trained and because they usually rotate, if the new staff come, we usually train them." (Interview, Nurse 3, Round 1, Upendo NBU)*

Like in Amani NBU, some health professionals, especially those who rotated in the NBU for a short period, reported needing time to familiarise themselves with the technologies and learn from other health professionals, especially when engaging with CPAP.

> *"So there is that experience part too because many things you will also find we [clinical and medical officer interns] even get into the field, we know the theory, practically, they [nurses] know more, so also you will exchange information, you lift each other." (Interview, Medical Officer Intern 2, Round 2, Upendo NBU)*

6.2.2 STAFF ROLES AND PRACTICES

After examining knowledge and skills of health professionals, I present their distribution of roles and practices associated with technology and discuss how these roles and practices shape communication and decision-making in the two NBUs.

Amani Newborn Unit

The power dynamics were reflected in the roles that the different disciplines of health professionals took in the NBU. Paediatricians, the most senior staff members made important technology-related decisions with minimal verbal engagement from other groups of health professionals. Paediatricians decided on which patients to start on technology, the duration of treatment and when to stop the treatment. They verbally communicated those decisions to medical and clinical officer interns. Their interactions primarily occurred during ward rounds and virtual conversations with medical officer interns, who would contact pediatricians when they were not present in the NBU.

I observed medical officer interns having phone consultations with paediatricians whenever they admitted patients, during referrals and medical emergencies. The practice added a task to clinical and medical officer interns and delayed some decisions. I observed interactions among medical and clinical officer interns before they executed the decisions of the consultants. They also document their discussions with paediatricians in the patient files.

"Okay, now, basically because we are interns, you see, sometimes we are prone to making mistakes, and we are not very sure what to do. So that is why the consultants really like to be involved in making the decision on whether the baby should continue on CPAP or phototherapy." (Interview, Clinical Officer Intern 3, Round 1, Amani NBU)

Nurses did not make technology-associated decisions; they implemented instructions from paediatricians written in patient files. Most nurses had formal or on-the-job training but did not put the skills to practice. I received mixed responses from nurses regarding why they did not participate in technology-associated decision-making. Some nurses said they were not allowed, while others thought it was beyond their job description.

"It is the doctors. They have to prescribe [CPAP] because of the way we practice our medicine the doctor prescribes, and then we do the treatment." (Interview, Nurse 5, Round 1, Amani NBU)

We inform them [the medical team], but they are the ones to start. We are not allowed to start. Well, there is a consultant who said, during the rounds, that the CPAP is supposed to be done by the doctors. So that meant you are not supposed to do it." (Interview, Nurse 1, Round 1, Amani NBU)

Nurses were not the only group of health professionals who felt uncomfortable and excluded. I observed, and clinical officer interns reported a lack of respect from nurses because they had a medical diploma and not a degree. It made them uncomfortable answering questions and engaging in technology-associated interactions.

"When it comes to nurses, this is what I would like them to do; if I make a decision as a clinical officer intern, I would like them to take it with weight, as they would when a consultant says it or makes such a decision or a medical officer intern does the same." (Interview, Clinical Officer Intern 2, Round 2, Amani NBU)

Following the introduction of three new nurses, new nurses reported being surprised by the role distribution, which excluded nurses from technology-associated decisions despite having comprehensive training.

> *"When I came to the newborn unit, everyone was friendly, but there is resistance to change. ………They [nurses] are scared – maybe because they do not remember how to use CPAP, or maybe they are used to their ways of doing things." (Interview, Nurse 3, Round 2, Amani NBU)*

Other health professionals, such as the nutritionist and the occupational therapist, did not participate in technology-associated communication. As a result, different groups of health professionals in the NBU operated in silos, which was a missed opportunity to share their expertise and advice with their colleagues.

> *The nutritionist said, "We do not have any interaction with the doctor unless something is not clear on our list and they ask. We also do not calculate the feeding amount or mode of feeding for babies on phototherapy or CPAP. It is the doctor's job." (Fieldnotes, Round 1, Amani NBU)*

Upendo Newborn Unit

I observed, and health professionals reported an inclusive distribution of roles, which allowed more groups of health professionals to engage in technology-associated decisions compared to Amani NBU.

Paediatricians, medical officers, medical and clinical officer interns, and nurses initiated, maintained, and stopped the use of technologies. I observed and heard from health professionals who reported being free to discuss and share their decisions with colleagues across groups regardless of their position in the NBU. For example, nurses interpreted bilirubin level results before starting babies on phototherapy. I regularly observed nurses advising medical and clinical officer interns. Medical and clinical officer interns also actively consulted nurses before making decisions, such as discharging babies and admissions. The practice prevented delays and allowed prompt choices regarding technology use.

> *"I can stop [phototherapy], the clinical officer can stop, the nursing officer can stop, so long as we have done the Total Serum Bilirubin and they are below threshold". (Interview, Medical Officer Intern 3, Round 1, Upendo NBU"*

> *I will say that in this ward, everyone is respected. Every decision that you make, as long as it is the best decision. I think there is no conflict about that. So, everyone's decisions matter. And if you have doubts and you ask, you come up with a general agreement. So, I think I would not say that there was something that I did and I was shunned from. (Interview, Nurse 9, Round 1, Upendo NBU)*

> *Later, the nurse who came in the afternoon politely requested the medical officer intern, "Please change the antibiotic[ceftriaxone] because the baby has jaundice and needs a different antibiotic to avoid possible side effects and complications".(Fieldnotes, Round 2, Upendo NBU)*

Unlike Amani NBU, the nutritionist worked closely with nurses and the medical team to choose a feeding mode for babies on CPAP and phototherapy. The nutritionist shared their suggestions verbally and documented the plan in a nutrition book. The occupational therapists and biomedical engineers verbally discussed with other health professionals in the NBU when they visited to provide their services. The practice strengthened their bond and allowed the alignment of baby management plans.

> *"Depending on the severity, you see, this baby has to feed regardless. So we make a decision with either it is the clinician and, or MO [Medical Officer] which mode do we use to feed this baby. And of course, for a baby who is on CPAP, we cannot go breastfeeding, so we have to use NG [nasogastric tube]………... I do not come at night, so I will come in the morning, and I find this baby was put on intensive*

[phototherapy], so we [nutritionist and the medical team] make a decision that this baby now needs to be fed on the tube." (Interview, Nutritionist 1, Round 1, Upendo NBU)

The new nurses aligned with the practice in the NBU, which already supported CPAP and phototherapy use compared to Amani NBU.

" I have noticed because there is more uptake of the CPAP and everybody is aggressive on starting the babies on CPAP……. they [new nurses] were also aggressive on starting the babies on CPAP." (Interview, Nurse in charge/nurse 6, Round 2, Upendo NBU)

6.2.3 NEW ROUTINE AND PATHWAYS

In this section, I discuss whether the interactions of health professionals with technology aligned with their existing roles and practices and if these interactions posed a threat to their scope of practice.

Amani Newborn Unit

Health professionals interacted during routine NBU activities such as ward rounds, admissions, and handovers. However, technologies added more communication responsibilities. For example, during the handover, nurses spent more time on babies using technologies, discussing technology settings and the feeding plan. Medical officer interns spent more time managing babies on technology because they consulted paediatricians, unlike the management of other babies not on technologies, which did not need consultation unless it was a medical emergency.

"I don't know the criteria for using CPAP. I will have to call the consultant to ask when I need to use it." (Fieldnotes, Medical Officer Intern 1, Round 1, Amani NBU)

Teaching and orienting other health professionals took significant time, especially engaging health professionals who rotated in the NBU for a short period. The lack of planned orientation and mentorship plans frustrated health professionals who were providing orientation.

“Each time a new group comes, you will have to explain to them; some of them do not get it well, and you get errors here and there, so I think that is also a challenge. Maybe they can do a mentorship for each group that comes.” (Interview, Nurse 8, Round 2, Amani NBU)

“So we would still do CME [Continue Medical Education] on CPAP, but you may see we may do a CME on CPAP, and someone is in their seventh week, another one is in their second week, and, you know? Yeah. So, the level of knowledge is not uniform for all of them.” (Interview, Paediatrician 1, Round 1, Amani NBU)

Lack of time for training was also an issue for those receiving it, especially for some health professionals who were rotating in the NBU for a short period.

“I will rotate in the unit for two weeks. I have not learnt how to operate machines such as CPAP and phototherapy machines because the time is short. Also, I always find other nurses have inserted the machine with no chance to observe.” (Fieldnotes, Intern nurse, Round 2, Amani NBU)

Using technology added to the documentation requirements. Health professionals filled out information on existing and new technology-focused tools. An example of a new tool is the Comprehensive Newborn Monitoring Chart, where health professionals document information on CPAP every three hours, such as *oxygen saturation pressure* and *the* CPAP settings information. For phototherapy, health professionals recorded information on phototherapy use, like bilirubin levels, every six hours. Health professionals reported a lack of time for documentation. I observed unfilled, incomplete and sometimes fabricated information in patient files. I will discuss compliance further in section 6.2.3.

Upendo Newborn Unit

Like Amani NBU, pre-planned teaching sessions allowed health professionals who were rotating in the NBU at different times the opportunity to learn. It allowed other health professionals to plan to attend the sessions.

> *The champion nurse responsible for technologies came into the newborn unit and informed other nurses and the medical team about the mentoring session they would have that afternoon. The session aimed to provide phototherapy and CPAP knowledge. (Fieldnotes, Round 2, Upendo NBU)*

Technology-associated documentation was also a challenge, especially among nurses with multiple documents. I observed nurses filling out forms after their shifts and sometimes leaving them unfilled.

> *Handover happened between one outgoing nurse and one incoming nurse. The outgoing nurse admitted to her colleague: "I have not filled babies' information in the charts. I will do it after the handover." (Fieldnotes, Round 2 Upendo NBU)*

> "*Sometimes you do not have time [for monitoring] if you are alone in a shift."* (Interview, Nurse 9, Round 2, Upendo NBU)

6.3 THE ORGANISATION

6.3.1 THE ORGANISATIONAL CAPACITY AND READINESS.

In this section, I explore the leadership and management styles within the NBUs and their impact on interactions among health professionals. Additionally, I examine the language preferences of health professionals and the role of financial support in shaping communication and decision-making.

LEADERSHIP AND MANAGERIAL STYLE

This section covers NBU leadership and managerial styles and their role in forming communication and decision-making among health professionals in the two NBUs.

Amani Newborn Unit

The Head of the Department, a paediatrician, had the final say on what were perceived as strategic NBU matters, such as training needs and technology use. The nurse-in-charge was responsible for nurses and running NBU's activities, such as ordering supplies and submitting reports to the hospital administration. The willingness to speak up and be included in conversations was based on medical ranking rather than staff experience or competency. Health professionals considered lower in the hierarchy did not feel able to share their experiences or voice their concerns about engaging with technologies. Their passive engagement created tension in communication and decision-making.

> *"If there is a disagreement on patient management, I always respect the person whose hierarchy is above me, and they will take the initiative of managing." (Interview, Medical Officer Intern 4, Round 1, Amani NBU)*

> *"I can never correct a paediatrician. I just cannot correct a consultant." (Interview, Nurse 07, Round 1, Amani NBU)*

The hierarchical nature was associated with aggressive interaction when a relatively senior-ranked health professional interacted with junior-ranked health professionals. Paediatricians reprimanded medical officer interns or nurses when they were unhappy with the practice in the ward. For example, during a ward round, the pediatrician called out the nurse-in-charge in an unsupportive and impolite manner about a baby who had not received the fluids or antibiotics as indicated in the file.

Health professionals interacted cautiously with their seniors to protect themselves from potential tensions. For example, to defend their actions, nurses documented in patient files the time it took for medical officer interns to see babies from the moment they were informed about the patients. It contributed to further drifting and a hostile environment which did not favour good communication and joint decision-making. I observed health professionals' hesitancy in collaboration and doing activities outside their responsibilities.

> *A medical officer intern (MOI) wrote the decisions the paediatrician ordered in the patient file, and he gave the file to a nurse. The nurse opened the file and said to him, "The duty of putting bolus IV fluid is yours and not ours. That is your work; please do it." The MOI looked confused. After a few minutes, he wanted to leave NBU, but the nurse told him, "Please do not leave without putting CPAP on the baby". The MOI looked worried and requested a clinical officer intern to help. (Fieldnotes, Round 2, Amani NBU)*

Upendo Newborn Unit

I did not observe hierarchy in Upendo NBU; health professionals worked as a team regardless of their qualifications and experiences. The nurse-in-charge, who was usually in NBU during the day, ran daily NBU activities, including decisions on using technologies.

The Head of the Department, a paediatrician, discussed strategic decisions with the nurse in charge and made joint decisions. They engaged other NBU health professionals and allowed them to express their opinions and concerns. Even junior health professionals reported feeling comfortable interacting with different groups of health professionals.

> *"I do not know about those other hospitals, but here you will see we have that unity as a family". (Interview, Medical Officer Intern 2, Round 1, Upendo NBU)*

> *"So, we agree, all of us [health professionals], we should titrate this oxygen, or we should prepare this baby for weaning off. So, it is not a one-man decision". (Interview, Nurse 2, Round 1, Upendo NBU)*

The friendly relationship among health professionals encouraged positive formal and informal interactions. Health professionals had a sense of belonging and were free to request assistance and discuss the management of babies and the decisions needed. They were comfortable taking risks in initiating or stopping both technologies.

> *“As the medical officer intern at the ground, even if we start CPAP or phototherapy, the nurse, in a way, can challenge that decision too, you see? (Interview, Medical Officer Intern 2, Round 1, Upendo NBU)*

LANGUAGES

In this section, I discuss the languages health professionals speak and how they shape technology-associated communication and decision-making. I present three languages used by health professionals in both NBUs – Kiswahili, Kikuyu and English. I also explore a pattern of words, such as professional titles, that health professionals included in their conversations.

Kiswahili and English are Kenyan national languages taught in primary school. While English is more spoken in higher education, businesses, and government offices, Kiswahili is more common in small-scale trade and media (Harries 1976; Chu 2016). English represents formality and high education status. Kikuyu is a tribal language spoken by 20% of the population (Maina 2006) and is prominent in both counties where I collected data.

Amani Newborn Unit

I noticed a difference in the languages health professionals in Amani NBU spoke (Figure 6.1). Kiswahili was the most spoken language, followed by English. Paediatricians mostly communicated with medical and clinical officer interns, nurses, and medical students in English and rarely spoke a few Kiswahili words. Medical and clinical officers, nurses and medical students used English to interact with paediatricians but spoke Kiswahili among themselves. The nutritionist, occupational therapist and biomedical engineers also mostly interacted in Kiswahili.

Some nurses I spoke with reported feeling more comfortable interacting in Kiswahili because it is a language they also use at home. Nurses and ward assistants occasionally used Kikuyu to communicate among themselves and with caregivers. I observed health professionals' interactions, which sounded formal. For example, they used titles such as "Sister" for nurses and "Doctor" for medical and clinical officer interns and paediatricians.

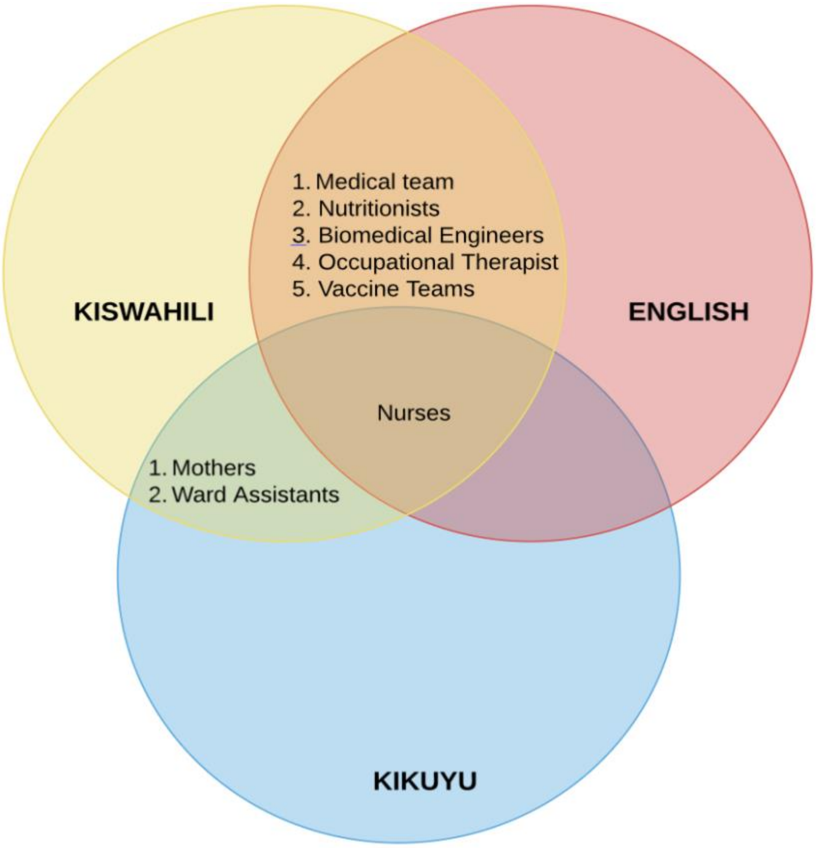


Figure 6.1 Language Use in Amani Newborn Unit

Using different languages and titles represented the status of various groups of health professionals. It was also a barrier to free interaction across groups of health professionals who engaged with CPAP and phototherapy.

Upendo Newborn Unit

Unlike Amani NBU, all health professionals except ward assistants used Kiswahili, English and Kikuyu in their interactions, regardless of their ranking and discipline (Figure 6.2). Like

Upendo NBU, Kiswahili was the most used language, but Kikuyu was second, and English was last. For example, I frequently observed paediatricians talking to nurses and medical and clinical officer interns in Kiswahili. In my conversation with the ward assistant, she reported not speaking English because she was not fluent in it. There was minimal use of titles such as "Doctor" and "Sister" when addressing each other. Instead, health professionals called each other by their names. Using the same languages and minimal professional titles among health professionals made them comfortable interacting.

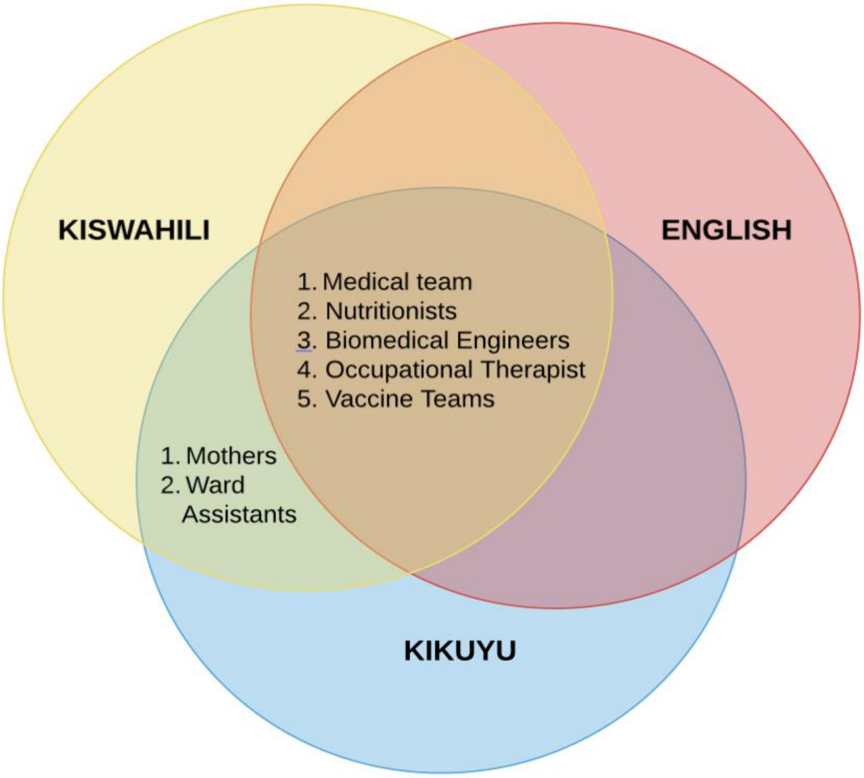


Figure 6.2 Language Use in Upendo Newborn Unit

FUNDING AND LOGISTIC SUPPORT

In this section, I discuss the financial capacity of the two NBUs and how it shapes health professionals' technology-associated communication and decision-making. I include the costs of continuous skill building, technology maintenance, documentation, and running clinical investigations for babies who require them.

Amani Newborn Unit

Following CPAP and phototherapy donor support, the NBU received training and technology repair support from the same organisation – the NEST360 programme. Their support kept technologies in good condition and enabled health professionals to make decisions to use them. Some health professionals in the unit were worried about the sustainability of using those technologies since the hospital did not cover costs. Previous donors who supported the NBU left two years before my research started.

Most mothers of babies in NBU had Linda Mama maternity insurance. Linda Mama is a maternity insurance scheme in Kenya designed to provide free maternity services to pregnant women. It is part of the National Hospital Insurance Fund (NHIF) and aims to ensure that pregnant women receive quality healthcare before, during, and after delivery. It covers a range of services, including, delivery and treatment for pregnancy-related complications. While the insurance supported delivery costs for mothers, this was not the case for sick newborn babies. Families had to pay KES 500 (£3) daily for a baby receiving CPAP and phototherapy. Unfortunately, most families could not afford the expenses related to using technology. When health professionals perceived a clinical investigation for a baby as too expensive for families to cover, they skipped it altogether. The practice denied health professionals evidence-based decision-making. For example, I observed health professionals not following the national guidelines by initiating phototherapy without testing babies' bilirubin levels because it was expensive.

> *"For blood investigations, their family pays in advance. Most families cannot pay, for example, for bilirubin levels. We just have to start babies on a phototherapy machine before checking bilirubin levels, contrary to the guidelines. Payment for using the machine is after the baby is discharged or dies. For example, CPAP and phototherapy machines cost KES 500 daily [£3/day]. They even pay for an incubator and suction machine." (Interview, Nurse 5, Round 1, Amani NBU)*

Charts and forms such as the Comprehensive Newborn Monitoring Charts were regularly out of stock because they were not purchased on time. I observed nurses and nursing students spending a significant amount of time using their hands to prepare similar templates on plain paper, which increased nurses' workload and reduced their time to interact.

Upendo Newborn Unit

Like in Amani NBU, Upendo NBU received technologies and financial support for technology repair and training of health professionals. However, unlike Amani NBU, Linda Mama Insurance covered hospital costs for both mothers and their babies because the county government where this hospital was located supported the services, ensuring coverage for both. Health professionals could conduct clinical investigations before putting babies on technologies. For example, all babies eligible for phototherapy had their blood tested for bilirubin before and daily when on phototherapy. It allowed health professionals to follow guidelines and use clinical investigation data, CPAP, and phototherapy decision-making.

Like Amani NBU, clinical charts and forms were also regularly out of stock. It increased nurses' and nursing students' workload since they had to hand-design similar templates using plain paper. Some health professionals expressed their wishes for the administration to invest more in maintaining technologies and ensuring the orientation of new NBU health professionals once the NEST360 programme ends.

> *"When the equipment gets broken down, it takes a lot of time to be replaced or repaired. There is a biomedical engineering department. They also have challenges repairing the equipment and are not so conversant with them." (Interview, Nurse 10, Round 1, Upendo NBU).*

6.3.2 WORK INVOLVED IN IMPLEMENTATION

In this section, I discuss the integration of CPAP and phototherapy and its role in communication and decision-making among health professionals. I provide insights into enacted practices, such as reward and punishment mechanisms, compliance strategies, the involvement of individual champions, and the impact of social networks on shaping interactions and decisions.

REWARD AND PUNISHMENT

The rewards or punishments that health professionals perceived from engaging with technologies affected communication and decision-making associated with CPAP or phototherapy. Positive rewards encouraged interprofessional communication and increased the decision to engage with technology.

In Amani NBU, some health professionals were unhappy with their lack of involvement in technology-associated activities. I observed and spoke with health professionals who reported being ignored or uncomfortable expressing their concerns to the NBU administration. It affected their morale and willingness to participate fully in communication and decision-making.

> *"One case is the fact that you [clinical officer intern] are not allowed to clerk a patient; you are not allowed to make changes on the patient sheet even if you find a mistake…….you being a clinical officer intern, they [paediatricians] do not take you as a medic. So you feel like you are just pushing the ground at times………... We raised them [concerns] to our in-charge, but basically, he does nothing about it, and so at times, you just flow with the system." (Interview, Clinical Officer Intern 2, Round 1, Amani NBU)*

Some health professionals feared negative feedback from senior staff members, especially if they made a mistake or if a baby on technology worsened the condition.

“I am afraid of stopping CPAP if the baby is using it – even if the child has improved…… I cannot discharge a baby who was on CPAP just in case the baby changes and returns to the hospital. I will be in trouble. I usually wait for the paediatricians to make that decision.” (Interview, Clinical Officer Intern 5, Round 1, Amani NBU)

On the other hand, positive feedback in Upendo NBU encouraged health professionals to communicate and make decisions to use technology. For example, during major ward rounds, the paediatricians repeatedly praised and encouraged nurses and medical and clinical officer interns to start technologies. Recognition of health professionals’ efforts positively shaped their practices and perceptions. Additionally, following the “CPAP book” introduction, nurses were encouraged to initiate prophylactic CPAP since they could report that in the book and receive recognition.

