The Transformative Role of Adaptation Strategies in Designing Climate-Resilient and Sustainable Health Systems

Martha Teshome[1]

[1] Cologne, Germany

m.w.teshome@gmail.com

16-digit ORCID: 0000-0002-1790-0422

Abstract:

This article describes the growing repository of evidence-informed climate-related health actions and builds a case for transformative adaptation strategies. The health impacts of climate change are far-reaching and diverse, affecting vulnerable populations disproportionately and at varying scales. While adaptation policies and plans are becoming increasingly intersectional, there is limited implementation of health-focused adaptation interventions. Securing finance at scale, for one, is a challenge. Funds are not being mobilized at the rate or scale required. Least developed countries and small island developing states are most at-risk and the least likely to recover, even under conservative global warming scenarios. Thus, this article spotlights opportunities for more resilient and equitable health systems across key dimensions of health surveillance, service delivery, infrastructure, finance, capacity development and policy coherence. Given limits to adaptation, co-benefits of mitigation and adaptation actions will need to be systematically assessed and prioritized to address the residual effects of climate disasters.

Keywords: health, climate change, adaptation strategies, resilience, health-systems, sustainability, policy coherence, decarbonization, capacity development, least developed countries.

1. Introduction

Human activity is an underlying driver of climate change in the 21st century with deleterious effects on the natural environment, human health, livelihood security, cultural heritage, among other related dimensions. Rising global temperatures continue to threaten the environment by causing disruptions to natural and managed ecosystems, engendering biodiversity loss, and increasing the intensity and frequency of climate change and extreme weather events. Elevated levels of greenhouse gas (GHG) emissions have the capacity to cause substantial environmental, human and socioeconomic harms, that if left unchecked, will continue to produce instability and undermine the integrity of natural and human systems. Due to the systemic nature of risk, it is important to recognize the complex interconnected pathways that determine the ways in which these dynamic systems function and coexist. With that, this article proposes transformative approaches to support the formulation and implementation of health-informed climate adaptation strategies and actions.

2. The human health impacts of climate change

The human health impacts of climate change are far-reaching and diverse, affecting vulnerable populations disproportionately and at varying scales. Emerging evidence suggests that noncommunicable diseases such as cardiovascular diseases and respiratory illnesses are worsened by heat stress and poor air quality. As such, poor household and ambient air quality will continue to exacerbate respiratory conditions such as chronic obstructive pulmonary disease (COPD),

asthma and respiratory infections. In 2010, over 7% of the global burden of disease was attributed to the inhalation of climate-altering air pollutants (CAPs) (Smith and Woodward, 2014). Against intensifying heatwaves and breaching of web bulb temperature safety thresholds, heat-related disorders such as heatstroke are also expected to occur with greater frequency (Zhao et al., 2021). Broadly speaking, close to half of the world population and over 1 billion workers are exposed to high heat events, while roughly a third of all exposed workers suffer adverse health effects (Ebi et al., 2021). Further findings suggest that at the global level, extreme heat events are becoming the mainstay of the summer periods, leading to heat-related health risks and excess deaths that can be prevented with targeted heat action plans and behavioral strategies (Ebi et al., 2021).

Going further, structural threats to mental health are expected to increase as heat stress, air pollution and extreme weather events cause anxiety and depressive disorders. This illustrates the systemic nature of climate risks, specifically the vulnerabilities and coping capacities of interconnected socio-ecological systems. As is the case with climate change induced mental health disorders, external shocks can cause disturbances to vulnerable systems (e.g., human societies or ecosystems) that can trigger cascading adverse effects in other interlinked areas. Equally significant is the rising incidences and transmissions of infectious diseases, particularly the reproduction and spread of vectors and pathogens due to changes in temperature and precipitation, which may cause ecosystem disruptions, “shifting patterns of disease” into currently unaffected areas (Smith and Woodward, 2014). Among other physical threats, climate variability is predicted to cause crop failures. Climate change gives way to unsustainable food systems by directly affecting “soil fertility, rain patterns, crop yields and food production, food-nutrient and anti-nutrient composition, and nutrient bioavailability”, which reduces the available macro- and

