

Operational framework for building climate resilient and low carbon health systems



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Acronyms and abbreviations

AF	Adaptation Fund
ATACH	Alliance for Transformative Action on Climate and Health
CEM	comprehensive emergency management
COP	Conference of the Parties
EPHF	essential public health functions
EWS	early warning system(s)
GCF	Green Climate Fund
GDP	gross domestic product
GEF	Global Environmental Facility
GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
GHGP	Greenhouse Gas Protocol
GHGs	greenhouse gases
HALE	health-adjusted life expectancy
H-EDRM	Health Emergency and Disaster Risk Management
H-NAP	Health National Adaptation Plan
HSI	Hospital Safety Index
LDCF	Least Developed Countries Fund
LDCs	least developed countries
LMICs	low- and middle-income countries
LT-LEDs	long-term low-emission development strategies
MHPSS	mental health and psychosocial support
NAP	National Adaptation Plan
NAPA	National Adaptation Programmes of Action
NCDs	noncommunicable diseases
NDCs	Nationally Determined Contributions
NHS	National Health Service
PHC	Primary Health Care
SCCF	Special Climate Change Fund
SDGs	Sustainable Development Goals
UHC	universal health coverage
UNFCCC	United Nations Framework Convention on Climate Change
V&A	vulnerability and adaptation
WASH	water, sanitation and hygiene
WASH FIT	Water and Sanitation for Health Facility Improvement Tool
WHA	World Health Assembly
WHO	World Health Organization

Executive summary

Climate change is increasing its negative impacts on society, including on health and health systems. This calls for urgent action to build climate resilience. However, while delivering health services and patient care, health systems are responsible for around 5% of greenhouse gas (GHG) emissions globally per year, thus contributing to climate change. In order to effectively protect the health of populations, health systems have the double responsibility of building climate resilience and reducing their own carbon footprint.

This document presents the World Health Organization (WHO) *Operational framework for building climate resilient and low carbon health systems*. This framework responds to the demands from Member States and partners for guidance on how the health sector can systematically and effectively address the challenges increasingly presented by climate change, while reducing its own contribution to climate change. It aims to contribute to the design of transformative health systems that can provide safe and quality care in a changing climate.

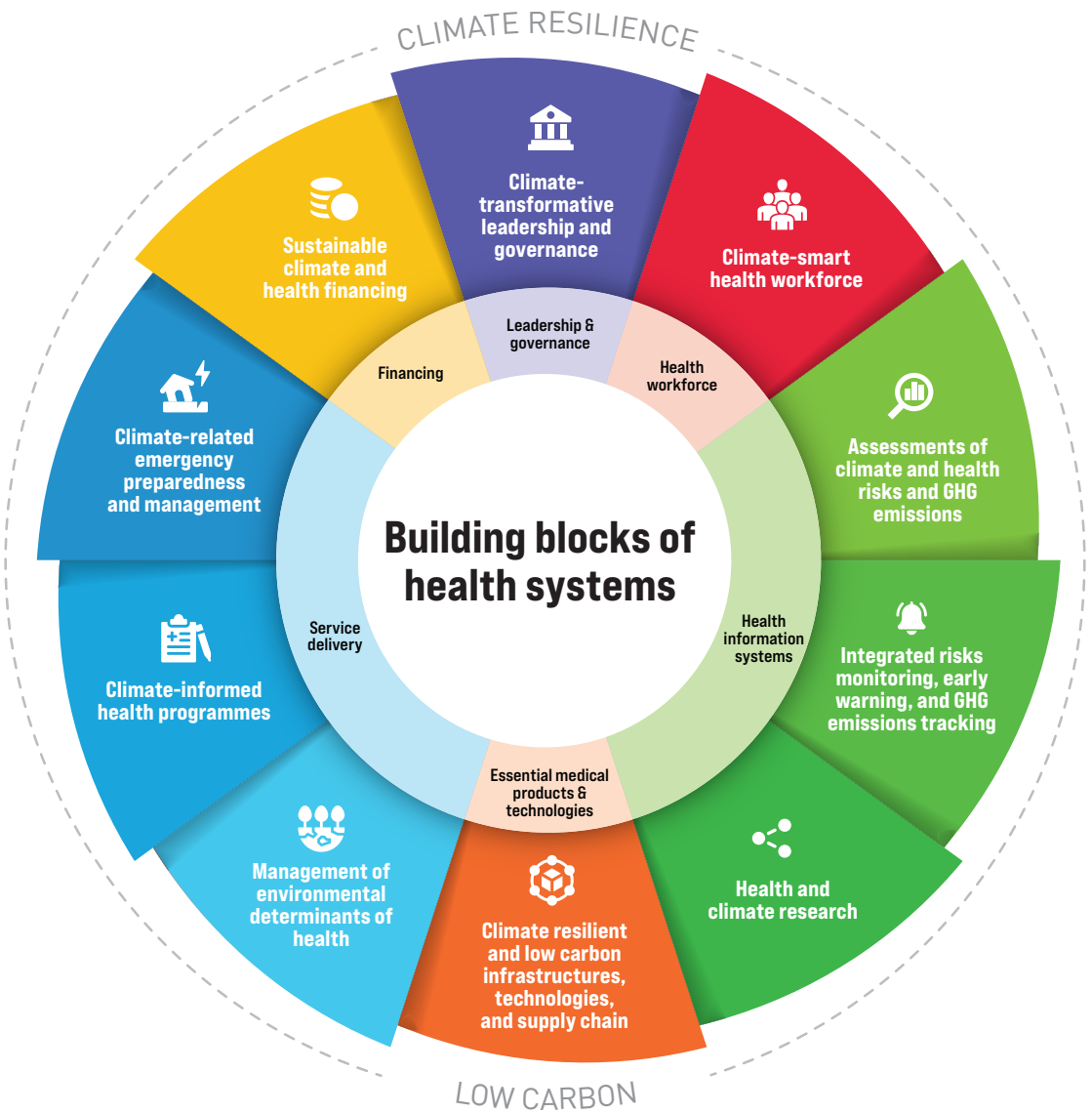
The framework's goal is to increase the climate resilience of health systems to protect and improve the health of communities in an unstable and changing climate, while optimizing the use of resources and implementing strategies to reduce GHG emissions.

The framework's objectives are to:

- guide health sector professionals, including through their collaborations with officials in health-determining sectors to understand and effectively prepare for the additional health risks posed by climate change, through climate resilient and low carbon approaches;
- present the main health system functions that need to be strengthened to build climate resilience and low carbon health systems, and use these as the basis for developing comprehensive and practical strategies (e.g. national climate change and health strategy) and plans (e.g. health component of National Adaptation Plan (HNAP) and healthy long-term low emission development strategies (LT-LEDS));
- support the development of specific interventions that can be implemented by health systems that address both the increased risks posed by climate change and progressive reduction of carbon emissions, and the synergies among these actions; and
- support health decision-makers to identify roles and responsibilities to develop and implement action plans for resilience, and low carbon pathways, engaging actors within and outside the health sector.

Implementation of this framework would help health organizations, authorities, and programmes to be better able to anticipate, prevent, prepare for, and manage climate-related health risks and therefore decrease the burden of associated climate-sensitive health outcomes. Implementing low carbon health practices would contribute to climate change mitigation while also improving health outcomes. Achieving these aims is an important contribution to universal health coverage (UHC), global health security, and specific targets within the Sustainable Development Goals (SDGs). This framework proposes interventions around the 10 components as well as indicators to monitor progress (Fig. 1).

Fig. 1. Operational framework for climate resilient and low carbon health systems



1. Introduction

Climate change will profoundly affect health systems and the efforts to improve and sustain human health for decades to come. It is widely recognized as one of the largest threats and challenges to human health and well-being and is jeopardizing the realization of universal health coverage (UHC) and increasing the burden of climate-sensitive health outcomes. These impacts are projected to increase as greenhouse gas (GHG) emissions continue to rise.

In the longer-term, the effects of climate change hazards will increasingly depend on the extent to which transformative and regulatory actions are taken to reduce carbon emissions. This transformation is needed across sectors, requiring a focus on the social and environmental determinants of health and the roots of climate change. Key health-determining sectors need to integrate health in their decision making and interventions.

The health system, in the context of all these challenges, needs to be reshaped in a way that continues to provide safe and quality care to its population. It can play a leading role in this transformation by implementing an effective sustainable and equitable approach to climate change and health, following a framework that should be enabled and supported by a sustainable governance mechanism, with high-level political commitment, and tailored to the national circumstances.

This document presents the World Health Organization (WHO) *Operational framework for building climate resilient and low carbon health systems*. This framework responds to the demands from Member States and partners for guidance on how the health sector can systematically and effectively address the challenges increasingly presented by climate change, while reducing its own contribution to climate change. It builds upon, and expands the scope, of WHO's *Operational framework for building climate resilient health systems* (1), which has been adopted and used by Member States, many technical partners, and all WHO Regions, in countries and settings to support climate and health action. The revised operational framework does not change the approach of the previous version but rather now integrates low carbon sustainability considerations. Countries that have already implemented the 2015 operational framework may find some updates in this version across the different components relevant to climate resilience and should build on their previous work to further expand their climate change programme so as to simultaneously and synergistically promote interventions that continue to prioritize building climate resilience while reducing their GHG emissions and overall environmental impact. For additional WHO guidance and tools on climate change and health see WHO's visual guide for country support on climate change and health (2); the Alliance for Transformative Action on Climate and Health (ATACH) Community of Practice (3); and the global knowledge platform for climate and public health (4).

The target audience of this document are decision-makers in health systems, including public health agencies, and other specialized institutions. Specifically, this document is a useful resource to health sector managers, public health professionals, and decision-makers to develop comprehensive plans, develop project proposals and implement interventions on climate change and health. This is also a useful resource for decision-makers in health-determining sectors, such as environment, food, agriculture and nutrition, water and sanitation, waste management, energy, transport, urban planning, emergency and disaster management, education, as well as Indigenous partners and civil society organizations.

Furthermore, international development agencies, investors, international financing institutions, and partners can use this framework to inform the development of a funding programme and requirements, and structure the development of project proposals and investment cases for climate change and health.

Key terms used throughout this document are health systems, climate-resilient health systems and low carbon health systems (Box 1.1).

Box 1.1 Key definitions

Health systems include all the organizations, institutions, people, resources, and actions whose primary purpose is to improve, restore or maintain health. The goals of a health system are improving health and health equity in ways that are responsive, financially fair and make the best or most efficient use of available resources. Six health system building blocks together constitute a complete health system – health service delivery; health workforce; health information; medical technologies; health financing; leadership and governance (5).

Climate resilient health systems are those capable of anticipating, responding to, coping with, recovering from, and adapting to climate-related shocks and stress, to bring about sustained improvements in population health, despite an unstable climate (1).

Low carbon health systems are those capable of implementing transformative strategies towards reducing GHG emissions in their operations, reducing short- and long-term negative impacts on the local and global environment.

Climate resilient and low carbon health systems are those capable of anticipating, responding to, coping with, recovering from, and adapting to climate-related shocks and stress, while minimizing GHG emissions and other negative environmental impacts to deliver quality care and protect the health and well-being of present and future generations.

Note: For additional definitions, see Annex B – Glossary. A comprehensive glossary on climate change and health (6).

2. Background

2.1. Public health and environmental health rationale

There is sufficient evidence that climate change is affecting health in numerous ways leading to illnesses, injuries, and deaths.

Health systems consist of all organizations, people, and actions whose primary intent is to promote, restore or maintain health. The overall goal of health systems is to improve population health outcomes in an equitable way without overburdening people with health care costs (7,8). Climate change threatens this goal. As depicted in Fig. 2.1, health risks from climate change are many and varied and can include:

- increase in severity and frequency of extreme weather events – such as extreme heat, storms, floods, droughts – and air pollution, all of which can cause several diseases, put pressure on health care, and disrupt livelihoods, especially in low-lying coastal zones, drought and flood prone areas, and in small island States due to storms, storm surges, and sea level rise;
- disruption of food systems resulting in food shortages and volatile prices, and negatively impacting human nutrition, well-being, and livelihoods;
- increase in infectious diseases, such as zoonoses and food-, water- and vector-borne diseases;
- increase in noncommunicable diseases (NCDs) such as malnutrition, respiratory and cardiovascular diseases, heat stress, and mental health issues; and
- potential increase in risk of conflict associated with resource scarcity, population movements, and economic factors that deepens health inequities.

Furthermore, climate change impacts are undermining many of the other social determinants of good health (such as livelihoods, equality and access to health services and social support structures), thereby increasing health risks, particularly in low- and middle-income countries (LMICs) and populations. Health risks from climate change are disproportionately higher among the most vulnerable and disadvantaged groups including poor communities, newborn and children, women, ethnic minorities, migrants or displaced persons, older populations, Indigenous Peoples, and persons with pre-existing health conditions. Many are affected by multiple risks simultaneously (1,9). Climate change also impacts health systems' operations through: damage to infrastructure; damage or loss of equipment (e.g. medical devices and products); impacts on water, waste, energy and transport systems; disruption of supply chains; and impacts on the health workforce. Consequently, the provision of health services is also impaired (10,11).

The COVID-19 pandemic exposed many weaknesses in health systems globally, having a focus on access to medical services, without capturing the broad determinants of health (12). It caused unexpected and unprecedented disruptions to health systems, but climate change is expected to have much greater consequences for countries, health systems and people (13). Climate change is already increasing humanitarian crises where climate hazards interact with high vulnerability (14).

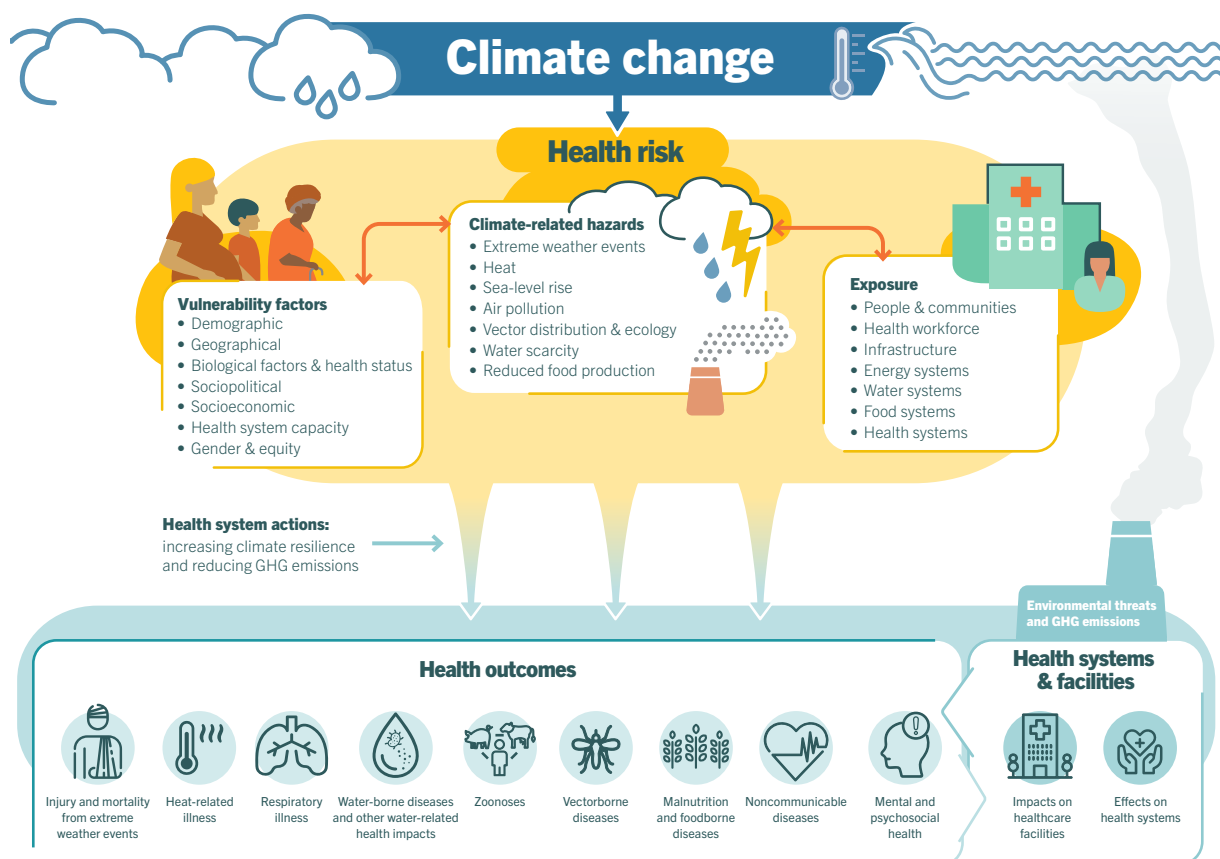
This calls for reimagining health systems, and the concept of “systems for health” captures this well. These systems are ready to respond to both known and emerging threats, hazards, and risks; they address social, economic, environmental, and commercial drivers of health that are critical to securing and enabling healthier societies (15).

Health systems are not only impacted by climate change, but their operations also contribute to environmental degradation including to climate change through their GHG emissions. Many health systems have unsustainable practices related to water, sanitation, waste, energy use, procurement, and supply chains (10). The Lancet Countdown on health and climate change 2022 noted that the health care sector contributed to approximately 5.2% (or 2.7 gigatonnes of CO₂ equivalent (GtCO₂e)) of global GHG emissions in 2019. The study also highlighted the large differences in health sector emissions by country. Of the 37 health systems analysed, the country with the highest (per capita) health sector emissions was 50 times higher than the country with the lowest health sector emissions (16).

Some emissions responsible for climate change are also responsible for air pollution, which causes approximately 7 million premature deaths per year globally (combining ambient and household air pollution (17). To fulfil its mandate to protect and promote the health of the population they serve, health systems should strengthen their climate resilience and lead by example by reducing carbon emissions and demonstrating real progress in moving towards low carbon systems and benefitting health.

Currently, no health system is completely climate resilient or fully decarbonized, although globally, health systems are advancing towards these aims (18).

