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The Intersection of Climate Change and Global Health Security

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ABSTRACT

The relationship between climate change and global health security represents a critical nexus that impacts global public health. Climate change exacerbates health vulnerabilities through direct consequences, such as extreme weather events, and indirect effects, including the spread of vector-borne diseases and challenges to food and water security. Health systems worldwide face strain from these impacts, particularly in vulnerable and resource-constrained regions. This paper examines the multidimensional links between climate change and health, reviews case studies of climate-related health impacts, and explores policy responses aimed at mitigating risks. Recommendations include integrating health and environmental strategies, strengthening health infrastructure, and fostering international cooperation to enhance resilience. Understanding these dynamics is essential for shaping sustainable and equitable policies to address the dual crises of climate change and global health insecurity.

Keywords: Climate change**,** Global health security, Public health policy, Vector-borne diseases, Health systems resilience, Environmental health, Climate adaptation.

INTRODUCTION

The current global scenario presents multidisciplinary challenges that require addressing both climate change and global health security. Climate change poses threats that go beyond the environment and affect public health. These are growing concerns that need robust interventions to prevent and mitigate the effects. Policy interventions are needed to promote understanding of the potential links, build global co-benefits, and present cohesiveness to the global community. A comprehensive response that links climate and health is the need of the hour, specifically in Asia where countries are already facing the hard-hitting consequences of pollution [1, 2]. Several research studies have explored the linkages between health and climate. Scholars have reviewed the impacts of air pollutants on health and called for an interdisciplinary approach to research in the field. Discussions on the broad aspects of the linkages between climate and health have provided much insightful information to create global quantitative assessments. The issue of global change and human health has been discussed in several publications. Research interventions for both of these issues are growing, and individual responses have also been discussed. Scholars have reviewed Australia's involvement in global environmental change and assessed the existing national initiatives to identify principal areas for future policy and program development. However, it is not clear how climate negotiations can deliver co-benefits for global health security. The objectives of this paper lie in enhancing our global understanding of the links between climate change, multidisciplinary processes, and health security, and the potential for future development of salutogenic policy application. We provide an overview of the present examination in four linked sequential parts with a view to policy and practice [3, 4].

Understanding Climate Change and Global Health Security

Climate change, defined as variation in the Earth's climate, is driven by human activities that emit greenhouse gases. By increasing the natural greenhouse effect, the atmosphere traps heat from the sun, causing the planet to warm. As the climate continues to change, so does the burden of health risks and potential impacts on the measures designed to ensure our collective health security. Health security has

been defined as the activities required to minimize vulnerability to acute public health events that endanger the collective health of populations living across geographical regions and international boundaries [2, 5]. Climate change is increasingly understood to indirectly affect health through factors that threaten health security, e.g., by reducing the availability of clean water or food or through extreme weather events that impact infrastructure. Anchored in the Ottawa Charter definition, and widely understood, is that health is not only linked to disease diagnosis or biological risk factors but that broader determinants of health – or upstream causes of the causes of ill health that sit outside of the control of the individual and require a population-based approach to interventions. The determinants of health under the broad categories of the social, cultural, and physical environment are constructed by the economic and social policy, such as energy transitions policy downstream changes in access to healthy choices – e.g., regular walking as active transport or the purchase of healthy fresh food without harmful chemicals. These social determinants should be understood as analogous in affecting the health of global populations through the differential risks of climate change. For example, there is now a strong body of evidence that the social determinants of health lead to some groups within societies being more vulnerable to the risks of climate change, which are exacerbated by, for example, poverty, poor access to health, and other social services, lack of access to resources, low education, and discrimination [6, 7].