micronutrient content in the global food supply (Owino et al., 2022). As a matter of course, climate change related food and nutrition insecurity is anticipated to increase under a global warming scenario of 2°C and associated higher GHG emission pathways (IPCC, 2022). Not discounting the fact that climate change can wield positive effects on the natural environment — for example, crops that are grown in high-latitudes can benefit from warmer climates and therefore more suitable growing conditions (Myers et al., 2022) — low-latitude, less-developed areas are generally at greatest risk from global warming due to both higher sensitivity and lower adaptive capacity (Schneider et al., 2007). In critical situations, health risks aggravated by climate change and extreme weather events can result in serious injury and even death.

3. The case for health-informed adaptation strategies

Adaptation strategies are a useful tool for moderating potential harms such as losses and damages associated with climate change impacts, and for harnessing potential benefits and opportunities (McCarthy and IPCC, 2001). In the near-term, climate-related health risks will be largely assessed by the vulnerability of societies, their capacity to cope given exposure to hazardous events, and the rate and scale of adaptation (WHO, 2021). Given limits to adaptation, in the long-run, health outcomes will increasingly hang by a thread of transformative actions taken in the present to ease carbon emissions and prevent "the breaching of dangerous temperature thresholds and potential irreversible tipping points" (WHO, 2021).

According to research findings, the adaptation of health systems is predicted to be more challenging at 2°C of global warming than at 1.5°C (IPCC, 2022). Even so, vulnerable regions

including least developed countries (LDCs) and small islands developing states (SIDS), who have historically contributed the least to GHG emissions, are set to experience a high number of interrelated climate risks at a global warming scenario of 1.5°C. To bolster country-level efforts, the health national adaptation plan (HNAP) was designed as an evidence-based strategic document to give credence to the national adaptation planning process from a health perspective. Effectively, the HNAP outlines actions to ensure climate-resilient health and to develop climate-resilient health systems that can predict, absorb and transform risks in uncertain climates, while optimizing the management of additional health risks (WHO, 2021). Notwithstanding, it should be noted that the integration of climate change adaptation into health planning is unlikely to follow a linear progression, therefore the process should remain iterative and flexible. In 2010, the World Health Organization (WHO) determined the share of health within national adaptation programme of actions (NAPAs) and while 11% of the priority projects considered health, only 4% of the Least-developed Countries Fund (LDCF) financing under the NAPA process addressed climate change health adaptation (WHO, 2014). A decade later, although adaptation strategies are becoming increasingly intersectional, there is still limited implementation of health-focused adaptation interventions relative to other key economic sectors.

4. How adaptation strategies address climate-related health risks

4.1. Health systems decarbonization

Globally, the health care sector contributes between 4.4–4.6 percent of GHG emissions and comparable amounts of toxic air pollutants from health care facilities and health care supply chains (Eckelman et al., 2020). Much of the burden of disease associated with air pollution is often borne by vulnerable populations in low- and middle-income countries (LMIC). Decarbonizing healthcare can offer diverse co-benefits for both mitigation and adaptation. Still, only 10 percent of nationally determined contributions (NDCs) refer to climate-related health risks, providing ample opportunity for countries to integrate health systems decarbonization plans in their respective NDCs (Prabhakaran, Karliner and Armstrong, 2023). Measures taken to decarbonize the healthcare sector, such as retrofitting existing healthcare facilities, investing in resilient and low emissions infrastructure to achieve energy efficiency, regulating anesthetic gas flowrates and improving hospital systems' fleet vehicles (Lakatos et al., 2023), are all essential to building sustainable health systems.

In effect, investments in early warnings are as critical for anticipating and reducing disaster risk, as secondary prevention in healthcare is for early diagnosis and treatment. Averting loss and damage associated with climate change and extreme weather events through early warning systems, greatly reduces the risk of damage to critical infrastructure, including disaster-related morbidity and mortality. Whereas concerted efforts within the healthcare sector to ensure prevention and early detection could potentially lead to considerable cost savings, quality-adjusted life years gained due to health risks prevented, and reduced levels of GHG emissions from underutilized health care facilities and health-related goods and services.