Fig. 2.1. Climate change risks to health and health systems, and outcomes

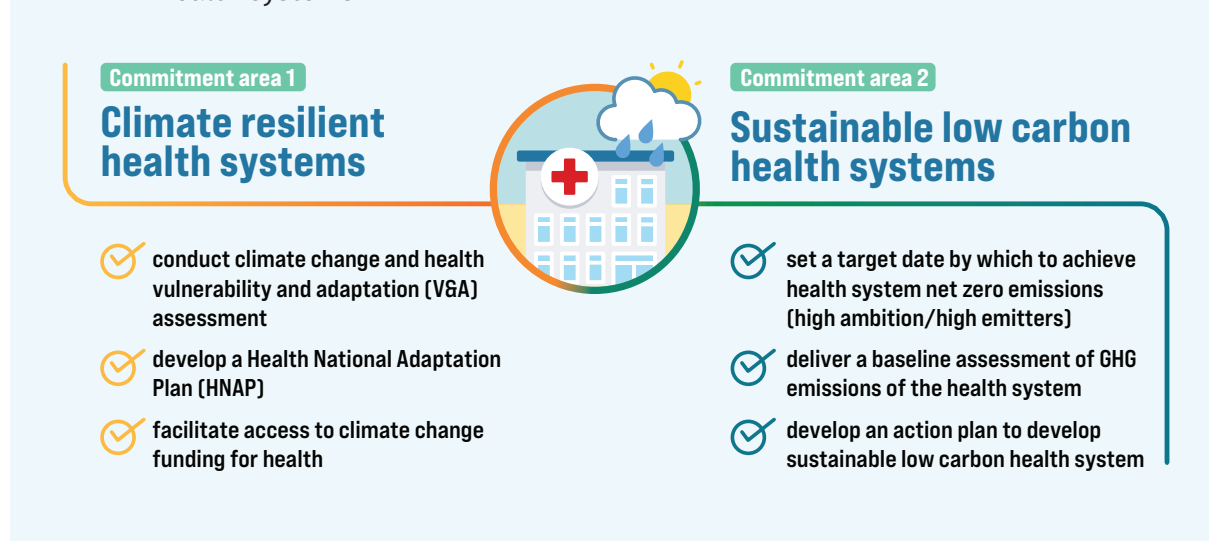


As depicted in Fig. 2.1, climate change risks to health and health systems result from a combination of multiple hazards, diverse vulnerabilities, and multiple exposures and exposure pathways. Furthermore, the figure also depicts the impact health systems have on the environment and climate change. Health systems actions should aim to modulate health risks by increasing resilience and reducing GHG emissions.

2.2. Policy context

Global awareness of the interconnections between climate change and health has significantly increased in recent years. For the first time under the climate change negotiations process, the United Kingdom, as President of the 26th Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC), promoted a health programme, in collaboration with WHO and other relevant partners in November 2021. The COP26 Health programme included two initiatives to be implemented by health systems, namely on climate resilience and low carbon sustainability. As a result, over 70 countries have committed to date at the Ministry of Health level to these initiatives (19,20); Box 2.1.

Box 2.1 COP 26 health initiatives on climate resilient and sustainable low carbon health systems



To support countries in their efforts to implement the COP26 health initiatives, WHO and the United Kingdom launched the ATACH in June 2022.

By joining the ATACH, health authorities can join the community of practice embarked in efforts towards building climate resilient health systems, share information and experiences, request for technical support or additional guidance from relevant partners, and learn how the operational framework is being implemented in other countries (key resources are available at <https://www.atachcommunity.com/>).

The framework is a useful tool to implement the ATACH goals.

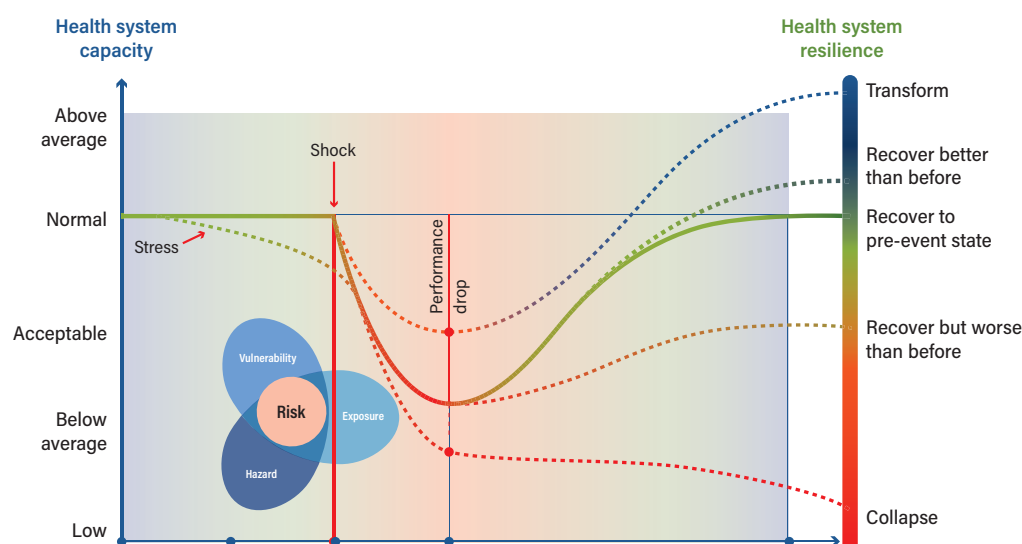
3. Applying a climate resilience approach to health systems

Resilience can be understood as the ability and agility of a system to change and flex according to circumstances, and continue to function under stress, while undergoing change. Resilience is about whole system capacity and not just the absence of vulnerability. WHO defines health systems' resilience as "the ability of all actors and functions related to health to collectively mitigate, prepare, respond and recover from disruptive events with public health implications, while maintaining the provision of essential functions and services and using experiences to adapt and transform the system for improvement" (21).

Adaptation to climate change and climate resilience building are closely related, but not synonymous. Adaptation is the "process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects" (22). WHO defines climate resilient health systems as "those that are capable of anticipating, responding to, coping with, recovering from, and adapting to climate-related shocks and stress, to bring about sustained improvements in population health, despite an unstable climate" (1).

A conceptual framework for climate resilience in health systems is shown in Fig. 3.1. The degree of resilience that a system possesses is a function of the strength of the hazard, the current vulnerabilities in the system and the extent of exposures. The health system capacity level (left axis) is a key determinant of the impacts of a shock or stress in the system. Low levels of resilience may result in the system collapsing (health operations cease) or experiencing setbacks (limited health service delivery capacity due to stock losses or staff shortages) that put them in a worse position than before the adverse events. Resilience is not just about responding to shocks or stresses to the system. Health systems can also learn from previous experiences and put in place interventions to recover, which can be at the pre-event state or better, achieve a transformation which would lead health systems to be able to anticipate, and promptly respond to increasing and more diverse threats posed by climate change (10).

Fig. 3.1. Health system capacity and resilience to climate change-related shocks and stresses, and possible pathways from collapse to transformation



Source: Based on references 10,23.

Building health system resilience to climate change is a cumulative and iterative process. It begins with making resilience a goal, while improving population health, ensuring an adequate health and care workforce, being responsive and efficient with an iterative management approach and providing social and financial protection.

Governments and communities can protect public health from climate change-related risks. A healthier population and stronger health system will be more resilient to climate change. Building climate resilience in health systems is a process to adapt more effectively to changing health risks due to climate change.

The process to building climate resilience occurs in two principal ways:

- reducing climate-related health risks (including hazards, exposures, and vulnerabilities), and
- developing specific health system capacities, integrating climate perspectives to health policy and operations (Box 3.1).

Box 3.1 Overarching considerations in building climate resilience

Manage climate-related health risks

Managing risks in health systems related to climate change is needed to reduce climate-related health risks and create health systems' resilience and healthier populations that can respond to, and be protected from, health impacts from climate change. This includes preparing and responding to current and future hazards, exposures, and vulnerabilities.

Develop health system capacity

To prepare a health system to promptly respond to climate change risks it would be necessary to address current gaps, improve the current health system or programme performance, and to adapt the infrastructures, technologies, and supply chain of health facilities. Furthermore, health systems should increasingly take steps to understand, plan and respond regarding how climate change will affect their population and their operations for delivering health services, and to enhance their institutional capacity accordingly. This entails building capacity to: recognize, monitor, anticipate, communicate, and prepare for changing climate-related health risks; prevent, respond to, manage, and cope with uncertainty, adversity, and stress; adapt operations to changing risk conditions; use climate and weather information to adapt the way health is delivered; recover from crises and setbacks with minimal outside support; and learn from experience to improve system capacity for the future.

Long-term vision and adaptive management

Climate-related health risks can occur at multiple timescales, from short-term climate variability (such as extreme heat and storms that can trigger health emergencies and disasters over timescales from days to weeks) to long-term climate change (such as timing of the onset of seasons and average number of hot days and nights over decades). Globally, the number of reported extreme weather events is increasing, and these trends will increase the risk of climate-related adverse impacts to humans and health systems, which will bring new challenges and costs. A future challenge for health authorities is that health adaptation will become progressively more difficult (because of increased impacts, complexity of impacts, increased demands for action, competition for resources, etc.). The implementation of interventions should therefore consider a structured and iterative process of decision-making with the aim to improve health service delivery and health system performance in the short- (weeks to few years), medium- (5–10 years) as well as long-term (decades) perspectives. It is important to monitor changes in climate and health risk trends over time to ensure adaptive management approaches that can reduce uncertainty and adjust the health system according to changes. There is also a need to foster new long-term and sustainable models of specific climate change funding streams and to mobilize additional resources into health policy funding mechanisms.

Promote whole-of-society action

Bringing together evidence and actions across the whole-of-society, including the health sector, health-determining sectors, and communities, it is necessary to enhance responsiveness and resilience in health systems. Local communities should be made aware of the complex reality of climate change risks and their effects on their health and well-being. Local level dialogue, two-way information exchange, and community mobilization should be considered as essential functions of the health system. Community empowerment can activate local capacity, increase the scope of available information, improve understanding of vulnerability, and build foundations for local resilience.

Sources: References 1,24,25.

4. Applying a low carbon approach to health systems

Demand, interest, motivation, and opportunities to cut GHG emissions in every sector and across society are increasing rapidly.

As recognized by the UNFCCC and enshrined in the Paris Agreement, countries have common but differentiated responsibilities and respective capabilities in their response to climate change (26). This principle acknowledges the unequal distribution of the causes and impacts of climate change worldwide, as well as the right to development of high-quality health systems. Health systems with a higher level of per-capita emissions have a responsibility to decarbonize more rapidly, beginning in the 2020s. Health systems in countries with lower historical contributions to global emissions should be supported to maximize health system performance and achieve climate resilience, as well as minimize their own emissions.

Taking action to reduce emissions can deliver significant cost savings – for example through reduced electricity and fuel costs, or more efficient use of resources – and lead to large and immediate health co-benefits for patients – for example by reducing new asthma cases, or minimizing exposure to local air pollution (27).

In settings where emissions are low, efforts to reduce emissions should not be made at the expense of protecting health. Thus, actions to support progress towards decarbonization need to focus on both optimal health and reduced GHG emissions (16).

While the health sector is not among the sectors responsible for most of the emissions, it is a substantial contributor to GHG emissions. Although the bulk of these emissions is in highly developed countries, this is changing rapidly as economies grow with reliance on fossil fuels.

Health care systems are responsible for approximately 5% of global emissions, mainly due to energy-intensive production and transportation of supplies, energy consumption, transportation, and waste treatment. These sources of emissions are often categorized by ‘scope’ as defined by The Greenhouse Gas Protocol (28). Standards to measure and manage GHG emissions are described in three “Scopes”:

- *Scope 1* are direct emissions from health owned or directly controlled sources (on site);
- *Scope 2* are indirect emissions from the generation of purchased energy (mostly electricity);
- *Scope 3* are other indirect emissions from production and transportation of goods and services, which include all domestic and international supply chains and end-of-life disposal.

Carbon footprint assessments are conducted with diverse tools which aid in understanding the current sources of GHG emissions from each health system. These may be used as a first step to determining the scale of current emissions by source and can highlight areas to target for emissions reduction.

Where sufficient capacity and data are available, health systems should develop improved estimates of emissions through a combination of ‘top-down’ and/or ‘bottom-up’ approaches (Box 4.1). The first estimates developed will be limited by data availability. However, improving carbon analytics’ capability over time will help to calculate emissions with more precision.

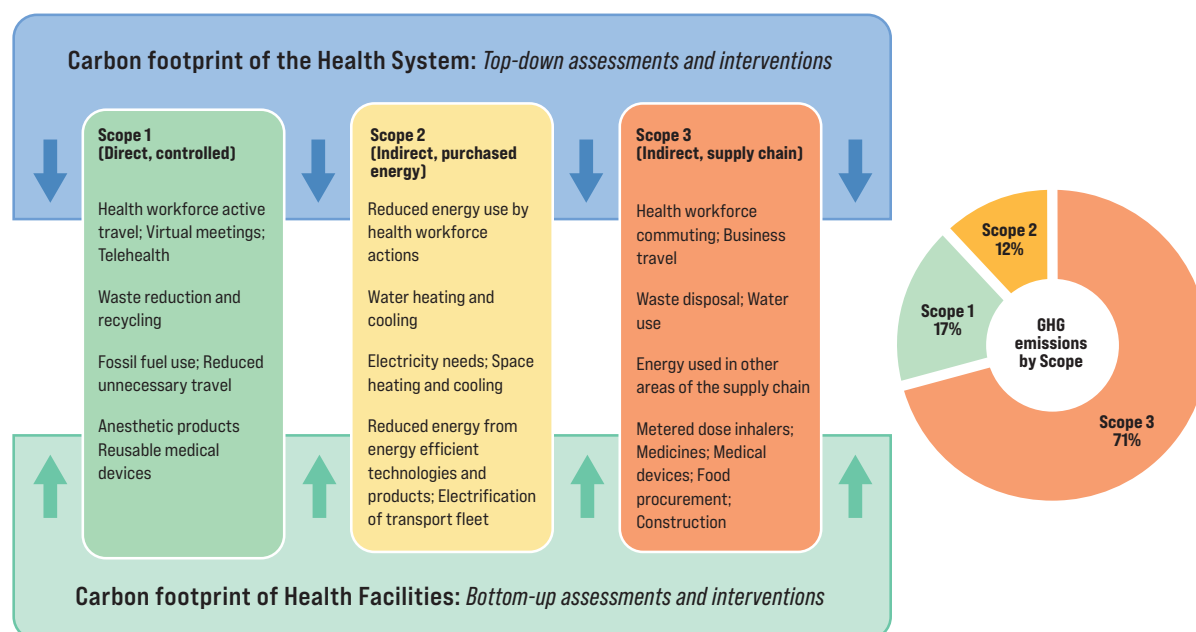
Box 4.1 Different approaches to estimate carbon footprint of health systems and facilities

‘Top-down’ approaches estimate the carbon footprint of the whole health sector (total GHG emissions, often presented as a fraction of national GHG emissions). This approach responds to questions such as *What fraction of all GHG emissions in a country are from the health sector? Where do these emissions originate from? and What are the high-level sources of emissions in the health system?* These estimates are typically based on aggregate measures such as total population or health care expenditure. Top-down approaches guarantee breadth of coverage but are less useful for precision or tracking changes over time. Published estimates comparing different health systems’ emissions are typically based on top-down methods.

‘Bottom-up’ approaches are based on counting activities across a health system (such as units of electricity used, or number of inhalers prescribed) and assigning an average GHG value (‘carbon factor’) to each activity. The sum of these activities can be combined towards a total footprint. Bottom-up approaches can also add emissions of different health facilities to national databases. These approaches offer the ability to track changes in emissions over time and a much more detailed picture of what activity is producing emissions in different parts of the health system. A pure ‘bottom-up’ approach will be limited by the activity data available and cannot offer 100% coverage. These approaches can help respond to more specific questions, such as *How many emissions did a specific health facility generate from diesel combustion?* or *What were the emissions savings compared to last year after installing energy-efficient LED lighting?*

Hybrid approaches combine the breadth of a top-down approach with the detail and insight of a bottom-up approach. A hybrid approach is likely to be the most suitable approach for improving an estimate of health system emissions over time. Over time, health systems should aim to integrate more bottom-up data into their footprint estimates. One such example is the NHS Carbon Footprint Plus model (29) that has been developed over several years and continues to replace ‘top-down’ estimates with new sources of ‘bottom-up’ activity data. These approaches are shown in Fig. 4.1, and the chart to the right shows a typical proportion of emissions from each Scope.

Fig. 4.1. Conceptual framework for low carbon health systems and health facilities (linking health system areas, Scopes, and approaches, with selected examples)



Note: A hybrid model allows for both top-down and bottom-up assessments and interventions together for increased accuracy and targeted action.

Source: Pie chart based on reference 30.

Even when countries are not able to assess their emissions due to lack of data or resources, they can implement several low regret interventions that will bring benefits in terms of climate resilience, low carbon sustainability, or both, and ultimately to the health of the populations they serve. Furthermore, estimations of emissions from health systems by Scope helps to understand where the key hotspots are and therefore inform low regrets interventions. Even in the absence of analytical capabilities and emissions estimates, some interventions can already be implemented to generate environmental, health, economic and/or social co-benefits. Relevant tools and guidance can be accessed in the ATACH Community of Practice (3).

5. Operational framework for building climate resilient and low carbon health systems

5.1. Goal and objectives

Framework's goal and objectives

The framework's goal is to increase the climate resilience of health systems to protect and improve the health of communities in an unstable and changing climate, while optimizing the use of resources and reducing GHG emissions. The framework addresses these two areas in an integrated manner leading to increased preparedness for current and future climate change risks and impacts, potential cost savings, and contributing to slowing down climate change.

Health systems should be increasingly strengthened and continue to be efficient and responsive to improve health, increase capacity, reduce inequities and vulnerability, and provide adequate social and economic welfare, considering the shocks and stresses posed by climate change. This must be done in an equitable, responsible, financially fair way with efficient use of available resources and delivery of health services. The framework aims to achieve its goal by proposing specific functions that, if implemented by health systems, will contribute to building their capacity to effectively monitor, anticipate, manage, adapt to, and help reduce the health risks associated with climate variability and change while minimizing its own environmental impact and GHG emissions.

