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Healthcare Facilities and Their Challenges Due to Hazards in the Himalayas: An Integrated Review

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Abstract

Healthcare facilities serve as the first responders to any calamity, operating under extreme pressure during disasters while often lacking the proper infrastructure needed to cope with surge demands. The health system faces a double challenge: managing regular patients while simultaneously caring for disaster survivors. International research documents the negative effects of climate change on healthcare facilities, with studies reporting damaged infrastructure, disrupted supply chains, and overwhelmed services. According to Braithwaite et al. (2024), health systems have remained unprepared for climate disasters. The WHO framework on climate resilient health systems and global case exemplars emphasize the urgent need for systematic adaptation, resilience, and recovery capacity. In the Indian context, climate change has emerged as a defining challenge for disaster management, especially in Himalayan regions. Rising temperatures, erratic rainfall patterns, and glacial retreat have intensified hazards like flash floods, landslides, and forest fires. The Kedarnath flood (2013) and the Chamoli glacier disaster (2021) exemplify climate shocks that severely disrupted communities and health systems . Recurring forest fires in Uttarakhand and Himachal Pradesh reflect longer dry seasons and rising temperatures, placing additional pressure on already vulnerable health systems [1-8].

Converging Hazards: Seismic Vulnerability and Climate Change Impacts

Research on earthquake vulnerability reveals alarming fragility in Himalayan healthcare infrastructure that compounds climate-related challenges. A critical assessment of health infrastructure in Uttarakhand—an earthquake-prone Himalayan province in seismic zones IV and V—found that 67.02% of surveyed healthcare facilities are projected to be non-functional after an earthquake, with 3.73% likely to be completely destroyed. This assessment underscores the extreme seismic vulnerability of medical infrastructure in India's most disaster-prone Himalayan region. The 2005 Kashmir earthquake demonstrated the catastrophic consequences of this vulnerability, causing widespread medical infrastructure loss that prompted subsequent seismic vulnerability studies in Himalayan townships like Mussoorie. These assessments reveal that hospital buildings in the Himalayas frequently lack earthquake-resistant design, adequate structural reinforcement, and disaster-resilient construction standards. Recent research assessing health facility preparedness in Nepal—another Himalayan nation—linked the 2021 Nepal Health Facility Service Provision Assessment with climate disaster data from 2018-2020, revealing significant preparedness disparities across facility types exposed to climate-related disasters. The study documented that healthcare facilities in the Hindu Kush Himalayan (HKH) region face compound challenges during disasters, with emergency preparedness varying substantially by facility level, location, and resources. A comprehensive narrative review on climate change impacts in the HKH region documented how multiple climate hazards—including floods, landslides, glacial lake outburst floods (GLOFs), heatwaves, and droughts—systematically disrupt healthcare delivery. Health centers close during disasters, water supplies become contaminated, essential medical services are interrupted, and supply chains for medicines and equipment are severed . Notably, for every 1°C temperature increase in mountain regions, there is a 5.05% increased risk of diarrhea, while vector-borne diseases like dengue and malaria are expanding to higher elevations above 2,000 meters, straining facilities ill-equipped to handle these emerging health threats. Extreme Heat and Infrastructure Deficiencies in Himalayan Healthcare. The 2026 editorial "Heat, Health and

the Himalayas" highlights how extreme heat—increasingly frequent due to climate change—disrupts critical healthcare functions in Himalayan facilities . Inadequate health infrastructure leaves medical facilities poorly equipped to handle heat extremes, with many facilities lacking air conditioning, having insufficient ventilation, poor building insulation, and experiencing intermittent electricity supply. These infrastructure gaps disrupt infection control protocols, compromise cold chain maintenance for vaccines and medications, reduce health workforce performance, and escalate emergency medical demands. Despite advances in early warning systems and preparedness initiatives, climate change has made disasters increasingly unpredictable, with impacts that are more chaotic and complex than ever before. The OECD's 2025 analysis of disaster risk and response in the Himalayan region emphasizes that healthcare infrastructure resilience remains a critical policy challenge in Nepal, Bhutan, and India, requiring coordinated disaster management and health sector planning [9-16].

