

CLIMATE CHANGE AND GLOBAL HEALTH SECURITY: INTERDISCIPLINARY PERSPECTIVES ON INTERNATIONAL GOVERNANCE AND INSTITUTIONAL RESILIENCE

Javed Iqbal¹, Dr. Alizay Shahzad², Muhammad Naveed Ahmed^{*3}

¹Previous Degree: LLB, and MPhil Politics & IR, and Current Degree: PhD Scholar in Political Science, Imperial College of Business Studies, and Communication Officer @EOC (Emergency Operation Centre) Polio Program, Lahore, Punjab, Pakistan.

²Previous Degree: MBBS, Lahore Medical & Dental College, and Current Degree: Mph, Health Services Academy, Prime Minister Health Complex, Park Road, Chak Shahzad (Opposite the National Institute of Health), Islamabad, Pakistan.

^{*3}Previous Degree: MBA, IBA-University of the Punjab, Lahore, and Current Degree: MS Management Sciences, University of Engineering & Technology (UET), Lahore, Punjab, Pakistan.

¹mjaved158@gmail.com, ²alize.shahzad14@hotmail.com, ^{*3}uetmna@gmail.com

DOI: <https://doi.org/10.5281/zenodo.22808923>

Keywords

climate change, global health security, international governance, health-system resilience, climate governance, institutional resilience, health emergencies, adaptation, global health diplomacy

Article History

Received: 30 January 2026

Accepted: 15 March 2026

Published: 31 March 2026

Copyright @Author

Corresponding Author: *

Muhammad Naveed
Ahmed

Abstract

Climate change has evolved from an environmental and developmental concern into a major threat to global health security. Rising temperatures, extreme weather events, changing patterns of infectious disease transmission, food and water insecurity, air pollution, displacement, and the disruption of health infrastructure increasingly interact with existing social and institutional vulnerabilities. These developments challenge conventional approaches to global health security that have traditionally emphasized outbreaks, biological threats, and emergency response while giving insufficient attention to the structural and environmental determinants of health emergencies. This article examines the relationship between climate change and global health security through a qualitative analysis of secondary sources, including peer-reviewed literature, international policy documents, reports, and institutional frameworks. The study adopts an interdisciplinary analytical approach integrating global health governance, climate governance, international relations, public health, health-system resilience, and institutional theory. It argues that climate-related health security cannot be effectively addressed through emergency response alone. Instead, it requires institutional resilience, anticipatory governance, integrated surveillance, climate-informed health planning, equitable international cooperation, sustainable financing, and stronger coordination among health, environmental, economic, humanitarian, and security institutions. The article further demonstrates that existing global governance arrangements remain fragmented: climate governance operates primarily through the UNFCCC and Paris Agreement, while health security is substantially organized through the World Health Organization and International Health Regulations. Although these regimes increasingly recognize their interdependence, institutional coordination

remains inadequate. The article proposes an integrated climate-health security governance framework based on risk anticipation, institutional preparedness, cross-sectoral coordination, equity, accountability, and adaptive learning. It concludes that climate change should be treated not merely as a background determinant of health but as a systemic risk multiplier capable of amplifying existing vulnerabilities and generating cascading health emergencies. Strengthening global health security therefore requires moving from reactive crisis management toward prevention-oriented, climate-resilient, and institutionally coordinated governance.

1. INTRODUCTION

Climate change has fundamentally altered the conditions under which global health security must be understood. For much of the modern global health policy era, health security was primarily associated with infectious disease outbreaks, pandemics, antimicrobial resistance, bioterrorism, and the capacity of states to detect and contain biological threats. Climate change complicates this traditional understanding because it does not represent a single health threat with a clearly defined point of origin. Instead, it acts as a **risk multiplier** that interacts with demographic change, poverty, urbanization, migration, environmental degradation, weak infrastructure, food insecurity, political instability, and inadequate health systems (Intergovernmental Panel on Climate Change [IPCC], 2022; Watts et al., 2021).

The scale of the challenge is increasingly visible. The World Health Organization (WHO) estimates that 3.6 billion people already live in areas highly susceptible to climate change and projects approximately 250,000 additional deaths annually between 2030 and 2050 from malnutrition, malaria, diarrhoea, and heat stress alone (WHO, 2023). The 2025 *Lancet Countdown* further reports that heat-related mortality has increased substantially and estimates approximately 546,000 heat-related deaths annually, while the climatic suitability for dengue transmission has also increased markedly compared with the mid-twentieth century (Romanello et al., 2025).

These developments reveal that climate change threatens health through multiple interconnected pathways. Extreme heat directly increases mortality and morbidity; floods and storms damage hospitals and water systems; drought

affects food production and nutrition; changing temperature and precipitation patterns alter vector habitats; wildfire smoke increases respiratory and cardiovascular risks; and climate-related displacement can disrupt vaccination, disease surveillance, maternal health services, and access to medicines (IPCC, 2022; WHO, 2023).

The significance of these developments for global health security is therefore not simply that climate change produces additional diseases. Its deeper significance lies in its capacity to stress the institutional systems upon which health security depends. A health system may possess adequate surveillance capacity under normal conditions but become overwhelmed when simultaneous heatwaves, floods, infectious disease outbreaks, population displacement, electricity shortages, and supply-chain disruptions occur. Consequently, health security depends not only on disease-control technologies but also on institutional resilience.

The governance challenge is equally important. Climate change is governed principally through international climate institutions, particularly the United Nations Framework Convention on Climate Change (UNFCCC), the Paris Agreement, national climate commitments, adaptation planning, and climate finance. Global health security, meanwhile, has developed through institutions such as WHO, the International Health Regulations (IHR), national public health agencies, surveillance networks, and emergency preparedness mechanisms. The two governance systems increasingly overlap, but they remain institutionally and politically distinct. The IHR, for example, provides a central international framework for preventing and responding to public health risks with potential international

implications, while the Paris Agreement focuses on climate mitigation and adaptation (WHO, 2025; United Nations Framework Convention on Climate Change [UNFCCC], 2015).