The framework's objectives are to:

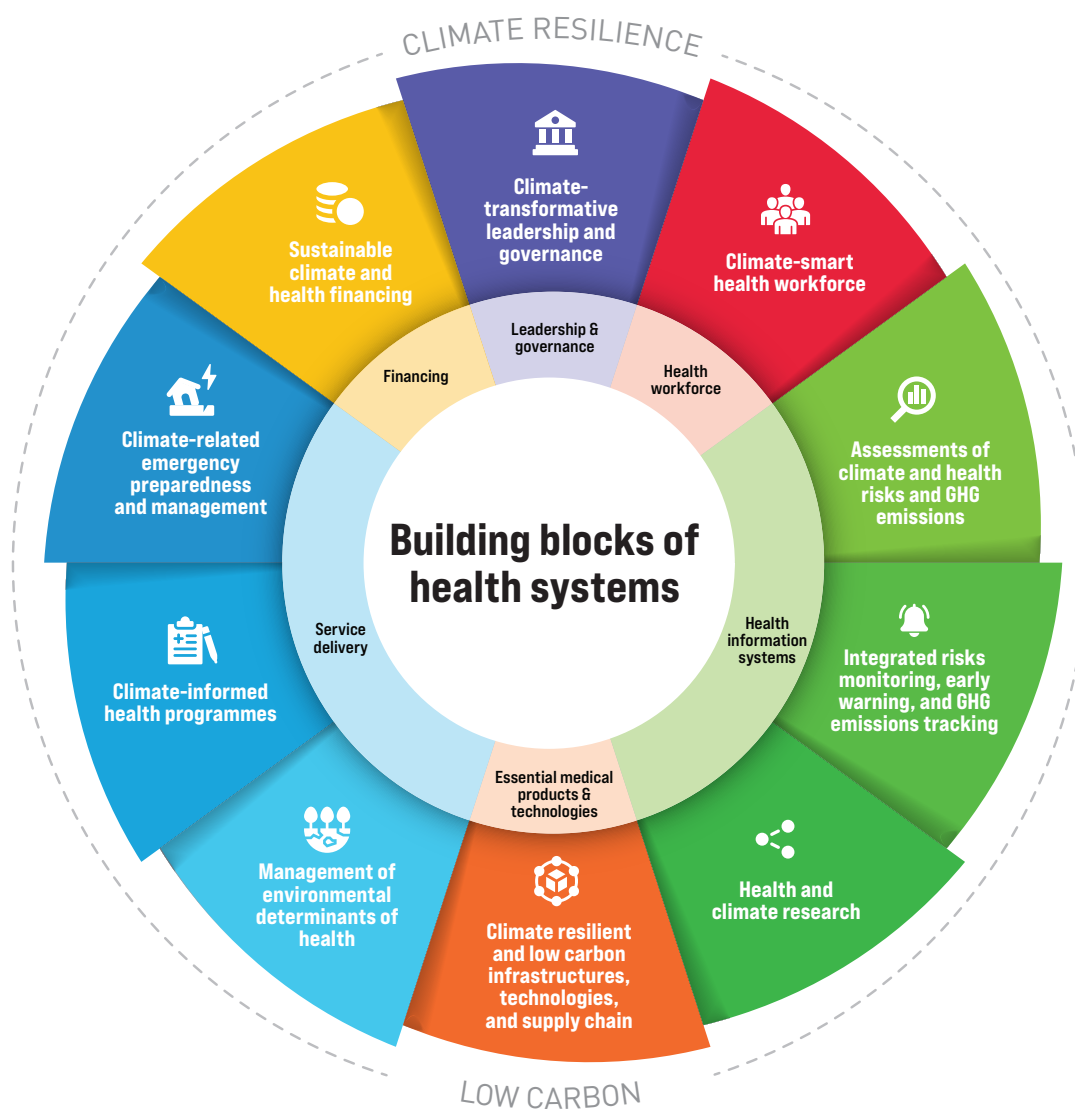
- guide health sector professionals, including through their collaborations with officials in health-determining sectors to understand and effectively prepare for the additional health risks posed by climate change, through climate resilient and low carbon approaches;
- present the main health system functions that need to be strengthened to build climate resilience and low carbon health systems, and use these as the basis for developing comprehensive and practical strategies (e.g. national climate change and health strategy) and plans (e.g. health component of National Adaptation Plan (HNAP) and healthy long-term low emission development strategies (LT-LEDS));
- support the development of specific interventions that can be implemented by health systems that address both the increased risks posed by climate change and progressive reduction of carbon emissions, and the synergies among these actions; and
- support health decision-makers to identify roles and responsibilities to develop and implement action plans for resilience, and low carbon pathways, engaging actors within and outside the health sector.

5.2 The operational framework and how to use it

Health systems vary around the world, but they all share common features in their ultimate goals and key functions. WHO has identified six building blocks that are common and relevant to all health systems, and are needed to support the delivery of UHC and improve health outcomes. These are: (i) leadership and governance; (ii) health workforce; (iii) health information systems; (iv) essential medical products and technologies; (v) service delivery; and (vi) financing (7). For the whole health system to become climate-resilient and have low carbon pathways, each of its six independent building blocks must integrate climate change considerations. To provide a comprehensive health response to climate change risks and

protect people's health and health systems, this new framework proposes 10 components or functions – linked to the six building blocks – that when implemented by health systems would get translated into increased climate resilience and reduced GHG emissions (Fig. 5.1).

Fig. 5.1. Operational framework for climate resilient and low carbon health systems



The framework components should be used to mainstream climate change into sector wide and/or vertical programmes, as well as guide the holistic design of policies, plans and strategies aiming to strengthen climate resilience and/or reducing GHG emissions and environmental impacts of health systems (e.g. HNAP, health in Nationally Determined Contributions (NDCs) (31), health in the LT-LEDs).

Each component plays an important role in promoting an integrated approach to climate resilience and low carbon sustainability. As a systemic approach, there are strong connections between the various components that serve to reinforce one another. The framework is not to be used as a definitive and rigid structure, but as a flexible and iterative approach that should be adapted to the national and local context.

By implementing the 10 key components laid out in this framework, health organizations, authorities and programmes will be better able to anticipate, prevent, prepare for, and manage climate-related health

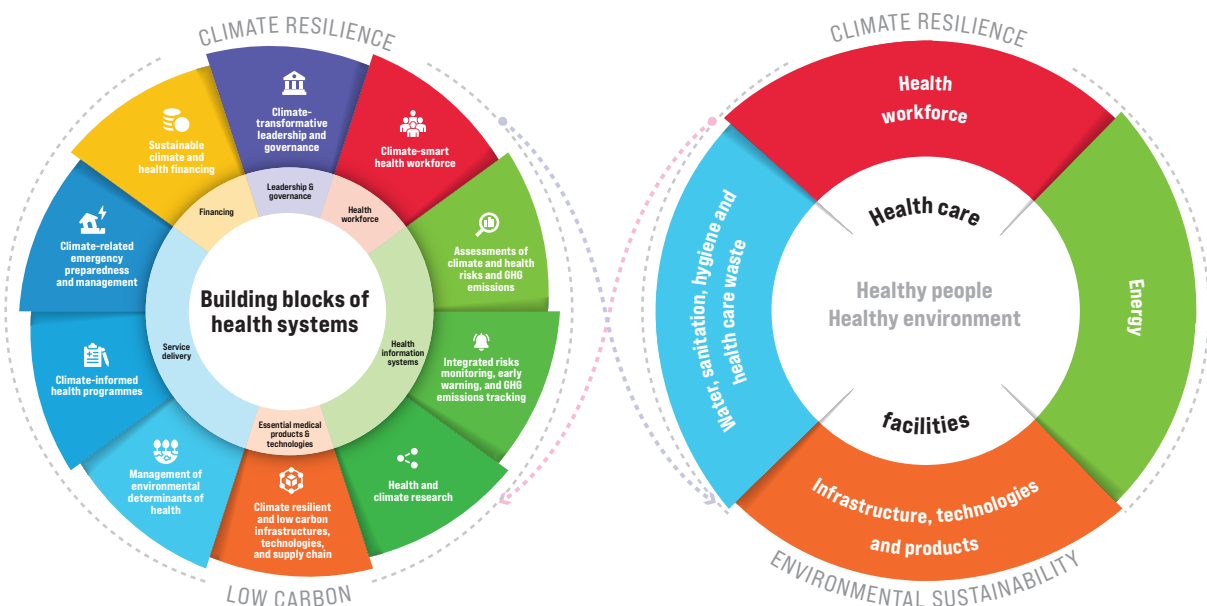
risks while implementing environmental sustainability including low carbon health practices, thereby improving health outcomes. Achieving these aims is an important contribution to UHC, global health security, and specific targets within the Sustainable Development Goals (SDGs).

Countries and partners using the previous (2015) operational framework will find that the current edition follows the same approach, integrates few updates regarding the proposed interventions for building climate resilience, and lays a new focus to simultaneously act on reducing GHG emissions. Thus, work performed up to now is a strong base to further expand climate change action by health systems.

The framework is useful to inform more focused action in health care facilities

Specific guidance providing interventions for strengthening the climate resilience and environmental sustainability in health care facilities (10) and assessing vulnerability of health care facilities in the context of climate change (11), is available for health facility managers and the overall health sector. Under the overall health system's framework for building climate resilient and low carbon health systems, the specific health care facility guidance focuses in four fundamental requirements for providing safe and quality health care in the context of climate change. These are: (i) health workforce; (ii) water, sanitation, hygiene, and health care waste management; (iii) energy; and (iv) infrastructure, technologies, products and processes. Fig. 5.2 shows how the broader health systems relate to action at health care facility level.

Fig. 5.2. The framework as a tool for building climate resilience and low carbon interventions in health facilities



5.3. Different pathways for building climate resilient and low carbon health systems in an integrated manner

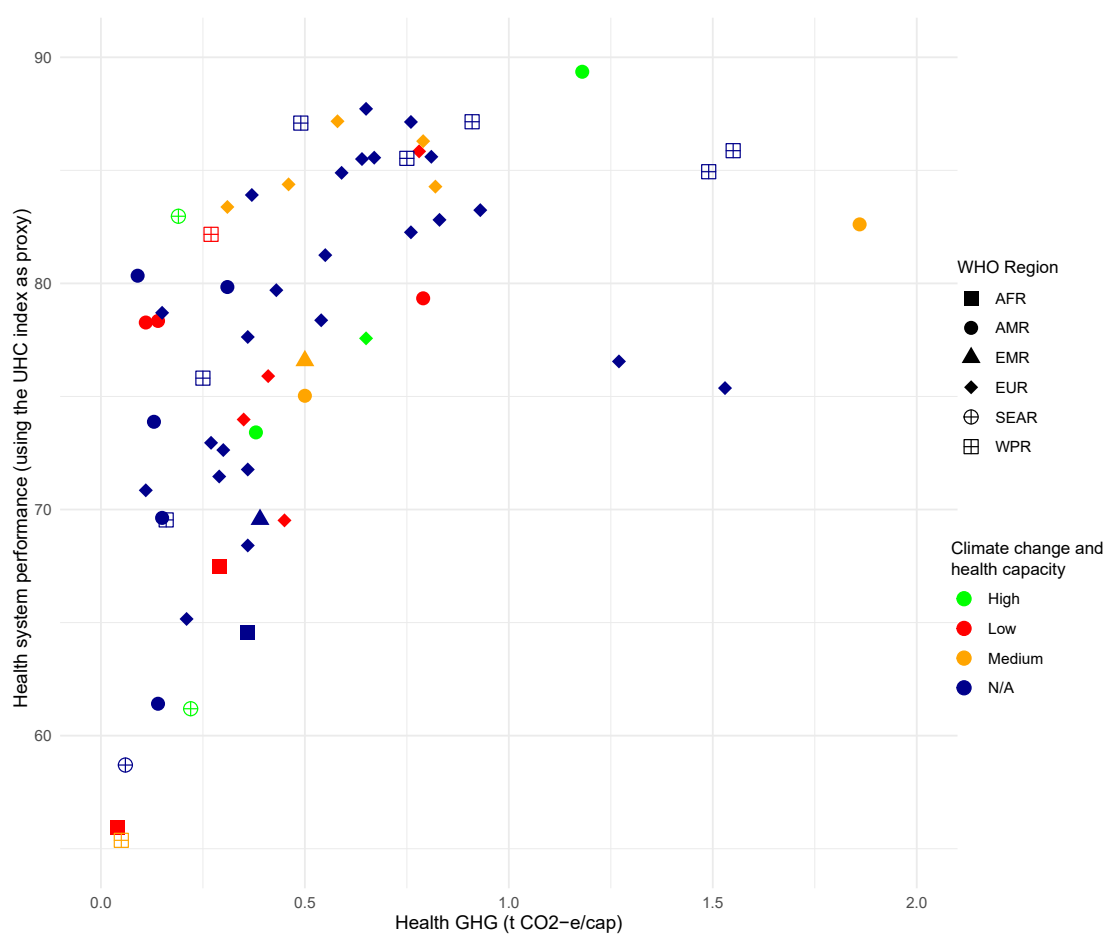
As health systems are faced with increasing threats from climate-related hazards, and direct climate change impacts, the future of health systems and health services need to be based upon complete systems transformation, through collaboration within and across all sectors (19,32).

For the purposes of suggesting specific pathways for health systems to follow in their efforts to build climate resilience and decrease their emissions, the WHO proposes an approach that considers the UHC index (available for all WHO Member States) and the health sector per capita GHG emissions (currently available for about a third of all countries (33). Furthermore, information on the climate change and health capacity of a selected number of countries based on WHO collected data (rated as high, medium

and low) is provided (currently available for about half of all countries). This information was established using the data available in WHO’s global survey on climate and health and was structured using an indicator for each of the building blocks of health systems (34).

The UHC index gives a measure of the overall level of performance of the health system, and underlines the centrality of high-quality, equitable health systems in protecting against all health risks, including those affected by climate change. The climate change and health capacity index aim to capture the additional steps that countries should take specifically to address the evolving health risks from climate change, and which can be implemented irrespective of the overall level of the UHC. The health sector per capita GHG emissions represent the impact of the health system on the climate, to guide countries to limit emissions, without compromising – and ideally enhancing the delivery of UHC and climate resilience (Fig. 5.3).

Fig. 5.3. Health systems performance, health sector GHG per capita emissions, and climate change and health capacity



Note: Selected countries with health sector GHG emissions data. UHC index is available for all countries (WHO Member States). Health sector emission data are available for 64 countries. Health sector climate change and health capacity is based on WHO climate and health survey data and are available for 95 countries.

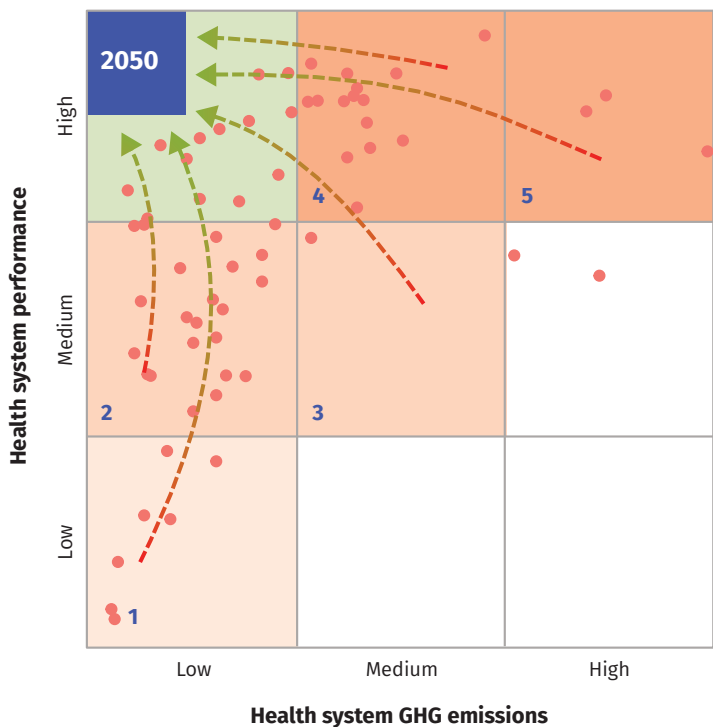
Sources: References 33–35.

The pattern that emerges is one of large differences in the different dimensions represented in Fig. 5.3. All sectors within countries need to reduce their GHG emissions. For the health sector, some countries with currently very high health sector GHG emissions need to urgently reduce emissions without sacrificing

quality of care, including climate resilience, while others with currently low health sector GHG emissions need to focus on strengthening the overall performance and specific climate resilience of their health systems; as a process towards a low carbon future with equity.

Based on Fig. 5.3, Fig. 5.4 helps to determine the baseline and targets for climate resilience and GHG emission reductions for health systems. Although health sector GHG emissions data is limited to around a third of all countries, it may still be possible for countries without such data to estimate where they are within broad categories of *low*, *middle*, or *high* health sector emissions. Considering a study (33) that produced data for 64 countries which comprised over 89% of global gross domestic product (GDP), it is reasonable to assume that many of the remaining countries, absent from Fig. 5.3 and currently without data, would have *low* or *medium* health sector GHG emissions. Fig. 5.4 shows the different pathways countries can follow to maximize health system performance, including climate resilience, while minimizing GHG emissions.

Fig. 5.4. Different pathways to maximize health systems performance, including climate resilience while minimizing GHG emissions



There are at least five baseline situations and proposed pathways for countries. These are summarized in Table 5.1.

Table 5.1. Pathways for strengthening climate resilience and low carbon sustainability of health systems

Area	Health system performance	Health sector GHG emissions	Climate resilience and low carbon pathways
1	Low	Low	Focus on climate resilience while adopting sustainable low carbon technologies
2	Medium	Low	Strengthen climate resilience while introducing sustainable low carbon interventions
3	Medium	Medium	Strengthen both climate resilience and low carbon sustainability
4	High	Medium	Strengthen low carbon sustainability while promoting climate resilient health systems
5	High	High	Focus on achieving net zero emissions while continuing to promote climate resilience
Target	High	Low	Net zero emissions and climate resilience by 2050

Note: For health system performance, **high** is preferable. For health sector GHG emissions, **low** is preferable.

The proposed pathways recognize that, although all health systems should be moving to low carbon pathways, in some cases they may temporarily increase their emissions to ensure quality of care. As an example, at least one billion people globally are served by health facilities without reliable access to electricity (36). Therefore, countries in area 1 (Fig. 5.4), which are not able to immediately adopt renewable energy, need to minimize growth in GHG emissions, thus ensuring their health system provides quality care, before reducing their emissions within for example, the next decade.

Countries can begin to assess where they find themselves in terms of both dimensions, by obtaining data already prepared, or estimating their own, where none are available. For health system performance, WHO produces several useful indicators, including the UHC index and health-adjusted life expectancy (HALE), and the WHO/UNFCCC country profiles on health and climate change (37). Availability of health GHG emission data for whole health system assessments is a constraint for some countries. However, it is not necessary to estimate current sector emissions quantitatively, as qualitative assessments are useful.

Countries in areas 1, 2 and 3 have the opportunity to continue strengthening their climate resilience while adopting low carbon technologies and implementing low regret interventions for decreasing their emissions (e.g. greener waste management practices, energy efficiency measures). These low regret interventions make sense from an economic, social, and environmental perspective.