Critical Gaps in the Literature

Despite growing attention to climate change and health, significant gaps remain in the literature on healthcare vulnerability to climate disasters in the Himalayas that limit our ability to strengthen healthcare resilience:

- Urban-centric focus limits applicability to mountain terrain. Most studies remain focused on cities and metropolitan disaster preparedness, which limits their applicability to the unique challenges of mountain terrain. The preparedness frameworks developed for urban settings do not account for the distinctive features of Himalayan healthcare delivery: remote locations, difficult accessibility during landslides and floods, scattered settlements, and limited infrastructure in rural health centers. This urban bias obscures the specific vulnerabilities of mountain health facilities that face isolation, terrain-related transportation barriers, and resource constraints fundamentally different from urban hospitals. The 67% non-functionality rate after earthquakes and the unique challenges of high-altitude healthcare remain understudied in mountain-specific contexts.
- Region-specific rather than universal facility preparedness in India. In India, facility preparedness in health facilities has remained region-specific rather than universal. Preparedness varies substantially by state, facility level, and local resources, with no standardized framework applicable across Himalayan states (Uttarakhand, Himachal Pradesh, Sikkim, Arunachal Pradesh, Jammu & Kashmir). This fragmentation means that interventions in one region cannot be easily replicated in another, despite similar hazard profiles and infrastructure challenges. The 2025 Nepal study highlighting preparedness disparities across facility types demonstrates this lack of universal standards, but India lacks even comparable systematic assessments across its Himalayan regions. Without universal standards, healthcare resilience efforts remain fragmented and ineffective.
- Limited community awareness of Early Warning Systems (EWS) and facility preparedness. There is little to no awareness among communities about Early Warning Systems (EWS) and health facilities' preparedness to shape health outcomes during recurring disasters. Even when EWS infrastructure exists, communities in remote Himalayan areas often lack knowledge of how to respond to warnings, where to seek care, or which health facilities remain functional during disasters. This awareness gap undermines the effectiveness of early warning investments and leaves communities unable to leverage healthcare facilities' preparedness efforts. The disconnect between facility-level preparedness and community awareness creates a critical implementation gap in disaster response, where even well-prepared facilities cannot serve communities that don't know how to access them during crises.
- Absence of comprehensive resilience frameworks for the Himalayas. No fully emerged frameworks and models describe resilience and provide operational guidance specifically for the Himalayan regions. While the WHO framework on climate-resilient health systems and global case exemplars offer general guidance, they lack Himalayan-specific operational details addressing: (a) seismic vulnerability叠加 with climate hazards, (b) high-altitude cold chain challenges, (c) GLOF and landslide-specific protocols, (d) remote mountain facility resource constraints, and (e) multi-hazard integration for earthquake-prone, climate-vulnerable regions. The OECD's 2025 analysis acknowledges this policy gap but offers no actionable operational framework for Himalayan healthcare resilience. This absence leaves policymakers and healthcare administrators without evidence-based guidance for building climate-resilient health systems in one of the world's most hazard-prone regions [3,4].

The Double Burden: Synthesis of Structural and Climate Vulnerabilities

These findings collectively reveal that Himalayan healthcare facilities face a convergence of structural, operational, and environmental vulnerabilities that create a double burden during disasters: Structural fragility combined with climate exposure: Earthquake-vulnerable building infrastructure meets increasingly frequent floods, landslides, GLOFs, heatwaves, and forest fires, with 67% of facilities at risk of non-functionality post-earthquake while simultaneously facing climate disaster disruptions.

Resource constraints amid emerging disease burden: Limited medical supplies, inadequate equipment, and poor accessibility in remote mountain areas coincide with rising temperatures driving vector-borne diseases to higher elevations and increased diarrheal disease risk. Infrastructure deficits during extreme events: Insufficient cooling, unreliable electricity, and inadequate ventilation exactly when these systems are most needed—during heatwaves that disrupt infection control and cold chain maintenance. Supply chain disruption during compound hazards: Transportation barriers during landslides and floods isolate rural health centers precisely when earthquake-damaged infrastructure limits alternative access routes. Recent evidence demonstrates that heat disrupts infection control, cold chain maintenance, and health workforce performance while escalating emergency demands in Himalayan settings. The mountain regions' particularly fragile health systems—with limited infrastructure, inadequate medical supplies, and poor accessibility during

disasters—cannot adequately withstand the compounding pressures of routine healthcare demands and escalating climate shocks.