Impacts of Climate Change on Global Health

Climate change can directly harm people's health through extreme events, such as increasing frequencies of damaging storms and other weather disasters. Extremes have impacted the mental health of affected populations in terms of depression, anxiety, and post-traumatic stress disorders, as well as displaced communities. Disasters are associated with serious civil disturbances and public health threats, including severe food- and water-borne diseases, such as cholera and acute gastroenteritis, as floodwaters inundate and contaminate populated areas. Animals such as rodents and insects seeking refuge in people's homes to escape floodwaters are also associated with potential vector-borne diseases. Furthermore, climate-related stress results as extreme events exacerbate the conditions of chronically ill persons and give rise to new threats, including climate-related infectious diseases. The relationship between natural disasters, people's mental health consequences, and chronic diseases has been little researched and is difficult to disentangle, especially since outbreaks of meningitis were also experienced in South Pacific islands following severe weather events [8, 9]. A direct health threat posed by climate change, in terms of Lyme disease, is the expansion of disease vectors' geographical range as temperatures increase and climatic conditions become more favorable for the parasites and even mutations to arise for more efficient transmission. Higher temperatures are also associated with increases in concentrations of ground-level ozone, which exacerbates respiratory distress through lung inflammation as ozone reacts with lung tissues. Global warming is reported to prolong and compound pollen seasons by accelerating the release of pollen and prolonging the allergy season, which can result in more hay fever, allergic asthma, and even skin conditions. Populations particularly susceptible to the negative health impacts of climate change include the elderly, children, poor people, and those in industrializing countries. The high costs associated with stressful effects like weather-related displacement, increases in chronic diseases, mental health issues, and the loss of loved ones and property under climate change have led to the suggestion of the adoption of adaptive measures to counteract health problems arising from weather and climate. Furthermore, the intensification of infectious diseases can occur indirectly through reduced health and human resource capabilities. For example, natural disasters such as hurricanes can compromise health and mental health professionals, as well as health facilities, critical medications, and life-saving medical equipment, which leads to insecure public health and safety in general [10, 11].

Vulnerabilities in Health Systems

The world's health systems have long faced vulnerabilities. Perceived and predictable resource scarcity, prolonged conflicts, and inequitable access to quality primary healthcare are just a few examples of deficiencies in the structure of healthcare systems across the world. Climate events exacerbate these vulnerabilities, finding more material than ever to attack. These resultant climate health shocks are often understood in the context of how specific environmental factors – temperatures, precipitation, storms, fires, and droughts – directly cause harm to human health. However, a less prototypical, but more insidious, part of the phenomenon is how the increased frequency and intensity of climate-related disasters strain health systems and how pre-existing weaknesses in health systems affect both climate-survivable resilience and, more broadly, public health [12, 13]. Challenges often related to the process of keeping the health machinery running – routine service disruptions for planned outages or management substitutions, or the potential for operational failures in supply chains, like inadequate storage of vaccines

that spoil during a power outage – during a disaster or emergency could cause escalation of injury, total facility closures, and increasingly negative health-related externalities. Given infrastructure failure – especially in a disaster-prone setting – how could the sensation of routine be a good signal? And what health system would be capable of delivering minimum care under a massive influx of injured or ill patients when it is regularly down for maintenance during off-hours? Arguments about whether to divert resources to maintain feasibility provisions or make sustainability investments secondary when the decision impacts real lives. Wealthier nations generally have the capacity and means to pandemic-proof their country; however, if the health engine is not built to be resilient irrespective of the type of calamity, then deviation from the standard provision policy towards intensification would have the same impact on the ripple of corresponding climate crises on the health sector [14, 15].

Case Studies

The following case studies provide real examples of the intersection of climate and infectious diseases in human populations. These cases demonstrate the connection between biogeophysical systems and disease outcomes, the way in which changing environmental conditions and drivers may influence disease transmission dynamics, and outcomes of management responses [16, 17].

Chikungunya in Italy

Aedes albopictus is a vector of chikungunya virus. This mosquito is implicated in the ongoing or potential future distribution of diseases at higher elevations in areas where it is newly or already established, such as in southern Europe. In Italy, the risk of an outbreak is increased with populations that have immunological naivety to the pathogen. The onset of disease typically takes about 3 to 7 days from the bite of an infected mosquito and ranges from mild fever to many months of incapacitating polyarthralgia or arthritis. In one estimate, the case rate was one case for every 50 people in the outbreak, approximately 270 cases per week. In some weeks of January and February, the number of cases exceeded 1,000 [18, 19]. In other words, while vector density was already high in all regions in 2008 and is decreasing year on year, ecological conditions may become more favorable to support chikungunya transmission in the North during this century, especially as a result of climate change. The chikungunya resurgence in Italy illustrates that it is not just the presence of a vector, in this case, Albopictus, that might produce or reintroduce a disease, but rather its inextricable linkage with climatological and immunological vulnerability. Climate governs entomological risk and with it, human vulnerability may change. Public health professionals should endeavor to learn as much as possible from what is happening now so that they are as knowledgeable as possible about the precise relationship between climate variation, mosquito density, and what happens in the clinical ecology of chikungunya, as well as the other viral, spirochetal, and protozoal pathogens associated with the spread of low and high latitude Aedes species before a major outbreak occurs [20, 21].

