**Strengthening Health Systems for mitigating Climate Change: Responding to Climate Change as Public Health Professionals**

Climate change poses the greatest threat to humanity and is rapidly becoming a public health emergency. The world is getting warmer at an unprecedented rate, with global warming likely to reach 1.5 \*C between 2030 and 20521. According to WHO, climate health emergencies are on the rise globally and account for more than half of the public health events recorded in the past two decades, with 56% of climate health emergency events recorded in the African region in 2021 directly linked to climate change2. Climate variability due to excessive heat and precipitation events pose a threat to population health and has increased the demand on health systems due to a rise in human morbidity and mortality1,3,4.

Evidence is emerging linking excessive heat to poor health outcomes especially in vulnerable populations. Pregnant women and children are disproportionally affected by climate change, with studies showing an association between excessive heat and poor pregnancy outcomes including preterm birth, low birth weight and stillbirth5-7. Heat stress, defined as the amount of heat that exceeds the level wherein the body can adapt prior physiological impairment8, has been shown to increase the prevalence of non-communicable diseases (NCDs) 9,10. Existing cardiovascular diseases and diabetes are worsening, respiratory diseases are also on the rise as a result of air pollution10. Although there is scarcity of literature, climate change has also been associated with mental health disorders including post-traumatic stress disorder, depression and extreme emotional distress11. All this adds to the burden on already fragile healthcare systems, particularly in poorly resourced developing countries including sub-Saharan Africa which, despite emitting less greenhouse gases compared to developed countries, are disproportionally affected by climate change1,12.

Climate change is also associated with a rise in infectious diseases including malaria and dengue13. Rising temperatures are changing vector breeding patterns and humans are exposed to increasing vector infectivity rates13. Water contamination due to floods are exacerbating the prevalence of diarrhoeal diseases such as cholera, particularly in the African region2. Food insecurity and malnutrition are on the rise due to loss of crops and diminishing biodiversity1. It is estimated that between 40 and 300 million people are at the risk of starvation globally as the climate crisis worsens1,13. Injuries and displacement of communities due to floods, wildfires and other natural disasters are contributing to the public health crisis. Migration from coastal and rural areas to safer urban areas are on the rise, with informal settlements, overcrowding and unhygienic living conditions further increasing the risk of infectious diseases and the emergence of zoonotics 1,3,13. Health systems are also bearing the impact of climate change directly as a result of infrastructural damage, interruptions to information and supply chain systems etc2.

The above threatens to undermine the achievement of United Nations (UN) sustainable development goals (SDGs), especially SDG 1: *ending poverty*; SDG 2: *ending hunger* and SDG 3: *achieving good health and wellbeing* by 2030, with the latter reliant on intact and responsive health systems. More than ever before, there is a need to strengthen and build resilient healthcare systems with increased capacity to absorb and withstand the impact of a worsening climate crisis, while delivering standard care and managing existing and emerging pandemics.

A well-resourced health workforce is at the core of health systems strengthening and healthcare professionals (HCPs) are critical to building strong and resilient healthcare systems that can mitigate the impact of climate change. A climate health crisis response requires HCPs who are well informed and are able to anticipate, prevent and manage challenges placed on themselves and on health systems due to climate change. The reality however, is that most HCPs are ill-equipped to manage the escalating climate health crisis. Public HCPs are disproportionately affected due to diminished capacity and support to sufficiently respond to the crisis. Lack of information and awareness on the extent of the climate health crisis and the urgent need to respond compounds the problem. Lack of clear climate health policy directives and resources is a barrier towards effective planning and execution. Although some HCPs in low- middle income countries (LMICs) have a perception of the climate change crisis9, climate change and health advocacy is limited to developed countries despite the urgent need for climate justice advocacy groups led by HCPs in developing countries.