Countries in area 4 and particularly area 5, on the other hand, need to make rapid transformations to reduce their GHG emissions and ideally, reach net zero emissions by no later than 2050.

In every case, the aim of the proposed pathway is to reach the target of a climate resilient and low carbon health system (green area) responding to the needs of countries across different levels of development. All health systems can eventually reach net zero emissions, and many should target to do this before 2050 (blue area).

6. Framework components for building climate resilient and low carbon health systems

COMPONENT 1



Climate-transformative leadership and governance

Overview

This component addresses the importance of strong leadership and governance for climate resilience, low carbon pathways, and environmental sustainability in health systems. It is implemented through ensuring specific governance for climate change and health; developing health policies and programmes that integrate climate change considerations; ensuring that health is integrated in climate change processes, policies, and plans; and cross-sectoral collaboration to protect health from climate change. Together these functions provide an enabling environment required for coordinated actions on climate change and health.

At the health system level, political leadership, and willingness at the highest levels within the government to address the health risks of climate change and to reduce emissions are essential to ensure the integration of climate change considerations by all health programmes. This includes strengthening collaboration across all relevant health programmes, such as environmental health; epidemiological surveillance; vector and zoonotic control; water, sanitation and hygiene; mental health and NCDs; maternal and newborn health; health care waste management; air quality surveillance; chemical surveillance; preparedness and management of disasters; health information systems; health workforce and human resources; pharmaceuticals, technologies, infrastructure and the supply chain; and operation and delivery of health services.

At the same time, an effective response to climate change implies assessment, monitoring, regulation, and management of climate-related health risks that originate in other sectors. These sectors include agriculture and food; water; waste; energy; transport; labour and industry; land planning; housing and infrastructure; and emergency and disaster risk management. In most countries these sectors have active programmes to respond and adapt to the impacts of climate change, however few integrate health considerations within those. Cross-sectoral collaboration will help reduce unintended risks to health and achieve large and immediate health co-benefits associated with the climate change adaptation and mitigation policies and programmes of those sectors. It will also increase the resilience of systems and services that support the operation of the health system (e.g. transport, food, water, energy, pharmaceuticals, medical devices) (23).

Cross-sectoral collaboration also refers to ensuring that partnerships required to warrant whole-of-society actions on climate change and health are implemented. Health sector participation on national or subnational climate change committees or participation by officials from health determining sectors

in climate change and health vulnerability and adaptation assessments can support cross-sectoral collaboration.

Accountability is an integral part of health governance and of effective and efficient health system functioning. It requires engagement with, and accountability to the wider communities that are affected by the decisions taken on their behalf, on the provision of affordable health services for all, ensuring equity, quality and efficient people-centred care and healthy communities in a changing climate.

Objectives for the implementation of this component

Governance – Specific responsibility and accountability mechanisms on climate change and health established within the Ministry of Health.

Policy development – Climate change considerations, both for resilience and low carbon sustainability, reflected in main health policies and programmes.

Cross-sectoral collaboration – Cross-sectoral collaboration strengthened, and synergies maximized to ensure that decisions taken in other sectors protect and promote human health.

Sample measurable outputs and indicators for climate-transformative leadership and governance

Climate-transformative leadership and governance

Objective 1: Governance

Climate change and health focal points designated within the Ministry of Health with specific programme of action and budget allocated

Health sector commitment to achieve climate resilience in the health system

Health sector commitment to transition the health system (including health care facilities and supply chains) to low carbon or net-zero emissions

Climate change and health focal points or units, working in collaboration with relevant climate-sensitive health programmes (e.g. vector-borne diseases, nutrition, infectious diseases, disaster risk reduction) to build climate resilient and low carbon programmes

Gender-sensitive approach adopted in the regulations and strategies on climate change and health

Meaningful participation of the health sector in main climate change processes at national, regional, and global levels with UNFCCC global negotiations, National Adaptation Plan, National Communications (NCs), Nationally Determined Contributions (NDCs), and long-term low-emission development strategies (LT-LEDS) promoted

Objective 2: Policy development

National strategy on health and climate change (covering both resilience and low carbon sustainability approaches) developed

Health component of National Adaptation Plan (HNAP) developed and integrated as a chapter in the overall NAP

Health is integrated into the Nationally Determined Contributions (NDCs)

Mechanism to estimate GHG emissions in the health system established

A roadmap or action plan for building climate resilience in health systems developed in collaboration with health-determining sectors and community actors to support HNAP implementation

A roadmap or transition plan for reducing GHG emissions in the health system developed in collaboration with health-determining sectors, including decarbonization targets

Coordinated strategies established within the health sector and in health-determining sectors to develop policies for building a climate-resilient and low carbon health system, maximizing health co-benefits

Objective 3: Cross-sectoral collaboration

Agreements (e.g. Memoranda of Understanding) established between the Ministry of Health and key stakeholders at national level (e.g. meteorological and hydrological services, ministries of environment, food and agriculture, energy, transport, planning), including specific roles and responsibilities in relation to protecting health from climate change and/or reducing the GHG emissions of health sector operations

Multisectoral governance and coordination (involving people, communities, civil society, private sector, and all other engaged stakeholders) mechanisms established to support climate resilience and decarbonization in the health system

Main policies and strategies from health-determining sectors reflect climate change and health considerations both in relation to adaptation (e.g. climate-resilient water and sanitation safety plans) and mitigation (e.g. promotion of policies maximizing health co-benefits in the transport sector)

Inter-ministerial group on climate change and health established and promoting health in all adaptation and mitigation policies of key health-determining sectors

Health impact assessments conducted for new mitigation and adaptation policies and programmes in all health-determining sectors, in accordance with article 4.1.f. of the UNFCCC (minimize adverse effects on public health)

COMPONENT 2



Climate-smart health workforce

Overview

The health workforce is key to building climate resilience and environmental sustainability of health systems. This component refers to: fortifying the health and care workforce to respond to climate-related health risks; the promotion of a fit-for-purpose health and care workforce with competencies and a conducive working environment in health systems to manage climate threats, and to reduce its own GHG emissions; and providing actionable information and communication to work with communities and health-determining sectors in the context of climate change and health.

A health system relies upon an effective health workforce to achieve the best health outcomes possible, given available resources and circumstances. Climate change may increase local demand for health services, thus potentially altering the number of health workers required, the skills mix of health workers needed, as well as their competencies. The availability of the required health and care workforce with the required capacity to act on climate change and health is a fundamental determinant of overall climate resilience as it strongly predicts the capacity of health systems to provide health services in a changing climate. Information, and technical and professional capacity of the health workforce, including health and care workers, cleaners and waste handlers, administrative personnel, managers and decision-makers, and community-based organizations, should be strengthened in a way that they are able to deal with the health risks from climate change while leading the reduction of GHG emissions and contributing to overall decreased environmental impacts in their respective areas of work.

Health workforce competencies can be developed through pre-service education, lifelong learning, and mentoring. Skills required include understanding and using climate information for health interventions and decision-making; engaging in cross-sectoral action; conducting research, assessments, and interventions; and effectively managing climate change risks to health and health system performance. In addition, a range of competencies would become increasingly important in the face of climate change, such as the ability to effectively work and communicate across disciplines, with health actors and the public, as well as analytical skills to interpret and use non-health information for decision-making. Increased health workforce capacity will help health systems to respond to risks associated with climate change, measure its carbon footprint, and promote innovative transition to low carbon or net zero emission systems, and become environmentally sustainable.

In addition to strengthening the technical and professional capacity of the health workforce, it is also strategically important to strengthen the organizational capacity to implement climate change and health actions both for resilience and low carbon sustainability. This includes modifying existing policies, programmes, and activities; ensuring the availability of sufficient financial, technical, and human resources; the efficient and targeted use of resources, information, knowledge, and processes employed by the organization (such as resource mobilization and income generation, human resources and staffing, health programmes and process management, health service delivery, energy and water consumption, waste management, technologies, infrastructure, and supply chain administration) (38,39).

Lastly, institutional capacity needs to be strengthened, including enhancing the ability of health systems to partner with other health-determining sectors to protect and promote health.

WHO projects a shortfall of 10 million health workers by 2030, with 73% of this shortage concentrated in the African and Eastern Mediterranean Regions (40). High-income countries are increasingly depleting the health workforce from an increasingly scarce pool of available health and care workers in LMICs (41). This situation further weakens the capacity of the already vulnerable health systems to manage climate related risks and be climate resilient (40).

Improved information, awareness and communication on health impacts of climate change, and opportunities for reducing emissions, targeted to different audiences (e.g. policymakers, health facility managers, media and communities) is critical and should be grounded in the principle of health equity. This involves the ability to define and fulfil responsibilities in collaboration with other sectors, and communicate with the public, including through the media. It is therefore important to build awareness and media capacity to communicate climate risks and associated uncertainty effectively and responsibly, and to identify how to best disseminate appropriate and constructive public service announcements.

Health actors can assist communities to be aware of the climate challenges they face, be involved in risk identification, and participate in decision-making, thus becoming empowered to effectively protect themselves. Community groups and leaders need to be prepared for responding to local risks, knowing what role they play in preparedness, prevention, and response, and being aware of potentially effective and equitable solutions and resources available to them. Communities often have valuable local information about risks, community capacity and vulnerability that can help guide the formulation of responses. Outreach, partnerships, stakeholder engagement, and effective two-way dialogue are vital to improving how the health system and their health workforce function with the community. Workers in other sectors need to be aware of the scope and scale of health risks that originate within their sectors; and the need for effective dialogue to enable effective collaborative planning, policy, and implementation of actions with co-benefits to health.

Objectives for the implementation of this component

Health workforce capacity – Sufficient number of health workers with the required technical capacity to deal with the health risks posed by climate variability and change and to lead reductions in GHG emissions.

Organizational capacity development – Resources, information, knowledge, and processes employed by health organizations used in an efficient and targeted manner to promote climate resilience and reduce their own GHG emissions and environmental impacts.

Information, awareness and communication – Improved information, awareness and communication on health impacts from climate change and opportunities for reducing emissions targeted among different target audiences (e.g. policymakers, health facility managers, media and communities).

Sample measurable outputs and indicators for a climate-smart health workforce

Climate-smart health workforce

Objective 1: Health workforce capacity

Percentage of health workers having received training on climate resilience in the past two years

Percentage of health workers having received training on low carbon sustainability in the past two years

Health workers in specific programmes have information and training on the interlinkages between specific health outcomes and climate variability and change

Health workforce capacity developed on decarbonization opportunities in health systems and health care facility operations, the supply chain and in-service delivery

Curricula on climate change and health covering both resilience and low carbon sustainability issues developed and imparted in secondary and/or tertiary levels

Objective 2: Organizational capacity development

Contingency plans for the deployment of sufficient health personnel for acute shocks (e.g. extreme weather events and outbreaks) developed at the relevant level (i.e. national, provincial, local)

Innovative approaches to reducing GHG emissions at health system or health care facility level (e.g. teams sharing best practices across different domains, and a system of rewards) promoted

Percentage of health workforce participating in decision-making, planning and management of climate change risks

Number of capacity building initiatives integrating climate change and health at early stages of professional health training

Innovative capacity building plans responding to identified human resources and institutional capacity gaps developed

Objective 3: Information, awareness and communication

Health professionals, the media and community leaders trained on climate change risk communication, including communication of uncertainty

Stakeholder forum on climate change and health established as a way to engage health determining sectors, the media and community groups

Internal and external health communication plans with focus on raising awareness of climate change risks and health outcomes and implementing efficient strategies to build climate-resilient health system developed

Internal and external health communication plans with focus on measuring GHG emissions and implementing strategies to reduce health system emissions developed

Health workers and communities understand potential future health risks related to climate change and the actions they can take

Awareness among decision-makers, health workers, the media and community leaders on climate change and health raised

Initiatives with focus on climate change risk communication established among different target audiences, developed in the health action plan

COMPONENT 3



Assessments of climate and health risks and GHG emissions

Overview

This component includes a range of assessments that can be used to generate policy-relevant evidence on the scale and nature of climate-related risks to health and health systems, and the impact of health systems operations and GHGs emissions on the environment. It also includes generation of information on health-promoting mitigation actions and policies in sectors responsible for most of the GHG emissions.

There are several tools to support this framework component. Specifically, the climate change and health vulnerability and adaptation (V&A) assessment is an essential tool for health policy and programmatic planning (42). V&A assessments can help identify which populations and geographical areas are most vulnerable to the different health impacts from climate hazards; establish baseline conditions and assess potential health impacts from future climate change; support assessing changes in disease risks; define the protective measures required; and the capacity of health systems to manage risks.

Successful V&A assessment processes will often include inputs from academic expert to ensure high quality evidence, as well as managerial and operational personnel to ensure relevance to policy and practice. The studies will examine health risks separately (e.g. heat stress, nutrition, dengue) and consider how they interact with each other and with changes in other health determinants, such as ageing and urbanization. Throughout the V&A assessment process a range of additional studies, analytical exercises and tools may be used to gain a more holistic perspective of health vulnerability to climate change. These include:

- vulnerability and risk mapping,
- modelling,
- scenario development,
- health system capacity and performance assessment,
- economic assessments,
- health impact assessments of decisions in other sectors,
- specific risk, events, and hazard assessments.

With regards to impacts from climate change, in addition to tools for assessing the health risks from climate change at the population level, tools are also available to assess the vulnerability and impact of climate change at health care facility level. Health facilities are often exposed to climate-related hazards such as storms, drought, floods, sea-level rise, extreme heat, and increased outbreaks from climate-sensitive diseases. Assessment of vulnerabilities and impacts, by hazard of concern can be done through completion of checklists as proposed by the WHO and integrated into health programmes (10,11,43).

As health systems are responsible for approximately 5.2% of global carbon emissions (16), approaches and tools to understand key hotspots of these emissions are needed. Understanding these emissions for

the three GHG Protocol scopes (28) is essential to advance towards low carbon and net zero emissions. New assessment tools for estimating GHG emissions from health systems and health care facilities are being developed. Measurement of emissions by health systems and health care facilities will inform the development of targeted decarbonization and environmental sustainability actions and plans. If the resource is available, emissions measurement and monitoring should ideally be carried out by teams embedded in each health system, with an expert knowledge of health system data and specific national contexts. Developing a dedicated carbon analytics capability in health systems will help to calculate emissions with more precision, fill evidence gaps, prioritize data-driven high impact projects, and monitor and verify emissions reductions.

Understanding the potential health co-benefits of climate action and the cost of inaction, also provides evidence for implementing effective and efficient actions, while increasing the capacity of health systems to protect and promote health in a changing climate.

Objectives for the implementation of this component

Health risks – A sound understanding of the main hazards, exposures, current and future health risks, vulnerabilities of different population groups, geographical areas, and health systems available in the country or region.

GHG emissions – Information on key hotspots of GHG emissions at national health system level and facility level available in the country or region.

Progress tracking – A process and system established to track progress in overall climate resilience and GHG emission in health systems as well as to assess health risks in an iterative manner.

Sample measurable outputs and indicators for assessments of climate and health risks and GHG emissions

Assessment of climate and health risks and GHG emissions
Objective 1: Health risks
Climate change and health vulnerability and adaptation assessments conducted, providing evidence on current and future health risks from climate variability and change
Baseline rates and climate sensitivity of health conditions, allowing the selection of priority risks, and continuous monitoring of changing risk conditions and health outcomes assessed
Information on health system’s capacity (for each of the ten components included in this framework) to address the increased health risks from climate change gathered as part of the V&A assessments
Results of V&A assessments integrated into health system planning and into key climate change processes (e.g. HNAP)
Vulnerable populations and areas prone to high current and future climate-related health risks identified and mapped
Health trends in climate-sensitive diseases assessed

Objective 2: GHG emissions

Assessment of GHG health sector emissions conducted

Publicly report a GHG inventory for a base year of emissions.

Information on the environmental impact, including GHG emissions, of products and services used or delivered by the health system

Information on key GHG emissions in health systems and/or health care facilities available and used to inform interventions aiming to reduce emissions

Low regret interventions for reduction in GHG emissions identified for each of the key GHG emission hotspots (e.g. access to renewable energy, energy efficiency, greener waste management practices, transition to low carbon transport, reducing emissions from anaesthetic gases and inhalers)

Interventions to reduce supply chain emissions identified, including through: more efficient use of resources; low carbon substitutions and product innovation; and requirements for health system suppliers to reduce GHG emissions

Agreements with health system suppliers to reduce GHG emissions in the supply chain established

Number of health facilities with GHG emissions assessed

Objective 3: Progress tracking

Assessments' results used to identify a set of key indicators to be tracked over time both for health systems' climate resilience and reductions in GHG emissions

Establish a dedicated climate change team responsible for coordinating implementation of the climate strategy and monitoring progress across the system

Assessments' results used to prioritize allocation of resources and effective climate change and health interventions both for resilience and low carbon sustainability

Plan defined and mechanism established for iterative assessments of health risks from climate variability and change

COMPONENT 4



Integrated risks monitoring, early warning, and GHG emissions tracking

Overview

This component aims to strengthen climate change and health integrated disease surveillance and climate-informed early warning systems (EWS); integrated monitoring and progress tracking including GHG emissions and other environmental impacts; and communication to inform timely action.

Climate change is altering the incidence and distribution of several climate-related health outcomes, including the transmission of vector-, water-, and food-borne diseases, and NCDs, such as cardiovascular diseases, respiratory illnesses, and mental health conditions. Building climate resilience to respond to these challenges entails: (i) developing adequate capacity and flexibility to understand how climate conditions influence health outcomes; (ii) being able to anticipate changing health risks; (iii) informing preparedness, surveillance, and response in a timely manner; and (iv) monitoring health outcomes. Developing integrated disease surveillance and climate-informed health early warnings will inform the way vertical programmes deliver them.

The aim of integrated risk monitoring is to generate a holistic perspective of health risks with real-time information. It uses a set of diverse instruments to bring together information about health, climatic and environmental conditions, and response capacity. It refers to the use of early detection tools and epidemiological surveillance in conjunction with in-situ and remote sensing observations of environmental determinants of health (e.g. water availability, air and water quality, variability in ambient temperature, precipitation, humidity, or extreme weather events). Monitoring a broad range of signals around a health risk can allow changing conditions to be identified more quickly in order to anticipate detection of outbreaks and emergencies related to weather and climatic conditions (44).

Tracking qualitative and quantitative information about community and health system vulnerability, preparedness and response capacity levels are also important elements of risk monitoring. For example, it is important to maintain up-to-date information on whether high-risk regions have adequate workforce and supplies during the cyclone season; whether certain areas have high concentrations of vulnerable groups; as well as to identify regions and/or health facilities that could be more vulnerable to extreme events due to setbacks caused by recent disasters, loss of leadership or resources.

