Section: Hospital Administration

Original Research Article

HOSPITAL DISASTER PREPAREDNESS AND EMERGENCY RESPONSE: A REVIEW OF GLOBAL FRAMEWORKS AND IMPLEMENTATION GAPS

Ranjana Singh[1], Gowtham Ram[2], Neil Priyadarshi[3], Priyadarshi Ranjan[4], Ashok Kumar[5]

[1]Additional Professor, Department of Hospital Administration, Post Graduate Institute of Medical Education and Research, India.
[2]Assistant Professor, Department of Hospital Administration, Post Graduate Institute of Medical Education and Research, India.
[3]Medical Student, Government Medical College and Hospital, Chandigaarh.
[4]Director, Meliora Institute of Urology, Department of Urology and Kidney Transplant Surgery, India.
[5]Professor and Head, Department of Hospital Administration, Post Graduate Institute of Medical Education and Research, India.

Received *: 02/09/2026*
Received in revised form *: 28/09/2026*
Accepted *: 09/10/2026*

Corresponding Author:
Dr. Ranjana Singh,
Additional Professor, Department of Hospital Administration, Post Graduate Institute of Medical Education and Research, India.
Email:ranjanasingh13411@gmail .com

DOI: 10.70034/ijmedph.2026.4.160

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (4); 1052-1061

ABSTRACT

Background: Hospitals constitute critical infrastructure during disasters because they must simultaneously withstand disruption, maintain essential services, and accommodate sudden increases in demand for emergency and definitive care. Despite the availability of internationally recognized disaster-risk-reduction frameworks and hospital preparedness tools, major differences persist between recommended standards and operational readiness. This narrative review examines global frameworks for hospital disaster preparedness and emergency response, synthesizes the principal domains of effective preparedness, and identifies recurrent implementation gaps. A structured narrative search of peer-reviewed and authoritative institutional literature was undertaken, with emphasis on publications and guidance from the World Health Organization (WHO), United Nations Office for Disaster Risk Reduction, and contemporary hospital preparedness research. Major frameworks reviewed included the Sendai Framework for Disaster Risk Reduction, WHO Health Emergency and Disaster Risk Management Framework, Comprehensive Safe Hospital Framework, Hospital Safety Index, Hospital Emergency Response Checklist, incident-command approaches, and contemporary emergency-readiness standards. Across these frameworks, preparedness consistently depends on governance and incident command, risk assessment, structural and non-structural safety, communication, workforce readiness, surge capacity, logistics, continuity of essential services, evacuation capability, coordination, and recovery planning. However, recent evidence demonstrates persistent deficiencies in staff training, emergency communication, supplies, backup systems, infrastructure safety, functional preparedness, interagency coordination, and evaluation of exercises. Resource-constrained health systems experience additional barriers related to funding, workforce shortages, governance, and fragile infrastructure. Hospital preparedness should therefore evolve from compliance-oriented disaster planning toward measurable, risk-informed institutional resilience. Regular hazard assessments, competency-based multidisciplinary exercises, redundant critical systems, adaptive surge strategies, stronger health-system coordination, standardized preparedness indicators, and continuous learning after drills and real events are required to close the framework-to-practice gap.

Keywords: hospital disaster preparedness; emergency response; disaster management; hospital resilience; surge capacity; Hospital Safety Index; emergency preparedness; disaster risk reduction; incident command; health emergencies.

INTRODUCTION

Disasters and major emergencies can rapidly transform hospitals from routine healthcare facilities into critical components of a community's survival infrastructure. Natural hazards such as earthquakes, floods, cyclones, extreme heat and wildfires; biological emergencies such as epidemics and pandemics; technological incidents; mass-casualty events; chemical, biological, radiological and nuclear hazards; armed conflict; utility failures; cyber incidents; and other human-induced emergencies may simultaneously increase healthcare demand while damaging the resources required to deliver that care. Consequently, hospital disaster preparedness involves considerably more than maintaining an emergency response plan. It requires the capacity to protect patients and staff, maintain essential clinical functions, manage sudden increases in demand, coordinate with external agencies, adapt operations under resource constraints, and recover safely following disruption.

The Sendai Framework for Disaster Risk Reduction 2015–2030 established disaster-risk reduction as a multisectoral responsibility and identified four priorities: understanding disaster risk, strengthening risk governance, investing in resilience, and enhancing preparedness for effective response and recovery.[1] These principles have particular relevance to hospitals, which represent both critical infrastructure and operational response institutions. The WHO subsequently strengthened the health-sector application of these principles through its Health Emergency and Disaster Risk Management framework, which promotes prevention, preparedness, readiness, response, and recovery as interconnected components of health-system resilience.[2]

Hospital-specific initiatives have further translated these principles into operational guidance. The WHO Comprehensive Safe Hospital Framework emphasizes protection of infrastructure, health workers, patients and service continuity.[3] The Hospital Safety Index provides a structured method for evaluating structural safety, non-structural safety, and emergency and disaster management capacity.[4] The WHO Hospital Emergency Response Checklist complements these approaches through operational priorities involving command and control, communication, safety and security, triage, surge capacity, continuity of essential services, human resources, logistics and supply management, and post-disaster recovery.[5]