The first Health Day at the 2023 UN Climate Change Conference (COP28) represented an important institutional development because it formally elevated health within the climate negotiations and demonstrated increasing recognition that climate policy is inseparable from health protection. Yet institutional recognition does not automatically produce institutional integration.

This article therefore asks a central question:

How can international governance and institutional resilience be strengthened to address climate change as a systemic threat to global health security?

The article makes three principal arguments. First, climate change should be conceptualized as a systemic risk multiplier rather than merely another environmental determinant of health. Second, existing global governance arrangements remain fragmented across climate, health, development, humanitarian, environmental, and security institutions. Third, effective climate-health security requires a shift from reactive emergency management toward anticipatory governance based on resilient institutions, integrated surveillance, climate-informed planning, cross-sectoral coordination, equitable financing, and adaptive learning.

2. Research Methodology

2.1 Research Design

This study employs a qualitative research design based exclusively on secondary sources. It does not involve surveys, interviews, questionnaires, experiments, or primary fieldwork. The purpose is interpretive and analytical rather than statistical: to examine how the existing literature and international institutional frameworks conceptualize the relationship between climate change, global health security, governance, and institutional resilience.

Qualitative document analysis is particularly appropriate because climate-health governance is reflected not only in peer-reviewed academic studies but also in international agreements,

WHO frameworks, IPCC assessments, policy documents, institutional strategies, and global monitoring reports (Bowen, 2009).

2.2 Sources of Evidence

The analysis draws on four broad categories of secondary evidence:

1. Peer-reviewed academic literature on climate change, health security, governance, adaptation, resilience, and health systems.
2. International institutional reports, particularly from WHO, IPCC, UNFCCC, and the *Lancet Countdown*.
3. International legal and policy frameworks, including the Paris Agreement and International Health Regulations.
4. Global health and climate indicators used to illustrate the scale and trajectory of climate-related health risks.

The analysis prioritizes authoritative and recent evidence while retaining influential conceptual literature that helps explain global health governance and institutional resilience.

2.3 Analytical Approach

The material was examined thematically. Five interconnected themes guided the analysis:

- climate change as a systemic health-security risk;
- fragmentation of international governance;
- institutional resilience and health-system capacity;
- equity and unequal vulnerability;
- anticipatory and adaptive governance.

The objective was not to calculate an aggregate effect size but to identify patterns, institutional gaps, conceptual relationships, and policy implications across different bodies of literature.

2.4 Conceptual Orientation

The article combines insights from global health governance, human security, institutional resilience, and climate governance. This interdisciplinary approach is necessary because climate-related health threats cross conventional disciplinary and jurisdictional boundaries.

The study treats global health security as broader than infectious-disease containment. It

encompasses the capacity of societies and institutions to prevent, prepare for, absorb, respond to, and recover from health threats that cross borders or generate significant population-level consequences (Kickbusch et al., 2013; McInnes & Roemer-Mahler, 2017).

3. Climate Change as a Global Health Security Threat

Climate change affects health through direct, indirect, and systemic pathways. These pathways are summarized in Table 1.

Table 1 Major Climate-Health Pathways Relevant to Global Health Security

Climate-related driver	Health consequence	Security/institutional implication
Extreme heat	Heatstroke, cardiovascular and renal disease, mortality	Pressure on emergency services
Floods and storms	Injuries, infectious disease, displacement	Health infrastructure disruption
Drought	Food insecurity, malnutrition, water scarcity	Humanitarian emergencies
Changing temperature/rainfall	Vector-borne disease expansion	Increased surveillance burden
Wildfires and smoke	Respiratory and cardiovascular disease	Cross-border air pollution
Sea-level rise	Displacement, sanitation disruption	Migration and humanitarian pressures
Ecosystem degradation	Zoonotic and vector risks	One Health preparedness challenge
Climate-related displacement	Interrupted healthcare and vaccination	Pressure on host health systems
Supply-chain disruption	Medicine and equipment shortages	Reduced health-system resilience

Note. Author's synthesis based on IPCC (2022), WHO (2023), and Romanello et al. (2025).

The 2025 *Lancet Countdown* demonstrates the scale of these risks. Across its indicators, 13 of 20 impact indicators were reported to be at concerning levels, illustrating that climate-health risks are not future possibilities but current global realities (Romanello et al., 2025).

Heat provides one of the clearest examples. The *Lancet Countdown* estimates that global heat-related mortality averaged approximately 546,000 deaths annually during 2012–2021, representing a substantial increase compared with the 1990s (Romanello et al., 2025). Heat also interacts with occupational exposure, cardiovascular disease, kidney disease, pregnancy, ageing, and urban inequality.

Climate change simultaneously modifies infectious disease ecology. Changes in temperature, precipitation, humidity, land use, and human mobility influence the geographic and

seasonal suitability of vector-borne diseases. Global evidence shows substantial increases in climate suitability for dengue transmission compared with the 1950s (Romanello et al., 2025). The implications extend beyond individual disease burdens because changing disease geography can require countries to develop surveillance and response capabilities for hazards that were previously considered geographically limited.

Extreme precipitation creates another security pathway. The 2024 *Lancet Countdown* reported that 61% of global land area experienced an increase in extreme precipitation days between 1961–1990 and 2014–2023. Extreme precipitation increases risks of flooding, contamination of water systems, infrastructure damage, and infectious disease transmission (Romanello et al., 2024).