More than ever, there is an urgent need to develop so called climate and environmental change and health (CECH) competent HCPs to manage the impact of climate change on health14. There is also a need for HCPs to contribute to the body of knowledge on the impact of climate change on the health of vulnerable populations in LMICs. Studies need to include causal links and clinical pathways of climate and health disease, e.g. heat and health, to better understand the pathophysiology, prevention and management thereof and evidence to support the effectiveness and efficacy of proposed climate and health interventions9,15.

An adequate response to the impact of climate change on health requires a non-traditional approach that embrace broader, transdisciplinary teams and multi-stakeholders outside of health. This includes collaborations and the establishment of knowledge sharing platforms with experts outside of the healthcare industry, e.g. environmentalists, climatologists, engineers etc., to develop a better understanding and to jointly implement comprehensive climate change adaptation-mitigation health interventions. Most academic institutes have yet to embrace this approach to learning and so most HCPs graduate without exposure to comprehensive transdisciplinary approaches to tackling climate change.

Evidence is mounting on the direct impact of climate change on the physical and mental wellbeing of HCPs. HCPs are often exposed to hazardous climate related working conditions, for example excessive heat in labour and neonatal units, exposure to adverse weather elements delivering community-based health services. The infrastructure of most public health facilities has not been designed to withstand rising temperatures and may compound the problem, for example the presence of steel rods that absorb heat, poorly ventilated rooms and lack of proper airflow design within clinics with high humidity and inability to clear infectious organisms. These work environments can intensify the impact of adverse weather and result in dehydration, heat exhaustion, emergence of acute illnesses and worsening pre-existing NCDs in healthcare workers4,9.

Excessive heat is also associated with loss of productivity in workers and HCPs are not spared from this8. The 2019 International Labour Office (ILO) report states that 2% of the total working hours are projected to be lost every year due to heat8. Loss of productivity is often associated with absenteeism, presenteeism and poor staff attitude as HCPs become overwhelmed and are unable to cope. This has direct impact on the quality of care provided and further weakens health systems as demand becomes greater than supply. Therefore, to strengthen health systems, HCPs need to be prepared to protect themselves against the impact of climate change on their health and preserve much needed health service delivery.

HCPs can significantly contribute towards an effective response to the climate and health crisis in various ways. These include i) the promotion of self-care through behavioural change and the adoption of protective and preventive measures; ii) health systems preparation to assess and mitigate the impact of climate change on e.g. infrastructure and other services; iii) support for the implementation of climate and health interventions targeted at patients and the community; and iv) support for climate and health advocacy, policy development and implementation. This should be underpinned by capacity building through formal and informal educational channels, so they are more knowledgeable and thus able to effectively respond to the crisis. Capacity building should include investments in research and development infrastructure to add to the body of knowledge in this relatively new field.

*Figure 1* below shows a yet to be published framework developed by *Chersich et al, 2022,* to describe interventions to address climate change and the impact on health. The framework describes various intervention components that include *behaviour change and awareness, health systems and new health services, built environment, nature-based solutions, poverty reduction and equity*, *policy action*, all embedded in the need for *climate financing*. These components are addressed from individual up to national levels. This framework can be adjusted for HCPs to include the following: **Promotion of Self-Care**; **Patient and Community Awareness** as part of behavioural change and awareness, **Management of Occupational exposure** and **Health System Preparedness** that includes support for interventions at nature-based solutions and the built environment and **Climate and Health Advocacy and Policy Advancement**; all embedded in **Capacity Building and Research**.

*Figure 1: Interventional framework for Healthcare Professionals*

Capacity Building and Research

1. Promotion of Self-Care

There is an increasing need to preserve health care systems through the protection of HCPs from the direct impact of climate change on their health. There is therefore a need to educate HCPs on the impact of climate change on their physical and mental well-being. Examples of prevention- protection measures include adequate hydration, rest between shifts, prevention of NCDs through good nutrition and exercise and the management of existing medical conditions. Mental screening, referral and management should be offered to HCPs working in adverse working environments. Early Warning Systems (EWS) and messaging targeted at vulnerable HCPs could be beneficial when for example temperature thresholds exceed the norm and may assist in the anticipation and adoption of the above measures.

