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Editorial

Climate Change and Medical Responses: From Clinical Effects to an Interconnected One Health Response

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Climate change is no longer solely an environmental concern; it is increasingly recognized as a major determinant of human health, a driver of social and biological vulnerability, and a critical challenge to the resilience of healthcare systems. Rising temperatures, extreme weather events, air pollution, ecosystem degradation, shifts in the distribution of infectious diseases, food and water insecurity, population displacement, and climate-related psychological distress all demonstrate that human health cannot be considered independently of the environmental and social systems in which it is embedded. The contributions included in this Special Issue, Climate Change and Medical Responses, converge on a central message: addressing climate-related health risks requires us to move beyond disease-specific and predominantly reactive models of care towards an integrated One Health framework that links environmental surveillance, prevention, primary healthcare, emergency preparedness, mental health, digital innovation, and the environmental sustainability of healthcare systems.

The COVID-19 pandemic provided a clear demonstration of this interconnectedness. It showed how a health emergency can rapidly extend across territories and sectors, affecting healthcare delivery, economies, mobility, social relationships, information systems, and individual well-being. Climate change poses a similarly systemic challenge, although its health effects often develop through multiple, interacting, and less immediately visible pathways. Medical and public health responses must therefore increasingly operate along a continuum that extends from environmental surveillance and risk assessment to prevention, diagnosis, treatment, emergency preparedness, recovery, and long-term monitoring [1–3]. From this perspective, climate-related crises should not be regarded as isolated events, but rather as manifestations of broader imbalances in the relationships among human populations, animals, ecosystems, and the physical environment.

Climate change is now widely recognized as one of the most significant threats to global health [4]. Rising temperatures, extreme weather events, changes in infectious-disease patterns, air pollution, water insecurity, ecosystem degradation, and displacement are already affecting populations worldwide [5]. Nevertheless, the overall burden of climate-related disease is likely to remain underestimated. In addition to mortality, hospital admissions, and emergency-department activity, climate change contributes to a broad range of chronic, respiratory, cardiovascular, infectious, psychological, and social health outcomes, many of which first become apparent within communities and primary healthcare settings [6,7].

Recent global health emergencies have further emphasized the need to strengthen prevention, preparedness, and health-system resilience. The COVID-19 pandemic demonstrated that healthcare systems cannot function effectively in isolation from environmental

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protection, social organization, and ecological stability. Effective surveillance, risk communication, early diagnosis, long-term monitoring, and community-based prevention increasingly require integrated models capable of connecting scientific disciplines, institutions, healthcare professionals, and citizens [8].

Within this context, One Health provides a particularly relevant framework for understanding and managing the complexity of climate-related health risks, based on the recognition that the health of humans, animals, plants, and ecosystems is closely interconnected [9]. Beyond its original application to zoonotic diseases and antimicrobial resistance, One Health has evolved into a broader interdisciplinary and intersectoral approach that can support climate adaptation by integrating medicine, veterinary sciences, environmental sciences, public health, social sciences, economics, and governance.

Climate-related hazards rarely act through isolated mechanisms. Heat exposure, air pollution, biodiversity loss, ecosystem disruption, emerging pathogens, and social vulnerability frequently interact and may generate health effects across different spatial and temporal scales. For this reason, healthcare professionals should not be considered merely end users of environmental information. Rather, they can play an active role within integrated surveillance, early-warning, prevention, and response systems by contributing clinical observations, identifying emerging patterns of disease, recognizing vulnerable populations, and supporting the translation of environmental data into public health action [7,10].

The articles included in this collection highlight the multidimensional nature of One Health implementation. Collectively, they address the health effects of climate change, the role of primary healthcare and prevention, environmental determinants of disease, emerging risks associated with pollution and ecosystem degradation, and innovative approaches to surveillance, adaptation, and community resilience. Taken together, these contributions demonstrate that effective responses to climate-related health threats require coordinated action across clinical medicine, public health, environmental sciences, and territorial governance.

The Special Issue also emphasizes the importance of bridging research and practice. Scientific evidence should not remain confined to academic settings but should inform policy-making, healthcare planning, and locally adapted interventions. Strengthening this interface can enable institutions, healthcare professionals, and communities to anticipate and reduce health risks rather than respond only after adverse events have occurred. From this perspective, One Health represents not only an analytical framework for understanding complex interactions but also a practical approach to governance in a rapidly changing environmental context [9].

