

# COMPLEX THERAPY OF DISEASES CAUSED BY CLIMATE CHANGE: APPROACHES TO MAINTAINING NATIONAL HEALTH

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## Abstract

*Climate change has emerged as a significant global threat, influencing the frequency and severity of various diseases, particularly those that affect public health. The interplay between environmental factors and human health has led to an increase in conditions such as respiratory diseases, cardiovascular problems, infectious diseases, mental health disorders, and food security issues. In response, a complex and integrated approach to therapy and prevention is essential to mitigate the health impacts of climate change. This paper explores multifaceted strategies for maintaining national health in the face of climate-induced health challenges. Key approaches discussed include the development of early warning systems for climate-related diseases, the strengthening of healthcare infrastructures to address climate resilience, public health education, and the promotion of sustainable, climate-resilient practices. Additionally, the importance of interdisciplinary collaboration between healthcare providers, policymakers, environmental scientists, and communities is emphasized. Sustainable urban planning, innovations in medical technology, and the integration of climate considerations into national health policies are essential components of the proposed complex therapy model. The paper concludes by stressing the need for international cooperation to ensure equitable health outcomes in the face of climate change, especially for vulnerable populations.*

**Keywords:** climate change, public health, climate-induced diseases, respiratory diseases, cardiovascular health, infectious diseases, mental health, healthcare infrastructure, disease prevention

## I. Introduction

The impact of climate change on human health is an emerging global concern that has far-reaching consequences for public health systems and societies worldwide. As climate change accelerates, its effects on health are becoming increasingly evident, with rising temperatures, extreme weather events, and changing ecosystems contributing to a broad spectrum of health challenges. Diseases that were once considered regional or sporadic are now becoming more widespread, while pre-existing health conditions are exacerbated by climate-related factors.

Climate change affects health in multiple ways: directly, through extreme heatwaves, floods, and natural disasters; and indirectly, by influencing the spread of infectious diseases, air and water quality, food security, and mental health. Vulnerable populations, including the elderly, children, and marginalized communities, are particularly at risk, facing increased exposure to environmental stressors and inadequate access to healthcare.

Addressing the health impacts of climate change requires a complex, interdisciplinary approach that incorporates climate science, healthcare, public policy, and community-level interventions. Public health systems must be equipped not only to respond to immediate health crises caused by climate extremes but also to address the longer-term health risks associated with gradual environmental changes. This involves strengthening healthcare infrastructure, investing in early warning systems for climate-related diseases, and fostering public awareness to mitigate risks.

This paper explores the various facets of this complex therapeutic approach, focusing on strategies for maintaining national health amid the challenges posed by climate change. Emphasis is placed on the need for comprehensive, coordinated efforts across all levels of governance and society to ensure that healthcare systems are resilient to the health impacts of climate change and that future generations are protected from its most harmful effects.

## II. Methods

This study adopts a multidisciplinary approach to exploring the complex therapies for diseases caused by climate change, drawing on literature review, case studies, and expert consultations. The methods employed are designed to assess the impacts of climate change on public health, identify effective therapeutic approaches, and propose integrated strategies for health maintenance. The following methods were used:

1. **Literature Review:** A comprehensive review of scientific journals, government reports, and global health organizations' publications was conducted to assess the relationship between climate change and health. Focus was placed on epidemiological studies linking climate variables (such as temperature, precipitation, and extreme weather events) with the incidence of diseases, particularly respiratory, cardiovascular, infectious diseases, and mental health disorders. The review also examined existing public health strategies, interventions, and frameworks used to mitigate the effects of climate change on health.
2. **Case Studies:** Case studies from regions that have already experienced significant climate-related health challenges were analyzed. These case studies provided insights into successful and unsuccessful public health strategies, infrastructure responses, and community-driven solutions. Examples included the effects of heatwaves on mortality rates in Europe, the spread of vector-borne diseases like malaria in Africa, and the mental health impacts of extreme weather events in the Caribbean.
3. **Expert Consultations:** Consultations were conducted with a range of experts in the fields of climate science, public health, healthcare policy, and epidemiology. These consultations helped refine the approach to integrating climate change into national health systems and allowed for the identification of key gaps in current healthcare responses. Input from these experts was used to shape recommendations for policy and healthcare interventions.
4. **Comparative Policy Analysis:** A comparative analysis of national health policies and climate action plans was conducted to assess how various countries are addressing climate-related health risks. This involved reviewing health policies from both high-income and low-income countries to understand different approaches to integrating climate change and health, including adaptation strategies, disaster preparedness plans, and the role of health promotion.