Integrated risk monitoring is the basis for establishing EWS to identify, forecast and communicate high-risk conditions. In the context of infectious disease epidemics, the use of climate-informed EWS has the potential to increase the effectiveness of disease control by intervening before or at the beginning of the epidemic curve, instead of during the downward slope. Currently, the initiation of interventions is heavily reliant on routine disease surveillance systems – data that often arrive too late for a preventative response. However, forecasting of disease outbreaks using surveillance and weather information shows promising potential. By combining these elements in a new EWS based on computational models, it would be possible to improve both the timeliness and impact of disease control. The core elements of climate-informed EWS are to: “(i) monitor environmental conditions; (ii) forecast high-risk conditions, and initiate active surveillance; (iii) send alerts and communication; and (iv) establish a mechanism for early response.” (44).

In addition to building and implementing climate-informed health EWS, the health sector's capacity to understand and respond to the EWS for extreme weather events should be strengthened. Advanced alert can provide additional lead-time to deploy appropriate preparedness measures and responses. Short- and long-term risks related to climate change need to be monitored to ensure that short-term interventions build flexibility and capacity to prepare for, respond to, and manage existing risks and additional future risks, considering the different climate-sensitive health outcomes (23). Effective risk monitoring and EWS can prevent illness, injury and death when coupled with adequate response capacity (44).

Information sources on climate-risks may originate from local community knowledge, as well as multiple fields of scientific and practice-based knowledge (such as epidemiology, meteorology and climate, environment, agriculture, water resource management, environmental health surveillance). Relevant information may be qualitative or quantitative, as well as observational or modelled.

Key environmental risks for the health system to monitor include extreme weather events, such as temperatures known to induce heat or cold stress; air quality; UV radiation; rainfall and humidity levels that favour or restrict vector abundance; El Niño/La Niña years; seasonal allergen loads and occurrences; water availability and quality; and water and sanitation infrastructure preparedness for extreme events.

Because information on environmental and climate conditions are generally best collected and analysed by their respective authorities, health authorities are not always expected (or have the capacity) to collect these additional data. It is recommended to establish partnerships with the relevant data custodians, such as meteorological agencies, hydrological and environmental services, academic institutions, or others to access and appropriately interpret non-health information.

In addition to monitoring and predicting risks, health systems should also build their capacity to monitor GHG emissions and track progress on emission reductions. This begins with measuring current emissions using existing approaches. Data collected through the GHG emission assessment (refer to component 3) will need to be integrated into the health monitoring system. Regular assessments of the GHG emissions, health and environmental outcomes associated with sustainability measures should be continuously improved to integrate new data and reflect the latest scientific evidence. Emissions progress should be regularly monitored and reported publicly, for example through annual reports and the UNFCCC Global Climate Action Portal. This will require collaboration across health sectors and among other sectors.

Environmental impacts from health systems are related to land use, air pollution and GHG emissions through energy consumption (transport, electricity, heating, and cooling) as well as product manufacturing, procurement, use and disposal. Sustainability, from this perspective, means implementing interventions that optimize the consumption of resources (such as water, energy, food), and reduce GHG emissions and waste discharge (including biological, chemical, radiological); and including procurement of goods and services that follow the principles of environmental sustainability (10). Multidisciplinary teams, public and private partnerships, and open access to consistent and comparable data will be essential to interpret and monitor the emissions within and outside the health sector. There is a need to refine current methods and tools that can be applied at the different levels of the health system (32,45).

Objectives for the implementation of this component

Integrated disease surveillance and early warning – Data on climate-sensitive environmental risks, hazards, and epidemiological trends collected, analysed and interpreted on a continual basis, and timely response to risks promoted.

Monitoring and progress tracking – Information on climate change, health risks, impacts, vulnerability, health systems capacity, environmental impacts and GHG emissions of health sector operations monitored and reported over time.

Communication – Timely warnings communicated to health decision-makers, the media and communities and translated into effective action to prevent negative health outcomes.

Sample measurable outputs and indicators for integrated risks monitoring and early warning, and GHG emissions tracking

Integrated risks monitoring and early warning, and GHG emissions tracking

Objective 1: Integrated disease surveillance and early warning

An integrated climate and health surveillance system for specific climate sensitive diseases implemented

Early detection tools (e.g. rapid diagnostics, syndromic surveillance) used to identify changing incidence and early action identified and implemented

Climate-informed health early warning systems that predict the risk of outbreaks of priority infectious diseases (e.g. malaria, dengue, cholera) developed and implemented

Climate and weather information used to assess risk of outbreaks of climate-sensitive diseases (i.e. integrated health and climate surveillance systems)

Participation of the Ministry of Health in cross-sectoral groups receiving warnings on extreme-weather events

Geographic and seasonal distribution of health risks and outcomes (e.g. risk mapping) tracked for priority climate-sensitive diseases

Objective 2: Monitoring and progress tracking

Monitoring process with a clearly defined mechanism for the tracking system to measure progress in GHG emissions reduction established

Impacts from main climate-related determinants of health (e.g. water availability and quality, air quality, food) monitored by the health sector

Indicators on climate change risks, impacts, vulnerability, capacity of health systems, and emergency preparedness capacity, as well as climate and environmental variables included in relevant monitoring systems at the national level and reported over time

Periodic reviews for improvement or deterioration of capacities identified in V&A assessments

Objective 3: Communication

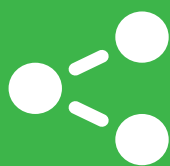
A communication plan or strategy on climate risks to health (both for acute shocks and stresses) developed and implemented, outlining the scope of information for diverse audiences (e.g. media, public, health personnel and other sectors) and events, including who should communicate, and the means of communications – developed and implemented

A communication plan or strategy on health system decarbonization – outlining the scope of information for diverse audiences (e.g. media, public, health personnel and other sectors) and events, including who should communicate, and the means of communication – developed and implemented

Information on the health system's carbon emissions and best reduction practices and opportunities shared with relevant stakeholders and communities

Community engagement and feedback mechanisms established to empower affected populations to respond to warnings, and to guide future development of monitoring and warning systems including with regards to environmental impacts of health care

COMPONENT 5



Health and climate research

Overview

This component addresses the importance of providing evidence base towards policy relevant norms and innovative solutions for climate change and health. It includes identifying strategic priorities for fostering research agenda development and implementation; strengthening capacity for research; and integrating research into policy.

Accurately estimating the impact that climate-sensitive health risks cause remains a challenge, despite the unequivocal reality that climate change affects human health. Long-term effects depend on current measures to reduce the emission of GHGs. Scientific research allows us to estimate increases in morbidity, injuries and mortality caused by global warming.

Building climate resilience calls for both basic and applied research to reduce uncertainty about how local conditions may be affected, gaining insight into local solutions and capacities, and building evidence to strengthen decision-making. Implementing strategies for sustainable low carbon health systems also need research support and development of assessment methods to support countries in measuring the total health system resilience and carbon footprint.

Much research has been developed to understand and improve the evidence base on health systems solutions across expanded networks for health, from action to improve health through safer and healthier environments to new and emerging environmental risks, which include climate change. To develop, evaluate, and update norms and regulations it is important to scale up evidence-based communication to raise knowledge of health risks, impacts, costs to society, and how to identify, assess, monitor, and respond to emerging environmental threats to health. This requires strategic policy relevant research to drive innovative policy actions (46).

Research on climate change and health is advancing, but it is still limited in many areas such as on methods to accurately estimate the burden of disease, the burden on the health system, effectiveness of interventions to address the health impacts from climate change and build health system climate resilience, methods for tracking the carbon footprint of health systems, and effectiveness of interventions to decarbonize health services and associated supply chains. Key priorities for research going forward include: promoting equity and social justice; strengthening the collection of sex-disaggregated data; conducting economic assessments to quantify both the economic impacts of climate change and the health costs of mitigation and adaptation actions; promoting collaborative intersectoral research; bridging the knowledge and action gap; and improving advocacy and communication for motivating and guiding choices and investments related to the reduction of GHGs and climate change and health adaptation (47).

Research from global to local level can be used in the following ways: to gather knowledge on climate risks to health and health systems' impacts on the environment; the modulating effect of social and environmental determinants of health; climate-sensitivity of diseases and risks; how communities and health systems currently understand and cope with climate risks and GHG emission reductions; how

local conditions and vulnerabilities are connected to broader social and environmental determinants; and the degree to which communities and local health services are prepared to reduce carbon emissions and environmental impacts while responding to climate-related stress and shocks. Applied research that can develop and test new low carbon technologies, data tools and instruments, and strategies for risk management is also critical to evidence-based decision-making.

Research should inform existing knowledge management platforms, support relevant multidisciplinary networks, be effectively communicated, and find opportunities to be translated into practice. Guidance on priority knowledge gaps and ideas to shape national research can be found in global and regional level research agendas, such as those led by the WHO (46,47). These may be made more relevant through the adaptation to specific national or subnational context. Furthermore, a coordinated and prioritized research agenda on climate change and health is necessary to support evidence-based programmatic, policy and financial choices, and other recommendations for decision-making, and to identify health co-benefits of adaptation and mitigation initiatives.

Objectives for the implementation of this component

Research agenda development and implementation – Multidisciplinary national research agenda on climate change and health defined, endorsed and implemented in collaboration with decision-makers and key stakeholders.

Research capacity – Research capacity on climate change and health developed, covering climate resilience, low carbon sustainability and built by supporting relevant multidisciplinary networks, making available financial resources and creating training opportunities.

Research into policy – Research on climate change and health integrated and translated into policies to build evidence-based capacity on adaptation and mitigation options and inform decision-making within and outside the health sector to transform practices and contribute to policy outcomes.

Sample measurable outputs and indicators under health and climate research

Health and climate research
Objective 1: Research agenda development and implementation
National research agenda on climate change and health developed
National research agenda on climate change and health incorporates health system decarbonization
The health system has a budget dedicated to climate and health research agenda
Results of a V&A assessment are used to inform a national research agenda on climate change and health
Research agenda incorporating the need to identify technologies for climate resilience with GHG emission reduction potential in priority areas
Objective 2: Research capacity
Multidisciplinary research partnerships, rosters of national experts, and knowledge management networks established to support research agenda development and implementation

Incentives for tertiary educational institutions to offer research programmes on climate change and health provided

Data-sharing agreements within and outside the health sector established for supporting research on GHG emissions and low carbon technologies established

Data-sharing agreements within and outside the health sector for supporting research on climate-sensitive disease surveillance and monitoring established

Data-sharing agreements within and outside the health sector for supporting research on climate resilience established

Financial investment mechanisms established to support research programmes and postgraduate research training programmes

Objective 3: Research into policy

Mechanism for researchers to inform planning, policy, and stakeholder groups established

Mechanisms to support, spread and scale innovation across the health system that supports climate resilience and/or health care decarbonization established

Research findings on climate change and health disseminated and used to develop key health (e.g. health sector strategic plans, strategies of priority vertical programmes) and climate change (e.g. NAP, NDCs, LT-LEDs) plans, policies and strategies

Evidence-based capacity for decision-making within and outside the health sector to contribute to policy outcomes developed

Health services-oriented climate and health research promoted

Research on climate change and health conducted and translated into health policy

Adaptation and mitigation decision-making based on the results of the research agenda implementation

Research on climate change and health responds to needs by policy makers

COMPONENT 6



Climate resilient and low carbon infra-structures, technologies, and supply chain

Overview

This component addresses the need for, and importance of, strengthening adaptation of current infrastructures, technologies, and supply chains; introducing new low carbon technologies; and promoting environmental sustainability of health operations.

An important component for strengthening climate resilience of health systems relates to health infrastructure and services, including the provision of essential preventive and curative health products, from vaccines for climate sensitive diseases to surgical equipment. This includes ensuring that the siting of health facilities and related building codes account for current and projected climate risks. It also includes consideration of essential environmental services to health facilities, such as water and sanitation and waste management services which may be compromised by extreme winds, flooding, sea-level rise, or drought, and electricity supplies that may be cut off during extreme weather events. In addition, infrastructures, technologies and supply chains need to ensure safety of the health workforce in the face of climate change (10).

In addition to focusing on infrastructure, climate resilience can also be enhanced using new technologies or approaches for better delivery of health interventions, particularly using information technology. For example, mobile technologies combined with satellite-based remote sensing of meteorological and environmental conditions on the ground have proven to be effective in improving access to reliable extreme weather warnings, monitoring climate conditions, and surveillance and mapping of the probability of transmission of climate-sensitive diseases (e.g. the detection of vector-borne or water-borne diseases and forecast of outbreaks).

Many operations are carbon intensive and therefore emit GHGs, contribute to air pollution and produce environmental contaminants including chemical, biological, and radioactive waste.

While building climate resilience, health systems and health care facilities can also significantly reduce their overall environmental impacts and GHG emissions through actions to develop sustainable infrastructure, facilities and supply chains. This may include interventions to reduce GHG emissions associated with energy and buildings, water, transport, food, and medicines, as well as the proper use and disposal of health waste, and using safer chemicals in medical products and devices. It also includes promoting opportunities for reducing consumption, reusing and/or recycling; eliminating non-essential single use plastics; reducing food wastage, and developing sustainable procurement guidelines (10,48). For example, mobile communication (e.g. tele-health or telemedicine) not only increases the speed and volume of health data collection while reducing costs and improving service delivery, including during emergencies, but also contributes to environmental sustainability by reducing the emissions associated with transport and travel.

Selecting to use less energy-demanding technologies, medical and food supply chains with a lower environmental carbon footprint and decentralized renewable energy sources, such as solar-powered photovoltaics, can simultaneously contribute to climate resilience and long-term environmental

sustainability. It is also important to support technologies that are climate resilient and suitable for the harsh conditions that are likely to be more common in a climate change context, such as higher temperatures.

Health care supply chains account for an estimated 60–80% of a health care system’s carbon footprint (29,49). It is therefore important that health care systems and their suppliers take action to reduce supply chain emissions. Health systems can leverage their purchasing power by persuading suppliers to decarbonize their own processes and onward supply chains, for example by reducing the carbon footprint of products through the use of cleaner energy, better design for reuse, repair and recovery of materials, and the choice of purchasing locally manufactured products (50). The NHS in England, for example, has published a net zero supplier road map setting out requirements for suppliers to align with the NHS’s net zero targets (51). Given the global reach and complexity of supply chains, health systems are encouraged to work with international partners – for example through the WHO’s ATACH group – to support health care supply chain decarbonization, including through the potential alignment of procurement standards across health systems internationally.

For the supply chain, it will not only be important to ensure access to key medical products, but also to understand how changing climatic conditions could influence the effectiveness of specific medical products. For example, antidepressants, antihistamines, antipsychotics and diuretics may predispose their users to heat stroke or heat stress when temperatures are high.

Sample interventions aiming to strengthen climate resilience and environmental sustainability in health facilities across four key components (i.e. health workforce; water, sanitation, hygiene, and waste management; energy; and infrastructure, technologies and products) is available in the *WHO guidance for climate-resilient and environmentally sustainable health care facilities* (10).

Objectives for the implementation of this component

Adaptation of current infrastructures, technologies, and supply chain – Current and future climate risks systematically considered in the context of revising and upgrading of infrastructures, technologies, products, and processes for climate resilient and low carbon sustainable health service delivery.

Promotion of new technologies – Innovative climate resilient and low environmental impact technologies, including low carbon measures, promoted and deployed by the health sector through transformative health service delivery.

Environmental sustainability of health operations – Low environmental impact technologies procured and promoted by the health sector to enhance resilience to climate change and contribute to long term sustainability.

Sample measurable outputs and indicators under climate resilient and low carbon infrastructure, technologies, and supply chain

Climate resilient and low carbon infrastructure, technologies, and supply chain
Objective 1: Adaptation of current infrastructure, technologies, and supply chain
Climate resilience interventions implemented at health system and/or facility level
Specifications for siting and construction of health facilities iteratively reviewed and revised in line with projected climate risks

Specifications for technologies and selection of products and processes of services, iteratively reviewed and revised in line with projected climate risks

Number of health facilities retrofitted according to climate resilient and low carbon standards

Specifications for siting and construction of health facilities, and energy, water, waste management and sanitation provisions iteratively reviewed and revised in line with (i) projected climate risks, and (ii) the latest standards for low or zero carbon and environmentally sustainable buildings

Training and recommendations for prescription of pharmaceuticals during extreme heat revised

Improvement plan for ensuring health service delivery during extreme weather events and outbreaks of climate-sensitive diseases developed based on results of vulnerability assessments of health care facilities

Objective 2: Promotion of new technologies

Access to renewable energy in health care facilities promoted as an adaptation and low carbon sustainable measure

Environmentally sustainable technologies suitable for harsh conditions (e.g. green cooling) adopted

New technologies such as e-Health, telemedicine or satellite imagery used to strengthen climate resilience and reduce carbon emissions, while contributing to improving health systems performance and UHC

Objective 3: Environmental sustainability of health operations

Assessments of health sector impacts on the environment, including GHG emissions, conducted

Decarbonization actions implemented at health system and/or facility level

Interventions implemented to reduce emissions from high carbon medicines at the 'point of use', e.g. reducing emissions from inhalers and anaesthetic gases

Active transport (e.g. cycling and walking) and the use of public transportation for patients, visitors, and health workers promoted

Health sector transportation systems transitioned to low GHG emissions

GHG emissions and environmental sustainability considerations integrated within health sector procurement policies and practices, with suppliers, procurement teams and other stakeholders engaged to support implementation

Purchases from companies with transparent sustainability standards and science-based targets (near- and long-term) for reducing GHG emissions for products and services prioritized

Cross-sectoral collaboration mobilized for improving practices on environment and health protection

Environmentally sustainable, low carbon diets and procurement of locally produced food promoted, and interventions implemented to minimize food waste in health care facilities

Number of health facilities incorporating climate variability and change in decisions related to siting, construction, technologies, procurement, and procedures to ensure provision of basic services (including energy, water and sanitation, waste management)

COMPONENT 7



Management of environmental determinants of health

Overview

This component aims to step up efforts to respond to environmental risks to health by strengthening monitoring and management of environmental determinants of health; developing and implementing regulatory instruments and mechanisms; and promoting coordinated intersectoral management.