1. Management of occupational exposure

There is a need to cushion HCPs from excessive impacts of climate change through rigorous occupational health policies that consider the impact of climate change on infrastructure and thus minimise exposure to climate related hazards within the working environment. This can be achieved through the adoption of mitigation interventions to minimise exposure to excessive weather elements. Examples include cool roofing of healthcare establishments, instalment of temperature monitors, cooling devices in facilities, placement of water tanks within the vicinity of working areas. Adaptation interventions include for example advising community health workers on the need for protective workwear such as hats and sunscreen during hot days and the screening and placement of HCPs at risk, e.g. those with obesity and NCDs in more climate-friendly working environments if feasible.

1. Patient and Community Awareness

Healthcare professionals are at the coal face of service delivery and are a trusted resource for patients and the community. HCPs are therefore well positioned to raise awareness on climate change and the impact on health. This can be done at various touch points including before and during consultation, at household and at community levels, leveraging community healthcare workers. At facility level, patient targeted climate related health education materials can be developed and displayed, and health promotion talks held in waiting areas. Patients most vulnerable to climate conditions can be identified and adaptation interventions such as drinking water, rest, managing existing health conditions discussed. Care-packages should include the establishment of referral pathways within and outside of the health sector for patients at most risk of climate related adverse health events.

1. Health Systems Preparedness

Healthcare professionals are well positioned to support health systems prepare for the direct impact of climate change. This can be done through disaster management and support for climate related adaptation and mitigation innovations within health systems.

4.1. Disaster Management

Climate related disasters are becoming more frequent and can either directly impact health systems because of infrastructural damage or indirectly due to referral of acute casualties for emergency assistance. The recent flooding in KwaZulu Natal in South Africa is an example of such an event. Disaster management requires anticipation, planning and coordination of resources, execution, post-event evaluation and staff debriefing. In anticipation of a climate related health disaster, HCPs can support facility-based vulnerability assessments to determine if facilities are able to withstand the impact of a climate health disaster. To do this, HCPs and other health authorities need to be aware of and align themselves with organizations and tools that build technical capacity for vulnerability assessments. For example, WHO Afro ClimHealth is a key resource to building in-country capacity to conduct facility-based vulnerability assessments. Planning also includes development and training on climate related disaster management policies, procedures and treatment protocols, and the allocation of resources. Execution includes triage during the event and referrals. Post event evaluation seeks to strengthen future responses while debriefing aims to build staff resilience to cope with events.

4.2) Health Systems Mitigation-Adaptation Innovations

Healthcare professionals sensitised to climate change can play a key role towards supporting innovative adaptation-mitigation interventions such as indoor temperature monitoring, roll out and implementation of climate and health indicators as part of routine monitoring and evaluation, roll out of patient targeted EWS and messaging including the implementation of adaptation interventions such as use of climate friendly fans, promotion of hydration etc. during care.

1. Advocacy and Policy Advancement

5.1) Advocacy and Climate Justice

Across the world, healthcare professionals are organizing themselves and are lobbying against the climate health crisis. Healthcare professionals are using their unique voice to lobby policymakers to prioritise interventions that mitigate the impact of climate change on the health. Advocacy group led by healthcare professional networks are on the increase. Unfortunately, most are located in developed countries. There is an urgent need for similar advocacy groups in LMICs to also promote climate justice for those disproportionately affected by the climate crisis. HCPs in LMICs should advocate for 1) Policymakers to heed the call for an urgent response; 2) A multisectoral call to action to halt or reverse the impact of climate on health; 3) The protection of the most vulnerable populations through evidenced based interventions; 4) Funding for investments in health systems to build resiliency