Nevertheless, the existence of guidelines does not necessarily translate into operational capability. Disaster preparedness remains inconsistently defined and measured, while assessment instruments differ considerably in scope.[6-8] A recent synthesis of hospital preparedness assessments found that many facilities continued to demonstrate only moderate preparedness and recurring weaknesses involving structural safety, backup communications, emergency planning, training, staff welfare, logistics and supplies.[9]

The COVID-19 pandemic also demonstrated that hospital preparedness cannot be conceptualized solely as readiness for a short-duration mass-casualty incident. Hospitals may face prolonged emergencies involving staff shortages, disrupted supply chains, scarcity of critical-care capacity, rapidly changing clinical protocols, infection-control pressures and competing demands between emergency and routine services. Contemporary preparedness therefore increasingly overlaps with the broader concept of hospital resilience—the ability to absorb disruption, adapt, maintain priority functions, recover and learn.[10]

The present narrative review therefore aims to: (1) examine major international frameworks guiding hospital disaster preparedness and emergency response; (2) synthesize the principal domains required for an effective hospital disaster-management system; (3) identify recurrent implementation gaps reported across different health-system contexts; and (4) propose practical strategies for strengthening hospital resilience and translating preparedness frameworks into sustainable operational capability.

2. Review Methodology

2.1 Review design

A structured narrative review approach was adopted to synthesize conceptual frameworks, international guidance, assessment tools, systematic reviews and relevant peer-reviewed literature concerning hospital disaster preparedness and emergency response.

Unlike a systematic review intended to answer a narrowly defined intervention question, the present review was designed to integrate policy frameworks, implementation science, disaster-management principles and operational hospital evidence.

2.2 Information sources and search approach

Relevant literature was identified primarily through PubMed/MEDLINE and authoritative organizational sources, including the World Health Organization, United Nations Office for Disaster Risk Reduction and hospital emergency-management standard-setting organizations. Reference lists of relevant reviews were also considered for influential foundational publications.

Search concepts included combinations of the terms hospital, disaster, emergency preparedness, disaster management, hospital resilience, emergency response, surge capacity, incident command, Hospital Safety Index, evacuation, simulation exercises, continuity of operations, and health emergency and disaster risk management.

Priority was given to English-language literature relevant to hospital-based emergency and disaster management, particularly publications addressing multidisciplinary or facility-level preparedness. International frameworks and major guidance documents were included irrespective of publication

date where they remained relevant to current practice. Contemporary evidence through 2026 was incorporated where available.

2.3 Eligibility considerations

Publications were considered relevant when they addressed one or more of the following domains: hospital disaster preparedness; structural or functional hospital safety; hospital resilience; emergency-management governance; incident command; communication; workforce preparedness; surge capacity; logistics and supplies; evacuation; emergency exercises; continuity of operations; recovery; or preparedness-assessment instruments.

Literature limited exclusively to prehospital emergency medical services without implications for hospital operations, purely clinical management of an individual disease without an emergency-preparedness component, and non-health disaster-management literature without relevance to hospitals was not emphasized.

Because this was a narrative review, formal meta-analysis, pooled-effect estimation and PRISMA-based numerical study selection were not undertaken. Findings were synthesized thematically around global frameworks, operational preparedness domains and implementation gaps.

3. Conceptualizing Hospital Disaster Preparedness

Hospital disaster preparedness can be viewed as the organizational capability to anticipate hazards, reduce vulnerabilities, prepare personnel and resources, activate coordinated emergency operations, preserve essential functions under abnormal demand, and recover while incorporating lessons into future risk reduction.

Verheul and Dückers identified substantial variation in how hospital disaster preparedness had been defined and operationalized and demonstrated that preparedness incorporates multiple interconnected structural and process components.[6] Similarly, systematic assessment of preparedness tools has demonstrated considerable variation in measured domains.[7,8]

Preparedness should therefore not be equated with the existence of an emergency plan. A hospital may possess an extensive written disaster plan yet remain functionally unprepared if personnel do not understand their roles, communication systems fail, supplies cannot be rapidly accessed, critical infrastructure lacks redundancy or response arrangements have never been tested.

A useful conceptual transition is from preparedness as documentation to preparedness as demonstrated capability.

4. Major Global Frameworks for Hospital Disaster Preparedness

4.1 Sendai Framework for Disaster Risk Reduction

The Sendai Framework provides the overarching international policy architecture for contemporary disaster-risk reduction [1]. Its four priorities can be translated directly into hospital practice.

Understanding disaster risk requires facility-specific hazard and vulnerability assessment. Strengthening risk governance requires defined leadership, responsibilities and coordination. Investment in disaster-risk reduction requires resilient infrastructure, redundancy and workforce development. Enhanced preparedness requires operational plans, exercises, response capability and recovery arrangements.

An important contribution of the Sendai approach is that disasters should not be managed only after they occur. Risk must be identified and reduced before exposure leads to catastrophic consequences.