Path Forward

Addressing Literature Gaps Through Integrated Resilience Strategies

These findings collectively underscore the urgent need for integrated strategies that strengthen healthcare resilience in the Himalayas. The four identified literature gaps point directly to critical research and policy needs:

- Mountain-specific preparedness frameworks that account for remote locations, terrain barriers, and scattered settlements rather than urban-centric models
- Universal standards for facility preparedness across India's Himalayan states to enable replication and ensure equitable healthcare resilience
- Community-facility linkage interventions that build EWS awareness and connect community preparedness with facility capabilities to improve health outcomes during recurring disasters
- Himalayan-specific resilience frameworks providing operational guidance for multi-hazard settings that integrate seismic vulnerability with climate change impacts
- Priority actions include linking disaster risk reduction with climate adaptation, incorporating earthquake-resistant design in healthcare construction, improving facility-level climate preparedness, ensuring reliable infrastructure (electricity, cooling, water), and building health systems capable of withstanding both routine pressures and increasingly unpredictable climate disasters. The convergence of seismic vulnerability and climate change impacts demands coordinated policy responses across disaster management, health sector planning, and climate adaptation frameworks in Nepal, Bhutan, and India. Addressing the identified literature gaps will enable evidence-based development of these critical resilience strategies for one of the world's most vulnerable regions.

Methodology

Study Design

This study employs a synthesized qualitative method integrating multiple data sources to comprehensively assess healthcare vulnerability to climate disasters in the Himalayan region. The approach combines secondary data from the WHO Hospital Safety Index, literature on Himalayan disasters, systematic review studies on climate-resilient health systems, and policy documents from national and organizational sources. This multi-source synthesis enables triangulation of evidence and provides a holistic understanding of healthcare facility challenges in mountain disaster contexts.

Data Sources

WHO Hospital Safety Index: The study utilizes the WHO Hospital Safety Index framework as a foundational assessment tool for evaluating healthcare facility readiness. The Hospital Safety Index provides standardized criteria for assessing hospital functionality during disasters across multiple domains including structural safety, non-structural hazards, and functional preparedness. This international framework serves as a benchmark for comparing healthcare facility preparedness across Himalayan regions.

Secondary Literature on Himalayan Disasters (2010–2025): The study systematically reviews secondary literature documenting disasters in the Himalayan region from 2010 to 2025. This 15-year timeframe captures major climate-related disasters including the Kedarnath flood (2013), Chamoli glacier disaster (2021), recurring forest fires in Uttarakhand and Himachal Pradesh, and various flash floods and landslides. The literature search encompasses peer-reviewed journal articles, conference proceedings, technical reports, and policy briefs addressing healthcare impacts, infrastructure damage, and disaster response in Himalayan contexts.

Review Studies on Climate-Resilient Health Systems: The synthesis incorporates systematic and narrative review studies examining climate-resilient health systems, particularly those focused on mountain regions, climate-vulnerable settings, and disaster-prone areas. These reviews provide evidence on best practices, intervention effectiveness, and gaps in current healthcare resilience strategies. Key sources include the comprehensive narrative review on climate change impacts in the Hindu Kush Himalayan region, health facility preparedness assessments in Nepal, and editorial analysis on heat and health in the Himalayas [12-14].

Policy Documents and Strategies: The study analyzes policy frameworks and strategies proposed by the National Disaster Management Authority (NDMA) and the Centre for Ecology, Environment and Climate Change (CEEW). NDMA guidelines provide national-level disaster management protocols, health sector preparedness standards, and risk reduction strategies specific to Indian contexts. CEEW reports offer climate risk assessments, healthcare infrastructure resilience recommendations, and evidence-based policy analysis for climate-proofing critical healthcare infrastructure in India. Thematic synthesis for this study was carried out using four broad analytical domains adapted from the World Health Organization Hospital Safety Index and modified to suit the unique geographical and disaster-related challenges of the Himalayan region. These domains were selected to understand how healthcare systems in mountainous areas respond to recurring climate-induced disasters such as floods, landslides, earthquakes, and forest fires. The framework not only focuses on the physical preparedness of healthcare facilities but also examines human resources, community awareness, and institutional governance that collectively shape disaster resilience.

Domain 1: Infrastructure and Resource Preparedness

This domain focuses on the ability of healthcare facilities to continue functioning during and after disasters. In the Himalayan region, health infrastructure often faces multiple risks due to difficult terrain, poor connectivity, and extreme weather events. Therefore, this domain examines the structural safety of hospitals and health centres, especially their vulnerability to earthquakes and landslides. It also evaluates the availability of essential services such as electricity backup systems, safe water supply, sanitation, waste management, and uninterrupted medical supply chains. Special attention is given to the maintenance of vaccine cold chains and the availability of additional space for handling sudden increases in patient load during emergencies. Accessibility of health facilities during road blockages, floods, and remote weather conditions is another important component of this domain.