The future of health will increasingly depend on our capacity to recognize and address these interdependencies. Human health is closely linked to ecosystem integrity, climatic stability, biodiversity, and social conditions that shape exposure, vulnerability, and adaptive capacity [10]. Addressing current and future health challenges therefore requires greater integration across sectors and disciplines, with a stronger emphasis on prevention, preparedness, and long-term resilience.

In this broader perspective, One Health, complemented by the principles of Integral Ecology, offers a conceptual basis for reconsidering the relationship between human societies and the natural environment, and for promoting healthier, more resilient, and more sustainable communities [11,12].

The contribution by Lauriola et al., which examines the role of Sentinel Physicians for the Environment from a Chilean perspective, provides a relevant example of how this transition may be operationalized [13]. Primary healthcare physicians and other community-based health professionals are often among the first to identify changes in symptoms, disease

patterns, and local health needs. Their clinical observations may complement conventional environmental and epidemiological surveillance, particularly in settings where environmental health data are incomplete or fragmented. Establishing structured links among general practitioners, pediatricians, public health authorities, researchers, environmental agencies, and local communities could therefore strengthen the capacity of health systems to identify emerging environmental risks and translate clinical observations into actionable public health information.

This local perspective is complemented by studies investigating the direct effects of environmental exposures on physical health. Portela Dos Santos et al., in a pilot study conducted in the Swiss canton of Valais, examine associations between changing climatic and environmental conditions and cardiopulmonary health in adults [14]. Their work illustrates the importance of locally generated evidence, as the health effects of climate change are strongly influenced by geographical, environmental, and population-specific characteristics. Mountain regions, urban areas, coastal zones, rural settings, and arid environments are exposed to different combinations of climatic hazards and social vulnerabilities. Medical and public health responses should therefore be supported by geographically explicit information integrating environmental exposures, population characteristics, and health outcomes.

Extreme heat represents one of the most direct and increasingly relevant examples of this interaction. The study by Toure et al. in Matam, Senegal, integrates climatic indicators, hospitalization data, and machine-learning methods to investigate heatwave-related hospital admissions [15]. Beyond its specific findings, the study illustrates the potential of predictive analytics to link environmental information with healthcare preparedness. Forecasting tools may help health systems move from predominantly reactive models towards anticipatory responses by supporting resource allocation, workforce planning, early-warning mechanisms, and the identification of periods or population groups at increased risk.

The health consequences of rising temperatures may be particularly severe in settings where geographical remoteness already limits access to medical care. Quilty et al. examine the implications of climate change for aeromedical retrieval services in remote Northern Australia [16], drawing attention to an aspect of climate-health research that is often overlooked: climate change can affect not only patterns of morbidity and mortality, but also the systems through which care is delivered. Increasing temperatures and more frequent extreme weather events may increase demand for emergency services while simultaneously disrupting transport, workforce availability, infrastructure, and access to remote communities. These findings suggest that climate adaptation should be incorporated into health-service organization and emergency preparedness, particularly in geographically isolated areas.

The health effects of climate change, however, extend well beyond physical morbidity. Several contributions to this Special Issue address the growing importance of mental-health outcomes. Jin et al., using longitudinal data from China, investigate the association of long-term apparent temperature and extreme-temperature exposure with depressive symptoms [17]. Mosca et al. address a related but distinct dimension by examining eco-anxiety and climate-related psychological distress [18]. Together, these studies illustrate that environmental change may affect mental health through different mechanisms, including direct exposure to climatic conditions as well as concerns about current and future environmental threats.

These findings have important implications for clinical practice and public health. Climate-related psychological effects may first emerge in primary care, schools, workplaces, families, and community services, where they may not be immediately recognized as consequences of environmental change. Incorporating mental-health assessment and support into climate-adaptation strategies may therefore improve the early identification of vulnerable

individuals and populations. At the same time, it remains important to distinguish between understandable concern about environmental change and clinically relevant psychological distress, particularly when climate-related fears interact with pre-existing social, economic, or individual vulnerabilities [17,18].

The COVID-19 pandemic also demonstrated the importance of the information environment during health emergencies. Fernandez et al., through a geospatial analysis of COVID-19-related discourse in Italian cities, highlight the value of infodemiology for examining how health information, misinformation, public perception, and geographical context interact [19]. Similar dynamics are increasingly relevant during climate-related emergencies, when rapidly evolving information may influence risk perception and individual behavior. Effective health communication therefore requires more than the dissemination of epidemiological evidence. It also depends on the ability to communicate uncertainty, identify information gaps, understand public concerns, and maintain trust between institutions, healthcare professionals, and communities.