Thus, climate change produces a compound-risk environment. A flood may simultaneously cause displacement, interrupt health services, contaminate drinking water, increase diarrhoeal disease, damage vaccine cold chains, and reduce access to healthcare. Similarly, a drought may generate food insecurity, migration, political pressure, and increased disease vulnerability. The health-security significance therefore lies not only in individual hazards but in their interaction.

4. From Environmental Risk to Systemic Security Risk

Traditional security thinking frequently separates environmental problems from security threats. Climate change challenges this distinction.

Human security scholarship has long emphasized that threats to health, food, water, livelihoods, and personal safety can undermine human wellbeing even when there is no conventional military conflict (Commission on Human Security, 2003). Climate change intensifies these interconnected vulnerabilities.

The security implications become particularly pronounced when climate hazards interact with fragile institutions. A country with robust hospitals, reliable electricity, effective surveillance, emergency logistics, social protection, and strong local government may absorb a climate shock more effectively than a country with comparable exposure but weaker institutions.

This produces an important analytical proposition:

Climate vulnerability is partly a function of institutional capacity.

The same temperature increase, flood, or infectious disease outbreak can generate radically different outcomes depending on governance quality, infrastructure, socioeconomic inequality, and preparedness.

This is why the climate-health relationship cannot be addressed exclusively through environmental policy. It requires institutional reform.

The IPCC (2022) emphasizes that climate risks emerge from interactions among hazards, exposure, and vulnerability. Vulnerability is shaped by social, economic, political, and institutional conditions. This provides a theoretical basis for treating health systems and governance institutions as central components of climate adaptation.

5. International Governance and the Fragmentation Problem

Global climate and health governance have developed through different institutional trajectories.

The UNFCCC and Paris Agreement provide the central architecture for international climate cooperation. Their principal concerns include greenhouse gas mitigation, adaptation, climate finance, technology, transparency, and national climate commitments (UNFCCC, 2015).

The WHO and International Health Regulations, by contrast, constitute important pillars of international health governance. The IHR establishes obligations and mechanisms for countries to develop capacities for surveillance, notification, verification, and response to public health risks with international implications (WHO, 2025).

The problem is that climate-related health risks fall between these institutional domains.

Climate institutions may focus on emissions, adaptation finance, national climate plans, and resilience, while health institutions focus on surveillance, hospitals, disease control, emergency preparedness, and health outcomes. Finance ministries focus on fiscal stability; agriculture ministries focus on food production; water authorities focus on resources; disaster-management institutions focus on emergencies; and humanitarian organizations focus on displacement.

The resulting governance structure is fragmented.

Table 2 Major International Governance Domains Relevant to Climate-Health Security

Governance domain	Principal institutions/frameworks	Major contribution	Persistent limitation
Climate governance	UNFCCC, Paris Agreement	Mitigation and adaptation	Health insufficiently integrated in many climate policies
Global health governance	WHO, IHR	Surveillance and emergency response	Climate risks exceed conventional health mandates
Disaster governance	UNDRR, national DRM agencies	Preparedness and response	Often event-focused rather than systemic
Development governance	UN, World Bank, development agencies	Infrastructure and financing	Health-climate integration varies
Food governance	FAO, WFP	Food security and nutrition	Limited integration with health surveillance
Environmental governance	UNEP and national environment agencies	Ecosystem and pollution management	Health consequences may be secondary
Humanitarian governance	UN OCHA, UNHCR, NGOs	Emergency assistance and displacement	Primarily reactive
National governance	Health, finance, environment, agriculture, planning ministries	Policy implementation	Institutional silos

Note. Author's synthesis from WHO (2023), UNFCCC (2015), IPCC (2022), and related literature. This fragmentation creates what can be described as an institutional coordination gap.

6. Climate Governance Must Become Health Governance

The conventional distinction between climate policy and health policy is increasingly difficult to defend.

WHO's Operational Framework for Building Climate-Resilient and Low-Carbon Health Systems explicitly identifies climate-transformative leadership, climate-smart health workforces, climate risk assessment, integrated monitoring and early warning, research, resilient infrastructure, environmental determinants, climate-informed health programmes, emergency preparedness, and sustainable financing as interconnected components of resilient health systems (WHO, 2023).

This represents a significant conceptual shift. Climate resilience is no longer viewed simply as building stronger hospitals. It involves governance, information, workforce, financing, infrastructure, supply chains, and environmental management.

Similarly, climate policy should be evaluated according to its health implications. WHO has emphasized the importance of incorporating health into Nationally Determined Contributions under the Paris Agreement because mitigation and adaptation policies can produce major health benefits (WHO, 2024).

For example:

- reducing fossil-fuel combustion reduces air pollution;
- improving public transport can increase physical activity;
- urban greening can reduce heat exposure;
- resilient water infrastructure can reduce infectious disease risk;
- climate-resilient agriculture can improve nutrition;
- renewable energy can increase the reliability of health facilities.

Climate-health integration therefore creates opportunities for health co-benefits rather than merely reducing losses.

7. Institutional Resilience as the Core of Global Health Security

Institutional resilience refers to the capacity of institutions to anticipate disruption, absorb shocks, maintain essential functions, adapt to changing conditions, and transform when existing arrangements become inadequate.

This concept is particularly important because climate change creates conditions of persistent uncertainty. Institutions cannot rely entirely on historical patterns when future climate conditions may differ substantially from past experience.

A resilient health system therefore requires at least six capabilities:

1. anticipation of emerging risks;
2. detection of hazards and changing conditions;
3. preparedness for probable scenarios;
4. absorption of shocks without catastrophic service failure;
5. adaptation during prolonged disruption;
6. learning and transformation after crises.

These capabilities are mutually reinforcing.