Domain 2: Human Resource Capacity

The second domain assesses the preparedness and capability of healthcare workers to manage disaster situations effectively. Healthcare systems in mountainous regions often suffer from shortages of trained personnel and difficulties in retaining staff in remote areas. This domain therefore evaluates the availability of healthcare professionals during both normal conditions and emergency surges. It examines staff training in disaster response, emergency medicine, triage systems, and multi-hazard management protocols. The framework also considers the availability of specialized personnel such as surgeons, anesthesiologists, and emergency physicians who are critical during disasters. In addition, it highlights the importance of mental health support for healthcare workers and continuity of care when staff members themselves are affected by disasters.

Domain 3: Early Warning Systems and Community Awareness

This domain explores the relationship between early warning systems, community preparedness, and healthcare outcomes during disasters. In many Himalayan communities, limited awareness about disaster warnings and evacuation procedures increases vulnerability during emergencies. Therefore, this domain evaluates the availability and effectiveness of early warning systems in disaster-prone areas and examines how warning information is communicated between healthcare institutions and local communities. It also assesses public awareness regarding evacuation routes, functional healthcare facilities during disasters, and preventive health measures related to climate-sensitive diseases. The integration of early warning mechanisms with healthcare emergency activation plans and community-based disaster response systems is considered an essential aspect of resilience in this framework.

Domain 4: Institutional-Level Policy Frameworks

The final domain examines the policy environment and institutional mechanisms that support healthcare resilience in the Himalayan region. This includes assessing whether healthcare facilities have formal disaster management plans and whether climate adaptation strategies are integrated into health sector policies. The domain further evaluates coordination between health departments, disaster management authorities, and climate-related agencies to ensure effective emergency response. Other important aspects include budget allocation for resilient healthcare infrastructure, enforcement of earthquake-resistant construction standards, and systems for monitoring and evaluating disaster preparedness. Given the transboundary nature of many Himalayan disasters, the framework also considers the importance of regional and cross-border collaboration in disaster risk reduction and emergency healthcare management.

Temporal and Geographic Scope

The study covers 2010–2025 to capture the period of accelerating climate change impacts and increasing disaster frequency in the Himalayan region. Geographically, the synthesis encompasses the Indian Himalayan region (Uttarakhand, Himachal Pradesh, Sikkim, Arunachal Pradesh, Jammu & Kashmir, Ladakh) and relevant comparator regions from Nepal and other Hindu Kush Himalayan countries where data provides transferable insights for Indian contexts.

Ethical Considerations

As a secondary data synthesis study, this research does not require ethical approval. All sources used are publicly available publications, policy documents, and organizational reports. The synthesis maintains academic integrity through comprehensive citation and transparent reporting of evidence sources.

Findings

Infrastructure Gaps

Healthcare facilities in the Himalayas face critical infrastructure deficiencies that compromise their ability to respond to climate disasters. There is a lack of adequate capacity, evacuation systems, and reliable power backups across most health facilities. Facilities located in flood- or landslide-prone areas predominantly experience:

- •Access disruption during disasters due to blocked roads, damaged bridges, and terrain-related transportation barriers
- Poor maintenance of critical equipment resulting from intermittent electricity, humidity, and limited technical support in remote locations
- Limited surge capacity for handling large numbers of patients during emergency situations, with inadequate space for expansion during disaster response

These infrastructure gaps were evident during the Kedarnath flood (2013) and Chamoli glacier disaster (2021), where health centers were isolated, power systems failed, and medical equipment became non-functional precisely when needed most.

Human Resource Limitations

The Himalayan region faces significant human resource constraints that undermine disaster response effectiveness:

- Poor staff training in disaster response, triage protocols, and emergency care specific to mountain contexts. Healthcare workers lack specialized training for multi-hazard response including earthquake, flood, landslide, and heatwave scenarios.
- Outdated Standard Operating Procedures (SOPs) with irregular updates that fail to incorporate lessons learned from recent disasters.
- Absence of formal Incident Command Systems (ICS), resulting in weak coordination during crisis situations. Without clear Chain of command and standardized communication protocols, inter-facility and inter-agency coordination deteriorates precisely when it is most critical.

These human resource limitations create a workforce that is ill-prepared for the compounding pressures of routine healthcare delivery and disaster response in challenging mountain environments.