“What we did when we found that we are not having so many babies who were being initiated on CPAP; we introduced a book where we will be recording the baby we put on CPAP when you started and when the baby was weaned out of CPAP. So, in that book, we wanted to know, who is the champion? So it has really helped us when we started recording those babies we are putting on CPAP and who have put them on CPAP. It has really helped us.” (Interview, Nurse in charge, Round 2, Upendo NBU)

COMPLIANCE

The presence of a mechanism to ensure staff compliance in NBU positively formed evidence-based decision-making and communication.

Amani Newborn Unit

The Amani NBU contained a copy of guidelines and protocols for CPAP and phototherapy use. In the first round of data collection, health professionals used the 2015 Basic Paediatrics Protocols (MOH 2015), while in the second round, they used the newly disseminated 2022 Kenya Comprehensive Newborn Care Protocols (MOH 2022). The latest version had detailed information on technology use, including CPAP and phototherapy.

There were no compliance mechanisms to encourage health professionals to use national standard treatment or the equivalent. For example, it was common for health professionals to put babies on phototherapy based on the physical assessment without consulting blood levels of bilirubin as per guidelines. Health professionals in Amani NBU reported not using phototherapy guidelines, which require a Total Serum Bilirubin test before initiating or stopping the therapy. They reported the reason being the time it takes to get results and because the procedures needed the involvement of the patient's family to pay for the test.

> *"The NEST360 training instructed us to test bilirubin levels before starting the baby on phototherapy. However, the test is expensive, and it takes time for relatives to raise that amount of money. We [health professionals] instead initiate a baby on bilirubin without testing to prevent kernicterus.[3]" (Interview, Nurse 8, Round 1, Amani NBU)*

> *"So I will confess that, especially with phototherapy, we [health professionals] have not necessarily used the protocols, and that is because of, you know, you need bilirubin level to be able to start, to decide if you start or not, and that is not something we are doing in our hospital." (Interview, Paediatrician 1, Round 1, Amani NBU)*

I observed health professionals, and they reported that they consult CPAP protocols occasionally. I saw two paediatricians contradicting each other on the criteria for putting a baby on CPAP because they were not following guidelines but their personal experience.

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[3] *Brain damage due to high levels of bilirubin in the blood*

Even when I asked nurses who were not involved in decision-making about CPAP use, they reported that the health professionals who were involved often did not follow the guidelines.

> *"We have those guidelines [CPAP guidelines], but most probably, we use our heads. There is no need of lying. Whatever we have in the head." (Interview, Nurse 1, Round 1, Amani NBU)*

I also observed nurses performing handovers without visiting each baby to see their progress. Sometimes, they chose a few babies to review, leading to missed or delays in doctors' requests, such as initiating phototherapy.

> *The incoming nurses told the afternoon one to give them a handover of very sick babies only. She did not open the patients' files but used her memory to brief them………… She said, "These two babies need resuscitation, and the baby in this incubator started phototherapy."They did not go over all 17 babies who were on phototherapy. (Fieldnotes, Round 1, Amani NBU)*

Poor accountability compromised the quality of information collected. Information was collected as routine rather than a way to assist decision-making. For instance, during my observations, I noted cases in which nurses documented inaccurate information regarding the progress of babies without taking patient measurements in the Comprehensive Newborn Monitoring Chart. Several times, I noticed that babies' phototherapy-related information was inconsistent across groups of health professionals who documented it. I also observed that the medical team did not consult the documentation of nurses for comparison.

> *The male nurse sat at the nurses' table, filling out information about the patient's progress, such as temperature, pulse rate and jaundice status, by making up figures without taking patient measurements…….. I reviewed two files of babies on phototherapy. Nurses indicated that the patient had no jaundice in the past two days by documenting "No jaundice" in the "Jaundice Status" section of the Comprehensive*

Newborn Monitoring Chart. However, the medical team notes recorded severe jaundice in the same two days. I asked the nurse about it, and he said, "I think this was a mistake because the nurse was sleeping; you can see these errors were made at night." (Fieldnotes, Round 2, Amani NBU)

The medical officer intern documented in the file of a baby with a cleft palate to start phototherapy, the instruction the paediatrician gave during the major ward round. A nurse came after 10 minutes, and after seeing the doctor's decision to start phototherapy, she went to the Comprehensive Newborn Monitoring Chart and retrospectively changed her documentation of the jaundice status of the baby from 'none' to 'positive' to match the doctor's judgement. (Fieldnotes, Round 2, Amani NBU.)

Upendo Newborn Unit

Like in Amani NBU, a hard copy of the guidelines and protocols for CPAP and phototherapy use was available in the NBU and kept on the table in the Health Professionals' Bay. In the first round of data collection, health professionals used the 2015 Basic Paediatrics Protocols (MOH 2015), while in the second round, they used the newly released 2022 Kenya Comprehensive Newborn Care Protocols (MOH 2022). In the second round, I noticed health professionals, including nurses and medical and clinical officer interns, had access to soft copy versions of the guidelines on their phones.

The Upendo NBU administration communicated and followed up to ensure that health professionals adhered to standard protocols and guidance while using technologies. I observed health professionals, and they reported using CPAP and phototherapy protocols. They reinforced this through continuous feedback on patient management they gave each other during routine activities such as the ward round and handover sessions and throughout their time in NBU.

“When we suspect jaundice, we use the rapid bilirubin test (BilidEx). That way, we can have the first reading for initiating phototherapy.” (Interview, Clinical Officer Intern 2, Round 2, Upendo NBU)

The medical officer told the clinical officer intern, “The baby is supposed to be off phototherapy because the bilirubin threshold is now low.” (Fieldnotes, Round 1, Upendo NBU)

I observed the medical team regularly referring to the nurses’ notes on the progress of babies to inform their decisions. A sample document on completing the Comprehensive Newborn Monitoring Chart was on the wall to guide health professionals in completing it correctly.

Accountability contributed to good communication quality. For example, nurses or supervised nursing students documented the progress of the babies only after taking vital measurements. When they had no time to measure babies, they left the Comprehensive Newborn Monitoring charts unfilled rather than falsifying information.

Medical Officer: I cannot make decisions on babies if no vitals are[4] *taken.*
Nurse: We have been busy today, and since the students are doing exams, there is no one to do it. We will leave the forms blank until we get time to do it. (Fieldnotes, Round 2, Upendo NBU)

INDIVIDUAL CHAMPIONS

The presence of health professionals who advocated for technology use started the conversations and encouraged health professionals to participate in communication and decision-making.

[4] Information about Temperature, pulse rate, jaundice status and other patient parameters.

In Amani NBU, some health professionals advocated for using technology and engaged their peers in the discussion. For example, one relatively new nurse who joined the unit as part of the HIGH-Q programme challenged other nurses who did not engage in technology discussions. However, I did not observe changes in practice following his encouragement to other nurses.

> *When I tell a fellow nurse that this baby needs phototherapy or CPAP, they say, oh, we cannot start that until we consult the doctor. (Fieldnotes, Nurse 6, Round 2, Amani NBU)*

In Upendo NBU, some health professionals advocated for and encouraged their colleagues to engage in technology-associated conversations and decisions. For example, the nurse in charge appointed one nurse as a technology champion. The champion mentored other health professionals, including nurses and the medical team. He was confident, friendly and ready to work with the team even past his regular shift hours. Health professionals and the NBU management trusted and gave him space to lead. Paediatricians and the nurse-in-charge also championed technology use by encouraging health professionals to engage with them.

> *"I was not trained in CPAP, but my fellow nurse [the champion] mentored me". (Fieldnotes, Nurse 2, Upendo NBU)*

SOCIAL NETWORKING

Engagement that health professionals made with others positively facilitated knowledge exchange, experience sharing and the confidence to make a decision to use technologies. Even with the limited social interactions in Amani NBU, some health professionals had a network of colleagues and friends with whom they felt comfortable engaging in technology-associated matters. I also observed several calls from lower-level hospitals asking for advice on managing babies on CPAP.

A nurse showed another nurse I had seen together often how to switch on and off a phototherapy machine. (Fieldnotes, Round 1, Amani NBU)

"I like to get advice and learn from them [other medical team members] because sometimes what is written in the books is not practical, particularly in a limited resource setting. They can advise on when to start a certain therapy, for example, oxygen or CPAP." (Interview, Medical Officer Intern 5, Amani NBU)

In Upendo NBU, health professionals' understanding of each other encouraged interactions and decisions in technology use. For example, nurses asked colleagues CPAP or phototherapy-related questions during informal chats at the Health Professionals' Bay. Regardless of their position in the NBU, health professionals consulted colleagues with whom they were comfortable engaging. They also maintained communication with other lower-level hospitals within the county.

The nurse in charge was on the phone with a lower-level hospital that requested to refer baby C for phototherapy. The nurse asked them questions regarding what they had done. She asked, "Have you done the Total Serum Bilirubin test? It is important." (Fieldnotes, Round 2, Upendo NBU)

6.4 THE WIDER SYSTEM

In this section, I examine broader hospital, county, and national-level issues shaping health professionals' communication and decision-making. Although my DPhil research focuses on NBUs, some wider contextual issues, including the political, economic, and regulatory situations, emerged during data collection, and I discuss how they shape the communication and decision-making of health professionals.

The Kenyan Ministry of Health supports the use of technology. It developed and disseminated the national protocols and guidelines I saw in both hospitals. Both NBUs were in the county political administration that supported the use of newborn technology. I spoke with NEST360 programme staff, who reported positive responses from both county administrations when rolling out the technologies. They met with political and health sector leaders who allowed the implementation of the programme in hospitals. However, neither county provided financial support for technology implementation.

Both hospital administrations positively accepted the programme and allowed NBU health professionals to participate in technology training and orientation. When I started my research, both hospital superintendents were optimistic about using technology to improve the quality of care.

While the political support was strong, the challenge was to ensure the financial sustainability of technology use in both NBUs once the NEST360 programme ended. With donor funding, there needed to be more internal financial support to activities such as training and purchasing of monitoring materials while ensuring technologies were well-maintained and adequate in number for skilled health professionals to interact with them. Health professionals also spent more time communicating with biomedical engineers during this time instead of making patient focused communication and decisions.

> *"We have monitoring machines which should help the babies on CPAP, but the probe is not working. We have asked for a replacement from the hospital administration, but this will take a long time to be fixed". (Interview, Round 2, Nurse in charge, Amani NBU).*

Technology repair relied on the NEST360 programme due to a lack of spare parts at the hospital level. While waiting for this support, NBU health professionals maintained communication with the biomedical team. Health professionals raised these concerns during my engagement with them.

"All three NEST360 and one other pulse oximeter are not working. We took them to the biotechnicians, and they said the problem was with the sensors. They are now waiting for NEST360 people to fix them". (Interview, Nurse 2, Round 1, Upendo NBU)

In both NBUs, there was a concern about multiple donor-supported research projects that increased administrative tasks for the nurses-in-charge or head of department to attend meetings. Health professionals engaged with the programme by participating in documentation and research work, such as interviews and focus group discussions. Six projects were operating in Amani NBU, while Upendo NBU had four projects. The higher number of projects in the already busy Amani NBU added to the workload and less time for communication.

	Amani NBU	**Upendo NBU**	**Engagement**
1	Gentamycin prescription research (REGENT).		• Monthly meeting with health professionals.
2	Research on infection in newborn babies.		• Blood test during the onset of symptoms. • The medical team single-point documentation of each baby with infection.
3	NEST360 programme	NEST360 programme	• The nurse in charge and paediatricians have monthly and quarterly meetings. • Health professionals train and engage with technologies.
4	Clinical Information Network (CIN)	Clinical Information Network	• Monthly meetings involving the NBU nurse in charge and paediatricians.
5	HIGH-Q programme	HIGH-Q programme	• Interviews with health professionals. ' interviews • Induction/feedback meetings.
6	Nurses' handover forms research	Nurses' handover forms	• Nurses' documentation during handover.

Table 6.1: Projects in Amani and Upendo Newborn Units During this Research.

Both NBUs received consultations from other departments within the same hospital, such as the labour ward, post-natal and gynaecology ward, because NBUs were the only hospital ward with newborn technologies. These departments also referred babies to the NBUs for CPAP and phototherapy. NBU health professionals discussed referrals with the referring department to get further information and understand the babies' condition. I observed that communication varied among health professionals, including cases of inadequate information sharing between the two parties.

> *The paediatrician asked the medical officer intern, "Who admitted this baby, and who accepted the admission? This baby does not need any machine [CPAP] and is stable. ….... Why is a medical officer deciding to send a patient to a newborn unit without consultation? They did not even call us." (Fieldnotes, Round 1, Amani NBU)*

> *A nurse from the post-natal ward entered the NBU with a file. She spoke to the deputy nurse in charge, sitting at the health professionals' bay, to get advice on whether the baby should be shifted to the NBU for phototherapy. She said the "COI from post-natal had done TSB, but the threshold was low, but I have come to ask ………The deputy nurse in charge told her, "If not qualified for phototherapy, then encourage the mother to breastfeed and repeat the test tomorrow." (Fieldnotes, Round 2, Upendo NBU)*

Since both NBUs were in referral hospitals, they received consultation calls from lower-level health facilities seeking more information about phototherapy and CPAP, such as criteria for using them and when to refer babies. Most of those health facilities did not have phototherapy and CPAP. In each NBU, I observed at least two babies per day from other health facilities being referred for care. I observed that sometimes there was no good communication among health professionals to manage expectations before or during the referral process.

The hospital phone in the nurse's room rang, and the nurse went to pick it up…… When he hung up, he told me, "A lower-level hospital wanted to refer a baby for CPAP, but I told them the ward was full and they should try another level 5 hospital, which is nearby." (Fieldnotes, Round 2, Amani NBU)

After placing baby N, who arrived from a lower-level hospital, in a cot, the Upendo NBU nurse asked the nurse who brought the baby: "This baby was born six days ago. Why are you bringing him at night? Do you want to tell me Y hospital has no phototherapy machine?….. Next time you come without filling the baby's weight [in the referral form], we will make you weigh the baby." (Fieldnotes, Round 1, Upendo NBU)

6.5 A COMPARISON OF THE ORGANISATIONAL AND WIDER SYSTEM CONTEXT IN AMANI AND UPENDO NEWBORN UNITS AND THEIR ROLE IN COMMUNICATION AND DECISION-MAKING AMONG HEALTH PROFESSIONALS.

SIMILARITIES

Regarding the capacity, the NEST360 programme provided the same training to selected health professionals in both NBUs. Trained health professionals in both NBUs provided orientation and mentorship to their colleagues. I discussed how both NBUs modified their routines and pathways when exchanging information and making technology-associated decisions. The two NBUs had social networks and champions to encourage health professionals' interactions.

In the wider context, the Ministry of Health politically supported the plan to roll out the technology in Kenyan hospitals but provided no funds to support the process. Both NBUs were level-five hospitals under their corresponding counties. County governments in both NBUs had yet to support the hospitals to ensure the sustainability of activities once external supporters ended their engagement. Health professionals in both hospitals were worried about the long-term prospects of using technologies because of a lack of prospective funds.

Both NBUs received technology-related consultations from other departments and hospitals, adding to their work.

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PARAMETERS	AMANI NEWBORN UNIT	UPENDO NEWBORN UNIT
Health professionals' skills	• Orientation and mentorship efforts are restricted to a specific group of health professionals. This limited approach means that crucial information is only disseminated within this particular group, excluding other members of the team. • The orientation for new health professionals rotating into the NBU is primarily informal, resulting in an inadequate transfer of knowledge.	• Orientation and mentorship are conducted across groups of health professionals, irrespective of their discipline, maximising knowledge transfer across the entire team. • In addition to informal conversations, orientation for health professionals rotating in NBU includes organised sessions, ensuring uniform and standardised knowledge transfer.
Roles and practices	• Paediatricians make technology-associated decisions, which are then implemented by other health professionals, such as nurses and medical officer interns, without mutual agreement.	• Technology-associated interactions were inclusive, involving a diverse range of health professionals such as paediatricians, medical and clinical officer interns, nurses, nutritionists, occupational therapists, and other relevant groups as needed.
Leadership and managerial style	• A hierarchal system that favours high-ranked health professionals such as paediatricians, in communication and decision-making.	• Inclusive leadership that encourages health professionals to engage in communication and decision-making, regardless of their discipline or experience.
Language	• There is a divide in the language used by health professionals: paediatricians prefer English, while other health professionals primarily speak Kiswahili and	• Most health professionals, regardless of their groups, primarily communicate in Kiswahili. English and Kikuyu are also used to a lesser extent. The use of a single

	Kikuyu. This language difference leads to a breakdown in technology-associated communication and decision-making.	language encouraged health professionals to engage in inclusive technology-associated communication and decision-making.
Funding for clinical investigations	• Families cover the costs for clinical investigations for babies, such as blood tests. This is a challenge to families that cannot afford tests for bilirubin, resulting in starting phototherapy without adequate testing.	• The NBU and hospital management cover the costs of medical investigations for babies, enabling the use of phototherapy in accordance with clinical guidelines by conducting bilirubin tests.
Reward and punishment mechanisms	• The hierarchical norms in the NBU create an environment of fear, where some health professionals are afraid to ask questions or take the lead in technology-associated decisions.	• There is a supportive environment for health professionals to express their knowledge, appreciation, and concerns, and actively participate in technology-associated decisions.
Compliance mechanisms	• There are no measures to ensure compliance, resulting in health professionals not adhering to standard guidelines and showing limited observance of proper documentation and data utilisation.	• Mechanisms are in place to encourage health professionals to adhere to guidelines and practice proper documentation and data utilisation.

Table 6.2 Differences of the Organisation in Amani and Upendo Newborn Units

6.6 DISCUSSION

In this chapter, I explored the organisational context of the NBU and the broader environment in which health professionals utilise CPAP and technology. I investigated how this context influences communication and decision-making among health professionals.

In Chapter Five, I focused on the importance of the number of health professionals in technology-associated communication and decision-making. In this chapter, I examined their skills, responsibilities, and relationships and how these factors shape communication and decision-making. Health professionals acquire skills through formal training, informal orientation, and mentorship. The informal orientation for new health professionals rotating into the NBU resulted in inadequate knowledge transfer, as seen in Amani NBU, while organised sessions, as in Upendo NBU, helped ensure uniform and standardised knowledge transfer.

My findings resonate with results from literature in LMICs, which highlight the importance of formal training for health professionals before or during their engagement with newborn technologies. Such training helps health professionals effectively engage with these technologies (Aneji et al. 2020; Agarwal et al. 2023; Nabwera et al. 2020; Nyondo-Mipando, Kinshella, et al. 2020). However, there are most instances where formal training does not translate into improved practice in using technologies. For example, a study conducted in Ethiopia found that training health professionals on using Health Information Technology did not lead to improved practice. The authors called for further research to better understand the reasons behind this phenomenon (Mengestie et al. 2023).

In my findings, I observed that when orientation and mentorship are restricted to specific groups of health professionals, as seen in Amani NBU, crucial information is disseminated only within that group, excluding other team members. In contrast, in Upendo NBU, orientation and mentorship are conducted across groups of health professionals, regardless of their discipline, facilitating knowledge transfer across the entire team. Similar findings in literature from high-income countries highlight the crucial role of teamwork and interdisciplinary learning in gaining technology-associated knowledge. Studies conducted in newborn care in the United States examining the use of extracorporeal membrane oxygenation simulations (Nater et al. 2023) and CPAP in Taiwan (Lu and Li 2020) support this notion. My research contributes to the knowledge of low-resource settings by emphasising the importance of interdisciplinary collaboration in fostering positive technology-associated communication and decision-making.

In addition to skills, I found the importance of ensuring inclusive and balanced roles and responsibilities for different groups of health professionals to participate in communication and decision-making. In Amani NBU, paediatricians make technology-associated decisions, which are then implemented by other health professionals, such as nurses and medical officer interns, without mutual agreement. In Upendo NBU, technology-associated interactions are inclusive, involving various health professionals such as paediatricians, medical and clinical officer interns, nurses, nutritionists, occupational therapists, and other relevant groups as needed. Balancing roles and responsibilities is crucial not only for effective communication but also for overall performance. Previous studies have also highlighted how a clear distribution of roles and responsibilities among health professionals is essential for teams to function, develop, and adhere to standards and protocols as they strive for improvement (Babiker et al. 2014; Orgambídez and Almeida 2020; Brault et al. 2014).

Another aspect of the organisation I explored is the management of newborn units. I discuss how the NBUs are managed and how the actions of the leaders shape how the health profesisonals communicate and make decisions.

In my research, I highlight the positive role of teamwork in creating inclusive technology-associated communication and decision-making. The teamwork in Upendo NBU facilitated friendly interactions and inclusive decision-making among health professionals engaging with CPAP and phototherapy. Health professionals were comfortable engaging and participating in decisions without worrying about reactions from their managers. My findings align with studies on teamwork that demonstrate how it increases performance (Schmutz, Meier, and Manser 2019) and improves the quality of work (Rosen et al. 2018). Other studies have highlighted how teamwork fosters a shared belief and a sense of safety and confidence among health professionals, enabling them to make difficult decisions (Edmondson 1999; Kahn 1990) and facilitating learning (Albritton et al. 2019; Edmondson 1999).

Another management style I found in my research is hierarchy in the NBU. The hierarchical system creates an uncomfortable environment for health professionals. The hierarchical system in Amani NBU favours high-ranked health professionals, such as paediatricians, in communication and decision-making, excluding other health professionals. Previous studies have examined how hierarchy affects different aspects of healthcare. My findings are similar to those of the literature that shows the contribution of hierarchy to health professionals lacking confidence in making decisions or taking risks, a phenomenon known as “low psychological safety” (Remtulla et al. 2021). Previous literature has similar findings, demonstrating that hierarchy affects the ability of staff to express themselves freely and negatively impacts the well-being of those low in power (Poole and Real 2003) and challenges collaborative care (Findyartini et al. 2019). Some suggestions to address hierarchy in healthcare include balancing power to support mutual respect and interdisciplinary collaboration (Busari, Moll, and Duits 2017; Noyes 2021). A scoping review exploring the impact and negotiation of hierarchy in healthcare organisations recommends further studies to understand hierarchy at the organisational level (Essex et al. 2023). My research contributes to understanding how hierarchy affects technology-associated communication and decision-making.

Another significant finding in understanding the organisation is the impact of the language health professionals speak during their interactions and decision-making processes. For instance, in Amani NBU, senior paediatricians predominantly spoke English, symbolising prestige and authority, while other health professionals conversed in a mix of Kiswahili and Kikuyu. This linguistic division created a barrier to effective communication among health professionals. In Upendo NBU, where the majority shared a common language, Kiswahili, interdisciplinary communication, and decision-making processes were smoother. Literature exploring the role of language in communication has primarily focused on language barriers between health professionals and patients and their impact on the quality of care (Al Shamsi et al. 2020; Albury et al. 2020; Ali and Watson 2018; Meuter et al. 2015; Pandey et al. 2021; Srivastava 2019; Caitríona and Zoë 2022). My study highlights the importance of understanding language use among health professionals and its role in technology-associated communication and decision-making, particularly within a multilingual context.

In my research, I highlight the positive role of networks in the use of newborn technology. In both NBUs, networks provide comfort and encouragement for health professionals engaging with newborn technologies. Health professionals utilise their networks to learn from each other. Networks have also been studied in healthcare and reported to contribute positively to care coordination and quality improvement. For instance, a review of 26 studies demonstrated that cohesive and collaborative health professional networks can facilitate care coordination and improve the quality and safety of care (Cunningham et al. 2012). In social network analysis, health networks were also found to promote innovative behaviours. For example, physicians who are more central in their professional network and have more connections with colleagues in hospital settings are more likely to display innovative behaviours (Di Vincenzo and Iacopino 2022). My study adds to the understanding of using social networks to improve communication and decision-making when using technologies.

My research found that champions in both NBUs play a positive role in technology-associated communication and decision-making. With support from management, the champion nurse in Upendo NBU encouraged their peers and ensured a good flow of information and decisions. However, I also identified challenges that champions may face in institutions that do not support their agenda. For example, the champion in Amani NBU initiated discussions to encourage nurses to make technology-associated decisions but lacked support from management.

These findings align with and contribute to existing literature showing the positive impact champions have when engaging with interventions. For instance, a systematic review demonstrates an association between champions and increased best practices in implementing healthcare innovations (Santos et al. 2022). Clinical champions provide leadership and information to change their peers' norms and attitudes (Morena, Gaias, and Larkin 2022; Warwick-Booth et al. 2013; George et al. 2022).

Through my research, I have demonstrated how established accountability mechanisms positively shaped health professionals' interactions and decisions regarding technology. The absence of such mechanisms in Amani NBU led to poor documentation and a lack of evidence-based decision-making, as evidenced by phototherapy without *bilirubin* testing. In contrast, the presence of accountability mechanisms in Upendo NBU fostered accurate documentation, utilisation of data, and adherence to guidelines in decision-making processes.

The literature highlights accountability as a crucial component of effective team functioning. For example, Lencioni discusses avoidance of accountability as one of the dysfunctions of teams, along with absence of trust, fear of conflict, lack of commitment, and inattention to results (Lencioni 2005). Leaders can employ strategies such as providing positive feedback, personal recognition, praise, and appreciation to motivate teams and foster accountability (Fahlevi, Aljuaid, and Saniuk 2022). My research provides valuable insights into the role of accountability in technology-associated communication and decision-making within healthcare settings.

In this research, I also provide insights into the role of broader factors, such as political, regulatory, and financial support, in communication and decision-making among NBU health professionals. For instance, while the Ministry of Health and local governments support the introduction of CPAP and phototherapy, a significant challenge lies in securing financial assistance to support various activities, including skill-building sessions, guideline procurement, technology repair, and clinical investigations. These activities are crucial for the quality and sustainability of communication and decision-making.