There are several illustrative examples that demonstrate the ways in which the healthcare industry is decarbonizing health systems to achieve net zero by 2030. One case example is Aga Khan Health Services (AKHS), which manages health operations across 8 LMICs. AKHS developed an innovative carbon emissions benchmarking tool to track its carbon footprint and implemented targeted plans to cut emissions (AKDN, no date). Findings indicate that of the areas that AKHS owns or controls directly (scope 1 emissions) and emissions that AKHS causes indirectly from activities in its value chain (scope 2 emissions), grid electricity, generators, and anesthetic gases comprised the highest shares of carbon emissions. Ultimately, the benchmarking tool demonstrated a clear business case for the actions required to reduce AKHS' carbon footprint, including no- or low-cost interventions. Other examples of decarbonization of large integrated healthcare systems include the Veterans' Health Administration which aims to achieve energy efficiency and resilience through quadrennial energy audits and NHS England, which sought in 2021 to transition to a zero-emissions ambulance fleet in line with the national mandate to decarbonize (Lakatos et al., 2023). These healthcare providers represent a few of the forerunners in the race to net zero. In the near-term, targeted actions to improve public health — such as the implementation of higher-quality preventive care that reduces superfluous energy consumption — will ease the transition of healthcare operations to lower carbon production. All in all, health systems decarbonization will experience the greatest leaps as the climate technologies and practices critical to reducing GHG emissions and advancing the adaptation planning process become increasingly available.

4.2. An integrated climate-informed health surveillance system

Across LMICs, the data collection process can often be complex and fragmented. In populations that are most at-risk, a coherent and streamlined surveillance system is key for identifying and predicting environmental, biophysical, psychological and social health impacts. In large part, the COVID-19 pandemic called attention to the traversable interface between human health and the natural ecosystem. It revealed that increased human activity coupled with a changing climate could intensify the breaching of natural systems and likely irreversible tipping points, with deleterious effects to both human health and the environment. What is more, the pandemic highlighted weaknesses in existing public health and epidemiological surveillance systems, along with the urgent need to introduce structural changes to public health to ensure integrative assessments and coordinated responses during health emergencies. To this end, this section calls for an integrated health surveillance and multi-hazard early warning system, with varied surveillance indicators to predict climate-related health shocks and anticipate preventative actions. Incidences of infectious diseases and outbreaks could be monitored to identify underlying trends and patterns, and to assess the exposure and vulnerability of at-risk communities. Going further, the integrated surveillance system could systematically collect, assess and report on the heat stress index, the air quality index, and the ultraviolet (UV) index; conduct biomonitoring based on environmental contamination and exposure to persistent organic pollutants (POPs); as well as track other multi-hazard data that covers the full-spectrum of climate-related health impacts.

The proposed surveillance system would offer a single platform that generates accessible, high quality, reliable data in real time (Xu et al., 2022). It would provide a horizontal and vertical interface with the capacity to broker contextualized and robust climate-health information. The devolved system would give access and agency to municipalities in the form of decision-making authority on interventions and policies that could wield a net positive effect on local communities under their jurisdiction (Manyuchi et al., 2021). To enhance interoperability, the integrated surveillance system would require "standardization of data entry, development of automatic validation systems to ensure data quality and the facilitation of multisource data fusion to reduce the number of independent systems" (Xu et al., 2022). Standardizing and integrating climate-related health risk indicators for disease outbreaks associated with specific hazards in vulnerable communities, could generate multiple co-benefits across different sectors and relevant institutions. An example of this is EpiPulse - an online portal designed to collect and analyze data based on cases of infectious disease and pathogens across the European Union and European Economic Area countries that may pose a public health risk. The platform supports real-time monitoring, risk assessment, outbreak response, and integrates several independent surveillance systems, offering access to data through a single platform (European Centre for Disease Prevention and Control, 2021). Equally, the goal behind Ethiopia's Epidemic Prognosis Incorporating Disease and Environmental Monitoring for Integrated Assessment (EPIDEMIA) project is to develop a malaria early warning systems that can be adopted by public health agencies (Neta et al., 2022). EPIDEMIA enables forecasting of future malaria risk based on epidemiological surveillance and climate monitoring data. Albeit its implementation and scale-up could be enhanced through capacity building training, technology transfer and a well-balanced approach that accommodates learning, co-development, and continued collaboration.