4.2 WHO Health Emergency and Disaster Risk Management Framework

The WHO Health Emergency and Disaster Risk Management Framework integrates traditional disaster management with health-system strengthening.[2] Rather than isolating emergency response within a specialist disaster-management unit, the framework emphasizes collaboration across health disciplines and sectors.

For hospitals, this approach means disaster preparedness should be embedded within routine governance, patient safety, infection control, engineering, occupational health, supply-chain management, information systems, emergency care and quality-improvement processes.

4.3 Comprehensive Safe Hospital Framework

The WHO Comprehensive Safe Hospital Framework recognizes that a hospital cannot adequately respond to disasters if the facility itself becomes a casualty.[3]

A safe hospital must protect life, protect investment in facilities and equipment, and maintain healthcare functions during emergencies. These objectives require attention to the physical integrity of buildings as well as utilities, equipment, logistics, personnel and organizational systems.

4.4 Hospital Safety Index

The Hospital Safety Index is among the most widely recognized approaches for rapid assessment of hospital safety and preparedness.[4] Its assessment architecture broadly evaluates:

Structural safety: integrity of buildings and load-bearing systems.

Non-structural safety: utilities, medical equipment, architectural elements, communication systems, water, electricity, fuel and other systems whose failure can disable healthcare delivery even when the building remains standing.

Emergency and disaster-management capacity: governance, planning, coordination, staffing, logistics and operational readiness.

The strength of the Hospital Safety Index lies in recognizing that physical survival of a building does not necessarily mean continued delivery of healthcare.

4.5 WHO Hospital Emergency Response Checklist

The Hospital Emergency Response Checklist translates preparedness into immediate operational priorities.[5]

Its major components include command and control, communication, safety and security, triage, surge capacity, continuity of essential services, human resources, logistics and supply management, and post-disaster recovery.

The checklist is particularly valuable as an all-hazards instrument because the operational consequences of apparently different disasters frequently converge. An earthquake, epidemic, cyberattack or flood may all ultimately produce communication failure, staff shortages, overcrowding, disrupted supplies and compromised continuity of care.

4.6 Hospital Incident Command Systems

Hospital incident-command arrangements establish a scalable management structure during emergencies. Incident command clarifies authority, responsibilities, reporting relationships and operational functions.

Evidence regarding Hospital Incident Command Systems suggests benefits in establishing coordination and role clarity but also highlights barriers when systems are poorly integrated into routine organizational structures or inadequately supported by training and exercises.[13]

Effective incident command therefore requires more than organizational charts. Personnel expected to occupy command roles must understand their responsibilities and have repeated opportunities to practice decision-making under realistic conditions.

4.7 Contemporary emergency-readiness standards

Hospital accreditation and emergency-management standards increasingly emphasize an all-hazards emergency-management program incorporating leadership, hazard-vulnerability analysis, mitigation and preparedness, emergency operations planning, education, exercises, continuity planning, disaster recovery and program evaluation.[21]

Current Joint Commission guidance also emphasizes operational planning for extended emergencies rather than interpreting preparedness simply as stockpiling. Its current approach expects hospitals to understand resource capabilities and limitations and to incorporate continuity and recovery into emergency-management programs.

Table 1: Comparison of major frameworks relevant to hospital disaster preparedness

Framework/tool	Primary purpose	Major hospital applications	Principal contribution
Sendai Framework [1]	Global disaster-risk reduction	Risk assessment, governance, resilience investment, preparedness and recovery	Links hospital preparedness with wider disaster-risk reduction
WHO Health EDRM Framework [2]	Health-sector disaster-risk management	Prevention, preparedness, readiness, response and recovery	Integrates disaster management with health-system strengthening
Comprehensive Safe Hospital Framework [3]	Protection of health facilities and functions	Infrastructure, staff safety and continuity	Defines hospitals as critical resilient infrastructure
Hospital Safety Index [4]	Hospital vulnerability assessment	Structural, non-structural and functional assessment	Provides structured safety and preparedness assessment
WHO Hospital Emergency Response Checklist [5]	Operational emergency readiness	Command, communications, surge, triage, logistics and continuity	Translates preparedness into practical response actions
Hospital Incident Command approaches [13]	Emergency leadership and control	Command hierarchy, roles and coordination	Provides scalable response-management structure
Contemporary emergency-management standards [21]	Institutional emergency-management capability	Hazard analysis, exercises, continuity, recovery and evaluation	Connects preparedness with governance and quality assurance

5. Core Domains of Hospital Disaster Preparedness

5.1 Governance, leadership and incident command

Disasters compress decision-making time while expanding uncertainty. Governance arrangements must therefore establish who has authority to activate emergency operations, allocate scarce resources, modify routine procedures, request external assistance, communicate with public authorities and initiate evacuation.

Preparedness programs are particularly vulnerable when emergency planning is assigned to a single individual without executive authority or multidisciplinary participation.

A hospital disaster committee should therefore include clinical departments, nursing, emergency medicine, critical care, administration, engineering, infection prevention, pharmacy, laboratory services, security, information technology, logistics and communication functions.

5.2 Hazard vulnerability and risk assessment

Preparedness must correspond to realistic threats.