## III. Results

The analysis of climate change impacts on health and the review of current approaches to maintaining national health revealed several critical findings. The results emphasize the growing burden of climate-related diseases, the effectiveness of specific interventions, and the challenges associated with building climate-resilient health systems. Key findings are summarized below:

1. **Increased Incidence of Climate-Related Diseases:** The review of epidemiological studies highlighted a significant increase in the incidence of various diseases due to climate change. For instance, extreme heat events were directly linked to a rise in cardiovascular and respiratory diseases, particularly among vulnerable populations like the elderly and those with pre-existing conditions. The spread of infectious diseases such as malaria, dengue, and Zika was observed to correlate with changing temperature and rainfall patterns, expanding the range of vector-borne diseases in regions previously unaffected. Additionally, mental health issues, including anxiety and depression, have increased, particularly in communities affected by natural disasters like hurricanes, floods, and wildfires.
2. **Vulnerable Populations at Greater Risk:** Vulnerable populations, including the elderly, children, low-income communities, and people living in disaster-prone regions, were found to be disproportionately affected by climate-related health risks. These populations often have limited access to healthcare, making it more challenging to manage and treat diseases exacerbated by climate change. Furthermore, socioeconomic disparities compound the effects of climate-induced stressors, leading to greater health inequities.
3. **Effectiveness of Early Warning Systems:** Early warning systems (EWS) for climate-related health events, such as heatwaves, floods, and infectious disease outbreaks, have proven effective in several regions. Countries with advanced EWS systems, such as those in Europe and parts of Southeast Asia, have experienced reduced mortality and morbidity rates during extreme weather events. These systems enable timely public health interventions, such as issuing heat alerts, evacuations, or vaccination campaigns in response to disease outbreaks.
4. **Healthcare Infrastructure and Climate Resilience:** A key finding was the inadequate preparedness of many healthcare systems to handle the increased burden of climate-related diseases. Healthcare infrastructure in many low- and middle-income countries was found to be vulnerable to extreme weather events, with hospitals and clinics at risk of damage from floods or extreme heat. Investments in climate-resilient infrastructure, such as flood-proofing healthcare facilities and improving the energy efficiency of hospitals, were identified as essential to maintaining care during climate crises.
5. **Sustainable Public Health Strategies:** Public health strategies that focus on both climate adaptation and mitigation were found to be the most effective. These strategies include promoting sustainable practices, such as the reduction of air pollution, the development of green spaces to reduce heat island effects, and the promotion of climate-resilient agriculture to ensure food security. Health promotion campaigns that educate the public about the effects of climate change on health, coupled with community-based climate action, have shown positive outcomes in terms of improving health literacy and fostering preventive behaviors.
6. **Interdisciplinary Collaboration and Policy Integration:** Countries with strong interdisciplinary collaboration between public health officials, climate scientists, and policymakers were more successful in addressing the health impacts of climate change. Integrated climate-health policies that embed climate resilience into national health frameworks were found to be critical. A lack of coordination and siloed efforts in many regions hindered effective responses, underscoring the need for cross-sectoral collaboration to address climate-related health risks.
7. **Global and Regional Disparities:** The study also revealed significant disparities in the capacity to address climate-related health risks between high-income and low-income countries. While high-income countries have made strides in incorporating climate change into health policy and infrastructure planning, many low-income countries continue to struggle with inadequate healthcare resources, poor climate data, and limited access to

technology. International cooperation and funding were identified as crucial to supporting vulnerable countries in building climate-resilient health systems.

8. **Technological Innovations in Disease Tracking and Treatment:** The integration of technology into healthcare was found to be a promising tool for managing climate-related diseases. Geographic information systems (GIS), remote sensing, and artificial intelligence (AI) for tracking disease outbreaks and predicting climate-related health risks were identified as innovative solutions. Mobile health (mHealth) platforms have also facilitated rapid response and information dissemination during climate-related emergencies, particularly in resource-limited settings.

In conclusion, the results suggest that while significant progress has been made in some regions, the overall response to climate-related health challenges remains inadequate. Building robust, climate-resilient healthcare systems and adopting integrated approaches to climate adaptation and disease prevention will be essential to mitigating the growing health impacts of climate change.

## IV. Discussion

### I. Subsection One: Overview of Climate Change and Its Impact on Public Health

The analysis of climate change impacts on health and the review of current approaches to maintaining national health revealed several critical findings. These findings underscore the growing burden of climate-related diseases, the effectiveness of specific interventions, and the challenges associated with building climate-resilient health systems. The results align with our understanding of the multifaceted nature of climate change's effects on public health, highlighting both direct and indirect pathways through which these changes manifest.