Disease Outbreaks Exacerbated by Climate Change

Several disease outbreaks in recent years have drawn attention to climate change's role in disease pandemics and global health security. As temperatures rise and precipitation patterns change, the disease is on the move; in the months following and even preceding major climate events, data show that those most at risk of drought, extreme temperatures, or fire are suffering from increased rates of hospitalization. Scientific modeling of climate change effects concludes that above all, fine-scale processes governing contact between infectious agents and the general population, mediated by highly local climate variables like temperature and precipitation, can be expected to change. These processes drive the transmission of vector-borne diseases like malaria and dengue fever. Heavy precipitation can be expected to lead to further transmission of waterborne illnesses such as cryptosporidiosis, which has been shown to increase after floods. While it is important to note that the biological context for these diseases remains equally important in understanding prevalence, climate conditions amplify the risks, especially for hotspots in terms of population at risk and vulnerability. Some health hardware installations can quickly adapt to these new local contexts, while local health workers are well positioned to advise on disease prevention for vulnerable patients using such systems [22, 23, 24]. There are several diseases for which climate variability is directly tied to both short-term outbreaks and long-term trends. These diseases, for which interventions are often mentioned, are more likely than not to increase in prevalence and geographic risk with a changing climate. Climate-informed disease modeling and advisories have been implemented and effectively used on a scalable basis. These programs provide a framework for developers of global health context hardware, those with the potential to support faster local adaptation in a changing world [25, 26].

Policy Responses and Recommendations

As a response, what do public health practitioners and policymakers have to work with? What policies or practices can mitigate, even as they prepare and adapt to, this existential intersection of public health and environmental change? But also, what direction should have the force of law? This becomes a conversation about what policy responses are necessary, and these answers rest entirely on systems of national and international governance. If policy, after all, is better when it is based on good science, grounded in social facts and justice, and the product of respect for democratic governance, we can clarify some key responses [27, 28]. At the most fundamental level, governments must work towards policy and policy frameworks that integrate health and environment: not merely an avoid-the-worst posture, but a strategy for the sound and sustainable development of society. Country-level responses offer promising early outcomes on several fronts. In the Netherlands, heat risk as a side effect of PM10 reduction has been fully accepted as a health policy strategy. France has been implementing and revising its National Heat and Health Action Plan since 2004 with promising results and official support across the national and local governments. In the United States, New York City marshals collaboration from multiple federal, state, and city agencies and universities to work on critical changes in city health and design strategies in response to global climate change. Cities in the global South are also working hard, with strong local support, to improve resilience to health challenges related to a changing and uncertain climate. What is required of all countries and, indeed, at the international level? Countries need to prepare their public health infrastructure for the coming climate changes. They need to update and refresh their basic public health infrastructure and systems, recognizing and revising the pronatal and pro-immigration policies of recent decades. And they need to focus on reducing health and environmental vulnerabilities inherent in localized, socially marginalized, and economically impoverished communities [29]. The essential platform for future policy action is cooperative federalism, particularly the participation of relevant governmental agencies in decentralized policymaking. For such recommendations to be actionable, institutional reforms require agreement across all sectors. Our dynamic approach has implications for communicating risk and developing tools to enhance public and individual readiness. This study also highlights the essential role of political and societal strategies in fast-tracking the mainstreaming of climate change and health concerns into domestic and international policy agendas. International cooperation may be needed to improve assessments and data sharing. Greater efforts on a stronger, more evidence-based approach to arguing for policies are required. Optimal health and adaptation policies appear to involve the redirection of funds from the highly vulnerable to all community health programs, rather than the development of new climate change and health-specific programs. Without strong political backing, public health advocates would have to make prioritization, waiting, and benefit-cost analyses a clear part of their political and public message [30]. Both global warming and climate change and a future avian influenza pandemic are potential catastrophic agents, capable of totally disrupting economic and human welfare. Two policy domains could potentially moderate such catastrophes: those affecting initiatives being used to deliberately reduce the risks via preparedness, including significant expenditure; and those affecting the environmental pressures driving the magnitude and probability of catastrophic events. Given that the latter is addressed at improving the prospects of reducing future risks, the preparedness domain is where relevant stakeholders are of thematic interest to this conference.

CONCLUSION

The intersection of climate change and global health security underscores the urgency of a multidisciplinary approach to address these converging challenges. The adverse health impacts of climate change—ranging from disease outbreaks to infrastructure vulnerabilities—demand coordinated efforts across national and international platforms. Strengthening health systems, integrating environmental considerations into health policies, and fostering international collaboration are pivotal to building resilience. Case studies highlight the importance of proactive measures, such as early warning systems and community-based health interventions, to mitigate risks effectively. Governments, health professionals, and researchers must prioritize adaptive strategies and equitable resource distribution to safeguard vulnerable populations. By embracing an integrated framework that combines science, policy, and societal engagement, the global community can better navigate the complexities of climate change and ensure health security for all.

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