Similar studies have highlighted the importance of the wider system support for integrating technologies in newborn care. For example, *The Lancet Global Health Commission on Financing Primary Health Care: Putting People at the Centre* recommended that healthcare financing adapt to accommodate additional activities needed to integrate new technologies (Hanson et al. 2022). It is also essential to consider other broader factors, such as government actions, funding sources, and the role of international organisations, as they can influence the diffusion of innovations (Hanson et al. 2022). Additionally, aspects of the wider organisation, such as clinical practice guidelines, provide a standardised approach to informing medical decisions in patient care (Ferreira and Patino 2019; Natsch and van der Meer 2003). These guidelines are vital in supporting health professionals in making informed decisions.

Another factor associated with the wider system is the internal and external referral systems and their impact on technology-associated communication and decision-making. Both NBUs interacted with other departments, such as the labour ward and post-natal units, and other lower-level hospitals before patients were referred. This interaction highlighted the significant time required to engage these departments, especially in inquiries to understand the criteria for treating babies with CPAP or phototherapy.

Some studies have examined the referral system in healthcare, focusing on aspects such as the ease of communication and characterising communication challenges perceived by primary care personnel and specialists. These studies found communication difficulties that require improvement, particularly with electronic health systems (Zuchowski et al. 2015). In

Kenya, poor communication and lack of knowledge among health professionals were identified as referral challenges at the sub-county level (Nguru and Ireri 2022). My research provides insights into the necessity of engaging other departments and hospitals in technology-related communication and decision-making, including the time required for such engagement.

Throughout this chapter, I have highlighted the role of the NBU organisational structure in communication and decision-making. The Adaptive Structuration Theory, primarily used in communication, argues that the structure of organisations, including tasks, technology, the internal system of the group, and the environment, shapes social interactions and outcomes such as decisions and quality. However, there has been a gap in the empirical testing of these relationships in the theory (DeSanctis and Poole 1994).

In addition to organisational context, I observed differences in communication and decision-making among health professionals based on the type of technology involved. For instance, health professionals in both NBUs reported spending more time familiarising themselves before deciding on CPAP use than phototherapy. I also noted that health professionals in Amani NBU did not adhere to phototherapy guidelines but occasionally followed CPAP guidelines. In the next chapter, I will explore each role of technology in shaping communication and decision-making among health professionals.

CHAPTER 7: THE ROLE OF TECHNOLOGY TYPE IN SHAPING COMMUNICATION AND DECISION-MAKING AMONG HEALTH PROFESSIONALS.

7.1 INTRODUCTION

Literature on how the technology type can shape communication and decision-making is scarce. In previous chapters, I have discussed the role of physical, organisational, and the wider system context in shaping communication and decision-making. In this chapter, informed by two NASSS framework domains: (i) the technology and (ii) the illness or condition, I explore the role of the type of technology in communication and decision-making – focusing on CPAP and phototherapy. I start by presenting CPAP and phototherapy use in the two newborn units. I explore the way the technology design, functionality and knowledge generated in the process of using technology shapes communication and decision-making among health professionals. I then link technology use to the baby's condition by examining whether the perceived severity of babies who use these technologies forms communication and decision-making among health professionals. I highlight the similarities and differences between communication and decision-making between the two technologies. I conclude by drawing on the literature to critically examine and understand the similarities and differences in communication associated with using the two technologies.

7:2 TECHNOLOGY

7.2.1 OVERVIEW OF CPAP AND PHOTOTHERAPY USE

Amani Newborn Unit

During the period of my research the Diamedica CPAP machines in the Amani NBU were in the store and not used in the wards. The nurse in charge told me they had forgotten how to use the Diamedica CPAP and preferred the Pumani CPAP provided by the NEST360 programme, which they had recently received training on.

CPAP and phototherapy use varied during my research (Figure 7.1). In the first round of data collection, at least one patient per day used CPAP, while in the second round, the use was reduced from one baby per day to an average of one baby per week. During my second round of data collection, the nurse in charge informed me that health professionals had lost motivation to use CPAP. She acknowledged the NBU management needed to do something about it. On the other hand, an average of five patients per day used phototherapy in both rounds of data collection. In one week, during the second round of data collection, the number of babies using it increased to 17 patients per day. This high number was during the week one paediatrician was away. The medical and clinical officer interns were waiting for delayed feedback from the present paediatrician before removing babies on phototherapy.

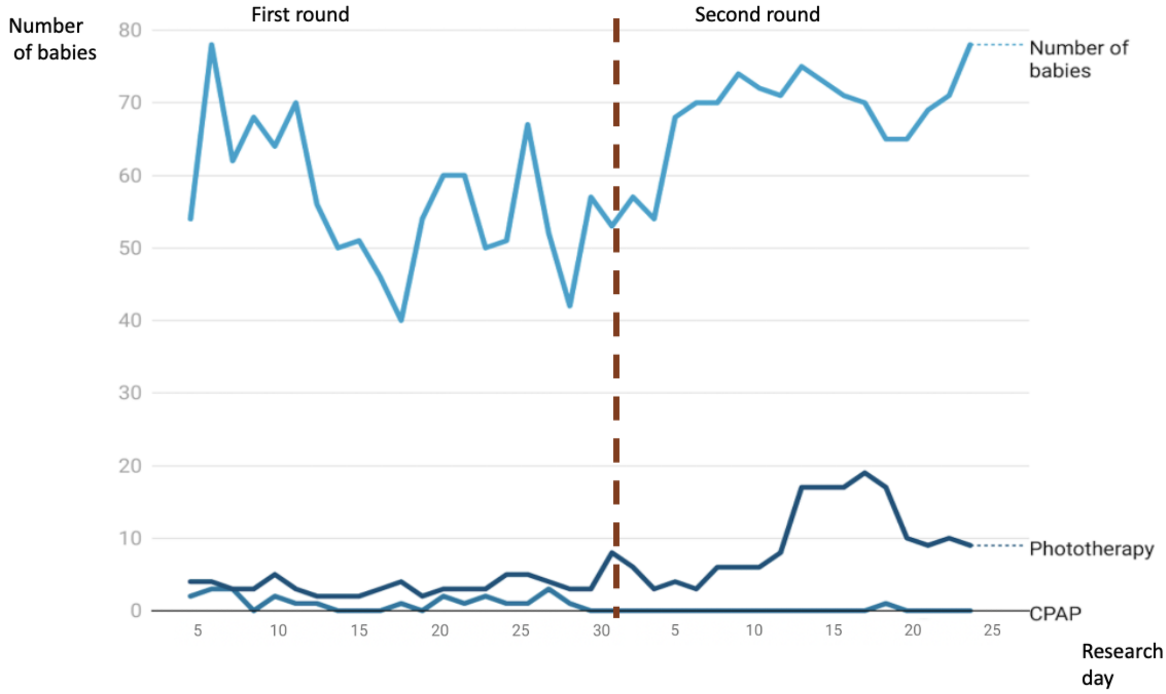

Figure 7.1 Number of Babies and CPAP and Phototherapy Use in Amani Newborn Unit.

Upendo Newborn Unit

During my time in Upendo NBU, an average of one patient used CPAP daily (Figure 7.2), with busy days having up to three patients on CPAP. It is similar to the number of patients in

Amani NBU despite the smaller size of Upendo NBU. Across my two data collection periods, unlike in Amani, I observed consistency in CPAP use in Upendo NBU. During my first period of fieldwork, babies did not share phototherapy machines, and only two or three of the four machines were used daily. At the beginning of the second round of data collection, up to eight patients used phototherapy – coinciding with the increased number of babies referred from lower-level facilities for phototherapy. I observed babies sharing phototherapy machines for the first time during this period.

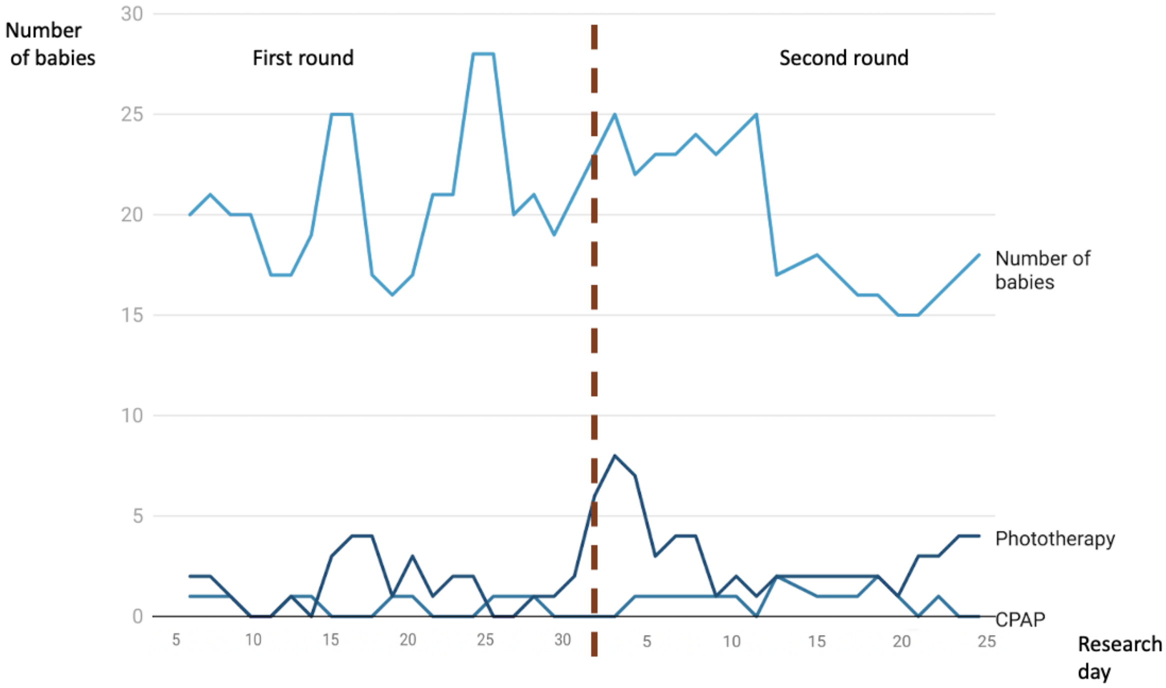

Figure 7.2 Number of Babies and CPAP and Phototherapy Machines Used in the Upendo Newborn Unit.

7.2.2 TECHNOLOGY FEATURES AND FUNCTIONALITY

Technology design and its characteristics played a part in communication and decision-making among health professionals in both NBUs. In both NBUs, health professionals considered CPAP a complicated technology that causes discomfort to babies even when used correctly. Health professionals considered it "sensitive" because it is noisy and invasive, with many tubes to connect. Therefore, consultation with colleagues is required before using it. When health professionals initiated CPAP before consultations because of an emergency, they engaged their colleagues afterwards. Health professionals also reported CPAP tubes as traumatising to babies who use them. As a result, they hesitated to initiate the use and involved their colleagues in discussions for assurance.

> *"For the CPAP machine, I feel like it is a consultant [to make decisions] because it is a bit sensitive." (Interview, Clinical Officer Intern, Round 1, Amani NBU)*

> *"Then the other concern is obviously trauma, the trauma to the nostrils. When you put the prongs on, some of them become so tight on the nostrils, so it causes a bit of trauma. And then, of course, the trauma on the scalp [skin covering the head, excluding face]; I think you have seen some babies with that." (Interview, Paediatrician 1, Round 1, Amani NBU)*

> *"You know, phototherapy, you just put the baby under the light, but for CPAP, it looks as if it is more complicated like there need to be consultations." (Interview, Medical Officer Intern 3, Round 1, Upendo NBU)*

When CPAP and phototherapy were employed, health professionals were supposed to use an "assisting technology". A pulse oximeter is used to inform the amount of oxygen needed for patients on CPAP, and a bilirubin test conducted in the laboratory or using a rapid test (*Bilirubinometer*) informs phototherapy use.

The pulse oximeter required to monitor the progress of patients added to the complication of using CPAP. Health professionals in both NBUs reported pulse oximeter availability as a significant determinant of decisions to use CPAP because it helped them to determine the progress of patients on CPAP.

> *"I think the biggest worry is CPAP. These days, we do not have enough pulse oximeters to keep the baby on the monitors. So, we just connect the CPAP and we just view it. So, we are not sure. Okay, we can intermittently check the saturations, but ideally, how we were trained, if the baby is on CPAP, you are supposed to be on a monitor so that you can see how the baby is faring." (Interview, Paediatrician 1, Round 1, Amani NBU)*

> *"All three NEST360 and one other pulse oximeter are not working. We took them to the biotechnicians, and they said the problem is with sensors…. We cannot use CPAP because we need to monitor the oxygen saturation pressure." (Interview, Nurse 4, Round 2, Upendo NBU)*

Health professionals in both NBUs reported, and I observed, frequent breaking down of CPAP machines, which required communication with the biomedical department. As a result, on most occasions that health professionals used CPAP, they spent significant time consulting their colleagues, monitoring patients, and documenting patient progress.

Health professionals consider a phototherapy machine simple, non-invasive and easy to operate. In most cases in both NBUs, health professionals spent less time engaging colleagues and monitoring and documenting phototherapy than during CPAP use. There was also less interaction with the biomedical department associated with phototherapy use because the breakdown of the phototherapy machines was rare.

> *"I would not say I have experienced any challenges when it comes to starting babies on phototherapy…...and the baby will survive." (Interview, Paediatrician 1, Round 1, Amani NBU)*

> *"It is something that you can see, and it does not require a lot of connections. So, you can start without much discussion." (Interview, Nurse 8, Round 1, Upendo NBU)*

Although a bilirubin test was required to determine the suitability of patients for the therapy, it was less of a determinant factor in assisting in using phototherapy machines than the pulse oximeter in CPAP use. For example, as discussed before, Amani NBU initiated phototherapy use without testing for bilirubin levels.

7.2.3 DATA GENERATED FROM TECHNOLOGY USE

In this section, I discuss data or information health professionals document regarding babies using technology. I highlight similarities and differences in the quantity of information and time health professionals spend collecting information from patients on CPAP and phototherapy.

In both NBUs, health professionals spent relatively more time monitoring the progress of babies on CPAP and their response to the treatment than patients on phototherapy or the general population of babies in the newborn units. This is because health professionals perceived information about the progress of babies, such as *oxygen saturation pressure* (SPO2) and *respiratory rate*, as crucial in CPAP decision-making even when health professionals were not following thresholds from the guidelines.

> *"Once you start the CPAP, you have to monitor closely ……… So maybe if someone starts the CPAP and they are not aware of the things that need to be done before it starts, I feel maybe they can mislead you, which might maybe cost a life." (Interview, Nurse 1, Round 2, Amani NBU)*

Despite the similarities between the two NBUs, health professionals in the Upendo NBU were more compliant in monitoring the babies on CPAP as recommended in the guidelines and filled in more detail in the monitoring charts than health professionals in the Amani NBU. This is explained by the Upendo NBU illustration of compliance that I discussed in Chapter Six. Nurses recorded vitals such as *pulse*, *respiratory*, and *oxygen saturation pressure* in documents such as the *Comprehensive Newborn Monitoring Chart* and *Nurses' Monitoring Chart.* Doctors documented patient management decisions in the patient files.

Health professionals in Amani NBU did not consider data in their phototherapy decisions because phototherapy was perceived as a simple technology.

> *The paediatrician asked the nurse to change the phototherapy intensity from standard to intense based on the baby's physical appearance. (Fieldnotes, Round 1, Amani NBU)*

Health professionals in Upendo NBU used documented phototherapy data to make decisions and comply with the NBU norms. Daily monitoring of *Total Serum Bilirubin* (TSB) in Upendo NBU provided information about bilirubin level decrease and when to stop phototherapy based on the recommended thresholds in the national protocols.

> *"If they [clinical officer interns and medical officer interns] find that the Total Serum Bilirubin has gone down, they just come and say, we can now disconnect the phototherapy, so we [health professionals] just put it off, and we remove the baby from that area". (Interview, Nurse 8, Round 2, Upendo NBU)*

7.3 THE CONDITION OR ILLNESS

7.3.1 NATURE OF CONDITION OR ILLNESS

In this section, I discuss the illnesses or conditions necessitating the use of CPAP and phototherapy in newborn babies. I consider the disease presentation, perceived severity and outcome after treatment with technology. I discuss how these parameters shape communication and decision-making among health professionals. I also highlight some of the conditions of mothers that shape decisions to use technology among health professionals.

The Kenyan national protocol recommends babies with the following criteria qualify to use CPAP:

a) Prophylactic CPAP: This is among babies born between 28 and 30 weeks of pregnancy and weighing between 1 and 1.3 kilograms. Babies born before 28 weeks of pregnancy and weighing less than 1000 grams do not meet the criteria for using CPAP.
b) Rescue CPAP: This is for babies born after 30 weeks of pregnancy or who weigh above 1.3 kilograms and present with difficulty breathing, *oxygen saturation pressure* less than 90% and a heart rate of beyond 100 per minute (MOH 2022).

Health professionals in both NBUs considered babies with "breathing difficulties" presenting with *respiratory distress* to be in critical and unstable condition and in need of CPAP. Communication and decisions around using CPAP were deemed necessary during and after starting CPAP.

> *"Because it is just the heaviness of the medical issue, and you find that you cannot compare a jaundiced patient with a patient who is already in meconium aspiration syndrome [One cause of breathing difficulties]. The patient who will require the most attention will obviously be meconium aspiration syndrome." (Interview, Medical Officer Intern 1, Round 1, Amani NBU)*

> *"For those babies born before 32 weeks, that time the surfactant has not matured. I have to start [CPAP] before I wait for that baby to start deteriorating." (Interview, Nurse 1, Round 1, Upendo NBU)*

The perceptions of health professionals regarding the outcomes of babies following CPAP use shaped the decisions to engage with CPAP. For example, the Amani NBU nurse-in-charge I spoke with on the first day of data collection expressed she was uncomfortable engaging with CPAP because of the deaths of babies who were on CPAP. She mentioned factors such as late initiating, CPAP misuse and critical conditions of babies as a contributor to deaths.

> *"I am not comfortable using a CPAP machine because babies die when I do so. Two of them did. I was trained, and every nurse expects me to be the best." (Fieldnotes, Nurse in charge, Round 1, Amani NBU)*

In Upendo NBU, two nurses that I interviewed were positive about making CPAP-associated decisions because they had witnessed positive outcomes from babies on CPAP.

> *"Something I love about these machines [CPAP] is they make my heart happy. Before these machines came, we were losing so many babies, so many babies to respiratory distress, but with the CPAP, we can see babies going through CPAP and surviving. For me, that one is a blessing." (Interview, Round 2, Nurse 5, Upendo NBU)*

> *"We used to just give oxygen to babies with distress, and it was a challenge. But with CPAP, we think it has also encouraged us; we have been in a position to save a lot of babies from respiratory distress." (Interview, Nurse 3, Round 1, Upendo NBU)*

According to Kenya's national guidelines, neonatal jaundice is physically manifested through a yellowness of the skin, including palms and soles. The blood test also reveals high levels of *bilirubin*. Phototherapy use is mainly a priority in babies with jaundice on day one of birth, born before the 35-week gestational period and with *rhesus incompatibility* with their mothers (MOH 2022). It commonly appears in babies with *infection* and *hemolysis*.

Despite being life-threatening, health professionals in both NBUs considered jaundice "a simple condition" because, in most cases, the patient appeared stable and improved after starting the therapy. Health professionals perceived lower death rates among patients with jaundice receiving phototherapy alone compared to those also receiving CPAP therapy. As a result, decisions associated with phototherapy use among health professionals were relaxed, with fewer reviews and documentation of patient progress.

> *"It [jaundice] is something you [health professionals] can make an observation by yourself and make the decision." (Interview, Nurse 1, Round 1, Amani NBU)*

7.3.2 COMPLICATIONS AND COMORBIDITY FACTORS

In both NBUs, babies with more than one condition, in addition to breathing difficulties or jaundice, were seen to elicit increased interactions among health professionals. Some babies in the NBUs had comorbidities and used multiple technologies for monitoring and support. For example, a baby with difficulty breathing, jaundice and low sugar levels could be placed on CPAP, phototherapy, a pulse oximeter, and the use of a glucometer. In such a situation, health professionals such as nurses, clinical officer interns and medical officer interns had an additional task to engage each other in discussing the management and progress documentation. In such situations, health professionals took longer to agree on the management, monitoring patient progress and documentation.

Over their time in the NBUs, some babies developed new symptoms or complications, triggering further discussions among health professionals. For example, *convulsions* during CPAP treatment led to stopping the treatment. Nurses and nursing students who spent more time in the unit than other groups of health professionals noticed threatening developments and reported them to the medical team.

The condition or perceived complications suffered by the mother also shaped the decisions around the use of CPAP and phototherapy. One condition is the pregnancy history of the mother. For example, mothers with a history of losing babies had decisions to start phototherapy or CPAP for their babies taken more urgently and with more time spent discussing, monitoring and documenting the progress of the baby.

“That mother lost three babies, and this baby is the only one she had. We had to do trial and error because when we put CPAP, he becomes cyanotic [the skin turns blue], and when we put oxygen, he improves.” (Fieldnotes, Medical Officer Intern, Round 1, Upendo NBU)

Another condition is for babies and mothers with *rhesus incompatibility*. For example, if the mother is rhesus negative in their blood group, and the baby is rhesus positive, this causes newborn complications. Health professionals spent extended time discussing such a scenario and made careful documentation.

“But somehow sometimes we see this is dangerous, this is a rhesus negative mother…… when it [jaundice] is that deep.” (Interview, Nurse 6, Round 1, Amani NBU)

7.4 A COMPARISON OF CPAP AND PHOTOTHERAPY-ASSOCIATED COMMUNICATION AND DECISION-MAKING IN AMANI AND UPENDO NEWBORN UNITS.

SIMILARITIES

Health professionals use CPAP and phototherapy to address specific medical conditions: CPAP for respiratory distress and phototherapy for jaundice. The features of both technologies, such as their physical appearance and ease of initiating a patient's treatment, shaped communications and decisions.

Auxillary technologies accompany the use of both CPAP and phototherapy for proper functioning. For example, CPAP often requires a *pulse oximeter* to monitor *oxygen saturation pressure*. Phototherapy should rely on a *bilirubinometer* or *total serum bilirubin* test in the laboratory to inform treatment decisions. Babies using CPAP and phototherapy may present with comorbidities, adding complexity to health professionals’ decision-making and communication. The condition and medical history of mothers following delivery, including factors such as previous baby losses and *Rhesus incompatibility*, shape decision-making regarding the use of both CPAP and phototherapy. These factors also impact the intensity of consultations and monitoring to assess progress.

PARAMETERS	CPAP	PHOTOTHERAPY
Technology Features and Functionality	• Health professionals consider the design “sensitive” because it is noisy and invasive, with many tubes to connect and frequent breakdowns. They consult their colleagues before initiating it and some hesitate to engage. • Health professionals consider the functionality complicated and causes discomfort to the babies even when used correctly. They have frequent and detailed consultations and monitoring before or during the initiation of CPAP.	• Health professionals consider the design simple and non-invasive. Consultations with colleagues were fewer. • Health professionals consider the functionality easy to under with mininal breakdown events. Considered simple and non-invasive. They spend less time engaging colleagues and monitoring babies on phototherapy. Fewer interactions with the biomedical departments because the breakdown of the phototherapy machines was rare.
Data Generated from Using Technology	• Despite varying intensity between the two NBUs, health professionals in both NBUs document the patient progress more in detail and frequency. • In Amani NBU, health professionals occasionally utilised CPAP data for decision-making, whereas in Upendo NBU, CPAP data was used more frequently.	• Health professionals documented relatively less the progress of patients on phototherapy. • In Amani NBU, health professionals did not use phototherapy data for decision-making while in Upendo NBU phototherapy data was used more often.

The Nature of Illness or Condition	• Health professionals consider babies with breathing difficulties in need for CPAP in critical and unstable condition. Communication and decisions around using CPAP were deemed critical and required careful consideration – also taking into account the perceived complicated nature of CPAP. They take decisions to start CPAP carefully and with more consultations. • Mixed perceptions among health professionals regarding baby outcome following CPAP use leading to mixed decisions regarding CPAP use.	• Health consider jaundice “a simple condition” because, in most cases, the patient appeared stable and improved after starting the therapy. Their decisions to start phototherapy has less consultations. Communication and decisions associated with phototherapy use were relaxed, with fewer reviews and documentation of patient progress. • Health professionals perceive good outcome of babies with jaundice using phototherapy leading to positive decisions to use phototherapy.

Table 7.1 Comparison of Health Professionals’ Communication and Decision-making in CPAP versus Phototherapy Use.

7:5 DISCUSSION

In this chapter, I presented how the type of technology shapes how health professionals communicate and make decisions. I looked into the specific features of CPAP and phototherapy machines and the knowledge in terms of data gained through their use. I explored the health conditions that require babies to use CPAP and phototherapy and how these conditions shape how health professionals communicate and make decisions. I drew on NASSS framework domains one and two while allowing flexibility in using the tool. For example, I did not include domain 2D: Technology supply model because it focuses on technology procurement, which is beyond my research focus.

In this research, I provided insight into the role of technological features and functionality in shaping communications and decision-making in newborn care. Studying CPAP and phototherapy offers me an opportunity to compare them. The perceptions of health professionals of the complicated features and operation of CPAP led to more frequent and detailed consultations and monitoring compared to phototherapy, which was viewed as a simpler technology.