A surveillance system without response capacity produces information without action. A hospital without resilient electricity and water supplies cannot maintain essential services during climate disasters. A national emergency plan without local implementation capacity remains largely symbolic. Nature Climate Change research similarly demonstrates that health-system preparedness involves workforce capacity, infrastructure, communication, surge capacity, service continuity, and financial preparedness (Berrang-Ford et al., 2024).

8. Early Warning Systems and Anticipatory Governance

One of the most important transitions in climate-health security is movement from reactive response to anticipatory governance.

Reactive systems respond after health impacts become visible. Anticipatory systems attempt to identify risks before they produce major harm.

WHO's climate-resilient health framework specifically emphasizes integrated risk monitoring and early warning. Effective early warning systems can prevent avoidable illness, injury, and death

when warnings are linked to adequate response capacity (WHO, 2023).

A climate-health early warning system can integrate:

- meteorological forecasts;
- temperature and rainfall data;
- vector surveillance;
- disease surveillance;
- hospital admissions;
- wastewater information;
- food and nutrition indicators;
- population mobility;
- air-quality measurements;
- satellite observations.

The value of integration lies in identifying relationships that are invisible within individual datasets.

For example:

Extreme rainfall → standing water → mosquito proliferation → increased vector suitability → increased dengue risk → targeted surveillance → preventive intervention.

The objective is not to predict the future with certainty but to improve the timing and quality of decisions.

9. Climate Change, Infectious Diseases, and Global Health Security

Infectious disease risks demonstrate the importance of interdisciplinary governance.

Climate change can affect vector ecology, pathogen replication, host behaviour, water quality, animal habitats, and human mobility. Consequently, climate-sensitive infectious diseases cannot be addressed exclusively through clinical medicine.

The One Health approach provides a useful framework because it recognizes interdependence among human, animal, and environmental health (Whitmee et al., 2015).

Climate change also increases the importance of cross-border surveillance. Pathogens do not respect national boundaries, and climate-driven changes in ecological conditions can alter disease distributions across regions.

Global surveillance therefore requires cooperation among:

- national public health agencies;

- meteorological institutions;
- veterinary authorities;
- environmental agencies;
- international organizations;
- laboratories;
- universities;
- humanitarian organizations.

This reinforces the argument that health security is fundamentally a governance problem as well as a biomedical problem.

10. Climate-Related Displacement and Health Security

Climate change also creates health-security challenges through human mobility.

Floods, droughts, sea-level rise, extreme heat, food insecurity, and livelihood loss can contribute to temporary or permanent displacement. Displaced populations may experience interrupted vaccination, maternal healthcare, chronic disease treatment, mental-health services, sanitation, and disease surveillance.

Migration should not be framed automatically as a security threat. Such securitization can generate discriminatory policies and undermine human rights. Instead, climate-related mobility should be treated as a health governance and protection challenge.

International institutions therefore need mechanisms to maintain continuity of essential health services during population movement.

11. Equity: Climate Change as a Global Health Justice Problem

Climate change is deeply unequal.

Those who have contributed least to historical greenhouse gas emissions often experience disproportionate health impacts. WHO notes that low-income countries and other highly vulnerable populations face some of the greatest risks despite comparatively low contributions to global emissions (WHO, 2023).

The 2025 *Lancet Countdown* similarly highlights the disproportionate burden experienced by highly vulnerable populations and small island developing states (Romanello et al., 2025).

This creates a fundamental justice problem.

Climate-health governance should therefore be guided by at least four principles:

11.1 Distributive justice

Resources should be directed toward populations facing the greatest risks.

11.2 Procedural justice

Vulnerable communities should participate in decisions affecting climate adaptation and health.

11.3 Intergenerational justice

Current policy decisions should not transfer disproportionate health risks to future generations.

11.4 Global responsibility

High-emitting states have a strong ethical and political responsibility to support adaptation and resilience in vulnerable countries.

Climate finance is consequently not simply development assistance. It can also be understood as an investment in global health security.

12. Climate Finance and Institutional Resilience

Institutional resilience cannot be created without financing.

Health systems in many low- and middle-income countries already face shortages of health workers, infrastructure, medicines, diagnostic capacity, and emergency resources. Climate change adds additional costs.

WHO estimates that the direct damage costs to health attributable to climate change could reach approximately US\$2–4 billion annually by 2030, excluding wider costs in health-determining sectors (WHO, 2023).

The financing problem is therefore two-dimensional:

1. health systems require funding to adapt to climate risks;
2. climate investments need to incorporate health outcomes.

A climate-resilient hospital, for example, may require flood protection, renewable energy, water security, cooling systems, resilient communications, backup power, and climate-

sensitive emergency planning. These are health-security investments.

The failure to finance resilience creates a paradox: societies may spend enormous amounts responding to climate disasters while underinvesting in prevention.

13. The Role of International Institutions

International institutions remain indispensable but require stronger coordination.

World Health Organization

WHO's role includes global standards, surveillance guidance, technical assistance, health-system strengthening, and coordination. Its 2023 operational framework provides an important foundation for climate-resilient and low-carbon health systems.

UNFCCC

The UNFCCC provides the primary political architecture for international climate cooperation. Health needs to become more systematically embedded in mitigation, adaptation, climate finance, and national climate planning.

World Bank and Development Institutions

Development banks can finance resilient infrastructure, water systems, health facilities, social protection, and climate adaptation. However, climate-health considerations should become explicit investment criteria.

UNDRR

Disaster-risk governance can connect climate adaptation with emergency preparedness and resilience.

UNEP

Environmental governance is crucial for air pollution, biodiversity, ecosystem protection, and pollution control.

FAO and WFP

Food-system resilience is inseparable from health security because climate shocks can generate malnutrition and food insecurity.

The institutional challenge is therefore not necessarily the absence of organizations. It is the absence of sufficient institutional connectivity.