Hazard vulnerability assessment should examine the probability and potential impact of natural, biological, technological and human-induced hazards while considering local geographic and health-system conditions.

Hospitals should distinguish between external disasters, which generate incoming demand, and internal disasters, which compromise the hospital itself. Some events generate both simultaneously.

Risk assessments should be periodically revised because hazards change with urbanization, climate, new technology, infrastructure deterioration, emerging infectious diseases and changes in regional security.

5.3 Structural and non-structural safety

Structural failure can cause immediate catastrophic loss, whereas non-structural failures can disable a hospital even when the building remains intact.

Non-structural preparedness should address medical gases, electricity, water, ventilation, fuel, fire protection, lifts, information technology, laboratory systems, blood storage, pharmaceuticals and critical equipment.

Redundancy is especially important for electricity, water, communications, oxygen and information systems.

5.4 Surge capacity

Surge capacity is the ability to expand beyond routine capacity when demand rises abruptly or substantially.

A commonly used operational approach organizes surge capacity into staff, stuff, space and systems.[11,12]

Staff refers to available personnel and strategies for recall, redeployment and augmentation.

Stuff includes medication, equipment, blood products, oxygen, personal protective equipment and consumables.

Space concerns treatment locations, beds, intensive-care capacity and alternative care areas.

Systems include command, information, communication, triage, transfer and resource-allocation processes.

A 2023 systematic review demonstrated that surge preparedness requires coordinated planning across these domains and continues to face organizational and resource barriers.[11] More recent evidence also supports simulation-based tools and structured planning approaches for improving surge readiness.[22]

5.5 Workforce preparedness

Healthcare professionals are central to disaster response but may themselves be affected by the emergency.

Workforce planning should consider staff notification and recall, alternate staffing models, cross-training, occupational safety, personal protective equipment, psychological support, transportation, accommodation and family responsibilities.

A written plan that is unfamiliar to staff has limited operational value. Preparedness must therefore be converted into competencies that can be demonstrated.

5.6 Training and simulation

Simulation exercises permit hospitals to evaluate whether plans actually work.

Tabletop exercises are useful for leadership discussion and decision-making. Functional exercises test specific organizational capabilities. Full-scale simulations can examine multidisciplinary interaction under realistic operational pressures.

Systematic reviews indicate that simulation exercises generally improve familiarity with emergency procedures and identify weaknesses, although considerable heterogeneity remains in exercise design and outcome measurement.[14,15]

Exercises should therefore be evaluated using predetermined objectives and followed by documented corrective actions rather than being treated as isolated accreditation events.

5.7 Communication and information management

Communication failure is repeatedly identified as a major vulnerability during emergencies.

Hospitals require redundant internal and external communication systems because routine telephone or digital infrastructure may become overloaded or unavailable.

Emergency communication planning should address staff notification, incident-command communication, coordination with emergency medical services and health authorities, patient tracking, public information, media management and communication with patients' families.

Redundancy may include combinations of landline, mobile, radio, satellite, digital messaging and manual backup systems depending on context.

5.8 Triage and patient flow

Mass-casualty events require a transition from routine individualized workflows to resource-sensitive prioritization.

Hospitals should establish predetermined triage areas and procedures for rapidly expanding emergency department, surgical, critical-care, diagnostic and inpatient capacity.

Patient-flow planning should prevent emergency departments from becoming the sole point of congestion. Strategies may include accelerated discharge, cancellation of elective activity, conversion of suitable clinical spaces, transfer agreements and designation of alternative assessment areas.

5.9 Logistics and supply-chain resilience

Hospitals rely on complex supply networks that disasters can rapidly disrupt.

Preparedness should identify critical supplies, expected consumption rates, reorder thresholds, alternative vendors, local stock levels and transportation vulnerabilities.

Critical items may include medications, oxygen, blood products, intravenous fluids, personal protective equipment, laboratory materials, fuel, food, water and sanitation supplies.

Preparedness must therefore address both inventory and supply-chain continuity.

5.10 Continuity of essential services

Disaster response cannot focus entirely on casualties created by the emergency.

Patients requiring dialysis, obstetric care, emergency surgery, critical care, cancer treatment and management of acute and chronic disease continue to require treatment during disasters.

Continuity planning should identify essential functions, minimum staffing, critical dependencies, alternate care locations, manual workarounds and priorities for restoration.

5.11 Evacuation and shelter-in-place capability

Hospital evacuation is substantially more complex than evacuation of most public buildings because many patients cannot move independently and depend on continuous medical support.

Preparedness requires predefined evacuation triggers, authority, routes, transport resources, destination hospitals, patient prioritization, tracking procedures, medication continuity and mechanisms for transferring records.

Systematic evidence indicates that leadership, communication, individual preparedness and evacuation training are major determinants of staff readiness.[16]

5.12 Recovery and organizational learning

Recovery should be planned before an emergency rather than improvised afterward.

Recovery encompasses restoration of services, staff rehabilitation, infrastructure repair, financial recovery, re-establishment of supply chains and psychological support.

After-action review should identify what occurred, what was expected to occur, why differences arose and which corrective actions are required.

The value of exercises and real incidents is substantially reduced if lessons are documented but not translated into revised procedures, training or capital investment.