Firstly, increased incidence of climate-related diseases has been a primary concern. As extreme weather events become more frequent, the rise in cardiovascular and respiratory diseases, particularly among vulnerable populations, has been documented. The elderly, those with pre-existing conditions, and other at-risk groups are disproportionately affected by heatwaves, which exacerbate existing health issues. Beyond heat-related illnesses, the spread of infectious diseases such as malaria, dengue, and Zika has also been linked to changes in temperature and rainfall patterns, expanding the range of vector-borne diseases into regions that were previously unaffected. Moreover, the mental health toll is significant, with rising levels of anxiety, depression, and post-traumatic stress disorder (PTSD) being reported in communities that have experienced climate-induced disasters, including hurricanes, floods, and wildfires.

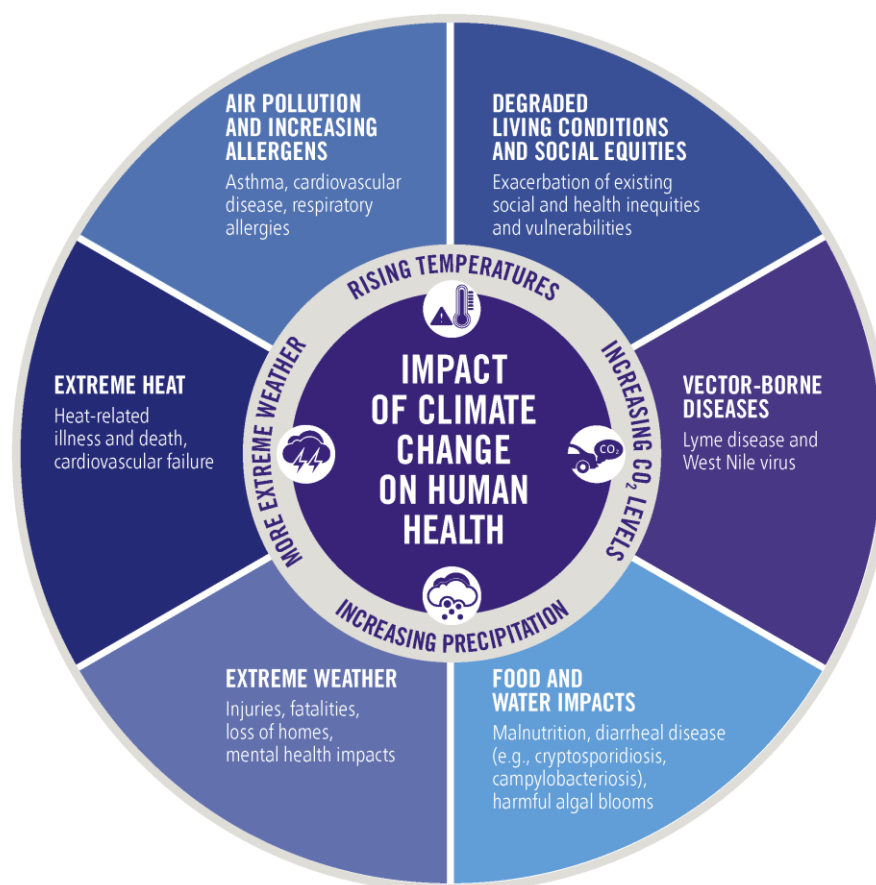


Figure 1. Impact of Climate Change on Human Health Infographic

Our climate is changing, with rising surface temperatures, melting ice and snow, rising sea levels, and increasing climate variability. Here in Ontario, we already experience some of these effects and scientists predict we will continue to see even more in the future (fig.1).

Changes to the air we breathe, the water we drink, the food we eat and the places we live may have substantial impacts on human health. Extreme changes in the weather and environment can increase existing health problems, as well as create new ones. The picture below shows the many ways a changing climate can impact health. It is crucial we are prepared and ready to act on climate change.

The second key finding is the disproportionate risk faced by vulnerable populations. These groups, including the elderly, children, low-income communities, and people in disaster-prone areas, are more likely to suffer from the health effects of climate change. Limited access to healthcare services and socio-economic disparities exacerbate these risks, leading to heightened health inequities. Vulnerable populations often lack the resources needed to prepare for or recover from climate-related health crises, making them more susceptible to both direct and indirect impacts of climate change.