14. Toward an Integrated Climate-Health Security Governance Model

This article proposes an integrated model based on seven interconnected pillars.

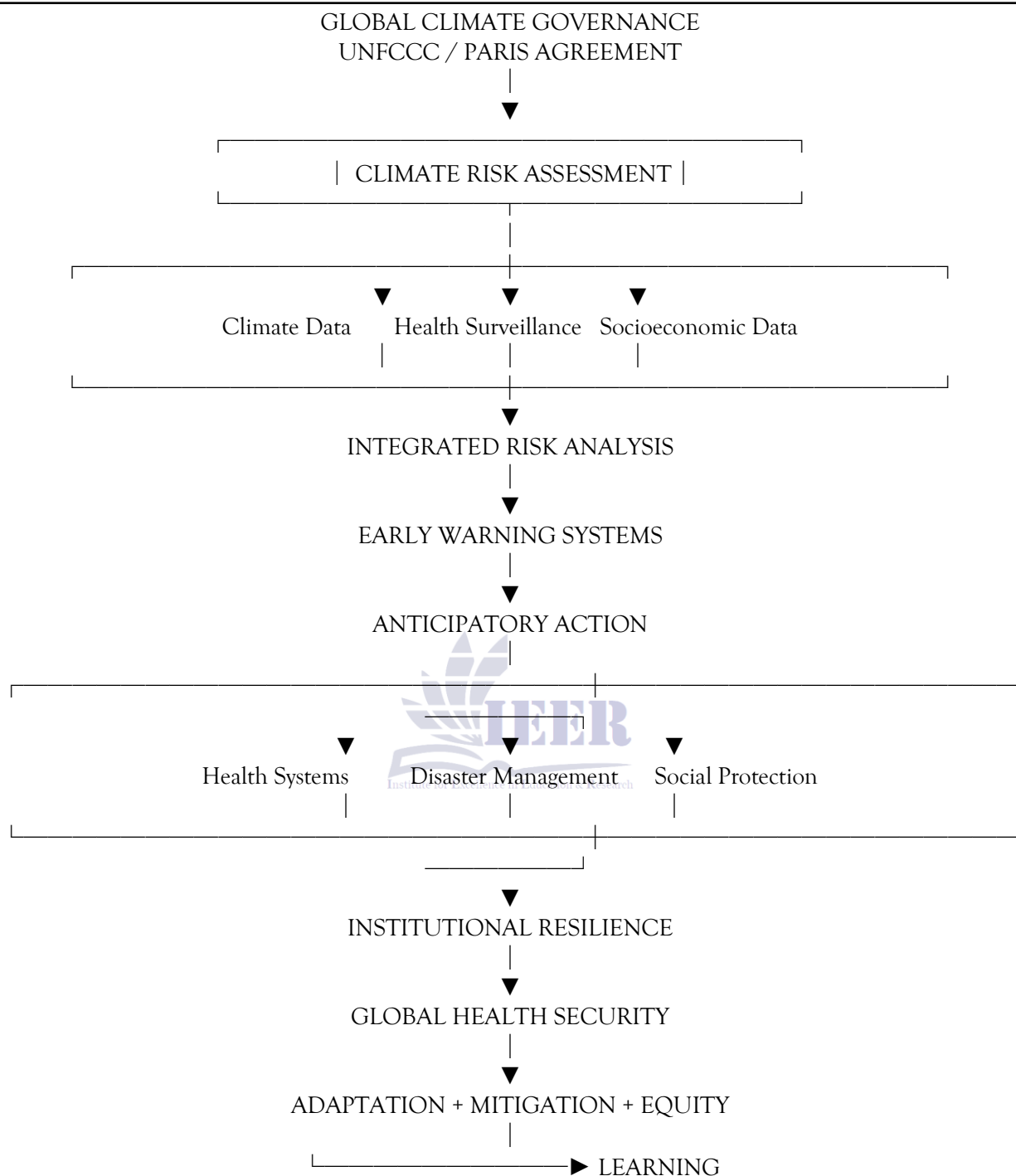


Figure 1 Proposed Integrated Climate-Health Security Governance Model

Note. Author's conceptual framework based on WHO (2023), IPCC (2022), UNFCCC (2015), and global health governance literature.

The model emphasizes that climate-health security should be understood as a continuous governance cycle rather than a one-time emergency response

15. From Reactive to Anticipatory Governance

Table 3 Reactive Versus Anticipatory Climate-Health Governance

Dimension	Reactive governance	Anticipatory governance
Risk orientation	Responds after impact	Identifies emerging risks
Data	Historical	Real-time and predictive
Planning	Event-based	Scenario-based
Institutions	Sectoral	Cross-sectoral
Financing	Emergency expenditure	Prevention and resilience investment
Surveillance	Disease-focused	Integrated climate-health surveillance
Infrastructure	Repaired after damage	Designed for future risk
Decision-making	Crisis-driven	Risk-informed
Community role	Recipient	Participant
Evaluation	Crisis outcomes	Preparedness and resilience indicators

Note. Author's synthesis.

Anticipatory governance does not mean predicting every crisis. Rather, it means systematically asking:

- What hazards are becoming more likely?
- Who is most exposed?
- Which institutions are most vulnerable?
- Which services are essential?
- What information is needed before a crisis?
- Which interventions can reduce exposure or vulnerability?
- What resources must be pre-positioned?

Such questions transform governance from reaction toward prevention.

16. Institutional Coordination and the “Whole-of-Government” Approach

Climate-health security cannot be located within ministries of health alone.

A whole-of-government approach should connect: *Health + Environment + Climate + Finance + Planning + Agriculture + Water + Energy + Transport + Disaster Management + Social Protection*.