Climate change threatens health through environmental determinants, strongly mediated by social conditions. For this reason, some of the most effective actions that can be taken by health systems are in collaboration with other sectors. Scaling up multisectoral public health prevention programmes can avoid negative health outcomes at their source and facilitate timely and increasingly effective responses to changing environmental and climate-related risk conditions. A timely health sector response to potential hazards from health service activities by itself or in coordination with other sectors is imperative (Table 6.1). Similarly, health-promoting policies and programmes in sectors, such as agriculture, transport, water, housing, and energy can lead to reduced health risks and improved environmentally sustainable health practices, behaviours, and processes.

Environmental risks are responsible for around a quarter of the total burden of disease (52). Notwithstanding substantive efforts to reduce environmental risks to health, traditional risks to public health (such as unsafe drinking water, poor sanitation, poor hygiene, and lack of access to safe and reliable energy) affect poor and vulnerable populations disproportionately, challenging efforts towards health equity. Despite important and ongoing efforts to protect health from these traditional risks, climate change is a huge challenge requiring scaling up of efforts in all countries. Climate change impacts on NCDs are also large, and in some cases less recognized, such as the impacts on mental health (46,53).

While the health sector does not have substantial direct control over environmental determinants, it has essential roles to play at both policy and programmatic levels in: (i) providing evidence on risk factor disease links; (ii) implementing effective preventive measures; (iii) raising awareness; (iv) jointly monitoring environmental exposures and health outcomes; and (v) defining regulatory standards and management of health risks. Management of environmental determinants of health requires intersectoral planning and coordination. Examples of joint actions aiming to manage the environmental determinants of health are included in Table 6.1.

Table 6.1: Examples of joint actions between ministries of health and other sectors to manage the environmental determinants of health

Environmental determinants of health	Important collaborating sectors	Examples of joint action
Air quality	Industry and labour Energy Transport	• Definition and monitoring of air quality standards, worker safety standards for heat • Promotion of energy-efficient heating and cooking • Scaling up energy access for health facilities in LMICs via renewable and other clean energy sources • Joint implementation of health impact assessments for key transport policies and programmes
Water quality and quantity	Water Municipal services	• Integration of health in water resources management policy • Promotion of adequate safe municipal water supply and water and wastewater treatment facilities • Implementation of climate resilient water safety plans • Definition and monitoring of water quality standards
Food and nutrition security	Agriculture and food	• Food security forecasting and nutrition screening • Integrated vector management (e.g. rodents)
Housing	Land planning Housing and infrastructure Disaster management and meteorological services	• Zoning and building regulations for health and other infrastructure taking account of flood and storm risks • Ventilation standards and improved housing and building design • Health and public safety plans and trainings for early warnings of extreme weather events
Waste management	Municipal services	• Waste minimization, safe disposal and recycling, including in health facilities

Objectives for the implementation of this component

Monitoring – Joint monitoring of climate-sensitive environmental risks based on evidence-based standards strengthened.

Regulatory mechanisms – Regulatory policies protecting populations from climate-sensitive environmental risks defined, revised, and enforced.

Coordinated cross-sectoral management – Environmental determinants of health jointly managed, with clear roles and responsibilities defined across sectors.

Sample measurable outputs and indicators under management of environmental determinants of health

Management of environmental determinants of health

Objective 1: Monitoring

Integrated monitoring systems collect data on environmental hazards (e.g. water quality, water availability, air quality)

Proportion of health facilities with access to energy, safe water, and sanitation services

Integrated monitoring systems allowing collection and analysis of data on environmental hazards, socioeconomic factors and health outcomes established

Objective 2: Regulatory mechanisms

Regulations on key environmental determinants of health (air quality, water quality, food quality, waste management) designed to reflect broader ranges of expected climatic conditions and the health sector's own contribution to GHG emissions and environmental impacts

Regulations for clean energy systems promoted as a means to improve local air quality and reduce the number of premature deaths from exposure to air pollution

Risk assessment and management approaches aiming to minimize the health impacts from climate change via water, sanitation and hygiene (WASH) implemented (e.g. climate resilient water and sanitation safety plans)

Objective 3: Coordinated cross-sectoral management

Environmental health impact assessments for policy and programmes in sectors such as transport, water, food and agriculture, and WASH implemented in coordination with the Ministry of Health

Joint multisectoral risk management approaches to health risks related to climate related emergencies and disasters, water, waste, food, and air pollution implemented

Low carbon sustainability approach integrated in managing the environmental determinants of health

Proportion of population with primary reliance on clean fuels and technologies increased

COMPONENT 8



Climate-informed health programmes

Overview

This component aims to use the information gathered in the components related to health information systems (i.e. assessments, research and monitoring) to inform the way specific climate sensitive health programmes deliver them.

The health sector, in coordination with other sectors, is often directly responsible for programmes that address climate-sensitive health risks (such as vector- and water- borne diseases, mental health, cardiovascular and respiratory diseases, maternal and newborn health, nutrition), preparedness and response to extreme weather and environmental events, as well as other crises. Emerging climate and environmental risks to health requires an update of existing health programmes and their management to strengthen their response capacity with adequate, effective, and sustainable interventions. Examples of climate-sensitive health programmes which should work in collaboration with climate change and health focal points or units in the ministries of health are emergencies and disaster risk management, public health preparedness, early warnings, food security and nutrition, occupational health, infectious disease monitoring, climate-sensitive disease surveillance, and several vertical programmes for communicable and NCDs and injury prevention. Such programmes can become climate resilient by using information about current and projected future climate conditions to assess risks against operating capacity gaps and inform policy, strategic investment, and planning decisions.

Health planning, programming and operations should consider environmental and climate risks to promote climate resilience in health systems and UHC. Climate services are specifically tailored information, tools, and products which can be developed in partnership with meteorological and climate services to enable health partners to access and use information about weather, climate, climate change, climate variability, trends, and impacts to improve decision-making in specific programme areas (54). Simultaneously health programmes should assess their environmental sustainability, ensuring that no adverse health and environment consequences result from their operations. This implies that health programming and operations should increasingly be designed and implemented considering both current and projected future climate change hazards. Assessments should consider how health programmes are impacted by climate change now and in the future; how to better prepare and respond; to what extent the health programme contributes to GHG emissions directly or indirectly; and how their operations may also release environmental contaminants.

Specific health programmes can use information gathered through the implementation of components 3 (assessment of climate and health risks and GHG emissions) and 4 (integrated risks monitoring, early warning, and GHG emissions tracking) to improve their decision-making capabilities and adjust the type and scale of intervention accordingly. For example, early warnings about a potential outbreak or extreme heat conditions can be used to prepare the health system in advance for increased patient loads and any other related needs. Climate-informed health programming needs to continually review and adjust service delivery according to new information. Table 6.2 provides examples of interventions on climate-related health risks that can improve health system capacity to improve climate change resilience and reduce carbon emissions.

Table 6.2: Examples of climate-informed health interventions for health systems (by health outcome and climate hazard)

Climate-related health outcomes and hazards	Examples of interventions
Health outcomes	
Water-borne and food-borne diseases	• Equip health facilities with Water and Sanitation for Health Facility Improvement Tool (WASH FIT) • Enhance monitoring and water- and food-borne disease surveillance systems during high-risk periods (drought, flood, extreme heat) • Strengthen food and water quality control (e.g. management of drinking-water quality, policies and regulations for food safety) • Improve sanitation, hygiene and waste management practices • Ensure availability of sufficient water for drinking, environmental cleaning, hand hygiene, food preparation, personal hygiene and other needs
Zoonotic and vector-borne diseases	• Establish environmentally sustainable vector/pest control policies and action plans • Expand the scope of diseases monitored, and monitor at the margins of current geographic distributions to detect spread • Establish EWS where appropriate • Enhance diagnostic and treatment options in high-risk regions/periods • Ensure adequate animal and human vaccination coverage
Allergic diseases and cardiopulmonary health	• Develop exposure forecasts – air quality, allergens, dust • Enforce stricter air quality standards for pollution • Plan for increased demand for treatment during high-risk seasons or weather conditions • Optimize ventilation methods to minimize population and health workforce exposure • Establish a risk communication plan about periods with high air pollution/high ozone levels with recommended behaviour
Nutrition	• Implement sustainable food plans, which includes purchasing food from local sources • Perform seasonal nutritional screening in high-risk communities • Scale up integrated food security, nutrition and health programming in fragile, climate impacted zones • Promote public education on food security and nutrition • Implement measures to reduce food waste in health facilities

Climate-related health outcomes and hazards	Examples of interventions
Mental health	• Integrate climate change considerations into mental health policies and programmes, including mental health and psychosocial support (MHPSS) • Integrate MHPSS in national strategies on health and climate change • Address special needs of mental health patients by developing emergency preparedness plans for extreme climate events • Establish community watch for people with mental illness during extreme weather conditions
Maternal, newborn and child health	• Address needs (including mental health) of maternal, newborn and child health by developing emergency preparedness and response plans for extreme weather events • Establish community support mechanisms for pregnant women, newborn and children during extreme weather conditions • Ensure health workforce is aware of heat-stress manifestation in pregnant and postpartum women, newborn and children, and are aware of potential impacts, i.e. increased risk of still births and preterm births, reduced breastfeeding, increased diarrhoeal disease, increased mental health disorders
Climate related hazards	
Extreme heat and thermal stress	• Develop intersectoral heat-health action plans and protocols, including early warning, public communication, preparedness and responses, such as cooling centres for high-risk populations • Ensure public health education to promote behaviour change (e.g. in relation to clothing and ventilation) • Improve health facility design, energy efficient cooling and heating systems appropriate for the needs of different population groups • Establish occupational health exposure standards to promote safe work practices in health service delivery • Ensure health workforce is aware of heat-stress manifestation particularly in vulnerable populations • Identify populations at risk and their immediate needs (e.g. prescriptions of pharmaceuticals during extreme heat conditions)
Storms and floods	• Include climate risk in siting, designing, or retrofitting health infrastructure • Establish safe procedures for procuring, storing, dispensing and proper disposing of pharmaceuticals and medical products
Droughts	• Implement water conservation strategies in health systems • Establish disease surveillance systems to track drought-related health outcomes

Climate-related health outcomes and hazards	Examples of interventions
Wildfires	• Provide clear messages on actions to reduce exposure to smoke, ash, and elevated temperatures (e.g. reducing outdoors activities; avoiding the use of exhaust fans; providing cleaner air spaces; setting air conditioners to recirculation mode, where safe) • Protect chemicals and fuel (e.g. store away from excessive heat) • Protect water tanks from excessive heat and contamination by fire particles

Note: More information can be found in references 1,10,11,43,48,53,55–59.

Objectives for the implementation of this component

Health programming – Information on current and projected (future) climatic conditions integrated into strategic planning of health programmes for climate-sensitive diseases.

Delivery of interventions – Public health programmes revise their standard operating procedures to integrate climate change considerations both in relation to resilience and low carbon sustainability in the delivery of interventions.

Sample measurable outputs and indicators under climate-informed health programmes

Climate-informed health programmes
Objective 1: Health programming
Information and evidence gathered in components 3–5 (i.e. addressing research, assessments, and integrated surveillance) used to inform action on priority climate-sensitive health programmes
Proportion of health programmes informed by a V&A assessment in integrating climate change and health adaptation and resilience actions within their own programmes
Proportion of health programmes integrating climate change mitigation actions
Procurement processes and mechanisms of specific health programmes are assessed and improved based on climate resilience and low carbon sustainability considerations
Investment plans to address identified capacity gaps in health programmes to deal with the increased health risks from climate variability and change developed
Information on current and projected climate change risks integrated into strategic health programmes
Number of health programmes with standard operating procedures to respond to environmental risks revised for integration of climate information
Service delivery informed by a sound understanding of the different exposure pathways from climate related hazards, and targeted to those most at-risk, considering gender differences and diverse vulnerability factors

Objective 2: Delivery of interventions

Health sector response plan for key climate-sensitive health risks implemented

Public health programmes are targeted to those most at-risk of health impacts from climate change (e.g. maternal, newborn and children, older people, migrants, people with pre-existing conditions)

Number of health sector programme areas implementing GHG emission reduction interventions

Number of short- and long-term climate resilience interventions defined and prioritized on key health programmes

Number of sustainable low carbon interventions defined and prioritized on key health programmes

Risk maps and analysis of seasonal trends in diseases used to target resources and preventive measures for those most at-risk

COMPONENT 9



Climate-related emergency preparedness and management

Overview

This component aims to build preparedness, response capacity and health security in health systems and communities by: implementing climate related risks management for emergencies and disasters, through climate-smart policies and protocols; establishing climate-informed health emergency and disaster risk management; and supporting community empowerment.

Outbreaks and health emergencies triggered by extreme weather events are primary concerns of climate change. Climate-informed preparedness plans, emergency response systems, and community-based disaster and emergency management are essential for building climate resilience in health systems and communities, which are vulnerable to a wide range of hazardous events. Thus, health systems and communities should aim to holistically manage overall public health risks and emphasize preparedness and prevention in addition to the usual focus on response capacity.

As climate change increases in magnitude, climate-related emergencies and disasters will continue to rise causing cascading damages and losses in ecological and human systems resulting in unprecedented losses. National emergency operation plans that apply an all-hazards strategy, comprehensive emergency management principles and whole-of-society approaches are necessary.

The Health Emergency and Disaster Risk Management (H-EDRM) framework is a rights-based approach to developing national strategies for emergencies and disasters. Addressing climate risks in H-EDRM requires whole-of-society actions (60).

To strengthen their readiness, health system operations including health facilities and public health infrastructure should implement integrated approaches to H-EDRM (60) as part of developing an all-hazards H-EDRM framework that includes climate hazards. Climate-based H-EDRM must use a comprehensive emergency management (CEM) approach. The CEM approach refers to a series of closely interrelated prevention/mitigation, emergency preparedness (including operational readiness), response, and recovery measures. It is based on the premise that prevention and mitigation measures can reduce the likelihood and severity of emergencies; that sound preparedness will lead to a more timely and effective response; that coordinated response will result in appropriate targeting of health services to the needs of those affected with a focus on the most vulnerable; and that recovery and reconstruction should be designed to reduce future risks.

The implementation of EDRM in health systems – considering climate change risks and low-carbon operations – contributes to building climate resilience and to protecting population health.

Furthermore, tools are available to support countries to assess hospital safety and vulnerabilities and make recommendations on necessary actions while promoting low-cost/high-impact measures for improving safety and strengthening emergency preparedness. These include the Hospital Safety Index (HSI) (48), the Smart Hospitals Toolkit (43), the Green Checklist and discussion guide (61), and Baseline Assessment Tool, developed for the Caribbean context (62). The latter tools are useful for guiding hospitals to identify and implement adaptation measures and inform retrofitting.

Community-based actions are at the forefront of protecting health in emergencies and disasters, including those related to extreme weather events. Policies, programmes, and strategies related to reducing health risks from climate change and related emergencies and disasters require multisectoral action with community participation (such as health workforce, various community groups, women groups, private sectors, key health-determining sectors, and private sector) in health decision making (60). Therefore, a stakeholder mechanism to support participation, dialogue and information exchange among community groups, including underrepresented population segments, would help implement effective actions towards emergency and disaster prevention, preparedness, and response from different types of climate events to reduce health risks and outcomes. Ensuring equity – particularly for vulnerable populations and regions at risk, including rights-based gender-sensitive issues, and environmental sustainability measures – is an important consideration in climate-smart policies and protocols for emergency and disaster risk management strategies (60).

Objectives for the implementation of this component

Policies and protocols – Climate sensitive health risks and low-carbon operations included within national disaster reduction strategies, plans and protocols and wider development processes.

Risk management – Strengthen health system capacity to manage risks so that overall vulnerability and exposure to climate hazards are reduced and residual risks and uncertainties effectively managed.

Community empowerment – Empower communities to effectively prevent and respond to health risks from extreme weather events.

Sample measurable outputs and indicators under climate related emergency preparedness and management

Climate-related emergency preparedness and management

Objective 1: Policies and protocols

Policies, protocols, plans, and strategies for Health Emergency and Disaster Risk Management (H-EDRM) reviewed and improved through the integration of climate-sensitive health risks and weather and climate information (e.g. El Niño/La Niña conditions)

Health sector contingency plans for extreme weather events developed and implemented

Gender sensitivity and equity approaches included in H-EDRM, considering vulnerable populations and regions at risk from climate related hazards

Health sector contingency plans for extreme weather events, including risk reduction, preparedness, and response, are aligned with the WHO H-EDRM or a local health emergency and disaster risk management framework

Protocols for H-EDRM integrate low carbon and environmentally sustainable practices including for logistics, supply change, procurement and storage of medicines and equipment, and transport

Objective 2: Risk management

Risk assessments for current and projected future exposure to extreme weather events routinely used to inform health sector strategic development plans

Climate change related emergency and disaster response plans for individual health facilities developed and implemented

Geographical and seasonal distribution of climate health risks and outcomes used to inform emergency and disaster response plans

EWS for extreme weather events and climate-sensitive diseases used to inform roles and responsibilities of different actors for H-EDRM planning

Objective 3: Community empowerment

Capacity development programmes implemented to support the roles of local communities to identify risks, prevent exposure to hazards, and take action to save lives in extreme weather events

Stakeholder mechanism to support participation, dialogue and information exchange, to empower civil society and community groups as primary actors in emergency preparedness and response established

Mechanisms in place to ensure information related to health risks from extreme weather events reaches communities in a way that preventive action by them is triggered



Sustainable climate and health financing

Overview

The objective of this component is to support countries in identifying and accessing sustainable financing to support climate change and health interventions and proposes ensuring access to: health specific funding and financing mechanisms, including climate change funding streams; and funding allocated for health-determining sectors.

Effectively protecting health from climate change will incur financial costs for health systems. The direct damage costs from climate change to health (excluding costs in health-determining sectors such as agriculture and water and sanitation), is estimated to be US\$ 2–4 billion per year by 2030 (63).

Given the dynamics of climate change risks and their likely effects on societal and human systems, governments will be required to have the ability to act timely and appropriately by using strategies that enable access to, release, and use of financial resources. For example, health systems may need to allocate resources to expand their geographical or seasonal range or population coverage of surveillance and control programmes for climate-sensitive infectious diseases, recruit and retain health workers, or retrofit health facilities to withstand more extreme weather events.

Investing in health will also create benefits from the reduction of economic impacts, such as reduction of direct and indirect costs from climate-related diseases and its impacts on health systems. Implementing measures that can increase climate resilience and sustainable low carbon in health systems can generate a high cost–benefit return, especially in the long term, reflecting in both environmental and social goods, and improving the health and well-being of populations (32). Additional investments may also be needed in other sectors to achieve health goals, such as implementing the promotion of healthy and sustainable diets, using cleaner energy sources and climate resilient water safety plans, or enhanced food security forecasting and nutritional screening during droughts.