Community Awareness Deficit

A critical gap in community awareness significantly increases vulnerability during climate disasters:

- Lack of knowledge about Early Warning Systems (EWS) and evacuation protocols leaves communities unprepared for landslides and flash floods. Even when warning infrastructure exists, communities in remote Himalayan areas often do not know how to respond to alerts, where to seek care, or which health facilities remain functional during disasters.
- Insufficient information on respiratory protection and health risk mitigation during forest fires. Despite recurrent exposure to forest fires in Uttarakhand and Himachal Pradesh, affected communities lack proper guidance on protecting respiratory health and minimizing exposure to smoke and air pollution.

This awareness gap undermines the effectiveness of early warning investments and creates a disconnect between facility-level preparedness and community capacity to access care during crises.

Reoccurrence of Disasters

Climate change combined with poor development policies in hill and mountain regions is driving increasing frequency of climate-related disasters:

- Rising temperatures and longer dry seasons intensify forest fire risk, while erratic rainfall patterns increase flash flood and landslide frequency.
- Reoccurrence of events in the same regions puts repeated stress on healthcare facilities, undermining their ability to recover between disasters and prepare for future shocks. Facilities struggle to restock depleted supplies, repair damaged infrastructure, and retain staff who experience disaster trauma repeatedly.
- This cycle of recurrent disruption prevents healthcare systems from building sustained resilience, as resources are continuously diverted to emergency response rather than long-term capacity building.

Global Context

The preparedness gaps identified in Himalayan healthcare facilities are systemic and universal, not region-specific. Studies by Gkouliaveras et al. (2025) and Braithwaite et al. (2024) demonstrate that many health systems worldwide are under-equipped for climate-linked disasters. This global pattern suggests that:

- Infrastructure deficits against disasters are not unique to Indian settings but reflect broader systemic challenges in healthcare resilience
- The gap between climate change acceleration and healthcare system adaptation is a worldwide phenomenon
- System-level reforms, rather than isolated facility or regional interventions, are necessary to address these universal preparedness gaps.

Discussion

Case Study Evidence: Kedarnath and Chamoli Disasters

The case studies of Kedarnath floods (2013) and the Chamoli glacier disaster (2021) demonstrate how sudden climate disasters overwhelm fragile health systems and infrastructure in the Himalayas.

These Events Revealed

- Complete disruption of supply chains for medicines, vaccines, and medical equipment due to blocked transportation routes
- Limited evacuation options for patients and healthcare workers trapped in affected areas
- Structural damage to health facilities from floodwaters, landslides, and debris flows
- Prolonged service interruption lasting weeks to months in severely affected regions

The recurring forest fires in Uttarakhand and Himachal Pradesh illustrate the chronic, escalating risk posed by rising temperatures and extended dry seasons. These fires not only strain the environment through air pollution and ecosystem degradation but also place sustained pressure on the health system through increased respiratory cases, burn injuries, and displacement-related health needs.

Comparative Evidence: Eastern India Multicentre Hospital Study The multicentre hospitals study from eastern India. provides important comparative evidence, demonstrating that even well-equipped and established facilities score poorly on surge capacity, SOPs, and staff training [17].

This Finding is Significant Because:

- These deficiencies are common across all Himalayan regions, suggesting that infrastructure investment alone is insufficient without parallel investments in human resources and operational protocols
- The gap between physical infrastructure and operational readiness exists even in better-resourced settings, indicating systemic challenges in healthcare disaster preparedness
- The Himalayan context amplifies these challenges due to remote locations, terrain barriers, and multi-hazard exposure
- Global Validation of Findings
- Global studies support the conclusion that poor infrastructure against disasters is not unique to Indian settings but represents a universal challenge. Gkouliaveras et al. (2025) and Braithwaite et al. (2024) document similar preparedness gaps across diverse health systems worldwide, underscoring the necessity of system-level reforms rather than isolated facility or regional interventions. This global pattern validates that:
- The Himalayan experience reflects broader trends in healthcare vulnerability to climate hazards
- Lessons from international climate-resilient health system frameworks are transferable to Himalayan contexts
- Addressing healthcare vulnerability requires coordinated policy responses across disaster management, health sector planning, and climate adaptation

WHO Framework-Compatible Strategies for Himalayan Regions Following the WHO framework for climate-resilient health systems, the following strategies are particularly relevant for addressing identified vulnerabilities in Himalayan regions:

Risk Assessment Tools

The WHO Hospital Safety Index and Indian-specific evaluation frameworks provide structured, standardized approaches to identify infrastructure and operational vulnerabilities. Implementing these tools across Himalayan health facilities enables:

- Systematic identification of structural and non-structural hazards
- Prioritization of infrastructure upgrades based on evidence
- Benchmarking of preparedness levels across facilities and regions
- Tracking of improvements over time through repeated assessments

Institutional Strengthening

Establishment of Disaster Management Committees, formal Incident Command Systems, and digitized SOPs can significantly improve coordination and response speed.