Similar literature has explored how technology features and their perceived complexity in using them impact the engagement of health professionals with them, often leading to stress. This has been observed in various contexts, such as Clinical Decision Support Systems (CDSSs) (Knop et al. 2022), technology-enhanced university learning (Wang et al. 2021) and vocational training (Beer and Mulder 2020). Studies focusing on electronic medical records and clinical decision support systems, mainly from North America and Europe, have shown that the complexity of technology influences the willingness of health professionals to use them (Ross et al. 2016). These findings underscore the importance of considering human factors in the process of technology use, as discussed in the literature (Taha, Simpson, and Sharkey 2023). My research contributes to this understanding by examining the role of technology features and functionality in shaping communication and decision-making among health professionals in low-resource settings. By comparing two technologies within the same context, it offers a unique perspective on this issue.

In my research, observed there were differences in the intensity of documentation between the two NBUs, with Upendo NBU showing higher levels, both facilities exhibited more detailed and frequent documentation of patients on CPAP than those on phototherapy. Previous literature emphasises the crucial role of patient documentation in ensuring effective patient management, particularly in nursing practice (Prideaux 2011). Regarding healthcare technologies, documentation becomes even more vital (Kuhn et al. 2015).

Several factors have been identified in previous research as influencers of proper documentation, including time available, patient volumes, availability of recording materials (Mutshatshi et al. 2018), competing priorities, technical challenges, motivation, a sense of security, and knowledge of documentation procedures (Bjerkan, Valderaune, and Olsen 2021). My findings contribute to the existing knowledge by emphasising how the type of technology shapes documentation practices among health professionals. This underscores the importance of considering how different technologies may shape the frequency and thoroughness of documentation in low-resource settings. This highlight the potential implications for workload management and data interpretation in healthcare facilities.

In my research, I found that the perception of health professionals of the patient's severity of condition, which necessitates the use of a particular technology, significantly shapes their interactions and decision-making. For instance, health professionals view babies with breathing difficulties requiring CPAP as being in a critical and unstable condition. Consequently, communication and decisions regarding CPAP usage are approached with great care and involve more consultations due to the perceived complexity of CPAP. In contrast, jaundice is often regarded as a more straightforward condition, with patients typically appearing stable and showing improvement after starting phototherapy. Therefore, decisions regarding phototherapy are made with fewer consultations and a more relaxed approach to communication and decision-making.

These findings resonate with a study conducted with physicians in Iran, which identified patient illness as a significant factor influencing doctors' job stress and, consequently, the quality of medical services (Mosadeghrad 2014). Patient illness is increasingly recognised as a crucial parameter in health technology evaluation, as recommended by quality institutions like the National Institute for Health and Care Excellence in the United Kingdom (NICE 2020). My research contributes to the understanding that while considering how technology types shape communication and decision-making, it is essential to also account for the illness or condition necessitating the use of that technology.

Some health professionals in my research perceived that CPAP treatment had negative consequences. This concept has been introduced previously in the literature. For example, Bonell et al. have discussed how public health interventions may unintentionally result in harmful outcomes, referred to as "dark logic," emphasising the ethical necessity to anticipate and understand these unintended consequences (Bonell et al. 2015). Sometimes, these unintended consequences of technology use can contradict the intended effects, a phenomenon known as paradoxical consequences, as discussed in the context of digital technology (Ziebland, Hyde, and Powell 2021; Timmermans and Kaufman 2020). While this perception was reported in one hospital, further studies to understand the outcomes of babies on CPAP and phototherapy, particularly in low-resource settings, and the reasons for their deaths would be beneficial.

These findings resonate with the Actor-Network Theory, which emphasises the agency of both human and non-human actors and highlights the dynamic relationships between them (Callon 1981; Doolin and Lowe 2002; Prout 1996). Actor-network Theory (ANT) informs how the perception of CPAP and phototherapy shapes communication among health professionals in this context. By treating these technologies as active participants in healthcare networks, ANT reveals how their roles, complexities, and associated health conditions influence the nature and intensity of professional interactions.

Under ANT, CPAP is not just a passive tool but an actor that actively shapes the relationships and communication networks among health professionals. Health professionals perceived CPAP as complicated because of its features, how it functions and monitoring requirements. These factors position CPAP as a point of heightened communication within health professional teams. Health professionals engage in detailed discussions, thorough documentation, and frequent consultations to ensure its proper use. This aligns with ANT's premise that objects in a network are not merely tools but active agents that structure communication in making technology-associated decisions.

The severity of respiratory distress further amplifies CPAP's influence within the network. Decisions about initiating or discontinuing CPAP often involve significant deliberation, reflecting the uncertainty and critical neonatal care. This cautious and collaborative approach to communication among health professionals underscores ANT's notion that non-human actors like CPAP can blur boundaries between the material and human worlds, shaping care delivery and the dynamics of professional relationships.

In contrast, phototherapy is perceived as a simpler technology. Within ANT, phototherapy’s simplicity reduces its active role in shaping communication networks. Unlike CPAP, health professionals engage in less consultation and have less detailed documentation, which leads to faster decision-making regarding phototherapy use. This reflects ANT's idea that the role of an object in a network depends on its context and the relationships it fosters. The predictable nature of jaundice and its treatment reinforces this perception, demonstrating ANT's principle that the influence of objects is context-dependent and fluid.

CHAPTER 8: DISCUSSION AND CONCLUSION

8.1 INTRODUCTION

In this thesis, I explored the role of physical context, socio-organisational context, and technology type in communication and decision-making among health professionals in two newborn units in Kenya. I discussed the relationship between technology and communication and decision-making, demonstrating how communication and decision-making shape the use of technology in newborn care and how, in turn, technology implementation impacts communication and decision-making practices.

The focused ethnographic approach I adopted allowed me to investigate the use of CPAP and phototherapy among health professionals. I used non-participatory observations, in-depth interviews, and document review methods. Combining different forms of data in the two neonatal units provided invaluable insights, offering a comprehensive understanding of health professionals' experiences across different circumstances and routines. In-depth Interviews provided health professionals a platform to share their stories, enhancing insights from observation and document review. This immersive approach allowed for firsthand experiences and reflections, enriching my knowledge beyond my prior experience of newborn units.

In Chapter One, I showed that despite evidence indicating the positive role of technologies such as CPAP and phototherapy in improving neonatal outcomes, there remains a limited understanding of strategies to ensure effective and sustained use, particularly in LMICs. I discussed the importance of understanding the context of complex health service delivery, including the role of communication about decisions in ensuring the successful delivery of interventions. I also highlighted gaps in the literature on communication among health professionals engaging with technology and presented research objectives and the outline of subsequent chapters.

The literature review presented in Chapter Two provided an overview of the importance of communication among health professionals and what is known regarding communication and decision-making among health professionals involved in using newborn technologies. I identified gaps in the current understanding regarding the dynamics of communication and decision-making, including the role of the context and technology type.

In Chapter Three, I explained the research design and methods, including details on the study area, population, ethical considerations, familiarisation with the research context, and data collection and analysis. In Chapter Four, I presented a comparative overview of communication and decision-making among health professionals in the two newborn units in Kenya. Based on the analysis of ethnographic data collected between January 2022 and April 2023, I explored and described communication between health professionals, including the content of communication, how staff interacted with each other and spatial considerations. I also discussed observed differences between the two newborn units and implications for subsequent results chapters.

In Chapter Five, I examined the physical context of two newborn unit settings, describing in detail the physical structure, layout, and the number of health professionals in the newborn units and the implications for communication and decision-making among health professionals. In Chapter Six, I discussed the organisational context and its critical influence on communication and decision-making among health professionals. I highlighted the importance of management style, language, availability of resources, and health professionals' skills. In Chapter Seven, I examined in detail how the specific technologies, in this case, CPAP and phototherapy, shaped and were shaped by communication and decision-making among health professionals. I discussed the implications of the features and functionalities of each technology in communication and decision-making.

In this final chapter, I bring together and critically discuss the findings, draw on them to revise the conceptual framework and consider the implications of integrating technology in newborn care in LMICs. I discuss the strengths and limitations of the study and present my recommendations and conclusions.

8.2 SUMMARY OF KEY FINDINGS

I have summarised the findings against my research objectives in Table 8.1.

OBJECTIVE	FINDINGS
Objective 1: To describe communication and decisions associated with CPAP and phototherapy use among health professionals in two newborn units in Kenya.	I observed that there were several characteristics of communication and decision-making among health professionals in the two newborn units. In summary: • While communication involving knowledge sharing and patient management were observed in both facilities, there were variations in implementation process, with Upendo NBU demonstrating greater inclusivity of various groups of health professionals, and more organised knowledge sharing plans, and better documentation. • Health professionals in both facilities used verbal, non-verbal, and written communication, but differences were observed: Upendo NBU fostered a blend of formal and informal exchanges, cultivating a friendly atmosphere among staff, while Amani NBU primarily featured formal interactions with occasional tension among health professionals. • The spaces in which interactions among health professionals occurred varied between the NBUs: in Upendo NBU, both formal and informal conversations occurred throughout spaces within the NBU without spatial distinction, while in Amani NBU, interactions were confined to patient rooms, with informal exchanges in places like the changing room.
Objective 2: To examine the physical contexts in which health professionals communicate and make decisions about using CPAP and phototherapy.	I identified that there were several physical contextual factors shaping communication and decision-making among health professionals in the two newborn units. In summary: • Designated areas for babies undergoing CPAP and phototherapy enabled focused monitoring and documentation efforts. • Spacious patient rooms encouraged communication and inclusive decision-making. The proximity of patient rooms and the communal space further supported engagement in decision-making processes, as physical closeness fostered interaction. • Implementing shorter work shifts for health professionals and ensuring diverse contributions to patient care helped alleviate workload and create opportunities for interaction among team members. • Fewer health professionals per shift caused higher workloads and less time for interactions, as observed in Amani NBU with three times the number of babies compared to Upendo NBU, with similar number of health professionals in both health facilities.

Objective 3: To explore the organisational contexts in which communication and decision-making about the use of CPAP and phototherapy occur among health professionals.	I identified that there were several organisational contextual factors shaping communication and decision-making among health professionals in newborn units. In summary • Common language use among NBU health professionals, teamwork, clear and roles and responsibilities that included various disciplines of health professionals encouraged effective technology-associated communication and decision-making. • Long-term and well-organised training plans to share knowledge on technology use among health professionals regardless of their background, provided skills and encouragement to engage with technology. • Mechanisms to support technology use such as accountability and compliance mechanisms and the use of champions and social networks strengthened interactions and encourage positive decisions among health professionals to use technology. • Enhanced monitoring, documentation, and utilisation of clinical data as evident in Upendo NBU, encouraged multidisciplinary involvement, compliance and accountability in communication and decision-making. • Financial support for resources provided by the hospital and county outside of the NBU reinforced communication and positive decision-making among health professionals.
Objective 4: To examine how the type of technology shapes the interactions and decision-making among health professionals in the two newborn units.	I observed that there were several factors relating to technology type shaping communication and decision-making among health professionals in newborn units. In summary: • Perceived complication in design and operation of technology resulted in frequent and detailed communication including consultations and monitoring and documentation as seen in CPAP, contrasting with perceived simplicity in technology, which required less frequent and detailed attention as observed in phototherapy. • Patient severity makes important difference to communication and decision-making in the technology use. Perceived patient negative clinical outcomes and severe cases lead to more consultations than in perceived positive patient outcome and less severity of the condition.

Table 8.1 A Summary of Key Findings.

8.2.1 A REVISED CONCEPTUAL FRAMEWORK

At the start of the study, I developed a conceptual framework to inform data collection, analysis and presentation. The initial framework showed that communication and decision-making about the use of technology are intertwined. It also showed that organisational and physical context and technology type shaped communication and decision-making. Based on my findings, I have made some modifications to the framework to illustrate my better understanding that these factors do not work in silos but are interconnected within each other (Figure 8.1). Each component plays its role but interacts with other factors to shape technology-associated communication and decision-making. I also learned the importance of the wider system beyond the newborn unit in shaping health professionals' communication and decision-making. I have added that to the modified conceptual framework.

Beyond these overall modifications, new insights emerging from my empirical research about each category of the conceptual framework are:

a. Physical context: The importance of the newborn unit design and layout in shaping technology-associated communication and decision-making.
b. Organisational context: The centrality of teamwork, compliance norms, and social networks in technology-associated communication and decision-making among health professionals, as well as the role of language.
c. Technology type: The use and role of documented data in technology-associated communication and decision-making.
d. Technology decision-making point: Technology repair is an unanticipated but regular topic of communication and decision-making.

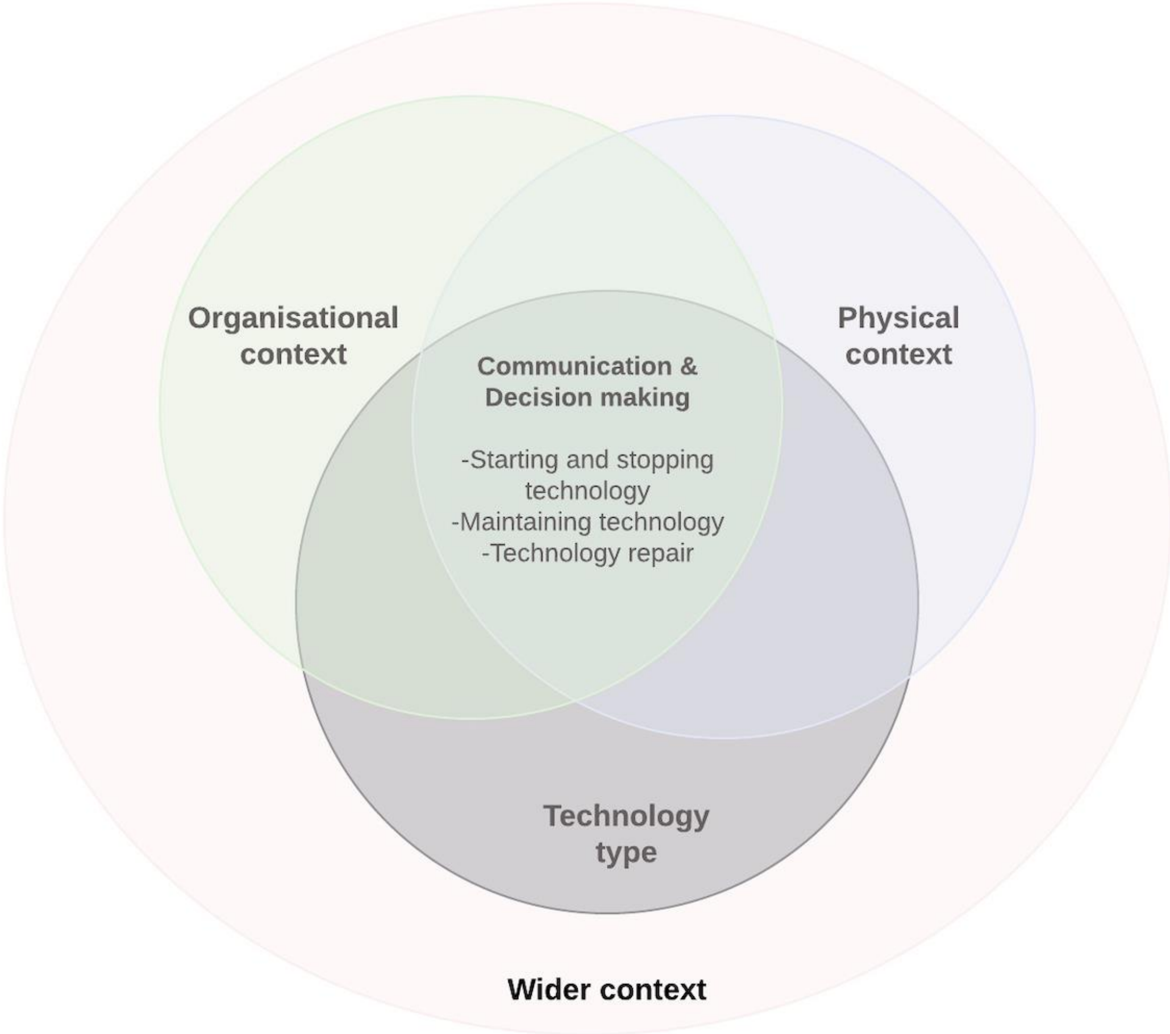

Figure 8.1: A Revised Conceptual Framework for Communication and Decision-making in Health Professionals Using Newborn Technologies and Influencing Factors.

In the following section, I discuss communication and decision-making within the context of using CPAP and phototherapy, focusing on critical decisions related to technology implementation as highlighted in the conceptual framework. I begin by discussing the role of communication and decision-making in starting and stopping CPAP and phototherapy. I combine their discussion since communication and decision-making shape both processes similarly. Following this, I will explore the role of communication and decision-making in maintaining babies on phototherapy and CPAP and then in the repair of these technologies. For each implementation point, I analyse how various factors—physical, organisational, technological, and the wider context plays a role in communication and decision-making and subsequently influences the implementation of CPAP and phototherapy.

8.3 COMMUNICATION AND DECISION-MAKING IN THE IMPLEMENTATION OF CPAP AND PHOTOTHERAPY: STARTING, STOPPING, MAINTENANCE, AND REPAIR.

In discussing factors shaping communication and decision-making in starting and stopping CPAP and phototherapy and then in maintaining and repairing technologies, I refer to the definition of health systems provided by Sheikh et al., as detailed in Chapter One. They categorise health system components into "hardware," which includes finance, medical products, information systems, human resources, forms of service delivery, and governance (Sheikh et al. 2011). They argue that beyond these concrete and tangible elements, the "software"—comprising ideas and interests, values and norms, and affinities and power that guide actions and underpin relationships among system actors and elements is also critical to overall health system performance.

8.3.1 COMMUNICATION AND DECISION-MAKING IN STARTING AND STOPPING TECHNOLOGY.

In this section, I discuss the crucial role of health professionals' communication and decision-making in shaping, starting and stopping the use of CPAP and phototherapy in neonatal care.

The physical context of newborn units as part of the system “hardware” plays a significant role in how health professionals communicate and make decisions regarding CPAP and phototherapy use. The design and layout of the newborn unit reported in Chapters Four and Five contributed to how health professionals communicated and decided to start or stop CPAP and phototherapy on babies requiring treatment. I observed that the spacious Upendo NBU design encouraged health professionals to collaborate and consult more effectively regarding starting and stopping phototherapy, discussing the criteria for starting the technology therapy, dose and duration of treatment. Overcrowding and limited space observed in Amani NBU hindered communication and decision-making, making it difficult for health professionals to interact and consult with each other.

I also observed from my empirical research that the NBU layout with a communal area for interdisciplinary health professionals fosters interaction between staff and inclusive decision-making in starting and stopping CPAP and phototherapy, as seen in Upendo NBU. Additionally, patient rooms that were closely arranged to each other and their proximity to the communal area provided a physical closeness that allowed health professionals to communicate and make decisions to start and stop babies on CPAP and phototherapy, as seen in Upendo NBU compared to Amani NBU.

My scoping review studies did not reveal any evidence indicating that congestion levels in the newborn unit impacted technology-associated communication and decision-making. My research provides valuable insight into this matter. A study conducted in an office outside the health sector provided an overview of the influence of the physical environment on employees' communication unrelated to technology use (Kamarulzaman et al. 2011). The authors report findings similar to those of my empirical data, which show that noise, crowdedness of people, distribution of supplies, uncomfortable temperature, and air circulation reduce privacy and make staff uncomfortable interacting with others.

In my scoping review, I did not find any discussion of the role of the layout and design of the newborn unit in communication and decision-making about technology use among health professionals. However, concerns about the influence of space and layout on communication among health professionals in hospital settings have been reported in the literature on communication among health professionals in NBUs. For example, a review of nursing unit designs across three acute care hospitals in the United States, comprising 24 different layouts, revealed that cross-shaped decentralised units had less effective communication structures among health professionals than layouts featuring a centralised nurses' workstation (Brewer et al. 2018). This outcome may be attributed to the longer, straight corridors associated with the cross-shaped units, which could reduce access to other staff members. Outside the health sector, the physical context has also been reported to play a role in communication and decision-making among colleagues. For example, a study conducted at a university focusing on land studies in the United States examined the impact of workplace design features on newly acquired communication skills (Kupritz and Hillsman 2011). The authors found that an environment with proximity for discussion and privacy to communicate and give feedback facilitated good communication and learning for workers in implementing health interventions.

Another physical context aspect and part of the system, “hardware”, that I found to influence communication and decision-making around the starting and stopping of CPAP and phototherapy was the number of health professionals in the unit. This number is influenced by the total numbers employed and factors such as shift schedules and job distribution, as discussed in Chapters Four and Five. In Upendo NBU, more health professionals led to more interactions and positive decisions about guidelines regarding CPAP and phototherapy starting and stopping compared to Amani NBU. These data echo the Malawian study of CPAP use conducted in four hospitals reported in my scoping review. That study found that a low number of health professionals was related to less use of CPAP (Kinshella et al. 2020). The authors described how a shortage of health professionals led to nurses being reassigned to labour and post-natal wards. This contributed to nurses' reluctance to initiate CPAP treatment in the NBU because of the high workload and lack of time to engage. Furthermore, the study exploring nurses' collective strategies to cope with work-related stress in Kenyan NBUs found that fewer health professionals than were needed to cope with the workload compromised their interactions with each other (McKnight et al. 2020) et al. 2020). These data suggest that communication is compromised in environments with low health professional-to-baby ratios. This negatively impacts decision-making regarding starting and stopping using technologies such as CPAP and phototherapy.

Intertwined with the physical context, the organisational context, and aspects of the health system "software," including management style and established communication mechanisms, influenced communication and decision-making around starting and stopping CPAP and phototherapy. In Chapters Four and Six, I show that a management style promoting teamwork and inclusive decision-making, as observed in Upendo NBU, creates a more balanced power distribution in starting and stopping technology among health professionals. This approach allows for active participation across all levels of staff, including nurses and junior professionals, ensuring that their insights and observations are valued during discussions and decisions about starting and stopping CPAP and phototherapy. By encouraging shared responsibility and mutual respect, the team dynamic at Upendo NBU overcame hierarchical barriers. In contrast, the hierarchical structure observed in Amani NBU established power dynamics that centralised authority among senior professionals, particularly paediatricians and limited the input of other health professionals. This top-down system created delays in discussions and consultations, as paediatricians were often unavailable, leaving decisions to start and stop phototherapy and CPAP on hold. Despite their training and frontline involvement, other health professionals, such as nurses, could not act independently, further exacerbating delays and communication gaps.

These findings align with those described in my scoping review, where the two studies in Malawian hospitals described how power dynamics and hierarchical structures shaped communication regarding the decisions to use CPAP. In one of the studies, the authors described how clinicians were positioned at the top of the decision-making hierarchy, with nurses trained on CPAP expected to consult them for starting or stopping CPAP. This structure reinforces dependency, with nurses being able to initiate CPAP only in critical situations and still requiring clinician approval for follow-up (Kinshella et al. 2020). Similarly, nurses in four hospitals in Malawi often received training, but clinicians held higher power in the decision-making processes to start or stop CPAP (Nyondo-Mipando, Kinshella, et al.

2020). In these studies, as in Amani, the starting of CPAP was often delayed due to the lack of availability of doctors to make decisions.

While the scoping review did not address this aspect, studies on non-technology-associated communication and decision-making emphasise the importance of monitoring and documentation, especially in LMICs (Lawn et al. 2014; Jalemba et al. 2015). Challenges to documentation, such as staff workload and complicated hardcopy tools, are common in these settings, as seen in a study from Bangladesh, Nepal, and Tanzania (Shamba et al. 2021). Standardised documentation tools and long-term efficient data generation from routine collection are recommended to address these issues (English et al. 2023).

In my research, I observed that accountability mechanisms within the organisational context, such as robust documentation and data use, encouraged and supported communication and decision-making associated with CPAP and phototherapy. Upendo NBU had implemented measures to ensure guideline adherence and accountability, promoting evidence-based starting and stopping of CPAP and phototherapy. Supportive measures like social networks, champions, and reward systems encouraged positive interactions and communication among health professionals, which was not the case in Amani NBU.

In addition to the broader physical and organisational contexts, perceptions about the technology itself (part of the health system's "hardware") shaped communication and decision-making about the starting and stopping of CPAP and phototherapy. My data suggest that in the two NBUs, health professionals perceived CPAP, with its numerous tubes and invasive nature, as a more complicated technology compared to phototherapy. This perception necessitated increased communication when starting and stopping CPAP because they perceived it as complicated to use and wanted to be sure of their decisions. In contrast, I found that simpler phototherapy requires fewer consultations and discussions among health professionals when engaging with it. These findings align with the findings from studies described in my scoping review. In India, a study conducted in 15 newborn units found that health professionals perceived CPAP as less complicated than a ventilator, making nurses more likely to initiate CPAP without consulting doctors than a ventilator (Dewez et al. 2018). Similarly, in Australia, discussions about using oxygen therapy were positive when health professionals perceived it safe for staff and patients (Peeler, Fulbrook, and Kildea 2015).

Alongside concerns about the complicated nature of the technology itself, my data suggest that in these two NBUs, the severity of the baby's clinical condition necessitating technology use also played a role in communication and decision-making. Health professionals considered respiratory distress, which leads to CPAP use, as a severe condition, prompting careful discussions and more consultations before starting and stopping CPAP. In contrast, jaundice requiring phototherapy was perceived as less severe, leading to less intensive discussion and simpler decision-making processes.