Unfortunately, most countries vulnerable to climate change impacts have no financial capacity to address the needed adaptation and mitigation actions (64).

In order to mobilize and utilize financial resources to adequately respond to climate threats, assessments of resource requirements, available finance, as well as finance gaps and opportunities to fill them, are needed. Resource requirements can be assessed through budget estimations of selected interventions as identified in the V&A assessment or HNAP, and identifying shortfalls in existing budgets and funding sources that need to be addressed through mobilization of new financial resources. For example, if an increase in extreme weather events is predicted, then resources will need to be mobilized for contingencies or to cover the costs of insurance or replacement costs for damaged health facilities, protecting and safeguarding health workers, and lost or damaged uninsured equipment. Planning and risk management teams should consider that in addition to adequate development funds to maintain the function of core health care and public health services, climate change specific funding mechanisms should be accessed so as to effectively build system resilience.

A comprehensive approach to financing health protection from climate change should first build on core investments in health systems, such as investments to ensure adequate numbers of competent health workforce and basic health infrastructure and services, which also help to address climate change risks. This can be supported from national resources or external donors (e.g. the Bill and Melinda Gates Foundation, and the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM)).

In addition to accessing health finance, funding can also be mobilized by integrating climate change and health considerations in investments in key health-determining sectors. For example, national governments and donors make very large investments in water and sanitation, which improve health and generally reduce climate vulnerability to impacts. Adding criteria for climate resilience and health promotion to investment strategies can ensure that these investments bring the greatest possible benefits in terms of human health, climate adaptation and social return on investment over the long term. Investing in implementing health and climate change interventions in health-determining sectors, such as water, energy, transport, and food and agriculture will protect health and advance climate justice. Interventions should consist of cost-effective approaches, and also consider the cost of inaction, for ensuring that selected approaches result in socioeconomic welfare.

Lastly, opportunities are available to mobilize climate change finance for health. The key international climate change funding streams are included in Box 6.1.

Box 6.1 Main global climate change funding mechanisms

Green Climate Fund (GCF): At the 16th session of the UNFCCC Conference of Parties (COP) in 2010, the Parties established the GCF to assist in mobilizing funding for low-emission and climate-resilient development. The GCF was designated as an operating entity of the financial mechanism accountable to the COP in 2011, and remains involved in decision-making regarding policies, programme priorities and eligibility criteria for funding. The WHO has been approved as a GCF Readiness Delivery Partner, enabling WHO to support countries in accessing GCF Readiness funds, undertaking adaptation planning and developing strategic frameworks to build their programming with the GCF.

Global Environment Facility (GEF): was established in 1992, is an international partnership with a large network of countries, international institutions, private sector, and civil society organizations. It serves as an operating entity of the financial mechanism of the UNFCCC to provide financial resources to developing country Parties.

Parties also founded the **Special Climate Change Fund (SCCF)** and the **Least Developed Countries Fund (LDCF)**, which are both managed by the GEF. The SCCF was established to finance initiatives relating to adaptation; technology transfer and capacity building; energy, transport, industry, agriculture, forestry and waste management; and economic diversification. The LDCF was established to support least developed countries in preparing and implementing National Adaptation Programmes of Action (NAPAs).

Adaptation Fund (AF): was established under the Kyoto Protocol in 2001, also supports environmental initiatives by financing concrete adaptation projects and programmes in developing countries that are particularly vulnerable to the adverse effects of climate change. The AF is managed by the Adaptation Fund Board.

Source: Finance for health and climate change (64).

Further guidance on the entry points for health under each of these funding streams is provided by the WHO (64). In addition to the main international climate change specific financing mechanisms, funding is also available through bilateral and regional channels.

The ATACH Finance Working Group aims to support countries aiming to access finance and funding for climate change and health by reducing barriers to funding and by maximizing investments in health (3).

Objectives for the implementation of this component

Health specific funding and financing mechanisms – Climate change considerations for both resilience and low carbon sustainability included in relevant proposals submitted to and funded by health funding mechanisms.

Climate change funding streams – Climate change finance accessed by the health sector.

Funding and financing for health-determining sectors – Health and climate change considerations incorporated in projects and programmes supported through funding for health-determining sectors.

Sample measurable outputs and indicators under sustainable climate and health financing

Sustainable climate and health financing

Objective 1: Health specific funding and financing mechanisms

Scale-up public financing to build the foundations of climate resilient and low carbon health system

Domestic or international funding accessed to strengthen climate resilience of health systems

Resources for climate change and health interventions, both for resilience and low carbon sustainability, included in national or subnational health investment plans

Domestic or international funding to strengthen low carbon sustainability of health systems accessed

Percentage of the national health budget addresses risks posed by climate variability and change including at health care facility level

Decadal and longer-term forecasts used to inform health investments (e.g. construction of new health care facilities)

Results of V&A assessment and H NAP used to access health funding and financing mechanisms

Objective 2: Climate change funding streams

Climate change and health projects and programmes submitted to and granted by the main international climate change funding mechanisms (e.g. Green Climate Fund (GCF), the Global Environment Facility (GEF), the Adaptation Fund (AF) and bilateral donors)

Investment cases for climate resilient and low carbon sustainable health systems developed by relevant actors (e.g. multilateral development banks) and used to facilitate access to funding and financing

Objective 3: Funding and financing for health-determining sectors

Health impacts of climate change monitored in programmes funded through financial mechanisms specific to health-determining sectors

Climate interventions across sectors with a focus on health, including sustainable low carbon health facilities funded

Climate change adaptation and mitigation projects and programmes submitted and granted to key health-determining sectors integrate costed activities related to assessing and monitoring potential positive and negative health impacts

Screening for climate variability and change, and related health risks included as criteria for selecting investments in key health determining sectors, such as water, sanitation, food and agriculture, energy, transport, and urban planning

7 Alignment with climate change, development, and specific health priorities

7.1. Alignment with climate change and development priorities

Building climate resilient and low carbon sustainable health systems, is the comprehensive health response to requests by Parties to the UNFCCC for provision of support in planning adaptation and mitigation to climate change in key sectors. Additionally, this framework responds to and is aligned with global agendas including the 2030 Agenda for Sustainable Development, the Sendai Framework for Disaster Risk Reduction (Sendai Framework), and the UNFCCC Paris Agreement. This framework can be used as a key tool to support countries integrating health within relevant national climate change planning and reporting mechanisms and processes such as to develop the health component of HNAPs, health in the NDCs, and health in the LT-LEDS (Box 7.1).

Box 7.1 Health in the main country commitments to the UNFCCC

Nationally Determined Contributions (NDCs)

NDCs are country commitments to deliver the goal of the Paris Agreement (adopted in 2015) of limiting global temperature rise to below 2°C, preferably to 1.5°C. Countries can strengthen their NDCs to the Paris Agreement by developing health-inclusive and health-promoting climate targets and policies. The inclusion of public health considerations in the NDCs provides an opportunity for increased ambition and outlines countries' current priorities and needs, ensuring healthy people and societies in a changing climate. Some recommendations on health promoting NDCs with public health measures that can benefit national mitigation and adaptation, and implementation priorities are proposed by the WHO (31,65).

Health National Adaptation Plan (HNAP)

The HNAP is a plan developed by a country's Ministry of Health as part of the National Adaptation Plan (NAP) process, which is an ongoing initiative of the UNFCCC to support countries to address the challenges of climate change risks. The process to formulate and implement NAPs is intended to provide support for the medium- and long-term adaptation planning needs in least developed countries (LDCs) and other developing countries to build resilience to climate change across all relevant sectors, including the health sector. HNAPs outline actions to build climate resilience for health, and in health system strengthening their ability to anticipate, absorb and transform in a changing climate, in order to protect population health while improving the management of other health threats. HNAP is an important process for mobilizing domestic financial resources for climate actions in health systems, maximizing synergies across sectors, and promoting cross-sectoral collaboration and cooperation for health (9,66).

Long-term low-emissions development strategies (LT-LEDS)

Parties to the Paris Agreement have underscored their commitment to achieving the long-term temperature target of the Paris Agreement by implementing LT-LEDS. A recent UNFCCC report assessed submitted LT-LEDS and identified country needs for large-scale transformation as a challenge to transition to low-emission development paths, especially in terms of financing. Many Parties highlighted opportunities to achieve a sustainable, equitable, and inclusive economic development. Human health was identified as an adaptation priority in 45% of reviewed LT-LEDS. Adaptation measures included developing a climate-resilient public health system and infrastructure, early warning systems for diseases and extreme weather events, research and innovation, training health-care professionals, and mainstreaming adaptation into health policies (67). The WHO conducted a similar assessment of health inclusion in LT-LEDS. Of the 53 available reports, 98% include health considerations, 75% identifies health co-benefits of climate mitigation, and 32% quantified these health co-benefits (65).

7.2. Alignment with health priorities

This framework responds to policy mandates to protect health, at global, regional, and national levels, including the World Health Assembly (WHA) and WHO regional committee resolutions on health protection from climate change, health system strengthening, implementation of International Health Regulations, UHC and health security strengthening, as well as national health emergency and disaster risk management (H-EDRM).

The framework is aligned with health system priorities and goals for health – which are: (i) the goals are UHC, better health, and health security; (ii) means to achieve the goals in health system strengthening; (iii) primary health care (PHC), that includes the essential public health functions (EPHF) – with the approach to strengthen health systems which ensures that values of health for all, solidarity, equity, social justice, community orientation, people-centredness and human rights are fulfilled (Box 7.2).

Box 7.2 The framework and health systems priorities and goals

What is needed and how can the framework contribute to UHC and PHC priorities and goals?

- *A radical reorientation of health systems towards PHC*, to address the carbon footprint of health systems and strengthen climate resilience. Secondary and tertiary care are often more costly and create more carbon emissions because of factors such as one-time use medical products and devices, heavy infrastructure, medical waste, and the need to travel farther from where people live.
- *Public health orientation underpinned by the EPHFs*, to address climate related health risks and impacts. Many public health services, including health promotion, prevention and protection services, while cost-saving are also able to respond to the impacts of climate change and various other public health challenges.
- *People-centredness*, where health systems are oriented towards and aligned with population health needs, responding to community health needs, and avoiding wastage of resources.
- *Community engagement*, because community ownership supports the sustainable change of health systems in the long term.
- *All-hazard health emergency and disaster management approach*, ensuring climate-resilience can be utilized as an entry point for all-hazards resilience of health systems; and thus, capacities and investments can be leveraged for multiple types of threats.
- *Health equity*, because climate-related risks often affect disadvantaged populations and communities disproportionately.
- *Multisectoralism*, because a climate-resilient and low carbon health system needs health sector leadership and coordination with allied sectors.

Source: References 5,60,68–71.

8 Monitoring progress at national level towards climate resilience and low carbon sustainability in health systems

Measuring the climate resilience and decarbonization actions of a health system is most effectively done with information and indicators that are tailored to needs, priorities, and available resources, and build on existing national surveillance and monitoring systems. Relevant international reporting mechanisms include data available in the WHO's Global Health Observatory, the WHO health and climate change global survey, and the SDGs and the Sendai Framework for Disaster Risk Reduction (23).

In order to measure climate resilience and low carbon sustainability in health systems, a comprehensive approach is suggested by which at least one indicator for each the 10 components are selected (both for resilience and low carbon pathways). Countries and health systems may refer to the list of indicative measurable outputs and indicators included in each of the components above, which are also compiled in Annex A, and decide whether those are relevant to their specific context or whether these should be adapted, or new ones developed.

In addition to measuring climate resilience and low carbon sustainability in health systems using specific indicators for each of the 10 components of this operational framework, the WHO paper on *Measuring the climate resilience of health systems* (23) recommends using additional indicators that track changes in: (i) the upstream determinants of exposures and vulnerabilities; (ii) the overall capacity of a health system to manage climate-related shocks and stresses; and (iii) the extent to which resilience outcomes change following adaptation interventions. Short- and long-term climate-related risks need to be monitored to ensure that near-term interventions build flexibility and capacity to prepare for and manage additional climate change impacts over the coming decades.

9 Conclusions

This framework provides the tools and validation for health systems to take action to build climate resilience and reduce carbon emissions. They also lead by example to protect people's health and the environment, with immediate and long-term health benefits for all.

By implementing the framework components, health organizations, programmes and partners would be better able to anticipate, prevent, prepare for, and manage climate-related health risks while implementing environmental sustainability, including low carbon health practices, leading to improved health outcomes. Application of this framework would result in an important contribution to UHC, global health security, and specific targets within the SDGs.

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Annex A. Compilation of sample indicators and measurable outputs for all the components of the framework

Component 1. Climate-transformative leadership and governance

Sample outcome indicator:

Multistakeholder mechanisms for climate change and health established

Objectives	Sample measurable outputs and indicators
Governance	- Climate change and health focal points designated within the Ministry of Health with specific programme of action and budget allocated - Health sector commitment to achieve climate resilience in the health system - Health sector commitment to transition the health system (including health care facilities and supply chains) to low carbon or net-zero emissions - Climate change and health focal points or units, working in collaboration with relevant climate-sensitive health programmes (e.g. vector-borne diseases, nutrition, infectious diseases, disaster risk reduction) to build climate resilient and low carbon programmes - Gender-sensitive approach adopted in the regulations and strategies on climate change and health - Meaningful participation of the health sector in main climate change processes at national, regional, and global levels with UNFCCC global negotiations, National Adaptation Plan, National Communications (NCs), Nationally Determined Contributions (NDCs), and long-term low-emission development strategies (LT-LEDS) promoted
Policy development	- National strategy on health and climate change (covering both resilience and low carbon sustainability approaches) developed - Health component of National Adaptation Plan (HNAP) developed and integrated as a chapter in the overall NAP - Health is integrated into the Nationally Determined Contributions (NDCs) - Mechanism to estimate GHG emissions in the health system established - A roadmap or action plan for building climate resilience in health systems developed in collaboration with health-determining sectors and community actors to support HNAP implementation - A roadmap or transition plan for reducing GHG emissions in the health system developed in collaboration with health-determining sectors, including decarbonization targets - Coordinated strategies established within the health sector and in health-determining sectors to develop policies for building a climate-resilient and low carbon health system, maximizing health co-benefits

Objectives	Sample measurable outputs and indicators
Cross-sectoral collaboration	• Agreements (e.g. Memoranda of Understanding) established between the Ministry of Health and key stakeholders at national level (e.g. meteorological and hydrological services, ministries of environment, food and agriculture, energy, transport, planning), including specific roles and responsibilities in relation to protecting health from climate change and/or reducing the GHG emissions of health sector operations • Multisectoral governance and coordination (involving people, communities, civil society, private sector, and all other engaged stakeholders) mechanisms established to support climate resilience and decarbonization in the health system • Main policies and strategies from health-determining sectors reflect climate change and health considerations both in relation to adaptation (e.g. climate-resilient water and sanitation safety plans) and mitigation (e.g. promotion of policies maximizing health co-benefits in the transport sector) • Inter-ministerial group on climate change and health established and promoting health in all adaptation and mitigation policies of key health-determining sectors • Health impact assessments conducted for new mitigation and adaptation policies and programmes in all health-determining sectors, in accordance with article 4.1.f. of the UNFCCC (minimize adverse effects on public health)

Component 2. Climate-smart health workforce

Sample outcome indicator:

Health workers trained to implement measures for climate resilience and low carbon sustainability

Objectives	Sample measurable outputs and indicators
Health workforce capacity	• Percentage of health workers having received training on climate resilience in the past two years • Percentage of health workers having received training on low carbon sustainability in the past two years • Health workers in specific programmes have information and training on the interlinkages between specific health outcomes and climate variability and change • Health workforce capacity developed on decarbonization opportunities in health systems and health care facility operations, the supply chain and in-service delivery • Curricula on climate change and health covering both resilience and low carbon sustainability issues developed and imparted in secondary and/or tertiary levels

Objectives	Sample measurable outputs and indicators
Organizational capacity development	- Contingency plans for the deployment of sufficient health personnel for acute shocks (e.g. extreme weather events and outbreaks) developed at the relevant level (i.e. national, provincial, local) - Innovative approaches to reducing GHG emissions at health system or health care facility level (e.g. teams sharing best practices across different domains, and a system of rewards) promoted - Percentage of health workforce participating in decision-making, planning and management of climate change risks - Number of capacity building initiatives integrating climate change and health at early stages of professional health training - Innovative capacity building plans responding to identified human resources and institutional capacity gaps developed
Information, awareness and communication	- Health professionals, the media and community leaders trained on climate change risk communication, including communication of uncertainty - Stakeholder forum on climate change and health established as a way to engage health determining sectors, the media and community groups - Internal and external health communication plans with focus on raising awareness of climate change risks and health outcomes and implementing efficient strategies to build climate-resilient health system developed - Internal and external health communication plans with focus on measuring GHG emissions and implementing strategies to reduce health system emissions developed - Health workers and communities understand potential future health risks related to climate change and the actions they can take - Awareness among decision-makers, health workers, the media and community leaders on climate change and health raised - Initiatives with focus on climate change risk communication established among different target audiences, developed in the health action plan

Component 3. Assessments of climate and health risks and GHG emissions

Sample outcome indicator:

Climate change and health risks and GHG emissions in health sector assessed

Objectives	Sample measurable outputs and indicators
Health risks	• Climate change and health vulnerability and adaptation assessments conducted, providing evidence on current and future health risks from climate variability and change • Baseline rates and climate sensitivity of health conditions, allowing the selection of priority risks, and continuous monitoring of changing risk conditions and health outcomes assessed • Information on health system's capacity (for each of the ten components included in this framework) to address the increased health risks from climate change gathered as part of the V&A assessments • Results of V&A assessments integrated into health system planning and into key climate change processes (e.g. HNAP) • Vulnerable populations and areas prone to high current and future climate-related health risks identified and mapped • Health trends in climate-sensitive diseases assessed
GHG emissions	• Assessment of GHG health sector emissions conducted • Publicly report a GHG inventory for a base year of emissions. • Information on the environmental impact, including GHG emissions, of products and services used or delivered by the health system • Information on key GHG emissions in health systems and/or health care facilities available and used to inform interventions aiming to reduce emissions • Low regret interventions for reduction in GHG emissions identified for each of the key GHG emission hotspots (e.g. access to renewable energy, energy efficiency, greener waste management practices, transition to low carbon transport, reducing emissions from anaesthetic gases and inhalers) • Interventions to reduce supply chain emissions identified, including through: more efficient use of resources; low carbon substitutions and product innovation; and requirements for health system suppliers to reduce GHG emissions • Agreements with health system suppliers to reduce GHG emissions in the supply chain established • Number of health facilities with GHG emissions assessed