5.2) Policy Advancement

Healthcare professionals historically play a critical role in the development and implementation of national health policies, this should be the same for advancing climate and health policy. The role that HCPs are best positioned to play include i) Generation of evidenced based climate and health scientific knowledge; ii) Technical support to policymakers and other health officials for the translation of science to policy; iii) Policy education and awareness to the broader community; iv) Policy implementation at sub-national levels; and v) Evaluation of impact, reach and the effectiveness of interventions to better refine policy. This is illustrated in Figure 2 below:

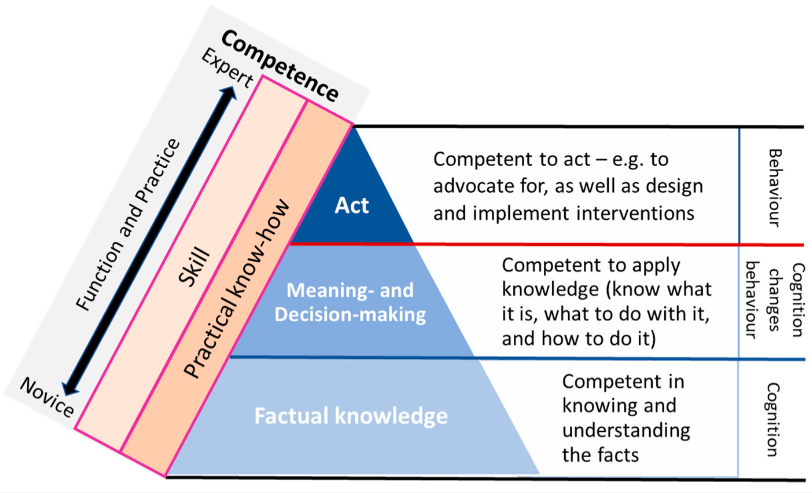
*Figure 2: Climate Health Policy Advancement*

1. Capacity Building and Research

6.1) Developing CECH competent Healthcare Professionals

To adequately respond to climate change, HCPs need to develop competency in the field of climate change and health14. A comprehensive competency framework that enables transition from novice to expert (see *Figure 3* below), can guide the development of such expertise. In this framework, competency is developed through 1) Obtaining **factual knowledge** on climate change and health; 2) **Applying meaning and decision making** based on factual knowledge; and 3) **Acting** on that knowledge – the ultimate level of competency14.

*Figure 3: The CECH Framework*



Source: Jagals et al14

Factual knowledge on climate change and health can be achieved formally through pre, post graduate training at learning institutes and informally through self-learning14. Training should accommodate different levels of healthcare professionals including community health workers, nurses, doctors and specialists and delivered in different mediums and methodologies. Curriculum for training should adopt non-traditional approaches and include transdisciplinary sectors, linking climate and environmental data to health data. For instance, healthcare professional training curriculum could include rotation to climatology and environmental health departments and vice -versa, to promote transdisciplinary knowledge and joint collaborations on adaptation-mitigation interventions.

There is a need to for healthcare professionals to develop practical skills through the application of theory in real life settings. This can be achieved through the placement of healthcare professionals in clinics for the application of theory. Climate and health educational toolkits should be developed and distributed in healthcare facilities to reinforce learning. There should be continuing medical education and ongoing assessment for new and established healthcare professionals to ensure they remain acquainted and relevant in a rapidly evolving climate change world.

6.2) Climate and Health Research and Development

A Climate and health research agenda should be incorporated as part of pre and post graduate curriculum in learning institutes. This will help generate much needed contextual knowledge on climate change and health in LMICs. Funding for climate change and health research should prioritise pre and post-graduate students and early career research scientists based in LMICs.

Conclusion

Healthcare professionals are at the centre of health systems strengthening and should be equipped to respond to and mitigate the impact of climate change on themselves and the populations they serve. A comprehensive approach should be undertaken with interventions from promotion of self-care through to advocacy and policy advancement. Capacity building, research and development embeds and enables this response. This if implemented effectively, has the potential to reverse or even halt the worsening crisis and the burden on the most vulnerable, who are already under the care of HCPs.

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