Lastly, my data suggest that influences outside the newborn unit also contribute to shaping communication and decision-making around stopping and starting CPAP and phototherapy. The relationship between health professionals in the neonatal unit and staff in various departments, such as the labour ward, post-natal ward, nutrition unit, and physiotherapy, was shown to shape communication and decision-making processes. For example, nurses from the post-natal ward consulted health professionals in the newborn unit to determine whether some babies admitted to the post-natal ward required phototherapy. This interdepartmental engagement often needed additional time and expertise, sometimes delaying the initiation of CPAP and phototherapy.

My scoping review did not find studies discussing the role of other departments in technology-associated communication and decision-making in newborn care. Previous research outside the newborn technology context has highlighted the importance of communication in referral systems. For example, a scoping review of factors contributing to the successful implementation of referral systems (Seyed-Nezhad, Ahmadi, and Akbari-Sari

2021) and a study on referral challenges in Kenya (Nguru and Ireri 2022) underscores the significance of functional coordination and feedback in supporting patient management. My research enhances my understanding of communication and decision-making practices in interdepartmental engagement and the referral process within and outside hospitals. It highlights their role in starting and stopping CPAP and phototherapy, alongside other influences.

8.3.2 COMMUNICATION AND DECISION-MAKING IN MAINTAINING THE USE OF TECHNOLOGY.

The monitoring and documentation of the progress of babies on CPAP and phototherapy were also significantly shaped by the physical context of the two newborn units—this shaped communication and decision-making around maintaining babies on these two technologies. My findings in Chapters Four and Five indicate that the higher number of health professionals in Upendo NBU, compared to Amani NBU, led to more thorough communication and decision-making influencing monitoring and documentation. Health professionals in Upendo NBU had more time to measure and document babies' progress using technology and use that information in patient decision-making. Additionally, I observed that the design and layout of the newborn units affected the ability of health professionals to monitor and document babies' progress on the two technologies and influenced how they communicated and made decisions regarding these technologies. Upendo NBU, with designated areas for babies on CPAP and phototherapy, allowed for focused monitoring and documentation, streamlining these tasks and facilitating the oversight of technology-specific monitoring.

The importance of having an adequate number of health professionals to carry out monitoring processes is echoed by my scoping review, which showed that a staff shortage in Malawian hospitals led to irregular monitoring of infants undergoing phototherapy (Kinshella, Salimu, et al. 2022). A similar issue was identified in Kenya, with high staff turnover and strikes challenging communication and documentation for babies on CPAP in a scoping review study (Nabwera et al. 2020). Beyond technology use, this workload burden in newborn care is linked to adverse events in Brazil (Lamy Filho et al. 2011), missed nursing care in the United States (Tubbs-Cooley et al. 2019), and increased workload during neonatal resuscitation in Canada (Zehnder, Law, and Schmölzer 2020).

Regarding the role of NBU layout and design, my empirical study provides new insights into the importance of layout in influencing the ability of staff to monitor babies using technologies such as CPAP and phototherapy. Previous studies have discussed how layout impacts non-technology communication and decision-making, influencing patient monitoring and documentation. However, little attention has been paid to the specific requirements for monitoring medical technologies such as CPAP and phototherapy. For example, single-family room designs in NICUs hinder visibility and increase walking distances, complicating team communication and infant monitoring (Doede, Trinkoff, and Gurses 2017). In contrast, open-bay NICU layouts facilitate visibility, documentation, and interaction among medical staff, enabling the simultaneous monitoring of multiple babies (Shahheidari and Homer 2012).

My data have also demonstrated that the organisational context can significantly shape the monitoring and documentation activities that influence decision-making. My findings demonstrate how power dynamics during the monitoring of babies on CPAP and phototherapy significantly shaped communication among health professionals. In Amani NBU, where hierarchical structures prevailed, nurses and junior staff, such as intern doctors, handled most of the documentation. Senior health professionals such as paediatricians often ignored this documented information in their review and sometimes deviated from the standard guideline criteria for managing babies on CPAP and phototherapy. In contrast, Upendo NBU exhibited a balanced power distribution, fostering a collaborative environment where all team members actively participated in monitoring babies' technological progress. This included using documented information from all staff in decision-making and ensuring consistent adherence to management protocols. As the literature emphasises, these dynamics highlight the importance of fostering mutual respect and interdisciplinary collaboration, which suggests that balancing power among health professionals promotes teamwork, effective communication, and improved patient care (Poole and Real 2003; Busari, Moll, and Duits 2017; Noyes 2021).

Another critical aspect I observed, which is rarely mentioned in the literature, is the role of language. In Upendo NBU, using Kiswahili fostered comfortable, inclusive, and positive communication, enhancing patient monitoring and documentation; conversely, in Amani NBU, linguistic divides involving Kiswahili, English, and Kikuyu complicated communication and decision-making.

Organisational accountability mechanisms further encouraged positive communication and decision-making. I have shown that at Amani NBU, nurses alone handled patient progress measurement and data recording for CPAP and phototherapy. Detailed recording was sometimes neglected or falsified, and there were no mechanisms to verify or take responsibility for inaccuracies. This resulted in a lack of trust in and use of the data. In contrast, Upendo NBU shared documentation responsibilities across the team, resulting in greater confidence in the data and use of information for clinical decision-making. The presence of champions—health professionals promoting technology use—also improved documentation and monitoring practices.

There was no evidence in my scoping review studies on the role of language in technology-associated communication and decision-making among health professionals in newborn care. My research contributes to understanding the role of language in technology-associated communication and decision-making among health professionals, particularly in LMICs. Language in my research was used to reinforce power relations among health professionals. Other studies unrelated to technology have highlighted similar language barriers between health professionals and patients (Meuter et al. 2015; Ali and Watson 2018; Srivastava 2019; Al Shamsi et al. 2020; Albury et al. 2020; Pandey et al. 2021;

Caitríona and Zoë 2022) , but I have not found a study that examined language barriers among health professionals.

My findings on the importance of accountability and follow-up mechanisms in ensuring effective communication and decision-making related to monitoring CPAP use echo the conclusions of a study in Malawi described in my scoping review, which showed the positive role of accountability mechanisms in communication among health professionals (Kinshella et al. 2020). The role of champions in maintaining healthcare interventions is also well-documented, with associations between champions and best practices in implementing healthcare innovations (Santos et al. 2022).

Technology as an intervention is another factor that my data suggest is important in shaping the monitoring and documentation of the progress of babies on CPAP and phototherapy. I found that CPAP, perceived as complicated due to its numerous tubes and invasive nature, prompted increased frequency and depth of monitoring and documentation compared to the simpler phototherapy technology.

The wider context of the hospital system within which the newborn units sit adds another layer of influence on the monitoring and documentation of babies on CPAP and phototherapy. The engagement of health professionals with various departments and hospitals led to delays in activities such as monitoring and documentation. For example, I observed during the monitoring of babies that a nurse in the Amani newborn unit received a phone call from a nurse from a lower-level hospital requesting advice on the possible CPAP treatment for a premature baby, taking them away from their routine monitoring. Resource shortages, such as a lack of documentation forms, necessitated improvisation. Health staff created their forms, which delayed communication and decision-making. Lack of financial support from the county for aspects like bilirubin tests, as seen in Amani NBU, compromised monitoring and documentation, as reliance on guesswork without clinical guidelines was common.

A study in the scoping review echoes the negative impact of resource shortages, in this case, challenges of decision-making related to phototherapy without a *bilirubin test* in four hospitals in Malawi (Kinshella, Salimu, et al. 2022). While the wider context challenges appear in the literature, my empirical study provides an in-depth understanding of communication and decision-making in maintaining technology use among health professionals engaging with CPAP and phototherapy. Beyond newborn care, studies underscore the importance of local support for newborn technologies in LMICs. For example, a health facility assessment across 68 neonatal units in Kenya, Malawi, Nigeria, and Tanzania revealed significant gaps in readiness to provide newborn care, particularly for CPAP and neonatal jaundice management (Penzias et al. 2024). My research emphasises the need for organisational resource investment to maintain newborn technology use. It identifies other actors outside the NBU that warrant investigation in future research to improve technology-associated communication and decision-making among health professionals.

8.3.3 COMMUNICATION AND DECISION-MAKING IN TECHNOLOGY REPAIR.

In Chapters Four and Five, I observed that the physical context of newborn units shapes communication and decision-making, influencing the repair of CPAP and phototherapy technologies. In Upendo NBU, the layout, with patients close to each other and a communal area bringing together different groups of health professionals, allowed health professionals to easily communicate issues to the nurse-in-charge when technologies like CPAP, phototherapy, and their assistive devices (pulse oximeters and bilirubinometers) were out of service. The spacious design of Upendo NBU, compared to Amani NBU, also made discussions easier and uninterrupted.

My scoping review studies did not report on the role of physical context in communication and decision-making related to technology repair. However, findings unrelated to technology use were reported in Nigerian newborn units (Amadi et al. 2023). The authors discussed how architectural design elements, such as workspace size and spatial proximity of coworkers, influence interactions. They recommend design features like see-through panoramic views and communication ports to enhance communication, though their focus was not explicitly on technology.

The organisational context discussed in Chapters Four and Six also plays a crucial role in shaping communication and decision-making about repairing CPAP and phototherapy equipment. From a power dynamics perspective, my findings show that in the teamwork-oriented approach at Upendo NBU, there was open communication and collaborative decision-making in reporting equipment needing repair. Health professionals felt psychologically safe in this setting, encouraging the active participation of health professionals.

Studies from my scoping review did not find literature on the organisational context's role in communication and decision-making related to technology repair. My research fills this gap by highlighting how teamwork enhances positive communication and decision-making regarding technology maintenance. Findings on teamwork and hierarchy within health systems unrelated to communication in technology repair report that hierarchical and authoritarian leadership diminishes psychological safety, leading to communication breakdowns and challenges in collaborative care (Remtulla et al. 2021; Findyartini et al. 2019). Psychological safety, defined as the shared belief that individuals can take interpersonal risks without fear of repercussions, has been shown to enhance team participation in discussions (Edmondson 1999; Kahn 1990). It emphasises the critical role of balanced power dynamics in creating an environment where health professionals can collectively address maintenance challenges, ensuring the sustainability of newborn technologies.

As discussed in Chapters Four and Seven, the type of technology also shapes communication and decision-making among health professionals, impacting the repair of

CPAP and phototherapy equipment. Health professionals reported that CPAP machines break down more frequently than phototherapy devices, prompting increased communication with colleagues and the biomedical team. This contrasts with phototherapy technology, which has minimal breakdowns and requires less attention. My scoping review studies did not report evidence on the role of technology type in communication and decision-making related to equipment repair. My empirical study fills this gap, providing new evidence on how different technologies influence these processes.

The wider context also influences communication and decision-making among health professionals, affecting equipment repair. Despite county governments endorsing the introduction of new technologies, health professionals expressed concerns about the long-term sustainability of these technologies due to a lack of financial commitment. The hospital administration and county government are responsible for budgeting and planning to support technology maintenance. However, health professionals in both newborn units reported resource-related challenges, such as delays in repairing pulse oximeters, which adversely affected decisions regarding CPAP use.

In my scoping review, there was no literature on the role of the wider context in communication and decision-making related to technology repair. A study on the capacity of eight hospitals in Kenya using a developed tool revealed similar challenges with resources in NBUs, lacking 30-56% of essential items for critically ill children or newborn babies (English et al. 2009). Similarly, a comparison between public and private newborn units showed that public facilities operated in more resource-constrained environments than private hospitals (Oluoch et al. 2023).

8.4 STUDY STRENGTH AND LIMITATIONS

The focused ethnographic approach I adopted for this DPhil allowed me to explore the contexts where health professionals use newborn technology in depth. Being based in the NBUs gave me a comprehensive understanding of health professionals' experiences and enabled me to experience life in the NBU first-hand and reflect on it beyond my limited previous exposure. Using multiple data collection methods added to data robustness: observations enabled me to capture real-time behaviours and practice, and in-depth interviews allowed health professionals to share their stories and experiences, allowing me to clarify observations and document review data. The document review method provided a further perspective on practice, providing insights that may not have been fully captured through interviews or observation alone.

I conducted the research in newborn units where health professionals used CPAP and phototherapy. While I could explore their experiences with these technologies, it was impossible to compare experiences before and after the introduction of the technologies. My research focused on CPAP and phototherapy machines. While this provided valuable insights into using these specific technologies in hospitals, there may be differences in using other technologies.

My previous experience as a medical doctor in the newborn unit was both a strength and a potential limitation. It facilitated my understanding of the medical terminologies used by health professionals in their communication and decision-making processes, knowledge that a non-medical researcher might overlook. Limitations were the potential for my dual role as a researcher and health professional. I met ethical challenges, especially when dealing with a clinical case that required intervention. Maintaining confidentiality and ethical boundaries was complex, primarily when documenting sensitive interactions or behaviours such as missed care or a medical emergency.

This research is embedded within the Learning to Harness Innovation in Global Health (HIGH-Q) programme, which looks at implementing newborn technologies and other areas, including missed nursing care and post-discharge care. Being part of the programme allowed me to provide feedback on my emerging findings at various HIGH-Q study meetings, which brought together different researchers working on the multiple arms of the programme and other stakeholders. These stakeholders included the administration and health professionals in the two hospitals where I collected data, researchers, development partners, and policymakers. Providing preliminary feedback from my work in these meetings and the regular reflective meetings with the HIGH-Q team and the broader social science team allowed for the discussion of findings. These fora, in conjunction with regular meetings with my supervisors, provided significant input to the research.

I conducted this research in two level-five government referral hospitals in Kenya. Health professionals' experiences in other facility levels or types of health facility settings, such as faith-based or private health facilities, may differ.

8.5 RESEARCH IMPLICATIONS

In this section, I discuss the implications of the research on methodology, technology integration, and health service delivery.

8.5.1 METHODOLOGY

Adopting the ethnographic approach offered a valuable social science lens to explore the implementation of newborn technology. To the best of my knowledge, this is the first ethnographic study in LMICs aiming to comprehensively examine technology-related communication and decision-making among health professionals in newborn care. There is a recognised need for a social science viewpoint within health policy and system research, which predominantly leans towards quantitative and biomedical perspectives (Bennett et al. 2011; Gilson et al. 2011; Braithwaite, Mannion, et al. 2018). My research contributes to filling this gap by offering a complementary social science perspective.

I have furthered the theoretical understanding by using the NASSS framework for data collection, analysis, and results presentation, marking among the first applications of this framework in an empirical study within LMICs. In this research, I developed a framework to inform the examination of communication and decision-making among health professionals who engage with newborn technologies. The conceptual framework illustrates how the interconnected elements of physical and organisational contexts, technology types, and the wider context shape communication and decision-making in newborn care around those technologies, hence technology implementation. While examining communication, I propose considering five key aspects, which are "What", "Where", "Ways", "Who", and " Weight and quality." I also incorporated several recognised pivotal moments in technology-associated decision-making, which include starting, maintaining, stopping, and repairing technology.

Alternative research methods could offer valuable insights into issues reported in this thesis. For example, structured observations can systematically monitor some practices of health professionals, such as documentation and handover of information. Time series analysis to examine the performance, patterns, and trends of selected communication and decision-making practices of health professionals to understand fluctuations and seasonality will be insightful.

8.5.2 TECHNOLOGY INTEGRATION

My research allows an in-depth understanding of implementing technologies like CPAP and phototherapy. Authors have previously emphasised the need for research on technology implementation in LMICs, including the specific contexts of CPAP (Wilkes et al. 2022) and phototherapy (Satrom, Farouk, and Slusher 2023). By addressing this gap, my work provides valuable insights to inform these technologies' successful integration and scaling up.

In this research, I focused on technology-associated communication and decision-making within newborn units. However, I noted the wider context beyond NBU that shapes communication and decision-making among health professionals. These include other departments, the referral system, hospital administration, and local and national government roles. Conducting further research to explore these issues would contribute to a more comprehensive understanding of technology integration within newborn units.

The research findings offer valuable insights to support ongoing initiatives to integrate technology into newborn care, such as the NEST360 programme, which is expanding to its second phase in Kenya, Tanzania, Nigeria, and Malawi (NEST360 2024). For example, it is crucial to systematically integrate formal and informal technology training to ensure continuous and high-quality knowledge transfer, given the dynamic nature of the NBU and the rotation of health professionals. Additionally, including all disciplines of health professionals, not just doctors and nurses, in training programs is essential. Securing funding for these initiatives and considering the specific technology types in the training materials are also important. Furthermore, it is essential to recognise that training takes time for health professionals to gain momentum, requiring patience and persistence.

8.5.3 HEALTH SERVICE DELIVERY

There are also research implications for health service delivery. From my research findings, I show why prioritising communication among health professionals to ensure quality newborn care. I highlight the need to expand on this aspect in essential guidelines, like the *Newborn Care Standard for Improved Care in Health Facilities* (WHO 2020a), whose current focus is communication between health professionals and families. My research contributes to understanding human resources for health by building upon existing research on workload and management style (Lamy Filho et al. 2011; Tubbs-Cooley et al. 2019; Zehnder, Law, and Schmölzer 2020). I offer insights into health professionals' communication and decision-making when engaging with newborn technologies, emphasising the significance of considering their working context and its impact on their communication and decision-making.

In the Kenyan context, my research informs ongoing initiatives, like communication training for nurses in newborn units (Musitia et al. 2022). Findings from my research can inform the integration of technology-associated messages into these sessions while considering the context of the technology implementation. Other recent interventions to enhance newborn care service delivery, such as the health service redesign initiative aiming to reorganise the provision of services to improve outcome, equity, and quality, (Croke et al. 2022; Roder-DeWan et al. 2023) stand to benefit from insights from my research, particularly on technology integration evidence, which is scarce in LMICs.

I conducted the research in two level-five government referral hospitals. A recent study in Kenyan newborn units reported a resource-constrained environment with limited interactions in a government hospital compared to a private hospital (Oluoch et al. 2023). Further research to understand the context of private and faith-based health facilities and compare it with public health facilities at various levels could provide valuable insights to inform technology implementation strategies.

During data collection, I noted that caregivers of babies spent significant time in the newborn unit and interacted with technologies. While investigating caregivers was beyond my research objectives, future studies aiming to understand how they communicate among themselves and with health professionals will provide valuable insights into fostering family-centred care, particularly in LMICs.

8.6 RECOMMENDATIONS

Drawing from my research, I offer recommendations to inform policy and practice at different levels – policymakers and local governments, development partners, health facility and newborn unit administration and health professionals.

8.6.1 POLICY AND GOVERNMENT SUPPORT

To effectively integrate newborn technologies, policymakers at national and local levels should adopt flexible approaches that recognise the diverse contexts within health facilities that support communication and decision-making among health professionals. This includes developing tailored strategies for each technology, supported by ongoing mentorship, clear guidelines and sustained financial backing. For example, the *Norms and Standards for Health Delivery in Kenya* guideline (MOH 2006) and guidelines regarding the materials to be used in construction do not currently address the physical design and layout of NBUs (MOH 2021). The Ministry of Health in Kenya can include layout and physical structure considerations in developing newborn unit guidelines to enhance technology-associated communication and decision-making, which plays a role in technology implementation.

By ensuring adequate staffing levels and optimising work environments through informed policy decisions, governments can significantly enhance communication and decision-making surrounding new technologies in newborn care, improving their implementation.

8.6.2 DEVELOPMENT PARTNERS

International organisations such as the World Health Organization (WHO) should deepen their understanding of contextual factors and technology-specific needs in technology-associated communication and decision-making, especially in LMICs. Given that many technologies originate from high-income countries, there is a critical need to adapt these innovations to align with the realities of LMIC settings.

Development partners should extend support beyond initial phases, focusing on long-term sustainability through activities supporting technology-associated communication and decision-making, such as robust documentation practices and planning and costing activities. For example, Tarus et al. developed and demonstrated a planning and costing tool for furniture, fixtures, and devices to support the scale-up of neonatal care, drawing data from Kenya, Nigeria, and Tanzania. However, their tool misses the planning and costing for the design and layout of newborn units, which is essential for technology-associated communication and decision-making (Tarus et al. 2023).

Other ways to ensure sustainability are through effective data utilisation strategies and evidence-based approaches to technology integration. This comprehensive support ensures that technology initiatives are effectively embedded within local healthcare systems, addressing resource constraints and leveraging local strengths.

8.6.3 HEALTH FACILITY AND ADMINISTRATION IN NEWBORN UNITS

Health facility and newborn unit administration should prioritise well-structured and tailored to the context of continuous professional development in the newborn unit environment with a constant rotation of health professionals. This will ensure health professionals are equipped to engage with others in technology-associated decision-making and participate in activities such as monitoring and documentation. Creating mechanisms to encourage health professionals to engage in communication, such as social networks and recognising the achievements of health professionals will enable them to engage in technology-associated discussions and decisions. Collaborative efforts with hospital management and county governments to allocate resources effectively, prioritise technology maintenance, and implement supportive policies are also essential for optimising communication and decision-making quality in technology use.

My findings show that effective teamwork among health professionals is crucial to practices such as documentation, learning, and shared decision-making. The administration should create structures that foster teamwork in the newborn unit. The administration should maintain a system that encourages the inclusion of various groups of health professionals in communication and decision-making.

8.6.4 HEALTH PROFESSIONALS

Health professionals play a pivotal role in successfully adopting and utilising technology in newborn care. Understanding and navigating the physical layout and organisational norms of their NBU are fundamental to improving daily interactions and decision-making processes. To create a supportive environment conducive to effective communication, stakeholders should prioritise peer learning, inclusive role distribution, and foster mutual respect among team members. Addressing individual attitudes and concerns regarding technologies through targeted training and mentorship programmes enhances communication effectiveness and decision-making capabilities in newborn care. For example, communication skills training has proven valuable to health professionals (MacDonald-Wicks and Levett-Jones 2012).

Exploring ways to extend communication training to all disciplines of health professionals and incorporating technology-related materials can provide them with the skills needed to communicate and make decisions about newborn technologies. The training should address the newborn unit's physical, organisational, and technological contexts where technology is used. Regarding the physical context, training should focus on factors such as the newborn unit layout. This includes understanding how the arrangement of spaces and the placement of technologies like CPAP and phototherapy machines influence interactions, accessibility, and the ability to monitor babies effectively. They should learn how a well-structured environment can significantly enhance collaboration and streamline workflows, ensuring that health professionals communicate efficiently while engaging with newborn technologies.

Training of the health professionals and their leaders on the organisational context, including team dynamics and power structures, is equally important. Training should emphasise the role of these factors in communication when making technology-associated decisions. Health professionals should learn how hierarchical dynamics and team roles affect the flow of information and the decision-making process, ensuring that all voices, especially those of junior staff, are heard. Furthermore, health professionals should be trained on the importance of accountability in engaging with newborn technology, including accurate and complete documentation and the use of routine data and other evidence across disciplines of health professionals to inform their decisions regarding technology use.

Health professionals will benefit from training tailored to address how they engage with different newborn technologies. This training should consider factors such as the perceived complexity of the technology, ensuring that the duration, intensity, and follow-up support are aligned with the specific features and functionality of the equipment. For instance, technologies like CPAP, often viewed as more complicated, may require extended training and support compared to perceived simpler technologies like phototherapy. Training should also cover the broader context in which the technology is used, including the patient's clinical condition. For example, CPAP is typically associated with respiratory distress, a life-threatening condition requiring intense monitoring, detailed documentation, and collaborative decision-making.

The training should also include technical aspects, such as equipment maintenance, troubleshooting, and repair, ensuring that health professionals can confidently manage these technologies. It should also address any misconceptions or myths surrounding specific technologies, fostering trust and improving their effective use. This tailored approach ensures timely and accurate responses, leading to the successful integration and implementation of these life-saving technologies in newborn care.

8.7 CONCLUSION

In this research, I address the gaps in technology implementation within Low-and Middle-Income countries (LMICs) by exploring how various factors, specifically the physical context, organisational context, technology type, and wider contextual factors, influence communication and decision-making among health professionals. The physical context includes NBU structure, layout, and staffing number. Organisational context encompasses management styles, language, health professionals' skills and various incentive mechanisms. Technology characteristics refer to design, functionality, and disease-specific considerations. Wider contextual factors involve interdepartmental relations, referral systems, and resource availability. These interconnected factors shape health professionals' communication and decision-making, influencing technology implementation from initiation, maintenance, discontinuation and repair. In this study, I highlight that technology and its context mutually influence each other, emphasising the critical interplay that dictates technology integration and use in the newborn care setting. This needs to be recognised by different stakeholders and incorporated into funding decision-making at various levels, as well as decision-making and support processes in newborn care.

ANNEXES

ANNEXE 2.1 SCOPING REVIEW PROTOCOL

Title: Communication experiences of health professionals using low-cost technology in newborn care: An exploratory scoping review.

BACKGROUND

Neonatal mortality is a global challenge. It accounted for 2.3 million liveborn babies' deaths in 2020 alone (Lawn, Ohuma, et al. 2023), which is over half of children dying below five years (Li et al. 2021). Most of these deaths are in Low-andMiddle Income Countries (LMIC), with the highest mortality in Sub-Saharan Africa. A baby born in Sub-Saharan Africa is ten times at risk of dying than those in high-income countries (WHO 2022b)

Affordable newborn technologies such as a phototherapy machine and continuous positive airway pump (CPAP) can significantly improve the quality of care and reduce preventable newborn deaths (Rosa-Mangeret et al. 2022; Bhutta et al. 2014). However, technologies can only work well and meet the intended aims with appropriate integration that considers the health system's complexity (Greenhalgh and Papoutsi 2018), the context implementation dynamics (May, Johnson, and Finch 2016), and social and organisational processes (Blaauw et al. 2003). Within this complexity, effective communication surrounding technology use is central to good clinical practice, enhanced patient outcomes, and improved interaction between families and health professionals (O'Daniel and Rosenstein 2008).