Key Interventions Include

- Creating dedicated disaster management units within health departments
- Standardizing incident comsmand structures across all facility levels
- Developing accessible, updated digital SOPs for multi-hazard response
- Establishing clear communication protocols between facilities, agencies, and communities

Community Engagement

Regular awareness campaigns, evacuation drills, and multi-channel dissemination of early warning messages empower local populations and reduce preventable harm. Essential strategies include:

- Community-based disaster preparedness training programs
- Regular evacuation drills involving health facilities and communities
- Multi-language, multi-format early warning communication (SMS, radio, community alert systems)
- Health education on climate-sensitive disease prevention and respiratory protection during forest fires
- Building community-facility linkages for coordinated emergency response

Climate-Proofing Infrastructure

Development of healthcare facilities to withstand floods, landslides, and fires through engineered solutions can significantly enhance resilience. Critical interventions include:

- Site selection on elevated locations away from flood plains and landslide-prone slopes
- Robust power supply systems including solar panels, battery storage, and backup generators with adequate fuel reserves
- Damage-resistant construction materials and earthquake-resistant design standards

- Elevated electrical systems and critical equipment placement above flood levels
- Redundant water supply systems with backup storage and purification capacity
- Fire-resistant building materials and defensible space around facilities in forest fire zones

Integrated Implementation Pathway

These measures, if implemented in an integrated manner, can transform disaster response from reactive emergency management into proactive, climate-resilient health systems in the Himalayas. The four strategy domains are interconnected: risk assessment identifies vulnerabilities, institutional strengthening enables coordinated response, community engagement ensures effective utilization of prepared facilities, and climate-proofing infrastructure provides the physical foundation for resilience. Successful implementation requires:

- Coordinated policy action across health, disaster management, and climate adaptation sectors
- Sustained financial investment in infrastructure upgrades and workforce development
- Regular monitoring and evaluation using standardized metrics
- Cross-border collaboration for transboundary Himalayan disasters
- Integration of traditional knowledge with scientific risk assessment and modern technology

Conclusion

The Himalayas stand at the forefront of climate change, facing recurring floods, landslides, and forest fires that place unprecedented pressure on both ecosystems and healthcare systems. Case studies from the Kedarnath and Chamoli disasters, combined with evidence from eastern India multicentre hospitals, demonstrate the systematic unpreparedness of healthcare facilities, human resource limitations, and inadequate staff training across Himalayan regions. Global studies confirm this is not unique to Indian regions but represents part of larger-scale systemic unpreparedness faced by health systems worldwide confronting climate-induced hazards. The convergence of seismic vulnerability (with 67% of facilities at risk of non-functionality post-earthquake) and accelerating climate impacts creates a double burden that current healthcare systems cannot adequately withstand.

Three Priorities are Critical for Building Resilience in the Himalayas

- Establishing institutional disaster management structures including formal Incident Command Systems, Disaster Management Committees, and standardized SOPs that enable coordinated multi-agency response
- Building healthcare preparedness through risk assessment tools, climate-proofing infrastructure investments, human resource training in disaster response, and surge capacity development
- Enhancing community awareness through EWS education, evacuation drills, and multi-channel communication that empowers local populations to protect themselves and access care effectively during disasters

By merging health system management with disaster risk reduction and climate resilience strategies, Himalayan societies can transition from reactive crisis response to proactive resilience, safeguarding lives and building health systems capable of withstanding the escalating challenges of climate change. This transformation requires coordinated action across government sectors, sustained financial commitment, community engagement, and integration of international best practices with local context-specific solutions. The window for action is narrowing as climate impacts accelerate, making immediate implementation of these evidence-based strategies essential for protecting healthcare access and health outcomes in one of the world's most vulnerable regions.

Limitations

This methodology has inherent limitations:

- reliance on secondary data may miss facility-level granular details
- urban-centric studies may bias findings away from rural mountain realities
- regional variations across Himalayan states may not be fully captured
- community awareness data may be limited due to sparse primary surveys. However, the multi-source synthesis approach mitigates these limitations through triangulation and cross-validation of findings across diverse data sources.

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