In response to these challenges, early warning systems (EWS) have proven effective in mitigating the health impacts of extreme climate events. Countries with well-established EWS systems, particularly in Europe and parts of Southeast Asia, have shown reduced mortality and morbidity during heatwaves, floods, and disease outbreaks. These systems provide timely alerts, enabling public health interventions such as heat alerts, evacuations, and vaccination campaigns in the face of infectious disease threats. Early intervention is crucial in minimizing the health impacts of climate-induced events, and these systems play a key role in improving the resilience of populations.

The preparedness of healthcare infrastructure is another critical area of concern. Many healthcare systems, particularly in low- and middle-income countries, are ill-equipped to handle the additional strain imposed by climate-related diseases. The vulnerability of healthcare facilities to extreme weather events—such as floods and heatwaves—was a recurring theme. To address this, investments in climate-resilient infrastructure are essential. Measures like flood-proofing healthcare facilities, ensuring reliable power sources during heatwaves, and improving the energy efficiency of hospitals are necessary to ensure continued healthcare delivery during climate crises.

Sustainable public health strategies that address both climate adaptation and mitigation have shown the most promising results. These strategies include reducing air pollution, developing green spaces to mitigate heat island effects, and supporting climate-resilient agriculture to ensure food security. Health promotion campaigns that educate the public about the health effects of climate change, alongside community-based climate action, have been effective in improving health literacy and fostering preventative behaviors. Public health initiatives that incorporate environmental sustainability can play a pivotal role in reducing the long-term health impacts of climate change.

The need for interdisciplinary collaboration among public health officials, climate scientists, and policymakers has been identified as a cornerstone of successful responses to climate-related health risks. Countries that have integrated climate resilience into their national health frameworks have been more effective in mitigating the health impacts of climate change. However, the lack of coordination and siloed efforts in many regions highlight the necessity for cross-sectoral collaboration. Effective climate-health policies require input from multiple sectors to ensure a comprehensive approach to managing climate-related health risks.

Global and regional disparities in addressing climate-related health risks remain a significant challenge. High-income countries have made substantial progress in integrating climate change considerations into their health policies and infrastructure planning. In contrast, low-income countries continue to face significant barriers, including inadequate healthcare resources, insufficient climate data, and limited access to advanced technologies. International cooperation and funding are critical to supporting vulnerable countries in building climate-resilient health systems and mitigating the health impacts of climate change.

Finally, the integration of technological innovations into healthcare management has shown promising results. Technologies such as Geographic Information Systems (GIS), remote sensing, artificial intelligence (AI) for disease tracking, and mobile health (mHealth) platforms are providing innovative solutions for managing climate-related diseases. These technologies allow for more accurate predictions of disease outbreaks and facilitate rapid responses to health emergencies, particularly in resource-limited settings.

In conclusion, while progress has been made in certain regions, the overall response to the health challenges posed by climate change remains inadequate. Building robust, climate-resilient healthcare systems and adopting integrated strategies for climate adaptation and disease prevention are essential to mitigating the growing health impacts of climate change. Addressing these challenges requires a holistic approach, with attention to vulnerable populations, healthcare infrastructure, early warning systems, and interdisciplinary collaboration to ensure that global health systems can withstand the pressures of a changing climate.

## II. Subsection Two: Approaches to Building Climate-Resilient Health Systems

The growing recognition of the health impacts of climate change has prompted a shift in public health strategies toward building climate-resilient health systems. These systems are designed to withstand the challenges posed by changing environmental conditions while continuing to deliver

effective healthcare services. Strengthening health systems in the face of climate change requires a multi-faceted approach, focusing on improving healthcare infrastructure, enhancing early warning systems, integrating climate considerations into health policy, and fostering interdisciplinary collaboration.

A key challenge that has emerged is the vulnerability of healthcare infrastructure to extreme weather events. Hospitals and clinics in many regions, particularly in low- and middle-income countries, are often ill-equipped to handle the strain imposed by floods, heatwaves, and other climate-related disasters. To mitigate these risks, healthcare infrastructure must be climate-proofed. This includes making facilities flood-resistant by elevating buildings and reinforcing structures, ensuring that essential medical equipment is protected from water damage, and investing in backup power systems to ensure continued healthcare delivery during power outages caused by extreme weather. Additionally, healthcare facilities should be equipped with energy-efficient cooling and ventilation systems to maintain optimal conditions for patient care during heatwaves.