One of the World Health Organisation's (WHO) standards for improving the quality of care for small and sick newborn babies is effective communication and participation (WHO 2020a). Although the WHO standards emphasise the interaction between health professionals and families, effective communication among health professionals is essential. It nurtures competence and provides trust, kindness and good relationships among professionals and families (Busari, Moll, and Duits 2017).

Current evidence and effort stress on digital technologies, mainly information and communication technology (Duran, Sommer, Otero, Daus, Benitez, Serruya, and Francisco 2020; Castiglia et al. 2023; Martin et al. 2019; WHO 2021; Duran, Sommer, Otero, Daus, Benitez, Serruya, and De Francisco 2020). Little about communication associated with newborn technologies supporting other care aspects. The emphasis has also been on communication between health professionals and patients (Tenfelde et al. 2023). There is scarce evidence of the interactions among various groups of health professionals who engage with these technologies, particularly in LMIC newborn care.

This review explores the nature and extent of literature on health professionals' communication associated with low-cost newborn technology use supporting care aspects other than information sharing.

METHODS

Search strategy

The Joanna Briggs Institute Manual for Evidence Synthesis (Peters et al. 2020) and Preferred Reporting Items for Systematic review and Meta-Analysis extension for Scoping Reviews (PRISMA-ScR)(Tricco et al. 2018) (attached below the protocol) informs the data collection and synthesis process.
The review answers these questions:
What characterises communication among health professionals using newborn technologies in the hospital setting?

What are the enablers and barriers to communication among health professionals using technologies in newborn care in the hospital setting?
I identified five keywords related to the review: communication, technology, health professionals, neonates, and health facility.

I use the World Health Organisation's communication definition, which refers to providing information, guidance, and advice to cause action to protect individuals' health (WHO 2017). Technology in this research is an innovation, a device, or a process introduced to change the existing practice. I also drew on the standardised definition of the newborn medical devices (Lawn, Ohuma, et al. 2023) and innovations for improving the newborn care (Lunze et al. 2015). All health professionals working in neonatal care are included in this review. A neonate is a baby from the day of delivery up to 28 days of life (WHO 2022b). I considered health facility at different levels, including primary health care centres, district/first referral, and specialised and general hospitals as defined by the World Health Organisation (WHO 2009).

I will conduct the first round of relevant literature reviews between June and August 2021 and update the list if required. I will search seven databases: PubMed, Web of Science, Scopus, Embase, ERIC, Cochrane Library, and Google Scholar.

The table below summarises information on the search terms:

Search term 1	communication OR interaction* AND
Search term 2	"Health worker*" OR workforce* OR "human resource for health" OR "Healthcare worker*" OR nurse* OR health professional*AND
Search term 3	Technolog* OR innovation* AND
Search term 4	Neonat* OR "new?born*" OR "bab?*" OR "below 28 days" OR "less than 28 days"
Search term 5	Hospital* OR Ward* OR "Health cent?*" OR "Health OR "neonatal unit" OR "new?born unit" OR facilit*"

Search terms used to identify articles on PubMed:
(((("communication" OR "interaction*") AND ("Health professional*" OR "Health worker*" OR "workforce*" OR "human resource for health" OR "Healthcare worker*" OR "nurse*")) AND ("Technolog*" OR "innovation*" OR "medical?device*")) AND ("Neonat*" OR "new?born*" OR "bab?*" OR "below 28 days" OR "less than 28 days")) AND ("Hospital*" OR "ward*" OR "health cent?*" OR "neonatal unit" OR "new?born unit" OR facilit*")

Eligibility criteria

I have highlighted in Table 1 below the criteria for including studies in the review:

Articles selection criteria	
Period	I will not put a time limit on the research data collection or article publication.
Document type	Peer-reviewed and published literature. Articles that discuss the use of low-cost technology in newborn care regardless of the geographical location.
Language	I include only articles published in English.
Research method	Studies that used qualitative, quantitative, and mixed methods.
Quality	Since the review aim was to scope the available evidence, I will not consider the quality of the articles.

Data charting and synthesis
I will develop a data collection tool on Microsoft Excel, which capture studies' characteristics, including the author (s), year of publication, geographical location, methodology, technology type, and limitations. Informed by previous studies, I will document findings based on identified essential areas in healthcare communication: groups of health professionals involved in the communication (Oliveros, Brailovsky, and Shah 2019), communicating ways/modalities (Vermeir et al. 2015; Chichirez and Purcărea 2018; Oliveros, Brailovsky, and Shah 2019), information content (Vermeir et al. 2015; Schroeder et al. 1999), time the communication took place and the quality (Chichirez and Purcărea 2018) and factors affecting communication (Vermeir et al. 2015; Chichirez and Purcărea 2018; Oliveros, Brailovsky, and Shah 2019).

I start the review by screening the article titles, followed by the abstract, to determine the articles' eligibility and remove duplicates. I will read full texts of articles that met the inclusion criteria. I will read references of key articles to scan for other eligible articles. Since the review focuses on scoping the available literature on health professionals' communication, I will include all articles regardless of the strength of the evidence.

I will extract data from all studies. Throughout the review process, I (the first reviewer) will present data to the second, third, and fourth authors for quality assurance. Drawing on Braun and Clarke (2006)(Braun and Clarke 2006), I will familiarised myself with data, generate codes, themes, and review and define themes to represent findings.

ANNEXE 2.2

Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	57
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	N/A
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	58
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	58
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	Annexe
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	58
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	58
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	58
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	58
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	59
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	59
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	N/A
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	60

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	59
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	60-62
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	N/A
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	60-62
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	60-75
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	75-77
Limitations	20	Discuss the limitations of the scoping review process.	77
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	81
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	Acknowledgement section of the thesis

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.
* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.
† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).
‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.
§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.

ANNEXE 3.1: IN-DEPTH INTERVIEW CONSENT FORM.

Lay Title: A study to learn if and how the introduction of new technologies and service delivery innovations improves the quality of care provided in neonatal units.

Institution	Investigators
KEMRI Wellcome Trust Research Programme	Dr. Michuki Maina,Dr. Dorothy Oluoch,Dr. David Gathara, Prof. Mike English, Prof. Sassy Molyneux, Prof. Caroline Jones, Joyline Jepkosgei, Dr. Jalemba Aluvaala, Dr. Tim Tuti, Ms. Edith Gicheha, Mr. John Wainaina,Mr Livingstone Mumelo
University of Nairobi	Dr Jalemba Aluvaala, Prof Grace Irimu, Prof Fred Were, Dr Brian Maugo
Ministry of Health	Dr Caroline Mwangi, Dr Laura Oyiengo
Moi University	Prof Fabian Esamai
Nursing Association of Kenya	Edna Talam
Neonatal Nurses Chapter	Josephine Bariu
Preemie Love Foundation	Ruby Kimondo
Nuffield Department of Medicine, University of Oxford, UK	Dr. Chrysanthi Papoutsi, Dr Chris Paton, Dr. Lisa Hinton, Ms. Gulraj Grewal, Dr. Abdulazeez Imam, Dr. Gloria Ngaiza and Ms. Naima Nasir, Dr Sebastian Fuller, Dr Jacob Mc Knight

You are being asked to take part in a study. The box below tells you important things you should think about before deciding to join the study. We will provide more detailed information below the box. Please ask questions about any of the information before you decide to participate. You may also wish to talk to others (for example, your line manager, family, or friends) about this study, before agreeing to join.

Key Information for You to Consider (Not more than 500 words)

- **Voluntary Consent**. You are being asked to volunteer for a research study. You can choose whether you would like to participate or not. If you do agree, you can change your mind at any time and withdraw from the research. This will not affect you now or in the future.
- **Purpose**. We are doing this research to find better ways of integrating necessary technologies into Kenyan health systems. In this study, we want to understand how the introduction of new technologies affect how nurses go around their work of caring for the newborns and if increasing the nursing workforce improves how the care is provided. Additionally, we aim to better understand if family experiences as their babies are treated will improve the acceptability of these technologies and improve patient care and follow up. We also aim to understand the governance structures that assess the safety and authorise the introduction of new technologies in the county
- **Duration.** Your participation in this study will last less than one and a half hours.
- **Procedures and Activities.** We will ask you to take part in an in-depth interview.

- **Risks or disadvantages.** There are no known harms/disadvantages in this study that could happen to you if you join. In this study, there is a possibility that you might be a little bit inconvenienced by the time it takes to complete the interview.
- **Benefits**. There are no direct benefits in this study. However, the outputs from this study will contribute to the improvement of hospital care for newborns. If the interventions are successful, the strategies that we are testing could be adopted much more widely across Kenya.

Lay Title: A study to learn if and how the introduction of new technologies and service delivery innovations improves the quality of care provided in neonatal units

Institution	Investigators
KEMRI Wellcome Trust Research Programme	Dr. Michuki Maina,Dr. Dorothy Oluoch,Dr. David Gathara, Prof. Mike English, Prof. Sassy Molyneux, Prof. Caroline Jones, Joyline Jepkosgei, Dr. Jalemba Aluvaala, Dr. Tim Tuti, Ms. Edith Gicheha, Mr. John Wainaina,Mr Livingstone Mumelo
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Key Information for You to Consider (Not more than 500 words)

- **Voluntary Consent**. You are being asked to volunteer for a research study. You can choose whether you would like to participate or not. If you do agree, you can change your mind at any time and withdraw from the research. This will not affect you now or in the future.
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up. We also aim to understand the governance structures that assess the safety and authorise the introduction of new technologies in the county

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- **Benefits**. There are no direct benefits in this study. However, the outputs from this study will contribute to the improvement of hospital care for newborns. If the interventions are successful, the strategies that we are testing could be adopted much more widely across Kenya.

Who is carrying out this study, and what is this study about?

This study is being carried out by KEMRI in collaboration with the University of Oxford, University of Nairobi and the Kenya paediatric association. KEMRI is a Kenyan government organisation that carries out medical research to find better ways of preventing and treating illness in the future for everybody's benefit.
In this research, we want to learn more about how to help hospitals use some technologies and health workers to provide better care for the sick babies that need to stay in the hospital for treatment soon after they are born. We are doing this by working with four other hospitals. We will work with the doctors and nurses from your hospital to find better ways of working that improve quality and safety. We will learn how to measure some aspects of babies' care and progress and use this information to promote improvements in care, and better prepare for your babies care once they are discharged from the hospital. To do this, we would like to hear the views of health care workers who have been treating the babies in the hospital's newborn unit. We will talk to people at their own convenient time.

Why do you want to talk to me (us) and what does it involve?

- We are interested in the experience of nurses/doctors/hospital managers with an understanding of / experience of health care provision in newborn units as exploring these experiences can help us understand how things really are and whether efforts to make improvements are working or not.
- I would like to ask you some questions about your role in the newborn unit /in hospital management and how things work in this hospital and how you think things may have changed. The interview will take between 40 minutes to 1 hour. If you do not want to answer any of the questions, you may say so, and the interviewer will move on to the next question. The discussion will take place here. No-one else but you and the interviewer(s) will be present unless you would like someone else there.
- If you are willing, discussions will be audio-recorded to assist in fully writing up the information later. No one will be identified by name in the recordings or in the writings.
- We may observe you while you carry out your duties.

Are there any risks or disadvantages to me / my child of taking part?

- The discussions should take approximately forty to sixty minutes of your time.
- We do not believe there are any risks to your taking part as we aim to ensure the confidentiality of all participants so that no comments can be directly linked to any person

Are there any advantages to me taking part?

There are no individual benefits to taking part. In talking to us, you will contribute to knowledge on how efforts to improve care on newborn units in Kenyan hospitals can work best. This may help other people in Kenya and elsewhere in the future, for example, through making the current approaches to improvement better or developing new strategies to improve care.

Who will have access to the information I give?

- All of our documents/ recordings are stored securely in locked cabinets and on password-protected computers. The knowledge gained from this research will be shared in summary form, without revealing individuals' identities, with study participants, hospital managers, policymakers and professional regulatory bodies.
- In future, information collected or generated during this study may be used to support new research by other researchers in Kenya or other countries on improving neonatal service delivery. In all cases, we will only share information with other researchers in ways that do not reveal individual participants' identities. For example, we will remove such as their names and where they live, and replace this information with number codes. Any future research using information from this study must first be approved by a local or national expert committee to ensure that the interests of participants and their communities are protected.
- The University of Oxford is responsible for ensuring that Oxford staff involved in the study in Kenya adhere to the safe and proper use of any personal information you provide, solely for research purposes.

Who has allowed this research to take place?

All research at KEMRI has to be approved before it begins by its Scientific and Ethical Review Unit who look carefully at planned work. They must agree that the research is important, relevant to Kenya and follows nationally and internationally agreed research guidelines. This includes ensuring that all participants' safety and rights are respected.

What will happen if I refuse to participate?

All participation in research is voluntary. You are free to decide if you want to take part or not. If you do agree, you can change your mind at any time without any consequences.

What if I have any questions?

You are free to ask me any question about this research. If you have any further questions about the study, you are free to contact the research team using the contacts below:

Dr. Michuki Maina, KEMRI Wellcome Trust Research Programme, P.O. Box 43640, Nairobi 00100. Telephone: 0722248890

If you want to ask someone independent anything about this research please contact:

Community Liaison Manager, KEMRI Wellcome Trust Research Programme, P.O. Box 230, Kilifi. Telephone: 041 7522 063, Mobile 0723 342 780 or 0705 154 386

And

The Head, KEMRI Scientific and Ethics Review Unit, P. O. Box 54840-00200, Nairobi;

Telephone numbers: 0717 719477; 0776 399979 Email address: seru@kemri.org

KEMRI-Wellcome Trust Research Programme consent form for a study to learn if and how the introduction of new technologies and service delivery innovations improves the quality of care provided in neonatal units

I have had the study explained to me. I have understood all that has been read/explained and had my questions answered satisfactorily. And I agree to take part in this research

I agree for the interview/discussion to be recorded ÿ Yes ÿ No

I understand that I can change my mind at any stage, and it will not affect me in any way.

Signature: ________________________________ **Date:** ________________

Participant/parent/guardian Name: ________________________________ **Time:** ______________

(Please print name)

Where participant/parent/guardian cannot read, a witness** *may observe the consent process and sign below if needed:

I attest that the information concerning this research was accurately explained to and apparently understood by the participant and that informed consent was freely given by the participant.

Witness' signature: ____ **Date** ______________

Witness' name: ____ **Time** _______________

(Please print name)

**A witness is a person who is independent from the study or a member of staff who was not involved in gaining the consent.*

Thumbprint of the parent as named above if they cannot write:

[Following section is recommended, and where verbal consent is obtained, <u>must</u> be signed by person undertaking informed consent.]

I have followed the study procedure to obtain consent from the participant. S/he apparently understood the nature and the purpose of the study and consents to the participation in the study. S/he has been given an opportunity to ask questions which have been answered satisfactorily.

Designee/investigator's signature: ______________________________ **Date** _____________

Designee/investigator's name: _______________________________**Time** _____________

(Please print name)

THE PARTICIPANT/PARENT/GUARDIAN SHOULD NOW BE GIVEN A SIGNED COPY TO KEEP

ANNEXE 3.2 NON-PARTICIPATORY OBSERVATION CONSENT FORM

Lay Title: A study to learn if and how the introduction of new technologies and service delivery innovations improves the quality of care provided in neonatal units

Institution	Investigators
KEMRI Wellcome Trust Research Programme	Dr. Michuki Maina, Dr. Dorothy Oluoch, Dr. David Gathara, Prof. Mike English, Prof. Sassy Molyneux, Prof. Caroline Jones, Joyline Jepkosgei, Dr. Jalemba Aluvaala, Dr. Tim Tuti, Ms. Edith Gicheha, Mr. John Wainaina, Mr Livingstone Mumelo
University of Nairobi	Dr Jalemba Aluvaala, Prof Grace Irimu, Prof Fred Were, Dr Brian Maugo
Ministry of Health	Dr Caroline Mwangi, Dr Laura Oyiengo
Moi University	Prof Fabian Esamai
Nursing Association of Kenya	Edna Talam
Neonatal Nurses Chapter	Josephine Bariu
Preemie Love Foundation	Ruby Kimondo
Nuffield Department of Medicine, University of Oxford, UK	Dr. Chrysanthi Papoutsi, Dr Chris Paton, Dr. Lisa Hinton, Ms. Gulraj Grewal, Dr. Abdulazeez Imam, Dr. Gloria Ngaiza and Ms. Naima Nasir, Dr Sebastian Fuller, Dr Jacob Mc Knight

You are being asked to take part in a study. The box below tells you important things you should think about before deciding to join the study. We will provide more detailed information below the box. Please ask questions about any of the information before you decide to participate. You may also wish to talk to others (for example, your line manager, family, or friends) about this study, before agreeing to join.

Key Information for You to Consider (Not more than 500 words)

- **Voluntary Consent**. You are being asked to volunteer for a research study. You can choose whether you would like to participate or not. If you do agree, you can change your mind at any time and withdraw from the research. This will not affect you now or in the future.
- **Purpose**. We are doing this research to find better ways of integrating necessary technologies into Kenyan health systems. In this study, we want to understand how the introduction of new technologies affect how nurses go around their work of caring for the newborns and if increasing the nursing workforce improves how the care is provided. Additionally, we aim to better understand if family experiences as their babies are treated will improve the acceptability of these technologies and improve patient care and follow up. We also aim to understand the governance structures that assess the safety and authorise the introduction of new technologies in the county
- **Duration.** Your participation in this study will last the length of your shift.
- **Procedures and Activities.** We will observe as you carry out your nursing tasks during your shift
- **Risks or disadvantages.** There are no known harms/disadvantages in this study that could happen to you if you join. In this study, there is a possibility that you might be a little bit inconvenienced by the time it takes to complete the interview.

- **Benefits**. There are no direct benefits in this study. However, the outputs from this study will contribute to the improvement of hospital care for newborns. If the interventions are successful, the strategies that we are testing could be adopted much more widely across Kenya.

Who is carrying out this study, and what is this study about?

This study is being carried out by KEMRI in collaboration with the University of Oxford, the University of Nairobi and the Kenya paediatric association. KEMRI is a Kenyan government organisation that carries out medical research to find better ways of preventing and treating illness in the future for everybody's benefit.

In this research, we want to learn more about how to help hospitals provide better care for sick babies that need to stay in the hospital for treatment soon after they are born. We are doing this by working with four hospitals. As part of this work, we will introduce existing technologies; educate healthcare providers; and provide supportive supervision and mentorship. We will assess the implementation process and the effects of these technologies on the care provision process and quality of newborn care. We will use this information to better understand to promote improvements in care and better design intervention implementation activities. To do this, we would like to observe health workers as they take care of the babies in the NBU in the course of their shift.

Where is the study taking place, how many people does it involve, and how are they selected?

The study is taking place in 4 hospitals in Kenya. We try and make non-participant observations for periods of several hours at a time, sometimes at the night and weekends too, over a period of 1 to 2 weeks so we can get as complete a picture as possible of newborn care in this hospital. Our observations could involve all the staff on duty on the days and at the times we come to the ward – we do not plan to observe any single person.

What does non-participant observation as part of the study involve for those who are in it?

The person who is the observer is just there to watch and learn. Before starting any observations, the observer explains the project (as I am doing now) and asks permission from those who are on the ward if it is OK to be there. They may make notes of what they see to remind them later of the way people work, but these notes will never have anyone's name in them. The person observing is not there to help with giving care and will make every effort not to inconvenience people. At any time, the staff or families can ask the observer to leave the ward, and this will not cause any problem.

Are there any risks or disadvantages to me / my child of taking part?

- The discussions should take approximately forty to sixty minutes of your time.
- We do not believe there are any risks to your taking part as we aim to ensure the confidentiality of all participants so that no comments can be directly linked to any person

Are there any advantages to me taking part?

There are no individual benefits to taking part. In talking to us, you will contribute to knowledge on how to introduce technologies in newborn units as part of efforts to improve care on newborn units in Kenyan hospitals can work best. This may help other people in Kenya and elsewhere in the future, for example, through making the current approaches to improvement better or developing new strategies to improve care.

Who will have access to the information I give?

- All of our documents/ recordings are stored securely in locked cabinets and on password-protected computers. The knowledge gained from this research will be shared in summary form, without revealing individuals' identities, with study participants, hospital managers, policymakers and professional regulatory bodies.
- In future, information collected or generated during this study may be used to support new research by other researchers in Kenya or other countries on improving neonatal service delivery. In all cases, we will only share information with other researchers in ways that do not reveal individual participants' identities. For example, we will remove such as their names and where they live, and replace this information with number codes. Any future research using information from this study must first be approved by a local or national expert committee to make sure that the interests of participants and their communities are protected.
- The University of Oxford is responsible for ensuring that Oxford staff involved in the study in Kenya adhere to the safe and proper use of any personal information you provide, solely for research purposes.

Who has allowed this research to take place?

All research at KEMRI has to be approved before it begins by its Scientific and Ethical Review Unit who look carefully at planned work. They must agree that the research is important, relevant to Kenya and follows nationally and internationally agreed research guidelines. This includes ensuring that all participants' safety and rights are respected.

What will happen if I refuse to participate?

All participation in research is voluntary. You are free to decide if you want to take part or not. If you do agree, you can change your mind at any time without any consequences.

What if I have any questions?

You are free to ask me any question about this research. If you have any further questions about the study, you are free to contact the research team using the contacts below:

Dr. Michuki Maina, KEMRI Wellcome Trust Research Programme, P.O. Box 43640, Nairobi 00100. Telephone: 0722248890

If you want to ask someone independent anything about this research, please contact:

Community Liaison Manager, KEMRI Wellcome Trust Research Programme, P.O. Box 230, Kilifi. Telephone: 041 7522 063, Mobile 0723 342 780 or 0705 154 386

And

The Head, KEMRI Scientific and Ethics Review Unit, P. O. Box 54840-00200, Nairobi; Telephone numbers: 0717 719477; 0776 399979 Email address: seru@kemri.org

KEMRI-Wellcome Trust Research Programme consent form for a study to learn if and how the introduction of new technologies and service delivery innovations improves the quality of care provided in neonatal units

I confirm that I have explained the study and the process of observation to the participant(s) named below in accordance with the SOP and that I helped them understand the study and the purpose of observation and gave them the chance to ask questions.

I also confirm that I explained to the participant(s) named below that they have the right to refuse to be included in observations and the right to withdraw their permission at any point.

I confirm that verbal consent was provided by the participant(s) listed below who agree to take part to take part in this research.

Participant Name: ____

ANNEXE 3.3: STAFF IN-DEPTH INTERVIEW (IDI) GUIDE.

Participant Name: ____

Participant Name: ____

Signature of researcher: ______________________________ **Date:** ______________

Researcher name: ______________________________ **Time:** ______________

(please print name)

Probe: Medical care? Nursing care? What are the most important practices? What about the way people work – on the ward, within the hospital? What about relationships with mothers? Do you think everyone shares your views?

1. There have been several interventions to improve care by the NEST360 team, which of these interventions were useful in improving care (and which did not result to care improvement)? Why do you think they led to care improving / not improving – for who and for what reason?

Probe: Do you think other healthcare providers found these interventions led care improvement? Who has taken the lead in trying to introduce/champion interventions? Can you tell me a bit about how these interventions led care improvement?

2. Do you think the senior staff [Hospital administration / Senior Hospital personnel] have found these interventions useful and consider them as one way of improving care for small and sick newborns? Have they supported any of the interventions? Might you have an example?

Probe: Are you happy with the support you are receiving from senior management? Do you think their view of newborn care provision has changed - Why / Why not?

3. Are you aware of the performance of your newborn care team in the provision of newborn care services and implementing interventions for small and sick newborns? Have you seen any feedback reports or had feedback presented/discussed with you – in what ways? Do you think the feedback is helpful to you – what is good/bad about it?

Probe: Do you think the feedback is accurate and fair? Does it result in any real action – can you give an example? Does it help to know how your performance compares to other hospitals?

4. What do you think were the most critical elements [list NEST360 interventions or activities NEST360 directly influenced] to effecting change in your unit on the NBU? What were the most exciting things to change? Does the NBU team have capacity to change some of the things that are not working well – why / why not?

Probe: In what ways did the care elements change – can you give an example? Why have some of the things stayed the same?

5. Do you think are some of the NEST360 interventions that have resulted to any undesirable/unintended effects? Can you give an example? How has this influenced care provision within the NBU?

Probe: How did the intervention lead to the undesirable/unintended effect? Do you think this might have been avoided? Has it affected how other interventions are implemented?

6. Given the opportunity, would you implement the NEST360 interventions differently? Why/why not?

Probe: What worked well/not well? What minimum resources would have needed to be in place? What additional support would have been useful?
Thank the interviewee for their time and inform them that they will be made aware of the findings.