4.3. Gaps in health-related climate adaptation financing

Investments that improve the adaptive capacity and resilience of health systems to climate impacts is paramount to ensuring positive health outcomes. The importance of addressing climate-related health threats and enhancing sustainable health systems is well documented in many NDCs. Yet, inadequate financing is a key barrier to implementation and despite a clear need for action, funds are not mobilized by governments at the rate or scale required (Romanello et al., 2022). To close the funding gap, the Green Climate Fund (GCF) proposed to mobilize international private and public financing for adaptation and to systematically manage barriers and moderate investment risks (GCF, 2022). Climate funds such as the Adaptation Fund, Least Developed Countries Fund (LDCF), and Special Climate Change Fund (SCCF) are available financing mechanisms under the United Nations Framework Convention on Climate Change (UNFCCC) designed to assist vulnerable populations in addressing the adverse impacts of climate change in developing countries, LDCs and SIDS, respectively. Still, less than 5 percent of total spending on global adaptation, and under 1 percent of multilateral climate adaptation funding is earmarked for health (Beyeler and Guinto, 2021). These anemic investments in climate-related public health interventions undermine the capacity of public health systems to address preventable morbidity and mortality associated with climate change impacts (Salas et al., 2020). Despite the latest findings that show that 86% of new or revised NDCs mention health (Romanello et al., 2022), and national adaptation plans that make frequent references to health, only a few LDCs are implementing climate adaptation projects with a health focus.

4.4. Policy coherence, governance and cross-sectoral coordination

Measures taken to streamline institutional mechanisms and policy frameworks in support of coherent and coordinated climate actions across multiple sectors and at all governance levels is key. This integrative process – in principle – tethers common and critical aspects of climate resilient and sustainable health systems. Adaptation options under the 1.5°C global warming scenario supported by enhanced multilevel governance and policy instruments are expected to demonstrate benefits for sustainable development (IPCC, 2022). An optimal approach to support cross collaboration and targeted interventions that reduce climate-related health risks, can be outlined in three points. Firstly, a supportive and enabling environment is key for effective policy coherence. Secondly, meaningful institutional engagement and a well-coordinated multi-sectoral approach can provide a solid base upon which commonalities, benefits and tradeoffs can be identified. Thirdly, the process to ensure horizontal and vertical coherence is expected to foster synergies among relevant institutions, mitigate the duplication of efforts among health and health adjacent sectors, and lower the transaction costs of implementation. An example of this is One Health, which is a widely recognized integrative approach that seeks to optimize the health of- and sustainable balance between humans, animals and ecosystems. By focusing on the environment, human and animal interface, One Health can take on a broad range of disease control ranging from prevention to preparedness, response and management, while advancing global health security in the process (WHO, no date). All in all, the post Covid-19 landscape has galvanized organizations

to make progress on One Health by streamlining collaboration and coordination among relevant sectors in pursuance of climate-resilient health systems.

4.5. Developing health workforce capacity

Capacity development for the health workforce is not merely important for harnessing and adapting the necessary skills to improve individual and organizational performance, but also contributes to building and maintaining resilient and sustainable health systems. Given the current state of climate-related health adaptation implementation, a greater level of awareness and understanding is needed to address the full spectrum of climate risks and impacts to health systems and health services. At the most basic level, capacity development should assess current health performance, foster ownership, address critical gaps and maximize development impact. For example, identifying the ways in which climate change will impact the amount of physicians needed, the percentage share designated to each specialty, and the required geographic distribution, will facilitate improved health care workforce training and recruitment (Salas et al., 2020). Beyond this, raising awareness on the health impacts of climate change among health professionals is expected to create behavioral change and strengthen adaptation strategies that will reduce vulnerabilities and ensure better public health outcomes (World Health Organization, 2023).