A One Health perspective also requires healthcare systems to consider their own environmental impact. The review by Wang and DasSarma on medical greenhouse gases and potential alternatives highlights this reciprocal relationship [20]. Healthcare systems are increasingly affected by climate change, yet some healthcare activities also contribute to greenhouse-gas emissions and other forms of environmental pressure. Climate resilience should therefore be accompanied by efforts to improve the environmental sustainability of healthcare delivery. This may include the evaluation of lower-impact technologies, procurement strategies, infrastructure, and clinical practices, provided that patient safety and standards of care are maintained.

Taken together, the studies included in this Special Issue address complementary aspects of climate-related health risk. Environmental and climatic data help characterize changing exposures, while epidemiological and clinical studies document their consequences for human health. Primary-care professionals may contribute to the early identification of emerging patterns at the community level, whereas digital tools and predictive methods can support surveillance and preparedness. Emergency and retrieval services illustrate the operational challenges posed by climate-related hazards, mental-health research broadens the range of recognized outcomes, and infodemiological approaches help explain how information influences public responses during crises. At the same time, attention to the environmental footprint of healthcare introduces an important element of reciprocity into the discussion [13–20].

Rather than representing a simple progression from environmental exposure to disease and subsequent treatment, these relationships are better understood as a set of interconnected processes. Environmental change modifies patterns of exposure and vulnerability; these changes influence both physical and mental health; healthcare systems detect, manage, and monitor their consequences; and the information generated through clinical and public-health practice can, in turn, support prevention and adaptation. Within this framework, healthcare systems are not only responders to climate-related health effects but also active participants in surveillance, preparedness, and environmental sustainability.

This interconnected perspective has practical implications. Climate and environmental information should increasingly become usable information for clinicians and health services. Conversely, appropriately aggregated and protected clinical observations can contribute to environmental-health intelligence. Strengthening interoperability among meteorological, environmental, epidemiological, clinical, and socioeconomic datasets could support earlier detection of emerging risks and more targeted preventive interventions. General practitioners, pediatricians, nurses, emergency professionals, and community-health

workers may play a particularly important role because they operate close to populations and can identify health signals that hospital-based statistics alone may overlook [6,7,13].

The future of health will depend on our capacity to recognize interdependencies. Human health is inseparable from ecosystem integrity, climatic stability, biodiversity, and the social conditions that determine vulnerability and adaptive capacity [10,12]. The challenges posed by climate change therefore require collaboration across disciplines and sectors, integration of environmental and health information, and greater emphasis on prevention and preparedness.

The Special Issue therefore suggests a broader understanding of medical response. Medical response should not begin only when a patient reaches an emergency department. In the context of climate change, it begins with preparedness and prevention and extends through environmental surveillance, early warning, primary care, community engagement, emergency response, clinical treatment, psychological support, and long-term follow-up [6–8]. Research must similarly cross disciplinary boundaries, connecting medicine with environmental science, epidemiology, climate science, data science, psychology, communication, and health-system planning.

The central challenge in the coming years will be to translate this interconnected knowledge into operational systems. Climate change requires healthcare systems capable not merely of absorbing additional disease burdens, but also of anticipating risks and actively participating in adaptation. One Health provides an appropriate conceptual framework for this transformation because it recognizes that protecting human health ultimately depends on safeguarding the ecological and social systems that sustain it [9].

Beyond their clinical and scientific roles, healthcare professionals can also contribute to strengthening cooperation and solidarity across communities and countries. The experiences represented in this Special Issue show that many climate-related health challenges are shared across geographical and social contexts. Addressing them requires reliable communication, international collaboration, and opportunities for healthcare professionals and researchers to exchange evidence, experience, and effective practices. In this respect, this collection contributes to a broader effort to strengthen cooperation around the common goal of protecting human and environmental health.

The contributions collected here offer different geographical, methodological, and disciplinary perspectives, yet converge towards a common direction. They encourage a transition from fragmented observation to integrated surveillance, from predominantly reactive medicine to anticipatory prevention, and from healthcare considered in isolation to healthcare understood as part of a broader One Health framework. In an era of climate change and interconnected environmental crises, medical responses must increasingly reflect these interdependencies.

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