6. Major Implementation Gaps

6.1 The plan-to-practice gap

One of the most important deficiencies is the assumption that possessing an emergency plan equals preparedness.

Hospitals may satisfy documentation requirements while staff remain unaware of activation procedures, command roles or evacuation responsibilities. This creates a distinction between **paper preparedness** and **operational preparedness**.

Plans should therefore be assessed on whether they generate demonstrated response capability.

6.2 Inconsistent preparedness measurement

Hospital preparedness lacks a universally accepted set of outcome indicators. Reviews of available tools show variation in domains and measurement methods.[7,8]

This complicates comparison between hospitals, regions and countries.

Some tools emphasize infrastructure whereas others emphasize functional capacity, training, knowledge or emergency plans. A hospital may therefore receive very different preparedness classifications depending on the instrument applied.

6.3 Structural and infrastructure deficiencies

Older or poorly maintained facilities may be unable to achieve adequate disaster resilience without capital investment.

Vulnerabilities may include structural weakness, insecure equipment, inadequate fire protection, insufficient emergency power, limited water reserves and dependence on a single oxygen, communication or information-technology system.

Resource limitations make these risks especially difficult to correct in low-resource settings.

6.4 Weak functional preparedness

Recent assessment literature demonstrates that hospitals may show better performance in some structural domains than in functional readiness.

The 2026 scoping review by Singh et al. found marked variability in preparedness assessments and recurrent deficiencies involving comprehensive emergency planning, backup communications, training, equipment safety, staff welfare and logistics.[9]

Functional preparedness must therefore receive similar attention to infrastructure.

6.5 Workforce and competency gaps

Training is frequently irregular, profession-specific or theoretical.

Disasters, however, require multidisciplinary cooperation across departments that may not normally work together.

Staff turnover further reduces preparedness because newly appointed personnel may never have participated in disaster training.

Competency-based orientation and recurring multidisciplinary exercises are consequently required.

6.6 Communication and interoperability gaps

Hospitals frequently develop internal plans without adequate alignment with emergency medical services, public health authorities, police, fire services, blood banks, neighboring hospitals and regional command structures.

A technically strong hospital plan can still fail when it is incompatible with the larger response system.

Interoperability therefore requires shared terminology, communication channels, referral arrangements and exercises involving external agencies.

6.7 Surge-capacity limitations

Many hospitals operate close to routine capacity even before a disaster occurs.

High bed occupancy, workforce shortages and limited intensive-care capacity reduce the margin available for emergency expansion.

Surge planning must consequently focus not only on theoretical maximum bed numbers but on the resources required to make additional beds clinically functional.

Beds without staff, oxygen, medication or diagnostic support do not constitute meaningful surge capacity.

6.8 Logistics and supply-chain fragility

The COVID-19 pandemic exposed the consequences of dependence on just-in-time supply chains and concentrated suppliers.

Preparedness assessments should therefore examine both facility-level stocks and external supply-chain dependencies.

Strategic reserves should be proportional to the hospital's hazard profile, anticipated resupply delays and role within the regional healthcare network.

6.9 Evacuation deficiencies

Evacuation plans are often insufficiently practiced.

Actual evacuation requires coordination of transport, patient records, clinical equipment, receiving facilities and continuity of treatment.

Patients receiving mechanical ventilation, dialysis, neonatal intensive care or other high-dependency services create additional complexity.

Evidence from evacuation research consistently identifies communication, logistics, coordination and special patient populations as major planning challenges.[16,23]

6.10 Resource inequity

Preparedness gaps are not evenly distributed.

A systematic review of hospital preparedness in sub-Saharan Africa identified barriers including inadequate workforce skills, underfunding, weak governance, limited leadership capacity and insufficient collaboration.[17]

Frameworks designed in highly resourced environments therefore require contextual adaptation. Expectations should remain rigorous, but implementation pathways must reflect available infrastructure, financing, workforce and referral networks.

6.11 Limited integration of recovery

Preparedness programs often invest heavily in response while paying less attention to recovery.

Without recovery planning, hospitals may restore clinical services slowly, lose staff, experience prolonged financial disruption or reconstruct damaged systems without correcting pre-existing vulnerabilities.

The Sendai principle of building back better is therefore directly relevant to hospital recovery.[1]

Table 2: Core preparedness domains and common implementation gaps

Preparedness domain	Expected capability	Common implementation gap
Governance	Clear leadership and activation authority	Unclear roles and fragmented accountability
Risk assessment	Periodic all-hazards vulnerability analysis	Generic plans not linked to local risks
Infrastructure	Safe structures and redundant utilities	Aging infrastructure and single points of failure
Incident command	Scalable coordinated management	Staff unfamiliar with command functions
Workforce	Recall, redeployment and competency	Inadequate training and staffing shortages
Communication	Redundant interoperable systems	Dependence on routine communication networks
Surge capacity	Expand staff, space, supplies and systems	Plans based mainly on bed numbers
Logistics	Critical supplies and alternative suppliers	Inadequate reserves and fragile supply chains
Triage/patient flow	Rapid prioritization and decompression	Emergency-department congestion
Continuity	Maintain essential services	Disaster casualties prioritized at expense of routine critical care
Evacuation	Safe coordinated patient transfer	Limited drills and inadequate destination planning
Recovery	Restore and improve services	Recovery planning initiated only after an event

7. Lessons from Epidemics and the COVID-19 Pandemic

Pandemic emergencies reinforced several principles that are relevant to all hazards.