At the global level, the Paris Committee on Capacity Building (PCCB), established at COP21, covers present and emerging gaps and needs in administering and improving capacity-building in developing countries and contributes to a coherent and robust institutional architecture for climate-related capacity-building for developing countries (UNFCCC, no date). The PCCB's

focus area for 2023 is on "capacity-building support for adaptation, with a focus on addressing gaps and needs in formulating and implementing national adaptation plans (NAPs)" (Paris Committee on Capacity Building, 2023). Indeed, more targeted actions to address challenges related to the provision of health workforce capacity-building support can be addressed through platforms at the subnational, national and regional levels. For example, the Climate Change and Health Adaptation Capacity Building Program (HealthADAPT) is "a multi-year program managed by Health Canada, providing $3 million over three years to support 10 projects at local, regional, and provincial and territorial levels of the Canadian health sector to prepare for and respond to the impacts of climate change" (Health Canada, 2019). As part of its program objectives, HealthADAPT seeks to improve understanding of climate change impacts to health and health systems and intends to pilot health vulnerability and adaptation assessment tools and training.

4.6. Health service delivery in climate disaster settings

A key aspect of health service delivery is the adaptive capacity of health systems to manage the extent of disruptions or damages caused by climate disasters. In any event, health systems must remain accessible, reliable and effective in delivering essential health services (WHO, no date). Still, depending on the scale and severity of the disaster, the capacity of health services may be limited, affecting the quality and pace of delivery. For example, medical electrical equipment and life-saving devices – such as, cardiac defibrillators, patient monitors and high frequency surgical equipment – reliant on electricity to function, could be exposed to power outages in the absence of backup provisions. "Ex-ante contingency planning prepares the capacity, staff, equipment, and protocols needed for emergency contexts, thus ensuring resilience to shocks at the frontline of

healthcare delivery" (Rentschler et al., 2021). As an example, power generators in hospitals and off-site facilities can support the use of emergency communications and provide access to digital systems including patient registries (Rentschler et al., 2021). Whereas, portable vaccine storages, emergency medical transport services, resilient infrastructure such as disaster relief shelters – during and in the immediate aftermath of a disaster – can all contribute to functioning supply chains in emergency settings.

To support a well-functioning health emergency preparedness and response, health systems need to be strengthened across all WHO core components of service delivery; health workforce development; health system financing; information systems; medical products, vaccines and technologies; governance and leadership; including contingency planning for climate disasters. Under the auspices of the Health Emergency Preparedness and Response Umbrella Program (HEPR Program) – a World Bank trust fund mechanism dedicated to health emergency preparedness and response – countries need to "focus on both preparedness-specific activities within the health sector (such as expanding surveillance efforts, practicing for emergencies, training health staff and developing contingency emergency plans, and strengthening laboratory networks) and preparedness-supportive activities in the health sector and other sectors (such as ensuring that essential health services are maintained and that surveillance, containment and response efforts in different sectors are cohesive, coordinated, collaborative, and conducive to action within countries and across their borders" (The World Bank, 2022). Beyond this, weather and climate emergency response require strategic coordination with medical centers and disaster response and civil protection agencies (Rentschler et al., 2021), while clearly defined roles,

responsibilities and mandates for crisis response are expected to enhance the overall effectiveness of healthcare systems.

5. Conclusion

To avoid unplanned, maladaptive responses to climate-related health risks, evidenced-based decision-making must be prioritized across all dimensions of health surveillance, service delivery, infrastructure, medical products and technologies, health finance, governance, health workforce development and policy coherence. Given limits to adaptation, the co-benefits of mitigation and adaptation actions should be systematically assessed and prioritized to address the residual effects of climate disasters. LDCs and SIDS are predicted to experience a disproportionate degree of interrelated climate risks at global warming scenarios of 1.5°C and 2°C and are the most likely to suffer from climate-related loss and damage. The silver lining – given the current baseline – is the expansive and immediate opportunity to foster more resilient and equitable health systems through the formulation and implementation of transformative climate change and health adaptation strategies.

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