At the international level, this should be complemented by a whole-of-system approach involving WHO, UNFCCC, UNDP, UNEP, UNDRR, FAO, World Bank, regional organizations, civil society, and scientific institutions.

WHO explicitly identifies climate-transformative leadership and governance as the first component of its climate-resilient health-system framework and calls for collaboration among environmental

health, vector control, WASH, disaster management, health information systems, agriculture, food, energy, and transport sectors (WHO, 2023).

This demonstrates that institutional integration is not an optional addition to climate-health policy. It is central to resilience.

17. Technology, Data, and Digital Governance

Digital technologies can strengthen climate-health security through integrated surveillance, geographic information systems, remote sensing, artificial intelligence, and early warning platforms. However, technology should not be treated as a substitute for institutions.

A sophisticated forecasting system is ineffective if:

- data are incomplete;
- local institutions cannot interpret warnings;
- communities do not trust authorities;
- hospitals lack capacity;
- emergency financing is unavailable;
- communication systems fail.

Technology therefore functions as an institutional amplifier. Strong institutions can use data technologies effectively; weak institutions may produce sophisticated dashboards without meaningful action.

Digital climate-health governance should consequently emphasize interoperability, data quality, privacy, transparency, cybersecurity, and equitable access.

18. Health-System Resilience and Infrastructure
Health facilities themselves are vulnerable to climate hazards.

Floods can damage hospitals and roads. Heat can reduce the effectiveness of medicines and increase cooling requirements. Water shortages threaten sanitation. Power failures disrupt intensive care, vaccination, laboratories, communications, and cold chains.

WHO's framework emphasizes climate-resilient infrastructure, sustainable technologies, resilient supply chains, environmental determinants, and emergency preparedness as interconnected elements of health-system resilience (WHO, 2023).

Resilience therefore requires investment in:

- climate-resilient hospital design;
- renewable and backup energy;
- water security;
- resilient medical supply chains;
- emergency communication;
- climate-smart laboratories;
- disease surveillance;
- resilient vaccine cold chains;
- health-worker preparedness.

The objective should be continuity of essential services during climate shocks.

19. Institutional Learning and Adaptive Governance

Climate change is characterized by uncertainty and nonlinearity. Consequently, institutions must be capable of learning.

Adaptive governance requires:

1. continuous monitoring;
2. evaluation of policies;
3. knowledge sharing;
4. revision of preparedness plans;
5. scenario exercises;
6. institutional memory;
7. feedback from communities.

This challenges rigid bureaucratic models that assume stable conditions.

Institutional resilience is therefore not simply the ability to “bounce back.” In a changing climate, returning to the previous condition may itself be inadequate. Resilience must include the capacity to transform institutions when previous structures no longer match emerging risks.

20. Policy Framework for Strengthening Climate-Health Security

Table 4 Policy Priorities for Integrated Climate-Health Security

Priority	Recommended action	Responsible actors
Governance	Establish national climate-health security mechanisms	Governments, WHO
Surveillance	Integrate climate, environmental, and health surveillance	Health and environment ministries
Early warning	Develop climate-informed health warning systems	Meteorological and health agencies
Infrastructure	Climate-proof hospitals and supply chains	Governments, development banks
Financing	Increase adaptation finance for health	International financial institutions
Workforce	Train health professionals in climate-health risks	Ministries, universities
Equity	Prioritize vulnerable communities	Governments, NGOs
Research	Expand interdisciplinary climate-health research	Universities and research institutes
International cooperation	Improve cross-border surveillance	WHO, regional organizations
Accountability	Develop measurable climate-health indicators	Governments and international institutions

Note. Author's synthesis based on WHO (2023), IPCC (2022), and global health governance literature.

21. Measuring Institutional Resilience

A major governance weakness is the tendency to measure climate-health preparedness through plans rather than actual capacity.

A stronger evaluation framework should examine:

Anticipation

- Are climate-health risk assessments conducted?
- Are future climate scenarios incorporated into planning?

Detection

- Can health authorities detect emerging climate-sensitive diseases?

Response

- Can institutions mobilize resources rapidly?

Continuity

- Can essential healthcare continue during disasters?

Adaptation

- Are lessons incorporated into future planning?

Equity

- Are vulnerable populations protected?

Coordination

- Do ministries and institutions share information effectively?

Financing

- Are sufficient resources available before emergencies?

These indicators provide a more meaningful assessment of institutional resilience than the existence of policy documents alone.

22. Discussion

The evidence reviewed in this article demonstrates that climate change is changing the meaning of global health security. It challenges the assumption that health emergencies are primarily discrete biological events with identifiable causes and short response cycles.

Climate change produces persistent, interconnected, and cumulative risks.

This has three major theoretical implications.

First, global health security should be expanded beyond infectious disease emergencies. Infectious diseases remain important, but heat, food insecurity, air pollution, water insecurity, displacement, infrastructure failure, and mental health are also health-security concerns.

Second, security depends on resilience. A country may possess strong emergency-response institutions but remain vulnerable if its hospitals, water systems, food systems, and social protection structures cannot withstand repeated climate shocks.

Third, governance fragmentation is itself a risk. When climate institutions, health institutions, disaster agencies, and financial institutions operate independently, information and resources may fail to move across institutional boundaries.

The central challenge is therefore not simply to create more institutions but to improve institutional connectivity.

The emergence of climate-health initiatives within WHO and the increasing presence of health in climate diplomacy represent important progress. The COP28 Health Day, for example, signaled stronger political recognition of the health dimension of climate change. Yet symbolic recognition must be converted into financing, implementation, accountability, and measurable resilience.

The same principle applies to national governance. A climate-health strategy without financing is unlikely to produce resilience. A health emergency plan without climate risk assessment will increasingly become outdated. A climate adaptation plan without health indicators may miss some of the most important consequences of climate change.