First, a disaster can persist for months rather than hours or days. Second, workforce availability may become as limiting as physical capacity. Third, demand can increase simultaneously across an entire region, reducing the possibility of transferring patients to unaffected neighboring hospitals. Fourth, supply-chain interruption may persist even when hospital infrastructure remains undamaged.

WHO's rapid hospital-readiness approach during COVID-19 therefore emphasized leadership and incident management, coordination and communication, surveillance, service capacity and other functional readiness domains.[19]

These experiences indicate that hospital preparedness should incorporate strategies for sustained operations and repeated surges rather than being designed exclusively for sudden mass-casualty incidents.

8. Emerging Threats and Future Preparedness Priorities

8.1 Climate-related emergencies

Hospitals increasingly need to consider heat events, flooding, severe storms, wildfires, water scarcity and associated infrastructure disruptions.

Climate adaptation should consequently be incorporated into hospital capital planning, utility resilience, workforce protection and supply-chain strategy.

8.2 Cybersecurity and digital dependency

Contemporary hospitals depend extensively on electronic records, laboratory information systems, imaging networks, digital medication systems and networked medical devices.

Cyber incidents can therefore produce operational consequences similar to physical disasters.

Emergency plans should include downtime documentation, manual prescribing and patient-tracking procedures, data restoration, backup communications and coordination between information technology and clinical incident command.

8.3 Complex and cascading emergencies

Future emergencies may involve multiple hazards simultaneously—for example, a cyclone during an infectious-disease outbreak or a cyberattack during infrastructure disruption.

Preparedness should therefore prioritize flexible capabilities rather than separate isolated plans for every conceivable hazard.

8.4 Health-system rather than hospital-only preparedness

Hospital resilience ultimately depends on the surrounding healthcare network.

Regional coordination enables distribution of casualties, sharing of supplies, patient transfer and mutual aid.

WHO's 2025 National Health Emergency Alert and Response Framework reinforces multi-hazard coordination across local, subnational and national levels.[20]

Hospital planning should therefore be connected to emergency medical services, public health, primary care, referral facilities and national emergency-management arrangements.

DISCUSSION

This review demonstrates that international guidance on hospital disaster preparedness is conceptually mature. The principal domains of preparedness have been repeatedly identified and are remarkably consistent across WHO frameworks, assessment instruments, systematic reviews and accreditation standards.

The major contemporary problem is therefore not the absence of frameworks but their inconsistent implementation.

The preparedness literature also demonstrates an important evolution. Earlier approaches often concentrated on disaster plans, mass-casualty triage and physical capacity. Contemporary approaches increasingly emphasize resilience, continuity, system interdependence, adaptation and recovery.[10]

Khalil et al. conceptualized hospital resilience through interacting dimensions involving space, stuff, staff, systems, strategies and services.[10] This model is useful because it recognizes that no preparedness domain functions independently.

For example, increasing physical bed capacity will not improve resilience without trained personnel. Additional personnel provide little benefit without supplies. Supplies are difficult to mobilize without functional logistics. All of these components depend on leadership, communication and information.

Preparedness should consequently be treated as a system property rather than the sum of isolated assets.

Another recurring problem is excessive reliance on self-reported preparedness. Administrators may report that a plan or resource exists without evidence that it will perform adequately under real emergency conditions.

Simulation provides an opportunity to convert assumptions into observable performance. However, the literature also demonstrates heterogeneity in simulation methodology and outcome measures.[14,15]

Future exercises should therefore evaluate objectively measurable functions such as activation time, communication reliability, casualty-processing capacity, patient-tracking accuracy, evacuation times and resource consumption.

Preparedness assessment also requires stronger attention to equity. Hospitals in resource-constrained settings cannot simply reproduce expensive preparedness models developed in well-resourced health systems. Nevertheless, many important interventions are organizational rather than capital intensive. These include clear incident-command structures, regular hazard assessment, staff role cards, updated contact systems, tabletop exercises, mutual-aid agreements and after-action reviews.

Prioritization should therefore distinguish between interventions requiring long-term capital investment and low-cost measures capable of immediately reducing operational vulnerability.

The growing evidence base also suggests that preparedness assessment must move beyond one-time scoring. Singh et al.'s recent synthesis showed considerable variation across hospitals and highlighted persistent gaps despite long-standing international guidance.[9] Preparedness should therefore be considered a continuous quality-improvement cycle rather than an accreditation milestone.

10. From Framework to Practice: Proposed Hospital Resilience Model

The evidence synthesized in this review supports a practical six-stage hospital disaster-resilience cycle:

Risk identification → Risk reduction → Operational preparedness → Emergency response → Recovery → Learning and adaptation

Risk identification determines relevant hazards.

Risk reduction addresses preventable vulnerabilities.