Objectives	Sample measurable outputs and indicators
Progress tracking	• Assessments' results used to identify a set of key indicators to be tracked over time both for health systems' climate resilience and reductions in GHG emissions • Establish a dedicated climate change team responsible for coordinating implementation of the climate strategy and monitoring progress across the system • Assessments' results used to prioritize allocation of resources and effective climate change and health interventions both for resilience and low carbon sustainability • Plan defined and mechanism established for iterative assessments of health risks from climate variability and change

Component 4. Integrated risk monitoring, early warning, and GHG emissions tracking

Sample outcome indicator:

Climate-sensitive health risks and outcomes and GHG emissions reduction monitored

Objectives	Sample measurable outputs and indicators
Integrated disease surveillance and early warning	• An integrated climate and health surveillance system for specific climate sensitive diseases implemented • Early detection tools (e.g. rapid diagnostics, syndromic surveillance) used to identify changing incidence and early action identified and implemented • Climate-informed health early warning systems that predict the risk of outbreaks of priority infectious diseases (e.g. malaria, dengue, cholera) developed and implemented • Climate and weather information used to assess risk of outbreaks of climate-sensitive diseases (i.e. integrated health and climate surveillance systems) • Participation of the Ministry of Health in cross-sectoral groups receiving warnings on extreme-weather events • Geographic and seasonal distribution of health risks and outcomes (e.g. risk mapping) tracked for priority climate-sensitive diseases

Objectives	Sample measurable outputs and indicators
Monitoring and progress tracking	• Monitoring process with a clearly defined mechanism for the tracking system to measure progress in GHG emissions reduction established • Impacts from main climate-related determinants of health (e.g. water availability and quality, air quality, food) monitored by the health sector • Indicators on climate change risks, impacts, vulnerability, capacity of health systems, and emergency preparedness capacity, as well as climate and environmental variables included in relevant monitoring systems at the national level and reported over time • Periodic reviews for improvement or deterioration of capacities identified in V&A assessments
Communication	• A communication plan or strategy on climate risks to health (both for acute shocks and stresses) developed and implemented, outlining the scope of information for diverse audiences (e.g. media, public, health personnel and other sectors) and events, including who should communicate, and the means of communications – developed and implemented • A communication plan or strategy on health system decarbonization – outlining the scope of information for diverse audiences (e.g. media, public, health personnel and other sectors) and events, including who should communicate, and the means of communication – developed and implemented • Information on the health system's carbon emissions and best reduction practices and opportunities shared with relevant stakeholders and communities • Community engagement and feedback mechanisms established to empower affected populations to respond to warnings, and to guide future development of monitoring and warning systems including with regards to environmental impacts of health care

Component 5. Health and climate research

Sample outcome indicator:

Global, regional, and national multidisciplinary research partnerships established to support the development and implementation of a climate change and health research agenda

Objectives	Sample measurable outputs and indicators
Research agenda development and implementation	• National research agenda on climate change and health developed
	• National research agenda on climate change and health incorporates health system decarbonization
	• The health system has a budget dedicated to climate and health research agenda
	• Results of a V&A assessment are used to inform a national research agenda on climate change and health
	• Research agenda incorporating the need to identify technologies for climate resilience with GHG emission reduction potential in priority areas
Research capacity	• Multidisciplinary research partnerships, rosters of national experts, and knowledge management networks established to support research agenda development and implementation
	• Incentives for tertiary educational institutions to offer research programmes on climate change and health provided
	• Data-sharing agreements within and outside the health sector established for supporting research on GHG emissions and low carbon technologies established
	• Data-sharing agreements within and outside the health sector for supporting research on climate-sensitive disease surveillance and monitoring established
	• Data-sharing agreements within and outside the health sector for supporting research on climate resilience established
	• Financial investment mechanisms established to support research programmes and postgraduate research training programmes

Objectives	Sample measurable outputs and indicators
Research into policy	• Mechanism for researchers to inform planning, policy, and stakeholder groups established • Mechanisms to support, spread and scale innovation across the health system that supports climate resilience and/or health care decarbonization established • Research findings on climate change and health disseminated and used to develop key health (e.g. health sector strategic plans, strategies of priority vertical programmes) and climate change (e.g. NAP, NDCs, LT-LEDs) plans, policies and strategies • Evidence-based capacity for decision-making within and outside the health sector to contribute to policy outcomes developed • Health services-oriented climate and health research promoted • Research on climate change and health conducted and translated into health policy • Adaptation and mitigation decision-making based on the results of the research agenda implementation • Research on climate change and health responds to needs by policy makers

Component 6. Climate resilient and low carbon infrastructure, technologies, and supply chain

Sample outcome indicator:

Climate resilience and low carbon sustainability strategies implemented in the health system

Objectives	Sample measurable outputs and indicators
Adaptation of current infrastructure, technologies, and supply chain	• Climate resilience interventions implemented at health system and/or facility level
	• Specifications for siting and construction of health facilities iteratively reviewed and revised in line with projected climate risks
	• Specifications for technologies and selection of products and processes of services, iteratively reviewed and revised in line with projected climate risks
	• Number of health facilities retrofitted according to climate resilient and low carbon standards
	• Specifications for siting and construction of health facilities, and energy, water, waste management and sanitation provisions iteratively reviewed and revised in line with (i) projected climate risks and (ii) the latest standards for low or zero carbon and environmentally sustainable buildings
	• Training and recommendations for prescription of pharmaceuticals during extreme heat revised
	• Improvement plan for ensuring health service delivery during extreme weather events and outbreaks of climate-sensitive diseases developed based on results of vulnerability assessments of health care facilities
Promotion of new technologies	• Access to renewable energy in health care facilities promoted as an adaptation and low carbon sustainable measure
	• Environmentally sustainable technologies suitable for harsh conditions (e.g. green cooling) adopted
	• New technologies such as e-Health, telemedicine or satellite imagery used to strengthen climate resilience and reduce carbon emissions, while contributing to improving health systems performance and UHC

Objectives	Sample measurable outputs and indicators
Environmental sustainability of health operations	• Assessments of health sector impacts on the environment, including GHG emissions, conducted
	• Decarbonization actions implemented at health system and/or facility level
	• Interventions implemented to reduce emissions from high carbon medicines at the 'point of use', e.g. reducing emissions from inhalers and anaesthetic gases
	• Active transport (e.g. cycling and walking) and the use of public transportation for patients, visitors, and health workers promoted
	• Health sector transportation systems transitioned to low GHG emissions
	• GHG emissions and environmental sustainability considerations integrated within health sector procurement policies and practices, with suppliers, procurement teams and other stakeholders engaged to support implementation
	• Purchases from companies with transparent sustainability standards and science-based targets (near- and long-term) for reducing GHG emissions for products and services prioritized
	• Cross-sectoral collaboration mobilized for improving practices on environment and health protection
	• Environmentally sustainable, low carbon diets and procurement of locally produced food promoted, and interventions implemented to minimize food waste in health care facilities
	• Number of health facilities incorporating climate variability and change in decisions related to siting, construction, technologies, procurement, and procedures to ensure provision of basic services (including energy, water and sanitation, waste management)

Component 7. Management of environmental determinants of health

Sample outcome indicator:

Monitoring systems for collecting data on environmental risks to health integrated into health programmes

Objectives	Sample measurable outputs and indicators
Monitoring	• Integrated monitoring systems collect data on environmental hazards (e.g. water quality, water availability, air quality) • Proportion of health facilities with access to energy, safe water, and sanitation services • Integrated monitoring systems allowing collection and analysis of data on environmental hazards, socioeconomic factors and health outcomes established
Regulatory mechanisms	• Regulations on key environmental determinants of health (air quality, water quality, food quality, waste management) designed to reflect broader ranges of expected climatic conditions and the health sector's own contribution to GHG emissions and environmental impacts • Regulations for clean energy systems promoted as a means to improve local air quality and reduce the number of premature deaths from exposure to air pollution • Risk assessment and management approaches aiming to minimize the health impacts from climate change via water, sanitation and hygiene (WASH) implemented (e.g. climate resilient water and sanitation safety plans)
Coordinated cross-sectoral management	• Environmental health impact assessments for policy and programmes in sectors such as transport, water, food and agriculture, and WASH implemented in coordination with the Ministry of Health • Joint multisectoral risk management approaches to health risks related to climate related emergencies and disasters, water, waste, food, and air pollution implemented • Low carbon sustainability approach integrated in managing the environmental determinants of health • Proportion of population with primary reliance on clean fuels and technologies increased

Component 8. Climate-informed health programmes

Sample outcome indicator:

Climate resilience and decarbonization actions integrated in the operations of health programmes

Objectives	Sample measurable outputs and indicators
Health programming	• Information and evidence gathered in components 3–5 (i.e. addressing research, assessments, and integrated surveillance) used to inform action on priority climate-sensitive health programmes
	• Proportion of health programmes informed by a V&A assessment in integrating climate change and health adaptation and resilience actions within their own programmes
	• Proportion of health programmes integrating climate change mitigation actions
	• Procurement processes and mechanisms of specific health programmes are assessed and improved based on climate resilience and low carbon sustainability considerations
	• Investment plans to address identified capacity gaps in health programmes to deal with the increased health risks from climate variability and change developed
	• Information on current and projected climate change risks integrated into strategic health programmes
	• Number of health programmes with standard operating procedures to respond to environmental risks revised for integration of climate information
	• Service delivery informed by a sound understanding of the different exposure pathways from climate related hazards, and targeted to those most at-risk, considering gender differences and diverse vulnerability factors
Delivery of interventions	• Health sector response plan for key climate-sensitive health risks implemented
	• Public health programmes are targeted to those most at-risk of health impacts from climate change (e.g. maternal, newborn and children, older people, migrants, people with pre-existing conditions)
	• Number of health sector programme areas implementing GHG emission reduction interventions
	• Number of short- and long-term climate resilience interventions defined and prioritized on key health programmes
	• Number of sustainable low carbon interventions defined and prioritized on key health programmes
	• Risk maps and analysis of seasonal trends in diseases used to target resources and preventive measures for those most at-risk

Component 9. Climate related emergency preparedness and management

Sample outcome indicator:

Climate resilience and low carbon sustainability actions integrated in emergency and disaster management

Objectives	Sample measurable outputs and indicators
Policies and protocols	• Policies, protocols, plans, and strategies for Health Emergency and Disaster Risk Management (H-EDRM) reviewed and improved through the integration of climate-sensitive health risks and weather and climate information (e.g. El Niño/La Niña conditions) • Health sector contingency plans for extreme weather events developed and implemented • Gender sensitivity and equity approaches included in H-EDRM, considering vulnerable populations and regions at risk from climate related hazards • Health sector contingency plans for extreme weather events, including risk reduction, preparedness, and response, are aligned with the WHO H-EDRM or a local health emergency and disaster risk management framework • Protocols for H-EDRM integrate low carbon and environmentally sustainable practices including for logistics, supply change, procurement and storage of medicines and equipment, and transport
Risk management	• Risk assessments for current and projected future exposure to extreme weather events routinely used to inform health sector strategic development plans • Climate change related emergency and disaster response plans for individual health facilities developed and implemented • Geographical and seasonal distribution of climate health risks and outcomes used to inform emergency and disaster response plans • EWS for extreme weather events and climate-sensitive diseases used to inform roles and responsibilities of different actors for H-EDRM planning
Community empowerment	• Capacity development programmes implemented to support the roles of local communities to identify risks, prevent exposure to hazards, and take action to save lives in extreme weather events • Stakeholder mechanism to support participation, dialogue and information exchange, to empower civil society and community groups as primary actors in emergency preparedness and response established • Mechanisms in place to ensure information related to health risks from extreme weather events reaches communities in a way that preventive action by them is triggered

Component 10. Sustainable climate and health financing

Sample outcome indicator:

Financing for climate change and health adaptation and mitigation actions accessed

Objectives	Sample measurable outputs and indicators
Health specific funding and financing mechanisms	• Scale-up public financing to build the foundations of climate resilient and low carbon health system • Domestic or international funding accessed to strengthen climate resilience of health systems • Resources for climate change and health interventions, both for resilience and low carbon sustainability, included in national or subnational health investment plans • Domestic or international funding to strengthen low carbon sustainability of health systems accessed • Percentage of the national health budget addresses risks posed by climate variability and change including at health care facility level • Decadal and longer-term forecasts used to inform health investments (e.g. construction of new health care facilities) • Results of V&A assessment and HNAP used to access health funding and financing mechanisms
Climate change funding streams	• Climate change and health projects and programmes submitted to and granted by the main international climate change funding mechanisms (e.g. Green Climate Fund (GCF), the Global Environment Facility (GEF), the Adaptation Fund (AF) and bilateral donors) • Investment cases for climate resilient and low carbon sustainable health systems developed by relevant actors (e.g. multilateral development banks) and used to facilitate access to funding and financing
Funding and financing for health-determining sectors	• Health impacts of climate change monitored in programmes funded through financial mechanisms specific to health-determining sectors • Climate interventions across sectors with a focus on health, including sustainable low carbon health facilities funded • Climate change adaptation and mitigation projects and programmes submitted and granted to key health-determining sectors integrate costed activities related to assessing and monitoring potential positive and negative health impacts • Screening for climate variability and change, and related health risks included as criteria for selecting investments in key health-determining sectors, such as water, sanitation, food and agriculture, energy, transport, and urban planning

Annex B. Glossary

Adaptation

Adaptation is the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects (1).

Climate resilient health systems

Climate resilient health systems are those capable of anticipating, responding to, coping with, recovering from, and adapting to climate-related shocks and stress, to bring about sustained improvements in population health, despite an unstable climate (2).

Climate resilient and low carbon health systems

Climate resilient and low carbon health systems are those capable of anticipating, responding to, coping with, recovering from, and adapting to climate-related shocks and stress, while minimizing GHG emissions and other negative environmental impacts to deliver quality care and protect the health and well-being of present and future generations (as defined in this document).

Co-benefits

Co-benefits are the positive effects that a policy or measure aimed at one objective could have on other objectives, thereby increasing the total benefits for society or the environment (1).

Decarbonization

Decarbonization is the process by which countries, individuals or other entities aim to achieve zero fossil carbon existence. Typically refers to a reduction in carbon emissions associated with electricity, industry and transport (1).

Essential public health functions (EPHF)

EPHFs are usually seen as a list of minimum requirements for countries to ensure public health (3).

Exposure

Exposure is the presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected (1).

Hazard

Hazard is the potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, *livelihoods*, service provision, *ecosystems*, and environmental resources (1).

Health National Adaptation Plan (HNAP)

HNAP is a plan led by the Ministry of Health, as part of the National Adaptation Plan (NAP) process. HNAP refers to the plan/document itself (4).

Health services

Health services refer to activities – any service (i.e. not limited to medical or clinical services) aimed at contributing to improved health or to the diagnosis, treatment and rehabilitation of sick people (3).

Health systems

The health system comprises all the organizations, institutions, people, resources, and actions whose primary purpose is to improve, restore or maintain health. The goals of a health system are improving health and health equity in ways that are responsive, financially fair and make the best or most efficient use of available resources. Six health system building blocks together constitute a complete health system – health service delivery; health workforce; health information; medical technologies; health financing; leadership and governance (3).

Impacts (consequences, outcomes)

Impacts (consequences, outcomes) are the consequences of realized risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather and climate events), exposure, and vulnerability. Impacts generally refer to effects on lives, livelihoods, health and well-being, ecosystems and species, economic, social and cultural assets, services (including ecosystem services), and infrastructure. Impacts may be referred to as consequences or outcomes, and can be adverse or beneficial (1).

Low carbon health systems

Low carbon health systems are those capable of implementing transformative strategies towards reducing GHG emissions in their operations, reducing short- and long-term negative impacts on the local and global environment.

Mitigation (of climate change)

Mitigation (of climate change) refers to a human intervention to reduce emissions or enhance the sinks of greenhouse gases (1).

National Adaptation Plan (NAP)

The NAP is a process established under the Cancun Adaptation Framework enabling Parties to formulate and implement the NAP as a means of identifying medium- and long-term adaptation needs and developing and implementing strategies and programmes to address those needs. It is a continuous, progressive and iterative process that follows a country-driven, gender-sensitive, participatory and fully transparent approach (5).

Nationally Determined Contributions (NDCs)

The term NDCs is used under the United Nations Framework Convention on Climate Change (UNFCCC) whereby a country that has joined the Paris Agreement outlines its plans for reducing its emissions. NDCs of some countries also address how they will adapt to climate change impacts, and what support they need from, or will provide to, other countries to adopt low carbon pathways and to build climate resilience (1).

Net-zero emissions

Net-zero emissions are achieved when GHGs emitted into the atmosphere are balanced by anthropogenic removals. Where multiple GHGs are involved, the quantification of net-zero emissions depends on the climate metric chosen to compare emissions of different gases (such as global warming potential, global temperature change potential, and others, as well as the chosen time horizon) (1).

Public health

Public health refers to all organized efforts (whether public or private) to prevent disease, promote health and prolong life among the population as a whole. Public health focuses on the entire spectrum of health and well-being from health promotion and prevention of disease, to early identification and management, to rehabilitation and end-of-life care, or promotion, protection and prevention. Public health usually includes three broad domains of practice: health protection, health service improvement and health improvement, with these being underpinned by health intelligence (3).

Public health services

Public health services refer to health services that promote and protect the health of a defined population. These include, among others, health situation analysis, health surveillance, health promotion, prevention services, infectious disease control, environmental protection and sanitation, disaster preparedness and response and occupational health. Public health services also include the provision of personal services to individuals, such as vaccinations, behavioural counselling or health advice (3).

Resilience

Resilience is the capacity of social, economic, and environmental systems to cope with a hazardous event, trend, or disturbance, by responding or reorganizing in ways that maintain their essential function, identity, and structure while also maintaining the capacity for adaptation, learning, and transformation (1).

Risk

Risk is the potential for adverse consequences where something of value is at stake and where the occurrence and degree of an outcome is uncertain. Risk results from the interaction of vulnerability (of the affected system), its exposure over time (to the hazard), as well as the (climate-related) hazard and the likelihood of its occurrence (1).

Universal health coverage (UHC)

UHC means that all people have access to the full range of quality health services they need, when and where they need them, without financial hardship. It covers the full continuum of essential health services, from health promotion to prevention, treatment, rehabilitation, and palliative care across the life course (6).

Vulnerability

Vulnerability is the condition determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards (7).

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