The most effective approach is therefore integrated governance.

23. Critical Assessment: Why Existing Governance Remains Insufficient

Despite significant progress, five major weaknesses remain.

23.1 Institutional fragmentation

Climate, health, disaster, development, and environmental institutions continue to operate through separate mandates.

23.2 Financing gaps

Climate adaptation finance has not sufficiently prioritized health-system resilience.

23.3 Unequal institutional capacity

Low-income and climate-vulnerable countries frequently have the greatest need but the least institutional and financial capacity.

23.4 Reactive policy cultures

Governments often allocate resources after disasters rather than investing sufficiently in prevention.

23.5 Weak accountability

International climate commitments do not always translate into measurable health-protection outcomes.

These weaknesses indicate that climate-health security requires governance reform rather than merely additional technical interventions.

24. Recommendations

Based on the qualitative synthesis, this article proposes the following recommendations.

1. Establish climate-health security as a formal policy domain

Governments and international organizations should explicitly recognize climate-related health risks within national and global health-security strategies.

2. Integrate health into climate governance

National climate plans, NDCs, adaptation strategies, and climate-finance mechanisms should contain measurable health objectives.

3. Strengthen WHO–UNFCCC coordination

Climate and health institutions should develop stronger institutional mechanisms for joint risk assessment, financing, monitoring, and accountability.

4. Establish integrated climate-health surveillance

Meteorological, environmental, epidemiological, and socioeconomic information should be connected through interoperable surveillance systems.

5. Invest in anticipatory capacity

Early warning systems should be linked directly to emergency financing, health-service protocols, community communication, and pre-positioned resources.

6. Climate-proof health infrastructure

Hospitals, laboratories, vaccine systems, supply chains, water systems, and energy infrastructure should be designed around projected future climate risks rather than historical averages.

7. Strengthen the health workforce

Climate-health competencies should be incorporated into medical, nursing, public health, epidemiology, and emergency-management education.

8. Prioritize equity

Adaptation resources should be directed toward populations facing the highest exposure and lowest adaptive capacity.

9. Improve climate-health financing

International development and climate-finance institutions should develop dedicated financing mechanisms for health-system resilience.

10. Establish measurable resilience indicators

Governments should report not only emissions and climate targets but also climate-related health outcomes and institutional preparedness.

25. Limitations

This study has several limitations. First, it is based exclusively on secondary sources and therefore does not provide original empirical evidence from national governments, health workers, or affected communities. Second, global climate-health evidence is uneven across countries and regions, meaning that some highly vulnerable populations remain underrepresented in published literature. Third, institutional frameworks evolve rapidly, and policy arrangements may change as international climate and health negotiations develop. Fourth, the interdisciplinary nature of the topic means that the article necessarily brings together evidence produced using different methodologies and conceptual frameworks. These limitations do not undermine the analytical value of the study but indicate the need for future empirical research.

26. Future Research Directions

Future research should move beyond broad descriptions of climate-health vulnerability and examine institutional performance.

Comparative studies could investigate why some health systems maintain essential services during climate disasters while others experience severe disruption. Research could also assess whether climate-health early warning systems actually improve health outcomes.

Future studies should examine:

- comparative climate-health governance across countries;
- effectiveness of climate-health financing;
- institutional coordination between health and environmental agencies;
- climate-related migration and continuity of healthcare;
- health-system resilience indicators;
- climate-sensitive infectious disease surveillance;
- community participation in climate-health adaptation;
- gender and socioeconomic inequalities;
- One Health approaches to climate-related health threats;
- effectiveness of international climate-health diplomacy.

Mixed-method and longitudinal research would be particularly valuable for assessing whether institutional reforms translate into measurable improvements in population health.

27. Conclusion

Climate change is no longer simply an environmental problem with consequences for human health. It is a systemic challenge to global health security because it simultaneously affects disease patterns, food and water systems, health infrastructure, human mobility, livelihoods, emergency preparedness, and institutional capacity. Its effects are amplified where governance systems are fragmented and where populations lack the resources necessary to adapt.

The central lesson of this analysis is that global health security cannot be strengthened through emergency response alone. It requires institutions capable of anticipating climate-related risks, detecting emerging threats, maintaining essential services during disruption, protecting vulnerable populations, learning from crises, and adapting continuously.

International governance must therefore move beyond parallel climate and health institutions toward stronger institutional integration. The Paris Agreement, UNFCCC, WHO, International Health Regulations, disaster-risk mechanisms, development institutions, and national health systems each provide important pieces of the governance architecture, but their effectiveness depends on coordination.

Institutional resilience should consequently become a central principle of global health security. Climate-resilient health systems, integrated surveillance, early warning, resilient infrastructure, sustainable financing, skilled workforces, equitable adaptation, and cross-sectoral cooperation are not separate policy agendas. They are components of a single security challenge.

Ultimately, the most important shift is conceptual: global health security should move from a reactive model that manages emergencies after they occur toward an anticipatory model that identifies and reduces systemic risks before they become crises. Climate change makes this transition unavoidable.

The future of global health security will depend not only on scientific and medical innovation but also on whether national and international institutions can cooperate, adapt, finance resilience, and place health at the centre of climate governance.