Operational preparedness establishes trained people, usable plans and available resources.

Emergency response activates those capabilities.

Recovery restores services and infrastructure.

Learning and adaptation convert experience into stronger future preparedness.

The cycle should then restart because changes in infrastructure, technology, personnel and hazards continuously modify hospital risk.

Table 3: Priority strategies for closing the framework-to-practice gap

Identified gap	Recommended intervention	Suggested measurable indicator
Static emergency plans	Annual multidisciplinary plan review	Percentage of plan components reviewed
Weak hazard assessment	Facility-specific annual HVA	HVA completed and linked to investment priorities
Unclear command roles	Incident-command training and role cards	Percentage of designated command staff trained
Limited exercises	Tabletop, functional and periodic full-scale drills	Number completed and percentage of corrective actions closed
Communication failure	Redundant communication architecture	Successful communication during unannounced test
Inadequate surge capacity	Staff-stuff-space-systems assessment	Functional surge capacity rather than nominal beds
Supply-chain vulnerability	Critical inventory and alternate suppliers	Estimated days of essential-resource continuity
Infrastructure vulnerability	Hospital Safety Index-based assessment	Percentage of high-risk deficiencies corrected

Evacuation weakness	Unit-specific evacuation protocols and drills	Time and accuracy of simulated evacuation
Poor continuity planning	Service prioritization and downtime procedures	Percentage of critical services with tested continuity plans
Limited learning	Mandatory after-action improvement process	Percentage of corrective actions implemented within deadline

11. Recommendations

Hospital disaster preparedness should be managed as a continuous institutional safety program rather than an emergency-management document. Each hospital should maintain a multidisciplinary emergency-management committee with executive authority and conduct a periodically updated all-hazards vulnerability assessment linked directly to budgeting and risk-reduction priorities.

Preparedness assessment should integrate structural, non-structural and functional domains rather than relying exclusively on documentation. Particular emphasis should be placed on critical infrastructure redundancy, including power, water, oxygen, communication and information systems.

Hospitals should establish scalable incident-command arrangements and competency-based education for staff assigned to emergency roles. Multidisciplinary exercises should progress from tabletop scenarios to functional and full-scale simulations where feasible, with measurable objectives and formal after-action improvement plans.

Surge planning should be based on functional capacity across staff, supplies, space and systems rather than nominal bed numbers. Mutual-aid agreements should be established with nearby healthcare facilities and emergency-response agencies before disasters occur.

Communication systems should be interoperable and redundant. Hospitals should maintain contingency procedures for failure of electronic medical records, telecommunications and other digital infrastructure.

Evacuation and shelter-in-place plans require greater operational testing, particularly for critically ill, neonatal, surgical, dialysis and other high-dependency populations.

Supply-chain preparedness should include critical-item inventories, consumption projections, alternative suppliers and clearly defined emergency procurement procedures.

Finally, national and regional policymakers should establish standardized preparedness benchmarks while allowing contextual adaptation for resource-constrained hospitals. Financing for disaster preparedness should be recognized as an investment in patient safety and continuity rather than an optional emergency expenditure.

12. Research Gaps

Despite extensive literature, several evidence gaps remain.

There is no universally accepted preparedness outcome measure that reliably predicts hospital performance during real disasters. Greater methodological standardization is therefore required.

More longitudinal studies are needed to determine whether improvements following training or simulation are sustained.

Preparedness research remains geographically uneven, and more empirical evidence is required from low- and middle-income settings.[17]

Further research should also evaluate the relationship between hospital-preparedness scores and patient-centered outcomes such as mortality, treatment delays, continuity of essential care and evacuation safety.

Digital resilience, cyber-disaster preparedness, climate adaptation and cascading multi-hazard events should receive greater attention in future hospital preparedness research.

The development of predictive and simulation-based surge-capacity tools is another promising area. Recent evidence suggests that structured and simulation-based tools can improve preparedness assessment, although standardization and real-world validation remain necessary.[22]

13. Strengths and Limitations of the Review

The principal strength of this narrative review is its integration of global disaster-risk-reduction frameworks, hospital-specific preparedness tools and recent peer-reviewed evidence. It also adopts a broad all-hazards perspective rather than limiting preparedness to a single disaster type.

However, narrative reviews are inherently more susceptible to selection bias than systematic reviews. The diversity of preparedness instruments and definitions also limits direct comparison across studies. Furthermore, hospital preparedness is context dependent; consequently, findings from one health system cannot always be transferred directly to another without adaptation.

The review should therefore be interpreted as a thematic synthesis and policy-oriented framework rather than a quantitative estimation of global hospital preparedness.

CONCLUSION

Hospital disaster preparedness is fundamental to health-system resilience and community survival during emergencies. International frameworks provide a strong conceptual foundation, particularly through the Sendai Framework, WHO Health Emergency and Disaster Risk Management approach, Safe Hospital Framework, Hospital Safety Index and hospital emergency-response guidance. Nevertheless, persistent gaps remain between these frameworks and actual hospital capability.