ANNEXE 3.4 NON-PARTICIPANT OBSERVATION GUIDE

The research team will observe the following:
1: Team composition

- Diversity and team composition? (Age, gender, cadres, hierarchy levels)
- What role does each team member play?
- How are tasks shared amongst staff

2: Context

- Observe resources available
- What are the challenges faced by staff in relation to resources and technologies, and how does this affect their work?
- How do staff deal with these challenges and what adoptions or changes to they make to make things work with the available resources?
- How do staff interact with families/mothers? Is there task sharing, and how is this supported? Are mothers/families provided with information about the new technologies?
- What do mothers/families feel of say about the new technologies

3. Individual competencies

- How are individual skills and abilities demonstrated during the use of the technologies?
- Is there training and support for the staff and mothers/families

4. Team interactions with technology

- Observe the process of how new technologies are introduced (by who, who is involved, is there a training/orientation)
- What do staff say about the new technologies (how do they talk about it, what they say about it, ease of use)

Do team members make an effort to participate in the discussions, or are they called upon, encouraged by the team leader?

ANNEXE 3.5 SCIENTIFIC ETHICS REVIEW UNIT (SERU) APPROVAL

KENYA MEDICAL RESEARCH INSTITUTE

P.O. Box 54840-00200, NAIROBI, Kenya
Tel: (254) 2722541, 2713349, 0722-205901, 0733-400003, Fax: (254) (020) 2720030
Email: director@kemri.org, info@kemri.org, Website. www.kemri.org

KEMRI/RES/7/3/1 **May 13, 2022**

TO: **DR. JACKSON MICHUKI MAINA**
PRINCIPAL INVESTIGATOR

THROUGH: **THE DEPUTY DIRECTOR, CGMR-C**
NAIROBI.

Dear Sir,

RE: **KEMRI/SERU/CGMR-C/229/4203 (REQUEST FOR ANNUAL RENEWAL): EVALUATING THE EFFECTS OF TECHNOLOGY AND WORKFORCE ENHANCEMENT TO SUPPORT NEONATAL HOSPITAL CARE IN KENYA**

Thank you for the continuing review report for the period **May 27, 2021** to **April 12, 2022.** The Expedited Review Team of the KEMRI Scientific and Ethics Review Unit (SERU) acknowledges receipt of the following documents:

1. Continuing Review Report
2. The last KEMRI SERU CGMR-C approval letter
3. The currently approved protocol, version 3.0.
4. Two manuscripts submitted for publication.

This is to inform you that the Expedited Review Team of the KEMRI SERU was of the informed opinion that the progress made during the reported period is satisfactory. The study has therefore been granted **approval** for continuation.

This approval is valid from **May 27, 2022** through to **May 26, 2023**. Please note that authorization to conduct this study will automatically expire on **May 26, 2023**. If you plan to continue with data collection or analysis beyond this date, please submit an application for continuing approval to SERU by **April 14, 2023.**

You are required to submit any amendments to this protocol and any other information pertinent to human participation in this study to SERU for review prior to initiation. You may continue with the study.

Yours faithfully,

PROF. CHARLES OBONYO,
THE ACTING HEAD,
KEMRI SCIENTIFIC AND ETHICS REVIEW UNIT.

In Search of Better Health

KENYA MEDICAL RESEARCH INSTITUTE

OFFICE OF THE DIRECTOR RESEARCH & DEVELOPMENT

In Search of Better Health

Tell: +254 020 2722541, 2713349,
0722 205 901, 0733 400 003

P.O. Box 54840-00200,
Nairobi Email:
ddrt@kemri.go.ke
Website: www.kemri.go.ke

KEMRI/RD/22 **May 18, 2023**

TO: **DR. JACKSON MICHUKI MAINA**
PRINCIPAL INVESTIGATOR

THROUGH: **THE DEPUTY DIRECTOR, CGMR-C**
NAIROBI.

Dear Sir,

RE: **KEMRI/SERU/CGMR-C/229/4203 (*REQUEST FOR ANNUAL RENEWAL*): EVALUATING THE EFFECTS OF TECHNOLOGY AND WORKFORCE ENHANCEMENT TO SUPPORT NEONATAL HOSPITAL CARE IN KENYA**

Thank you for the continuing review report for the period **May 27, 2022** to **April 04, 2023.**

The Expedited Review Team of the KEMRI Scientific and Ethics Review Unit (SERU) acknowledges receipt of the following documents:

1. Continuing Review Report
2. The last KEMRI SERU CGMR-C approval letter
3. The last KEMRI/SERU protocol amendment approval dated February 15, 2023.
4. The currently approved protocol, version 3.1 dated November 2022
5. Copies of manuscripts submitted/accepted for publication.

This is to inform you that the Expedited Review Team of the KEMRI SERU was of the informed opinion that the progress made during the reported period is satisfactory. The study has therefore been granted **approval** for continuation.

This approval is valid from **May 27, 2023** through to **May 26, 2024**. Please note that authorization to conduct this study will automatically expire on **May 26, 2024**. If you plan to continue with data collection or analysis beyond this date, please submit an application for continuing approval to SERU by **April 14, 2024.**

You are required to submit any amendments to this protocol and any other information pertinent to human participation in this study to SERU for review prior to initiation.

You may continue with the study.

Yours faithfully,

ENOCK KEBENEI,
THE ACTING HEAD,
KEMRI SCIENTIFIC AND ETHICS REVIEW UNIT.

In Search of Better Health

ANNEXE 3.6 OXFORD TROPICAL RESEARCH ETHICAL COMMITTEE (OXTREC) APPROVAL

Oxford Tropical Research Ethics Committee

University of Oxford
Research Services, Research Governance, Ethics & Assurance
Boundary Brook House, Churchill Drive, Oxford OX3 7GB
Tel. +44 (0)1865 (2)82106
E-mail: oxtrec@admin.ox.ac.uk

UNIVERSITY OF OXFORD

Professor Mike English
Centre for Tropical Medicine and Global Health
Peter Medawar Building for Pathogen Research (PMB)
South Parks Road
Oxford OX1 3SY

4 May 2023

Dear Professor English,

Full Title of Study: Evaluating the effects of technology and workforce enhancement to support neonatal hospital care in Kenya (HIGH-Q).
OxTREC Reference: 26-21

Thank you for your letter of 4 April 2023 requesting an amendment to the above study. The revised documents that you have submitted for consideration are as follows:

Documentation:	Version:	Date:
Protocol	V3.1	November 2022

I am pleased to inform you that this amendment has been approved.

Yours sincerely,

DocuSigned by:
Sami Kelsh
B4D7A3FB68764444

Sami Kelsh
Research Ethics Administrator, OxTREC

for
Dr. Rosemary Musesengwa
Research Ethics Manager, OxTREC

Direct Line Tel: +44 (0)1865 (2)82106
Email: oxtrec@admin.ox.ac.uk Web: https://researchsupport.admin.ox.ac.uk/governance/ethics

Oxford Tropical Research Ethics Committee

University of Oxford
Research Services, University Offices
Wellington Square, Oxford OX1 2JD
Tel. +44 (0) 1865 (2)82106
E-mail: oxtrec@admin.ox.ac.uk

UNIVERSITY OF OXFORD

Professor Mike English
Centre for Tropical Medicine and Global Health
Peter Medawar Building for Pathogen Research (PMB)
South Parks Road
Oxford OX1 3SY

25 November 2021

–

Dear Professor English,

Full Title of Study: Evaluating the effects of technology and workforce enhancement to support neonatal hospital care in Kenya (HIGH-Q)

OxTREC Reference: 26-21

Thank you for your letter of 15 November 2021 in which you have responded to the Committee's request for further clarification.

I am pleased to confirm that approval has now been granted for this study. This is valid for the first five years and is subject to receiving the local ethical approval (if this approval has not yet been received).

The documents approved for this study are as follows:

Documents:	Version:	Date:
OxTREC application form		
Protocol (including appendices)	V3.0	19/05/21
Addendum to protocol		10/08/21
Information Leaflet		
PI Signature Form		

Any subsequent changes to the application must be submitted to the Committee as an Amendment. This should include a letter to give the reasons for the proposed modifications and all revised documents with changes tracked.

Please ensure that you submit a completed Annual Report form on every anniversary of this approval and a final End of Study Report. The relevant forms can be found on the OxTREC website: https://researchsupport.admin.ox.ac.uk/governance/ethics/apply/oxtrec.

Finally, please note the following **important information**:

Tel: +44 (0)1865 (2)82106
Email: oxtrec@admin.ox.ac.uk
Web: https://researchsupport.admin.ox.ac.uk/governance/ethics

FIELD VISIT MANUAL

Research topic: Technology integration in newborn care: Communication and decision-making in Kenyan health professionals.

Researcher: Gloria Ngaiza, DPhil student at the University of Oxford.

Supervisors: Prof Caroline Jones, Dr Dorothy Oluoch, Prof Catherine Pope and Prof Sassy Molyneux

INTRODUCTION

Research project summary

My DPhil research is embedded within the HIGH-Q programme. The programme will study the effect of introducing technologies through the NEST360 programme and changes in workforce numbers in Kenyan newborn units. The project will answer five main questions:

i. What influences the use and the effects on care of new technologies introduced into Kenyan New-Born Units (NBUs)?

ii. How does the introduction of additional professional nurses and ward assistants to NBUs affect the quality of care provided?

iii. How might we harness innovation and organisational changes to improve follow-up care for babies who have been discharged from the hospitals?

iv. What strategies and information do the government and other responsible organisations use to decide which types of technology and service innovations to introduce?

v. What are the costs and budget implications of the introduction of technologies and additional health workforce? The study is taking place in NBUs in 13 public hospitals located across 11 counties in Kenya.

The focus of the DPhil research project is on the first and second questions of the HIGH-Q research programme:

1b) Implementation of technologies in Kenyan hospitals.

2b) Staff experiences following the introduction of an additional workforce.

The choice of technologies

The NEST360 programme introduced a bundle of neonatal technologies in selected Kenyan neonatal units. Figure 2 shows a list of all technologies the programme supports. Technologies that the DPhil research will focus on are in the blue boxes (Figure 1). The selection considered personal interest and experience in the medical field on the most available technologies in hospitals. The choice also considered technologies that need time to use and a combination of invasive/non-invasive and commercial availability in Kenya.

	Technology from NEST360	Commercially available	Invasiveness	Researcher's interest	Significant time on technology *
a. Breathing Support	Continuous Positive Airway Pump (CPAP)	✔	✔	✔	✔
	Pulse oximetry	✔	x	✔	✔
	Oxygen concentrator and splitter	✔	✔	x	✔
	Suction pump	✔	✔	✔	✔
	Respiratory rate monitor	✔	x	x	✔
	Protective system for oxygen concentrator	✔	x	x	✔
b. Temperature Stability	Temperature monitor	x	x	✔	✔
	Warming crib	x	x	x	✔
	Radiant warmer	✔	x	x	✔
c. Diagnose and Manage Jaundice	Phototherapy light and meter	✔	x	✔	✔
	Serem bilirubin test	x	✔	x	x
d. Preventing and Treating Infection	Syringe pump	x	✔	✔	✔
	Sepsis diagnostic	x	✔		
e. Hydration, Nutrition & Drug Delivery	Syringe pump	x	✔	✔	✔
f. Point-of-Care Diagnostics	Glucose monitor	✔	✔	✔	✔
	PH monitor	x	✔	x	x
	Haemoglobin monitor	x	✔	x	x
	Bilirubin monitor	x	✔	x	x
	Sepsis diagnostic	x	✔	x	x

Figure 1: NEST360 technologies and criteria for selected DPhil technologies.

Selected technologies in the DPhil research are in red cycles (Figure 2). This is a diverse range of technologies – to help with feeding, diagnosis, breathing and management of jaundice.

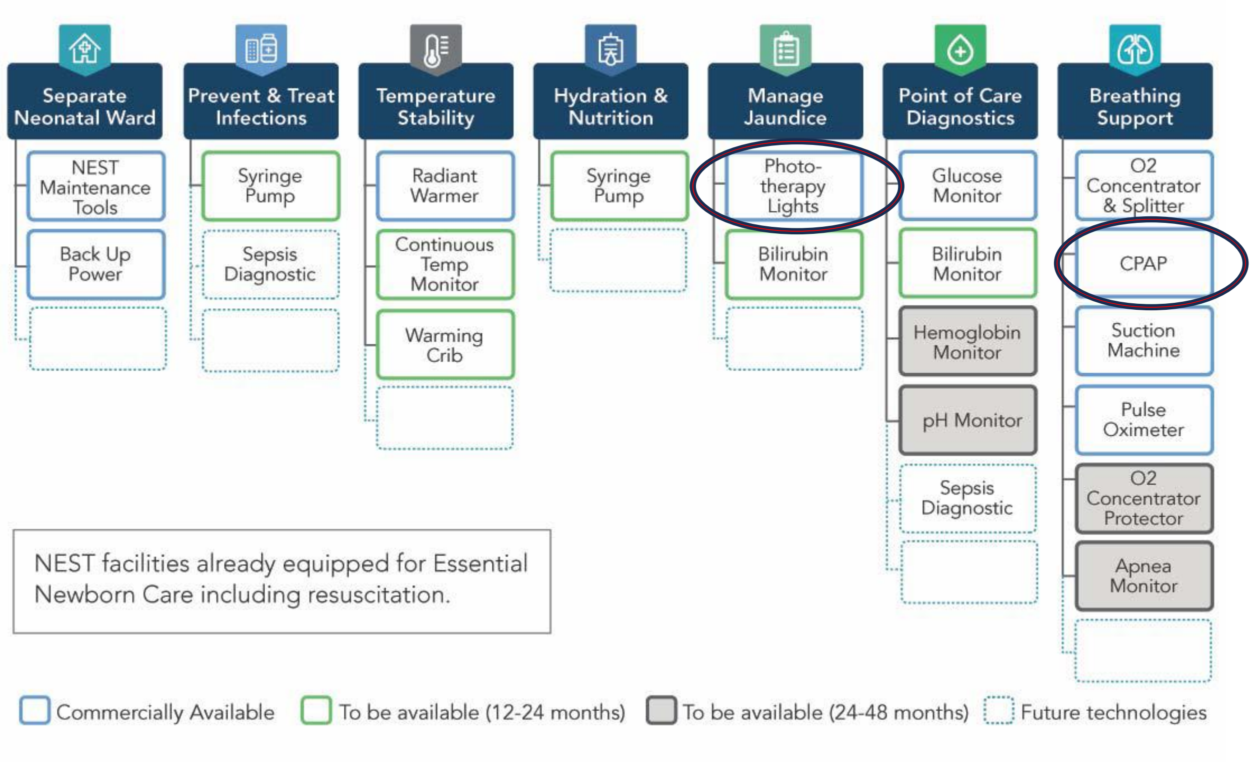

Figure 2: NEST360 technologies

Research objectives

Broad objective: To understand the integration of technology in newborn care, focusing on health professionals' communication and decision-making.

Specific objectives

1. To describe communication and decisions associated with CPAP and phototherapy use among health professionals in two newborn units in Kenya.

2. To examine the physical contexts in which health professionals communicate and make decisions about using CPAP and phototherapy.

3. To explore the organisational contexts in which communication and decision-making regarding using CPAP and phototherapy occur among health professionals.

4. To examine how the type of technology shapes the interactions and decision-making among health professionals in the two newborn units.

Methodology

- Study design – A qualitative ethnographic study design.

- Study area – Newborn Units in hospitals with technologies and workforce interventions. These will help to understand communication and decision-making regarding neonatal technology use in Kenya. The choice of multiple hospitals will provide varied perspectives and insights based on the context for the robustness of data.

- Study population – Health professionals in the Newborn Units. To also observe engagement with caregivers of sick newborn babies.

- Research methods
  - (i) Non-participatory observation in the Newborn Units (NBU)
  - (ii) In-depth interviews with health professionals.
  - (iii) The review of documents

- Sampling technique – Stratified purposeful sampling of participants until saturation.

Philosophical assumption

This research will use social constructionism as a philosophical standpoint. This position acknowledges multiple realities. The researcher will use different methods to co-construct it based on the field experiences.

The leading researcher acknowledges her medical background's influence/effect on how she sees things, which might differ from the health professionals' and caregivers'.

- Ontology – Multiple realities through experience and interaction with health professionals and caregivers of sick newborn babies.
- Epistemology – The reality is co-constructed by a researcher/ researched and shaped by individual experiences.
- Axiology - Individual values are honoured and negotiated among individuals.

FAMILIARISATION

October to December 2021

The engagement with partners and respective counties will start before data collection. The period will involve:

Stakeholders engagement

I will start engaging stakeholders virtually in October 2021 and meet the rest in Kenya in November 2021. The list of stakeholders is highlighted in Table 1 below:

No.	Stakeholder	Aim and outcome
1.	DPhil Supervisors	• To meet DPhil supervisors in Kenya and agree on ways of working, familiarisation plan and other supervision procedures.
2.	KEMRI team	• To familiarise with the wider team that the research will interact in meetings, field visits and other research activities. • To get background information on previous studies relevant to the DPhil research. • To meet the Assistant Research Officer and Research Officer who will assist in data collection.
3.	County authorities	• To introduce the project – alongside the HIGH-Q team. • To get an understanding of how counties work and key contact persons. • To get necessary approvals for research activities to be implemented in respective countries.
4.	Two hospitals	• To meet the hospital administration and get an understanding of the hospital structure and function. • To understand the NBUs in the hospital and possible ways of collecting data.
5.	Clinical Information Network of Pediatrics	• To get information on the paediatric system of care in Kenya and available data that could inform the DPhil research. • To understand how the network will potentially work with the HIGH-Q programme and the DPhil research.
6	NEST360 team and other partners doing similar work.	• To discuss the objective and progress of the programme. • To explore where there is a comparative advantage and possibility to work together.

Table 1: Stakeholders to visit in Kenya

FAMILIARISATION WITH TWO HOSPITALS WHICH ARE THE STUDY AREA

This will be an opportunity to explore before commencing data collection:

- Existing collaboration and relationship with respective hospitals.
- Distance between the hospitals and the time it will take to commute from one hospital to another.
- Types of NBUs services provided in the hospitals and the structure of the units.
- NBUs health professionals' characteristics, the demographic features of the newborn babies admitted in respective hospitals and other factors that could make those hospitals unique.
- Exploring participants recruitment process and possibilities.
- Ethical issues that could emerge during the research duration.
- To practice the reflective process e.g. keeping a diary and discussion with supervisors.

Testing of the data collection methods.

To understand the hospital environment and the challenges of observation in the neonatal ward given the medical background of the researcher. To explore an alternative venue for data collection if it cannot occur at the hospital. To explore how to conduct in-depth interviews with health professionals.

Testing of data collection tools for corrections and amendment.

Please see other annexes for the HIGH-Q data collection tools. I will build on the tools and narrow the focus according to objectives. The validation aims:

i. To understand and agree on the duration of various activities in the field.

ii. Pilot testing the interview questions, informal conversations with health professionals and observation. The process will help refine and develop research instruments, assess the degree of observer bias, frame questions, collect background information and adapt research procedures (Creswell, 2013).

SCENARIOS

The researcher has planned the familiarisation visit according to two scenarios:

Scenario 01

Condition: If the COVID-19 situation in Kenya is stable and the DPhil researcher has permits from the University of Oxford and Kenya Medical Research Institute (KEMRI) to travel before baseline data collection in January 2022.

Plan: To visit Kenya and conduct the familiarisation visit as highlighted in the table. The researcher will join the rest of the HIGH-Q team members who introduce the programme to stakeholders.

Scenario 02

Condition: The COVID-19 situation in Kenya does not allow the DPhil researcher to visit Kenya before baseline data collection in January 2022.

Plan:

- To work with the research team in Kenya to conduct a virtual introduction of the DPhil research during the programme visit to various stakeholders.

- Stakeholder online engagement. To explore the option of working with the Assistant Research Officers and Research Officers to conduct the familiarisation visit on behalf of the DPhil student.

- To move forward with the piloting of data collection until January 2022, the Research Officer identifies participants to include in the piloting study.

5.DATA COLLECTION

(I) Location site

The initial plan includes four hospitals. However, the familiarisation activities will inform the feasibility of working in the hospitals within the timeline. If required, the researcher will expand or narrow the focus to two.

(II) **Access and rapport**

I will seek to understand the environment in the ward, the routine of provision of care and interaction in the ward. It will be the time to build rapport and gain the confidence of the NBU health professionals and identify the right time to talk to staff and caregivers of newborns without interfering with the provision of care.

The first days/ weeks of the research in each hospital are dedicated to the activity. I will assess the feasibility and acceptability of the suggested data collection methods. It will also work out processes to handle any ethical dilemmas for the researchers.

(III) Purposeful sampling

I will choose NBU health professionals for interviews using the stratified purposeful sampling technique. I will select participants from different cadres in NBU. Where applicable, I will apply snowball sampling to follow up contacts suggested by interviewees and convenience sampling to find participants in a setting observed.

	Method	Target/ hospital
1.	Non-participatory observation	All shifts during the week and weekend. An observation of the whole setting up/activities in the Newborn Units, including at least 168 hours of observation in each hospital.
2.	In-depth interviews	At least 5 interviews for health professionals in each hospital.
3	Review of documents	To review documents in each hospital

Table 2: Data collection target

(IV) The conceptual framework

I will have a copy of the conceptual framework I developed to help in considering issues in the field. However, I will explore other emerging issues outside the conceptual framework.

(V) Data collection

There will be two rounds of data collection across the hospitals, each lasting 2-3 months:

i. Baseline - Before the introduction of the workforce interventions
ii. After the introduction of additional health professionals.

Please see a separate document for the data collection schedule.

<u>Data collection flow</u>

I will collect data from one hospital at a time before moving to another hospital. The process will begin with familiarisation of the hospital setting and the NBU. It will include the review of relevant documents.

Non- participatory observations will target all shifts (day/night, weekend and weekday) as prior work has shown variations in care during different time periods. Through in-depth interviews, I will probe on issues observed and gain more insights into their experiences with the technology and workforce interventions.

(VI)Recording information

During non-participatory observation, I will keep a field notebook, making handwritten field notes on the activities undertaken by staff and caregivers. It will include interactions among caregivers, staff and between caregivers and staff.

The recording will comprise personal reflections, insights, ideas, confusions, hunches, initial interpretations and breakthroughs. During in-depth interviews and focused group discussions, conversations will be tape-recorded. The review of documents will provide information that the researcher will record in the field notebook.

Storing data

I will collect data from the interviews in audio files, which will be transcribed verbatim. Transcribed data from field notes will be imported into NVIVO 13 software for management and analysis. The audio files will be archived and destroyed after the complete study and all the data verified. The team will use field notes to collect information from non-participatory observations and the review of documents. The notes will be typed into a standard computer word format. The file storage will be in a secure folder on a password-protected computer One Drive.

I will anonymise data – participant's identities will be removed and replaced with unique study codes. Data access will be available only to the research programme personnel from KEMRI-Wellcome Trust and Oxford University.

PREVENTING AND RESOLVING FIELD ISSUES.

I will work to prevent and address personal and ethical field issues (Table 3). Since qualitative research is interpretation research, the team acknowledges that various factors might bias the research process. These include personal backgrounds such as gender, history, culture, values and socio-economic status that affect the process of conducting research. To address this, the DPhil researcher has reflected on it below:

	Factor	Issue	Measure
1.	Education and work background	Medical training and work experience might bias how the researcher thinks.	- Data triangulation using different sources of information. - Data checking with a member/participant of the study to determine the accuracy of findings. - The researcher's self-reflection and an understanding of the bias brought into the research. - To present negative information which might be contrary to the theme(s). - To spend a prolonged time in the field to have an in-depth understanding of the context. - Peer debriefing to check the accuracy of the account. - Exploring the possibility of using an external auditor to review the work.
2.	Gender	A female researcher in a setting where most caregivers of the children and nurses is women.	- To actively be aware of the bias. Where possible, to seek to involve both male and female participants in the study.
3.	Race	A black African researcher in a context whereby most participants are black African.	- To actively reflect on pre-conceived racial ideas and how they may bias the research throughout the process.
4.	Culture	A Kiswahili and English-speaking country. A context with a culture influenced by tribes and other experiences.	- To use the familiarisation period to understand the culture before the data collection period.

Table 3: Some of the background factors that can affect this research and mitigation measure

6. DATA ANALYSIS

(I) Using multiple sources of data

The research will use different sources of information – observations, in-depth interviews, focused group discussion and the review of documents. This will ensure the developed themes come from several sources of data and perspectives from participants.

(II) Data transcribing and translation

Data collection through in-depth interviews and focused group interviews will use both English and Swahili languages. Participants will be requested to choose a language that they are comfortable with. The research will then translate the information into English. Data from the field will then be transcribed verbatim. Notes from non-participatory observation will be in English.

(III) Organising the data

The researcher will organise data from observation, interviews and document analysis on a computer. The information storage will be either in the form of text or image – dependent on the type of data that will be collected in the field. I will use the latest version of NVIVO computer software.

(IV) Reading and memoing

I will review the field notes from observation, transcripts or visuals several times and note down short phrases, ideas and key concepts that emerge. This information helps to form initial categories.

(V) Describing, classifying and interpreting data into codes and themes

I will first detail describe what I see in the context of the 'participants', 'place' or 'event'. I will develop themes through the formation of codes and interpret them. The plan is to develop up to 20 codes and then narrow them. The code names will be a mixture of words I will compose to best describe the information, words participants use and from health or social sciences. The codes will represent information I expect to find, unusual information I did not expect to find and information surprising to both me and participants. Several codes will form themes.

(VI) Interpreting Data

This involves making sense of data and lessons learnt. Interpretation is linked to larger research literature other people have developed.

Data Back-Up

The first option is one drive that KEMRI uses. The second option is the H drive that the University of Oxford offers.