REFERENCES

- Berrang-Ford, L., Siders, A. R., Lesnikowski, A., Fischer, A. P., Callaghan, M. W., Haddaway, N. R., Mach, K. J., Araos, M., Shah, M. A. R., Wannewitz, M., Doshi, D., Leiter, T., Skeie, R. B., Campbell, D., Pringle, P., Lesnikowski, A., & others. (2024). Analysing health system capacity and preparedness for climate change. *Nature Climate Change*, 14, 536–546. <https://doi.org/10.1038/s41558-024-01994-4>
- Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, 9(2), 27–40. <https://doi.org/10.3316/QRJ0902027>
- Commission on Human Security. (2003). *Human security now: Protecting and empowering people*. United Nations.
- Intergovernmental Panel on Climate Change. (2022). *Climate change 2022: Impacts, adaptation and vulnerability*. Cambridge University Press. <https://doi.org/10.1017/9781009325844>
- Intergovernmental Panel on Climate Change. (2023). *Climate change 2023: Synthesis report*. IPCC.
- Kickbusch, I., Silberschmidt, G., & Buss, P. (2007). Global health diplomacy: The need for new perspectives, strategic approaches and skills. *Bulletin of the World Health Organization*, 85(3), 230–232. <https://doi.org/10.2471/BLT.06.039222>
- Kickbusch, I., & Reddy, K. S. (2013). Global health governance: The next political revolution. *Public Health*, 127(9), 838–842. <https://doi.org/10.1016/j.puhe.2013.07.015>
- McInnes, C., & Roemer-Mahler, A. (2017). From security to risk: Re-framing global health security. *Global Society*, 31(1), 4–17. <https://doi.org/10.1080/13600826.2016.1231146>
- Romanello, M., Di Napoli, C., Green, C., Kennard, H., Lampard, P., Scamman, D., Arnell, N., Ayeb-Karlsson, S., Ford, L. B., Belesova, K., Bowen, K., Cai, W., Callaghan, M., Campbell-Lendrum, D., Capstick, S., Chambers, J., Chu, L., Ciampi, L., Dalin, C., ... Costello, A. (2024). The 2024 report of the Lancet Countdown on health and climate change: Facing record-breaking threats from delayed action. *The Lancet*, 404(10465), 1847–1896. [https://doi.org/10.1016/S0140-6736\(24\)01822-1](https://doi.org/10.1016/S0140-6736(24)01822-1)
- Romanello, M., Walawender, M., Hsu, S.-C., Moskeland, A., Palmeiro-Silva, Y. K., Scamman, D., Ali, Z., Amann, M., Ayeb-Karlsson, S., Belesova, K., et al. (2025). The 2025 report of the Lancet Countdown on health and climate change: Climate change action offers a lifeline. *The Lancet*.
- Sachs, J. D., Karim, S. S. A., Aknin, L., Allen, J., Brosbøl, K., Barron, G. C., Daszak, P., Espinosa, M. F., Gaspar, V., Gaviria, A., Haines, A., Hotez, P. J., Mathieson, K., Meara, J. G., Pate, M., Serageldin, I., Ezzati, M., & others. (2022). The Lancet Commission on lessons for the future from the COVID-19 pandemic. *The Lancet*, 400(10359), 1229–1280. [https://doi.org/10.1016/S0140-6736\(22\)01585-9](https://doi.org/10.1016/S0140-6736(22)01585-9)
- United Nations Framework Convention on Climate Change. (2015). *Paris Agreement*. United Nations.

- Watts, N., Amann, M., Arnell, N., Ayeb-Karlsson, S., Beagley, J., Belesova, K., Boykoff, M., Byass, P., Cai, W., Campbell-Lendrum, D., Capstick, S., Chambers, J., Coleman, S., Dalin, C., Daly, M., Dasandi, N., Davies, M., Di Napoli, C., Dominguez-Salas, P., ... Costello, A. (2021). The 2020 report of The Lancet Countdown on health and climate change: Responding to converging crises. *The Lancet*, 397(10269), 129–170. [https://doi.org/10.1016/S0140-6736\(20\)32290-X](https://doi.org/10.1016/S0140-6736(20)32290-X)
- Whitmee, S., Haines, A., Beyrer, C., Boltz, F., Capon, A. G., Dias, B. F. S., Ezeh, A., Frumkin, H., Gong, P., Head, P., Horton, R., Mace, G. M., Marten, R., Myers, S. S., Nishtar, S., Osofsky, S. A., Pattanayak, S. K., Pongsiri, M. J., Romanelli, C., ... Yach, D. (2015). Safeguarding human health in the Anthropocene epoch: Report of The Rockefeller Foundation–Lancet Commission on planetary health. *The Lancet*, 386(10007), 1973–2028. [https://doi.org/10.1016/S0140-6736\(15\)60901-1](https://doi.org/10.1016/S0140-6736(15)60901-1)
- World Health Organization. (2015). *Operational framework for building climate-resilient health systems*. WHO. <https://www.who.int/publications/i/item/9789241565073>
- World Health Organization. (2021). *COP26 special report on climate change and health: The health argument for climate action*. WHO.
- World Health Organization. (2021). *Ethics and governance of artificial intelligence for health*. WHO.
- World Health Organization. (2023). *Climate change and health*. WHO.
- World Health Organization. (2023). *Operational framework for building climate resilient and low carbon health systems*. WHO. <https://doi.org/10.1016/j.puhe.2023.11.001>
- World Health Organization. (2024). *Quality criteria for integrating health into Nationally Determined Contributions*. WHO.
- World Health Organization. (2025). *International Health Regulations (2005), as amended in 2014, 2022 and 2024*. WHO.
- World Health Organization. (2025). *Global strategy on health, environment and climate change*. WHO.
- World Health Organization. (2025). *Health and climate change: Country support and climate-resilient health systems*. WHO.
- World Meteorological Organization. (2025). *State of the climate and health*. WMO.
- United Nations Development Programme. (2023). *Climate change and health: A human-centred approach to climate adaptation*. UNDP.
- United Nations Environment Programme. (2023). *Climate change and health: Understanding the links*. UNEP.
- World Bank. (2022). *Climate and development: An integrated approach to building resilience*. World Bank.