Figure 2. Barriers to health system adaptation to climate change

The absence of a supportive policy environment, inadequate prioritization of climate change adaptation actions, and limited integration of climate and health issues into planning are policy challenges that hinder health system adaptation to the changing climate. Additionally, there are few plans and programs addressing health risks associated with climate change, and existing adaptation initiatives often do not target these risks (fig.2). For example, a lack of adaptation policies for mental health has been reported. Evidence shows that uncertainty around climate projections and the best adaptation options, as well as fragmented policies and contradictions, present further obstacles to health system adaptation. Moreover, unclear long-term planning and national adaptation plans that do not prioritize health have been noted. Few adaptation policies address occupational health and safety, and climate change is not integrated into the core curricula of medical schools, indicating a narrow climate policy framework that may affect the implementation and evaluation of climate actions. Furthermore, the lack of preparedness for the burden of climate migration and insufficient surveillance and assessment of vulnerabilities related to climate change impacts pose additional

challenges for health systems in their efforts to adapt effectively to the climate crisis. Insufficient financial resources, combined with the challenge of securing long-term funding, hinder health system adaptation to climate change. Moreover, slow disaster preparedness in health facilities, lack of resource planning for disaster response, and limited efforts to prepare for extreme weather events have also been reported. Inadequate political will or support further exacerbates this situation, limiting resource allocation and hindering the implementation of effective strategies. Difficulties in mobilizing resources and a lack of investment in the health system amplify the constraints faced in responding to climate-related health risks. Additionally, poor infrastructure and the introduction of underdeveloped and expensive new technologies present significant barriers that hinder health systems' ability to effectively adapt to the challenges posed by climate change.

In addition to infrastructure improvements, enhancing early warning systems (EWS) is essential for reducing the health impacts of climate-related events. EWS that integrate climate and health data can provide timely alerts, enabling public health authorities to take preventive actions such as issuing heat alerts, activating evacuation plans, or launching vaccination campaigns during disease outbreaks. Countries with robust early warning systems have shown reduced mortality and morbidity during climate-induced events. For example, integrating climate forecasts with disease surveillance data can help predict the spread of vector-borne diseases like malaria, dengue, and cholera, allowing for targeted interventions before outbreaks occur. Moreover, community-based early warning systems, which involve local populations in monitoring and disseminating climate information, are critical in regions where formal infrastructure may be lacking.

Building climate-resilient health systems also requires the integration of climate change considerations into national health policies. Governments must mainstream climate adaptation and mitigation strategies into their health policies, ensuring that climate-related health risks are addressed at all levels of governance. This includes setting specific targets to reduce exposure to climate-related health threats, such as heatwaves and air pollution, and ensuring that climate-resilient agriculture and sustainable practices are promoted to safeguard food security. Health impact assessments should be conducted for climate adaptation projects to evaluate their effects on public health, ensuring that both climate mitigation and health objectives are met.

Sustainable public health strategies that focus on both climate adaptation and mitigation have proven effective in several regions. These strategies include promoting air quality improvement measures, creating green spaces to reduce heat island effects, and supporting climate-resilient agriculture to ensure food security. Public health campaigns that educate people about the health risks of climate change and the steps they can take to mitigate these risks—such as staying hydrated during heatwaves, using insect repellents to prevent vector-borne diseases, and improving home ventilation—can reduce the strain on healthcare systems and help prevent disease outbreaks.

Interdisciplinary collaboration is another critical component of building climate-resilient health systems. Public health officials, climate scientists, urban planners, and policymakers must work together to ensure that health systems are prepared for the challenges posed by climate change. Strong governance structures that facilitate cooperation across sectors are essential for effective climate-health interventions. Integrated climate-health governance allows for coordinated efforts in addressing climate-related health risks, ensuring that climate change considerations are embedded into national health frameworks and that all stakeholders contribute to building climate resilience.

Finally, investing in technological innovations can enhance the ability of health systems to respond to climate-related challenges. The use of Geographic Information Systems (GIS), remote sensing, and artificial intelligence (AI) to track disease outbreaks and predict climate-related health risks provides valuable tools for improving healthcare responses. Mobile health (mHealth) platforms also play a key role in disseminating health information and coordinating emergency responses during climate-induced health crises, particularly in resource-limited settings.



In conclusion, building climate-resilient health systems is a complex but essential task in addressing the growing health impacts of climate change. A comprehensive approach that combines infrastructure improvements, enhanced early warning systems, climate-resilient policies, community-based action, and interdisciplinary collaboration will be crucial in ensuring that healthcare systems can continue to protect public health in a changing climate. By prioritizing climate adaptation and mitigation within health systems, countries can reduce the long-term health impacts of climate change and ensure that vulnerable populations are protected.

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