Cross-Package Information Sharing

This research work falls under the HIGH-Q programme Work Package I (WP I). To ensure cross-package learning and information sharing, the programme will organize regular bi-weekly meetings. The meetings will also help me to get informative cross-package information that could inform their research. The meeting will cover the following aspects of the programme activities, based on the progress in different stages of the implementation:

- Field visit plan for data collection
- Challenges in the field and possible solutions
- Data analysis and preliminary findings
- Manuscripts presentation and publications.

ETHICAL DIMENSION OF THE STUDY

Some ethical issues that could arise during the research and mitigation measures are highlighted below table.

Timing	Issue	Mitigation measures
Prior to conducting the study	Seek relevant college/university and other bodies' approval.	This research is part of the HIGH-Q programme which has got approval from the Scientific Ethics Review Unit (SERU) and the National Commission for Science, Technology and Innovation (NACOSTI) in Kenya.
	Meeting professional association standards	The HIGH-Q programme works closely in partnership with the Government of Kenya and the Kenyan Paediatrics Association.
	Select sites without a vested interest in the outcome of the study.	The programme will work in sites already benefiting from the NEST360 programme. The choice of sites involved the relevant local authorities and other relevant stakeholders.
	Negotiate authorship for publication	The author/ DPhil researcher to give credit for the work done in the project and decide on the author's order. To decide who to be included in publications and their role in the research.
The beginning of the study	To disclose the purpose of the study	To inform participants of the purpose of the study without engaging in deception about the nature of the study.
	Informed consent issues	Not to pressure participants into signing the forms and inform them it is voluntary.
	Respecting norms of the particular society.	To learn about culture, gender and other differences that need to be respected.
	Sensitivity to the vulnerable populations (particularly children in neonatal wards).	Obtain an appropriate consent before engaging with the group. To be sensitive to avoid exposing them.
Collecting data	Respect to the data collection site	Build trust and convey the extent of anticipated disruption in gaining access.
	Deception to participant	To discuss the purpose of the study and how data will be used.
	Power imbalance and the possibility of exploiting participants. The researcher shares personal information which leads to bracketing.	To avoid leading questions, to withhold sharing personal impressions, to avoid disclosing sensitive information.
	Reciprocity – giving back to participants for their time and efforts.	To provide rewards for participation according to the standard approved rates in Kenya.

	Confidentiality towards participants.	The DPhil researcher to protect the confidentiality of participants through anonymity. For example, by assigning numbers or aliases to individuals. The researcher to develop case studies of individuals that represent a composite picture rather than an individual picture.
	Data collection in neonatal unit and what point to intervene.	
Data analysis	Disclosing only positive results Siding with participants (going native)	To report multiple perspectives and contrary findings.
	Respecting the privacy of participants Participants requests that go beyond social norms. Participants share information 'off the record'.	Assign fictitious names or aliases, and develop composite profiles.
Reporting data	Falsifying authorship, evidence, data, findings, conclusions	Honest reporting.
	Plagiarism	Avoid using someone's work and acknowledge them once done so.
	Disclosing information that could harm participants	Use composite information so that individuals cannot be identified.
	Communication style	To use a language appropriate for audiences of the research.
Publishing study	Sharing data with others	To provide copies of the report to participants and stakeholders. To share results in various fora and to consider publication.
	Duplication or piecemealing publications	To avoid using the same material for more than one publication.
	Completion of proof of compliance with ethical issues and conflict of interest.	To disclose funders and beneficiaries of the research.

Table 2: Ethical consideration in the research

DEBRIEFING PLAN

The research team comprising the Senior Researcher (Work Plan Lead and DPhil Supervisor), DPhil student, Assistant Research Officer and Research Officer will meet weekly for a debrief. They will also attend the HIGH-Q project-wide bi-weekly ethics meetings, which will build on the existing practice in Kenya.

To come up with a plan to organise and document debriefs. The discussions /reflections will be useful in refining the research foci – including the next rounds of interviews/observations. It will also inform the positionality.

CHECKLIST OF APPROVALS BEFORE FIELDWORK

i. NACOSTI approval
ii. SERU Ethical approval
iii. Special pass to work in Kenya
iv. Health and Safety Assessment to be in Kenya
v. Travel Risk Assessment by the University of Oxford
vi. COVID-19 Risk Assessment by the University of Oxford

ANNEXE 5.1 AMANI NEWBORN UNIT LIST OF DOCUMENTS

Information Posted on the Wall

- Handwritten paper with numbers of discharged mothers who had premature babies and were invited to the hospital for Premature World Day.
- Staff contact numbers – Medical officer interns on call, consultants on call, and various departments in the hospital such as nutrition, counselling, surgery, and mortuary (handwritten).
- Documents on the national guideline charts on examining a baby, history taking, management of hypoglycaemia, management of exposed babies and screening for retinopathy of prematurity (printed).
- Quality improvement dashboard (Jul to Sept 2021), the Dosing of Anti-Retroviral drugs (ARVs), the medical and clinical officer interns' roster, drug advertisement – Aptanil – infant milk (printed).
- Letters from the management regarding the supervision of students, documentation of the management of patients, and research fees for students who have placement in the ward (printed).

Documents In The Patient Files

1. Newborn admission records had information about the baby, including how well the baby was after delivery, baby's weight, temperature, skin colour and any other details at birth—a nurse from the labour or theatre filled in this information.
2. A comprehensive newborn monitoring chart kept records of babies while in the Newborn Unit. It had information on babies' measurements, such as heart rate, breathing rate, and *oxygen saturation pressure*. It also recorded the management of the baby. The document was seven pages long and had a space for a doctor or nurse to fill daily. Most files had this document but were unfilled.

3. Nursing cards – Nurses documented the management they gave a baby from admission to discharge. They documented what they do, for example, procedures, medication and other actions such as calling the doctor to review.
4. CPAP monitoring sheet – for children with CPAP. It required nurses to record the baby's progress for six hours, the machine's status and other recommendations. Most files had half-filled information—for example, the baby's condition twice daily instead of every six hours.
5. NeoBac – This is a form for testing and recording results of babies who do blood culture and sensitivity.

A list of books in the Nurses' Room.

1. The admission book
2. The nurse report book
3. The report book for the matron
4. Referral book
5. The unpleasant event book
6. CPAP book
7. Death book
8. Duties book
9. Random Blood Sugar (RBS) book
10. Continuous Medical Education book

ANNEXE 5.2 UPENDO HOSPITAL LIST OF DOCUMENTS

Information Posted on the Wall

At the main NBU entrance

- A handwritten paper saying, “Please remove your shoes and put them on a shoe rack”.
- Five moments of handwashing and how to hand rub document.
- A big blue hardboard on patients' obligations summarised information on services, client obligations, waiting time and charges.

Nursery service	**Client obligations**	**Waiting time**	**Charges**
Admission and informing the doctor	Be courteous and respectful to health professionals. Be patient and calm	Up to 10 minutes Immediately	Free
Clerking and investigation	Provide accurate information Inquire about costs. Seek information on the illness.	Up to 20 mins	Free
Feeding	Comply with medical instructions about feeding	Every 3 hours	Free
Observation of vital signs	Care for health records in their possession	Every 3 hours	Free
Maintenance of treatment	Comply with treatment. Refrain from seeking preferential treatment.		Free

On the corridor near the cabinet

- Actions for danger signs (handwritten on dark blue paper)

- Neonatal discharge criteria (handwritten)
- Top 10 conditions according to the second quarter of 2021 (handwritten)

In the second round, new documents were typed in A4 size format. They talked about Ebola notification for health professionals to be careful, new staff clinic notification, a reminder of days the ward should go to the pharmacy for medication, note not to take unauthorised students, duty coverage during the national elections, Isoniazid Preventive Therapy and a sheet on how to do a proper handover.

Outside the window of the Acute Term Babies' cubicle

- A sample of how to fill the newborn monitoring sheet (handwritten)
- Newborn monitoring information sheet (printed) – green, amber, and red. It documented the baby's routine and abnormal vital signs according to the reading and threshold. For example, Pulse rate (PR)<80 or >160 is red (danger), 80-99 amber (borderline) and 100-160 green (standard).
- A checklist with 11 items documented (handwritten on a white paper) – the items on the checklist are inventory (equipment), RBS records, room temperature monitoring chart, nursing care plan for all babies in category A, nurses' cardex forms well documented, treatment sheet, daily bed return, particular report book, monitoring charts (example standard and intensive), resuscitation equipment checklist.
- Duty allocation for students (handwritten) – Students were divided into A-D cubes daily.
- Duty rota for mortician (handwritten)
- Internal memo about two new radiologists (typed)

Outside the window of the preterm cubicle (and opposite it)

- Biomedical engineer contacts (handwritten), internal memo on ambulance charges (printed), phone extensions (handwritten), a calendar (printed), a poster on five moments of handwashing (printed).

- Actions for danger signs (handwritten) – the signs mentioned are difficulty in breathing, failure to breastfeed, fever/hypothermia, convulsions, red cord stamps, change of activities (floppy/stiff).
- Discharge information – conditions on discharge, follow-up (none, Paediatrics Outpatient Clinic (OPC), local clinic, Surgery Outpatient Clinic (SOPC), Gynaecology Outpatient (GOPC), HIV Outpatient Clinic (CCC)), discharge drugs (Mixavit drops, Folic acid, Saferon), advice on discharge (follow-up clinic, drugs, exclusive breastfeeding, keeping the baby warm, family planning, immunisation, danger signs, Kangaroo Mother Care (KMC)).

The wall opposite the kitchen

- How to make 500mls of 10% dextrose, fluid therapy for neonatal hypernatremia secondary to failure to breastfeed, medical officer on-call rota, contacts of doctors, how to make chlorine solutions, general guide on disinfection with chlorine, insulin dilution for hypoglycaemia.

Inside Acute Term Babies' cubicle

- Two posters – one says to stop and sanitise hands before and after holding a baby, and the second on five critical moments of handwashing.

Inside the Preterm Babies' cubicle

- Segregation of medical wastes, warm newborn chains,
- Nursing diagnosis /care plan includes respiratory distress syndrome, diagnoses, goals, nursing interventions and goals.
- A list of nicely laminated documents hangs on one side of the room by the window – the use of ARVs/PMTC in the labour and delivery unit, the cornerstone of neonatal care (warmth, love, food, air, baby at risk and infection management); guideline for nevirapine dose, resuscitation council United Kingdom (Newborn life support); Firinstrome score for assessment of newborn, gestational age HIV prevention protocol;

Ballard score for gestational age guideline for HIV medication according to weight; and danger signs for an infant.

Documents in Patient's Files.

- Lab requisition form - with name request report (back page)
- Nursing notes – written at 6 am, 7:30 a.m., 8 am, 9 am, 12 pm, 12:30 pm, 3 pm, 6 pm, 6:30 pm, 9 pm, 12:00 am 3 am.
- Paediatric treatment chart – regular drugs -drug dose, route, start date frequency, duration, time.
- Comprehensive newborn chart – with information on temperature, pulse, respiratory rate, oxygen, cyanosis or respiratory distress, jaundice apnea, and blood sugar, completed by. Then, more information on breastfeeding sufficiently, *expressed* breast milk, and volume, formula volume, vomit, urine, and stool.
- Continuation sheet – written by (doctor), diagnosis, treatment and other information.
- Referral forms (to the hospital) – name, date of admission, date of referral, referring facility, the reason for referral, referring clinician, name, signature, date and stamp.
- Paediatric referral form – facility details patient details, condition at referral, vitals, and interventions are given.
- Radiology request form
- Newborn Unit admission record with information regarding infant details such as name, date of birth, IP number, mode of delivery, elective or emergency delivery, multiple deliveries. It also documented mother's other information like name, IP number, age, number of children (parity), blood group, HIV status, information on diabetes, hypertension, a prolonged second stage of labour and the mother's problem during pregnancy. Another information is on the baby’s presenting problem and treatment. History and examination, anthropometric summary, a summary of presenting problem, investigations ordered, admission diagnoses were also included.

A list of books at the Health Professionals' Bay

1. Patient record book
2. Handover report book
3. Random Blood Sugar book
4. Temperature monitoring book
5. Round book for major ward round
6. Patient referral book
7. Nutrition support
8. Equipment documentation book
9. Patient report book (Special cases details)
10. Implementation guidelines
11. Non-pharmaceutical commodities (medical supplies) with information on the date received, quantity used, reference number and signature.

ANNEXE 5.3: A SAMPLE OF DOCUMENTS IN UPENDO AND AMANI NEWBORN UNITS.

[HOSPITAL NAME] **COMPREHENSIVE NEWBORN MONITORING CHART** Version 2.8

Name	IP NO	Sex M □ F □ Indeterminate □	D.O.A	D.O.B
Date today	Diagnosis			
Birth Wt gm	*Interventions: CPAP □ Oxygen □ Phototherapy □ Blood tranfusion □ Exchange transfusion □ KMC □*			

Daily Clinician Feed and Fluid prescription

Day of Life | Current Wt = gm | HC________cm

Total feed + fluid =______ mls/kg/day = _______mls

Feed: BF □ EBM □ Term Formula □ Pre-Term Formula □

Route: Cup□ NGT□ OGT□

Volume & Frequency = ________mls 3hrly □ 2hrly □

24hr Feed Volume = ________mls

IV Fluid & Additives	Vol (ml)	Duration

Other prescribing instructions

Clinician's name Time:

Daily IV Fluid Nursing plan

Start time:

Hourly rate= ________ mls (___ drops/min)

Planned vol = ________ mls in_______ hrs

	Monitoring Freq___hrs | Time												
Vitals	Temp (^{0}C)												
	Pulse (b/min)												
	Resp Rate (b/min)												
	Oxy Sat (%) or Cy^0 Cy$^+$												
Assessment	Resp Distress 0,+,+++												
	CPAP Pressure (cm H_2O)												
	FiO_2 (%)												
	Jaundice 0,+,+++												
	Apnoea Y/N												
	Blood Sugar (mmol/l)												
	Completed by (name)												
Feed	Breastfeeding sufficient Y/N												
	EBM vol given (ml)												
	Formula vol given (ml)												
Fluid	IV volume given (ml)												
	IV Line working Y/N												
Output	Vomit Y/N												
	Urine Y/N												
	Stool Y/N												
	Completed by (name)												

Morning shift notes
Category: A□ B□ C□
For this shift: Total feed______ mls
Total fluid ______ mls
Total feed/fluid deficit______ mls
Completed by (name)

Afternoon shift notes
Category: A□ B□ C□
For this shift: Total feed______ mls
Total fluid ______ mls
Total feed/fluid deficit______ mls
Completed by (name)

Night shift notes
Category: A□ B□ C□
For this shift: Total feed______ mls | Total fluid ______ mls
Shift deficit______ mls
Total feed+fluid input in 24hrs______ mls
24hr deficit_____ mls
Completed by(name)

Jaundice 0 none, +mild(face),+++severe(feet) Tick the category of baby after assessment Alerts : circle readings outside normal range with red pen and action

Pumani CPAP Monitoring Sheet

Patient name ________ Birth date ______ Birth weight __________

Day of life ________ Today's date ______ Current weight __________

Diagnosis ____

Indications for CPAP ____

Patients on CPAP must be monitored very closely:

- Assess patient 1 hour after starting CPAP or making setting changes
- Assess patient every 6 hours if stable on CPAP settings

		Current CPAP Settings					Vital Signs				Respiratory Distress Signs			Maintenance				
Date	Time	Water Level	Total Flow	O2 Flow	Bubbling	Prongs in place Check hat	RR	HR	SpO2	Temp	Grunting	Nasal	Recessions (mild, mod, severe)	Abd Dist	OGT	Suction Saline drops	Changes made	Staff Initial

Routine Initial CPAP Settings : Water level = 6 cm, Total Flow = 6 LPM, O2 flow = 3 LPM

Goals : RR < 60
SpO2 > 90%
Improved respiratory function

NURSING HANDOVER TOOL

Situation	Name:		D.O.B:	D.O.A			SEX	IP NO:
Background	Diagnosis				Referral Y/N			
	Weight	Birth weight:						
	Date today	D.O.L		Current weight:		Date today:	D.O.L:	Current weight:
	SHIFT		Morning	Afternoon	Night	Morning	Afternoon	Night
	Vitals	Vitals taken Y/N *Comments*						
	Feeding status	Feeds given Y/N Comments						
	Fluid management	Indicated Y/N						
		Cannula in-situ Y/N						
	Medication	Given Y/N *If N, why?*						
		Oxygen use Y/N *Comments*						
		On CPAP Y/N						
	Investigations	Done Y/N *Comments*						
Assessment	Mothers' status	Stable Y/N *Comments*						
	Plans/changes from ward round	Re-categorised: Y/N *Comments*						
		New investigations: Y/N *(If Y, Specify)*						
		Treatment changed: Y/N *(If Y, specify)*						
		For referral: Y/N						
		For review: Y/N *Comments*						
Recommendations	Pending/outstanding issues							
Name/Initials/Signature			Received by _____ Handed over by ____	Received by _____ Handed over by ____	Received by _____ Handed over by: ____	Received by: _____ Handed over by ____	Received by: _____ Handed over by: ____	Received by: _____ Handed over by: ____

DISCHARGE CARD

NAME ____

AGE: ____

SEX: M F

IP/NO: ______________________________

Date of Admission: ________/______/________

Date of Discharge: ________/______/________

Diagnosis: ____

REMARKS:

____

____

____

____

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____

____

____

DOCTOR'S NAME: ____________________ SIGNATURE ________________

Internal Newborn Unit Transfer Form

Complete for all newborns in Maternity requiring admission to the Newborn Unit

Date..(dd/mm/yyyy) Time....................................am/pm

Mother's details

Name			Age		IP No.		
Parity	+	Gestation	wks	LMP	dd/mm/yyyy	EDD	
ANC attendance	Y☐ N☐	Blood Grp	A☐ B☐ AB☐ O☐ unkn☐		Rhesus	Pos☐ N	
VDRL	Pos☐ Neg☐ unkn.☐	PMTCT Status		Pos☐ Neg☐ unkn.☐	Mother ARVs		
Diabetes	Pos☐ Neg☐ unkn.☐	Current TB treatment		Y☐ N☐ unkn.☐	Antibiotics		
Fever	Y☐ N☐	APH	Y☐ N☐	Multiple PG	Y☐ N☐ *If YES nu*		
HTN in Pregnancy	Y☐ N☐ unkn.☐	Pre eclampsia	Y☐ N☐	Eclampsia			
Any other maternal condition							
Current Maternal Drugs							

Delivery

Labour	1st Stg	hr	2nd Stg	min	Time of Delivery	am/pm	ROM <18h☐ >=18h☐
Fetal Distress	Y☐ N☐	Thick Meconium	Y☐ N☐	If yes, Meconium grade? 1☐			
Delivery	SVD☐ CS☐ Breech☐ Vacuum☐ Forceps☐	If CS, type?	Elective☐ E				
Reason for Emergency CS							
BVM Resuscitation?	Y☐ N☐	Placenta Complete?	Y☐ N☐	Abnormal Placenta?			
Specify Placenta Abnormalities							
Preventive care given	OPV Y☐ N☐	BCG Y☐ N☐	TEO Y☐ N☐	Vit K Y☐ N☐	CHX		

Infant's Details

Date of Birth	(dd/mm/yyyy)	Sex	F☐ M☐ Indeterminate☐	IP No		
Apgar	1m	5m	10m	Birth Wt.	grams	Weight now
Baby from postnatal ward?	Y☐ N☐ *If Yes Fill in Age and BBA*			Age	days	
Born outside this facility?	Y☐ N☐ *If Yes, born where?*		Home/Roadside☐	Other		

Reasons for referral to NBU

Completed by(Name): **Signature**

Baby received on NBU by:

Time.................................am/pm

Version August,20

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

DEPARTMENT OF HEALTH SERVICES

[redacted]

REF: DATE:

CONSENT FOR DISPOSAL OF INFANTS AND STILL BORN

I………………………………………………………being…………………………

of the deceased has given the hospital authority to dispose off the body of…………………………………………………………being an infant/still born at their own cost.

NAME……………………………………………………SIGN……………………………

OFFICER INCHARGE

NAME……………………………………………………SIGN……………………………

DATE……………………………………

X-RAY REQUEST FORM

TYPE OF INVESTIGATION REQUESTED				NAME
WALKING	CHAIR	TROLLEY	PORTABLE	SEX AGE
APPOINTMENT			TIME	HOSPITAL No.
HISTORY OF ALLERGY.....................................(YES/NO) IF YES Specify..				IP/OP
				REPORT TO BE SENT TO
L.M.P.. IF PERIODS MISSED IS EXAM STILL NECESSARY YES / NO) BRIEF CLINICAL SUMMARY				PREVIOUS X- RAY No. OFFICIAL USE ONLY.
				NO. OF FILMS
				CHARGES
				COMMENTS
REQUESTING DOCTOR (PRINT NAME)				
SIGNATURE			DATE	RADIOGRAPHER NAME
X-RAY No.				SIGNATURE

X-RAY REPORT

RADIOLOGIST NAME	SIGNATURE	DATE

INTAKE- OUTPUT CHART

NAME: | IP No. :
AGE: | WEIGHT:
DATE: | DIAGNOSIS:
FLUID/FEED/BLOOD AS PRESCRIBED: | TO TAKE ______ mls OVER THE NEXT ______ HOURS
START TIME: | END TIME:

TIME	INTAKE (ml)						OUTPUT (ml)					
	Route IV ☐			NG ☐			Urine (mls)	NG Aspirate/ Drains	Stool (TICK)	Observations		
	Type of Fluid	IV Amount		Type of NG feed/fluid	NG Amount							
		Put up	Gone in		Gone in (mls)	If vomited (TICK)				T	P	R
	Total			Total								

GRAND TOTAL INTAKE OVER ______ HOURS ☐ AMOUNT OVER OR UNDER TARGETED INPUT (balance) ☐

Shift 1 Name: ____________ Sign: ____________
Shift 2 Name: ____________ Sign: ____________

INTAKE- OUTPUT CHART

NAME: | IP No. :
AGE: | WEIGHT:
DATE: | DIAGNOSIS:
FLUID/FEED/BLOOD AS PRESCRIBED: | TO TAKE ______ mls OVER THE NEXT ______ HOURS
START TIME: | END TIME:

TIME	INTAKE (ml)						OUTPUT (ml)					
	Route IV ☐			NG ☐			Urine (mls)	NG Aspirate/ Drains	Stool (TICK)	Observati		
	Type of Fluid	IV Amount		Type of NG feed/fluid	NG Amount							
		Put up	Gone in		Gone in (mls)	If vomited (TICK)				T	P	R
	Total			Total								

GRAND TOTAL INTAKE OVER ______ HOURS ☐ AMOUNT OVER OR UNDER TARGETED INPUT (balance) ☐

MINISTRY OF HEALTH

M.O.H.

IN- PATIENT/OUT-PATIENT

CONTINUATION SHEET

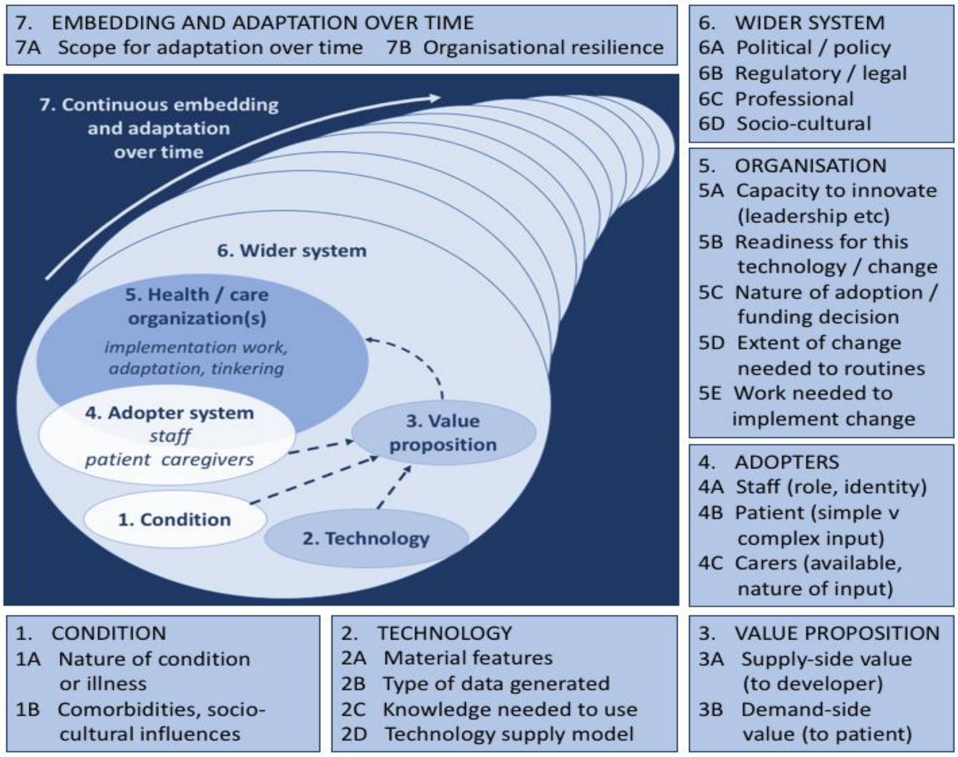
Name:..

Age:.............................. Sex...........................

Address...

Date..

ANNEXE 7.1: NONADOPTION, ABANDONMENT, AND CHALLENGES TO THE SCALE-UP, SPREAD, AND SUSTAINABILITY (NASSS) FRAMEWORK.



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