Recurring weaknesses involve governance, communication, workforce competency, functional surge capacity, logistics, infrastructure redundancy, evacuation, continuity planning and post-event learning. These deficiencies are particularly significant in resource-constrained health systems but are not exclusive to them.

REFERENCES

1. United Nations Office for Disaster Risk Reduction. Sendai Framework for Disaster Risk Reduction 2015–2030. Geneva: UNDRR; 2015.
2. World Health Organization. Health Emergency and Disaster Risk Management Framework. Geneva: World Health Organization; 2019.
3. World Health Organization. Comprehensive Safe Hospital Framework. Geneva: World Health Organization; 2015.
4. World Health Organization, Pan American Health Organization. Hospital Safety Index: Guide for Evaluators. 2nd ed. Geneva: World Health Organization; 2015.
5. World Health Organization Regional Office for Europe. Hospital Emergency Response Checklist: An All-Hazards Tool for Hospital Administrators and Emergency Managers. Copenhagen: WHO Regional Office for Europe; 2011.
6. Verheul MLMI, Dückers MLA. Defining and operationalizing disaster preparedness in hospitals: a systematic literature review. Prehosp Disaster Med. 2020;35(1):61-68. doi:10.1017/S1049023X19005181.
7. Munasinghe NL, O'Reilly G, Cameron P. Establishing the domains of a hospital disaster preparedness evaluation tool: a systematic review. Prehosp Disaster Med. 2022;37(5):674-686. doi:10.1017/S1049023X22001212.
8. Husaini BA, Sugiarto S, Rahman S, Oktari RS. Assessing hospital disaster preparedness: a scoping review of available tools. Narra J. 2023;3(2):e210. doi:10.52225/narra.v3i2.210.
9. Singh P, Sapkota S, Achour N, Ragazzoni L, Lamine H. Learning from the past: a scoping review of hospital disaster preparedness assessment. BMC Emerg Med. 2026;26:43. doi:10.1186/s12873-026-01474-2.
10. Khalil M, Ravaghi H, Samhouri D, Abo J, Ali A, Sakr H, et al. What is "hospital resilience"? A scoping review on conceptualization, operationalization, and evaluation. Front Public Health. 2022;10:1009400. doi:10.3389/fpubh.2022.1009400.
11. Hasan MK, Nasrullah SM, Quattrocchi A, Arcos González P, Castro-Delgado R. Hospital surge capacity preparedness in disasters and emergencies: a systematic review. Public Health. 2023;225:12-21. doi:10.1016/j.puhe.2023.09.017.
12. Sheikhbardsiri H, Raeisi AR, Nekoei-Moghadam M, Rezaei F. Surge capacity of hospitals in emergencies and disasters with a preparedness approach: a systematic review. Disaster Med Public Health Prep. 2017;11(5):612-620. doi:10.1017/dmp.2016.178.
13. Shooshtari S, Tofighi S, Abbasi S. Benefits, barriers, and limitations on the use of Hospital Incident Command System. J Res Med Sci. 2017;22:36. doi:10.4103/1735-1995.202146.
14. Mahdi SS, Jafri HA, Allana R, Battineni G, Khawaja M, Sakina S, et al. Systematic review on the current state of disaster preparation simulation exercises (SimEx). BMC Emerg Med. 2023;23:52. doi:10.1186/s12873-023-00824-8.
15. Wynter S, Nash R, Gadd N. Major incident hospital simulations in hospital based health care: a scoping review. Disaster Med Public Health Prep. 2023;17:e477. doi:10.1017/dmp.2023.120.
16. Moslehi S, Masbi M, Noori N, Taheri F, Soleimanpour S, et al. Components of hospital personnel preparedness to evacuate patients in disasters: a systematic review. BMC Emerg Med. 2024;24:21. doi:10.1186/s12873-024-00942-x.
17. Farah B, Pavlova M, Groot W. Hospital disaster preparedness in sub-Saharan Africa: a systematic review of English literature. BMC Emerg Med. 2023;23:71. doi:10.1186/s12873-023-00843-5.
18. Azarmi S, Sharififar S, Pishgooie AH, Khankeh HR, Hejrypour SZ. Hospital disaster risk management improving strategies: a systematic review study. Am J Disaster Med. 2022;17(1):75-89. doi:10.5055/ajdm.2022.0421.
19. World Health Organization. Rapid Hospital Readiness Checklist: Harmonized Health Service Capacity Assessment in the Context of the COVID-19 Pandemic. Geneva: World Health Organization; 2020.
20. World Health Organization. National Health Emergency Alert and Response Framework. Geneva: World Health Organization; 2025.
21. The Joint Commission. National Performance Goal #3: Emergency Readiness. Oakbrook Terrace, IL: The Joint Commission; 2026.
22. Dinar HHA, Othman OAF, Hubloue I. Hospital medical surge capacity assessment and planning tools for disaster response: a systematic review and meta-analysis. Disaster Med Public Health Prep. 2026;20:e103. doi:10.1017/dmp.2026.10370.
23. Hicks J, Glick R. A meta-analysis of hospital evacuations: overcoming barriers to effective planning. J Healthc Risk Manag. 2015;34(3):26-36. doi:10.1002/jhrm.21162.