



Hospital preparedness for disasters: a global perspective on research trends in health promotion and resilience

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ABSTRACT

Hospitals play a central role in maintaining the continuity of healthcare services during crises, underscoring the strategic necessity of disaster preparedness to strengthen the health system's resilience. This study analyzed global trends, research developments, and scientific influences related to hospital disaster preparedness to identify knowledge gaps and future priorities for enhancing resilience and promoting health. Data were retrieved from the Scopus database using the keywords "hospital" and "disaster preparedness" for the years 2015–2025, screened according to the inclusion criteria, and analyzed using VOSviewer and Scopus Analytics. A total of 628 articles met the criteria. The number of publications increased sharply after 2020, with notable dominance by high-income countries and leading academic institutions with substantial research funding. Bibliometric mapping revealed four major research clusters: (1) hospital emergency management and system preparedness, (2) healthcare workforce resilience and lessons from the pandemic, (3) education, training, and behavioral preparedness, and (4) cross-country collaboration in disaster response. Although the multidisciplinary dimension of hospital preparedness is evident through the inclusion of engineering and computer science fields, technology-related keywords did not appear at the applied threshold, suggesting that research on technology integration remains limited. Contributions from Low- and Middle-Income Countries (LMICs) are also underrepresented, highlighting disparities in research capacity and funding. This study expands global understanding of hospital disaster preparedness by identifying emerging and underexplored areas, emphasizing the importance of multidisciplinary collaboration, equitable research partnerships, and the integration of health promotion approaches to build adaptive, resilient hospitals worldwide.

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1. Introduction

Disasters, both natural and man-made, continue to pose serious challenges to global health systems. Natural disasters accounted for nearly 70% of all 25,000 recorded events globally, with



Asia being the most affected region [1]. Between 1995 and 2022, 11,360 natural disasters occurred worldwide, averaging 398 per year, causing more than 90,000 deaths annually and substantial economic losses [2,3]. Hydrological events such as floods are the most frequent, while geophysical disasters contribute the highest fatalities, and biological hazards cause the most injuries, particularly in Africa [2]. Climate change continues to increase the frequency and severity of events such as floods and storms [3,4]. Moreover, biological hazards such as epidemics and pandemics further strain health systems and intensify disaster risks when they occur alongside other hazards [5]. Moreover, COVID-19 exhibited high morbidity and mortality, with hospital mortality globally varying widely across countries, such as 15% in Algeria and 0.2% in Singapore [6], underscoring disparities in health system capacity. Their increasing intensity disproportionately affects developing countries due to weak adaptive capacity, limited resources, and inadequate infrastructure and governance [7].

Hospitals are among the most affected sectors during disasters, facing patient surges, resource shortages, disrupted essential services, and infrastructure damage; thus, strengthening preparedness is necessary, as hospitals themselves can become disaster victims [8]. Disasters significantly impact physical, psychological, social, and economic health, particularly among vulnerable groups who face unique risks and consequently experience disproportionate losses during and after disasters [9]. Failures in communication and emergency response systems further challenge service delivery, requiring comprehensive disaster plans, standardized triage, and enhanced communication to optimize resources and ensure patient safety [10]. Improved coordination and specialized tools are also needed to support surge capacity and maintain essential healthcare services for affected populations [11], while preparedness plans must enable continuity of routine and emergency care even when operations are compromised [12].

Several bibliometric studies have examined global research trends on disasters, emergency management, and health system preparedness, highlighting the growing volume of publications and the influence of major global crises such as COVID-19 [13–16]. However, many of these analyses provide limited organizational insight into hospitals as adaptive systems. More recent bibliometric studies have begun to explore hospital resilience and healthcare system preparedness, yet they tend to focus primarily on publication productivity and citation patterns, with less emphasis on thematic development, multidisciplinary perspectives, or the broader policy relevance of preparedness research [17–19]. Furthermore, the extent to which resilience-oriented and health promotion perspectives are reflected in hospital preparedness research, as well as how global disparities in research contributions are addressed, remains insufficiently examined [20].

Despite discussions on emergency response, limited focus has been placed on promotive and preventive aspects of hospital preparedness, particularly in enhancing organizational and community resilience. From a health promotion perspective, disaster preparedness should improve not only emergency responses but also prevention, health literacy, and community engagement. This study aims to analyze global trends and research developments in hospital disaster preparedness, identify knowledge gaps, and suggest priorities for future research to strengthen health systems and promote resilience-building approaches.

This study presents a novel, comprehensive global bibliometric analysis of hospital disaster preparedness research over the past decade, integrating thematic mapping, temporal trends, and collaboration patterns with a specific focus on resilience and health promotion. Unlike previous studies, it highlights underexplored technological dimensions, disparities between high-income countries and low- and middle-income countries (LMICs), and the importance of promotive and preventive approaches in strengthening hospital preparedness. These findings provide evidence-based insights into global research trends, priority themes, and knowledge gaps, supporting policymakers, hospital managers, preparedness planners, and researchers in shaping strategic

research agendas, guiding capacity-building initiatives, and integrating health promotion principles into hospital disaster preparedness policies and practices.

2. Method

This study uses a bibliometric approach to hospital disaster preparedness. The analysis was conducted using data from the Scopus database, processed through Scopus Analytics and VOSviewer, utilizing a systematic search and filtering approach. The research procedure included four stages: identification, screening, eligibility assessment, and final inclusion (Figure 1).

2.1. Data Search Strategy

Data were retrieved from the Scopus database, which provides comprehensive coverage of peer-reviewed literature across multiple disciplines. The search terms used were: TITLE-ABS-KEY ("hospital" AND "disaster preparedness"). The search was limited to publications from 2015 to 2025. The search was limited to journal articles and conference papers that had undergone review until the final publication stage and were written in English. The subject area and keywords of this study were not limited or excluded, as disaster-related topics span various types and disciplines, requiring a broad, multidisciplinary scope.

2.2. Selection and Eligibility Assessment

Based on initial Scopus data, 1,206 articles were retrieved. A total of 837 articles were obtained by limiting documents to the 2015–2025 period during the initial screening stage. Furthermore, in the final stage, the documents were limited to journal articles and conference papers, resulting in a total of 628 articles. These documents were then analyzed bibliometrically, following a manual relevance check to ensure their suitability to the research focus: hospitals and disaster preparedness. The overall selection process is visualized through a PRISMA flowchart (Figure 1).

2.3. Data Extraction and Analysis

Bibliographic data were systematically processed and analyzed using VOSviewer to map and visualize research networks, keyword co-occurrences, and citation relationships in the domain of hospital disaster preparedness. The keyword co-occurrence analysis was conducted in VOSviewer with a minimum term frequency threshold of 3, which allowed for the visualization of dominant themes while excluding infrequently used or peripheral keywords. Three types of visualizations generated by VOSviewer were used to enhance interpretation. Network Visualization illustrates the clustering and interrelationships among related terms and collaborative groups, while Overlay Visualization depicts the temporal evolution of research themes over the study period. Meanwhile, Density Visualization highlights the concentration and intensity of research activity across specific thematic areas. Additionally, complementary descriptive indicators, including annual publication trends, field distribution, institutional affiliations, and funding sponsors, were summarized using Scopus Analytics. Collectively, these visual and quantitative analyses provide a comprehensive overview of the dynamics of global research in hospital disaster preparedness.

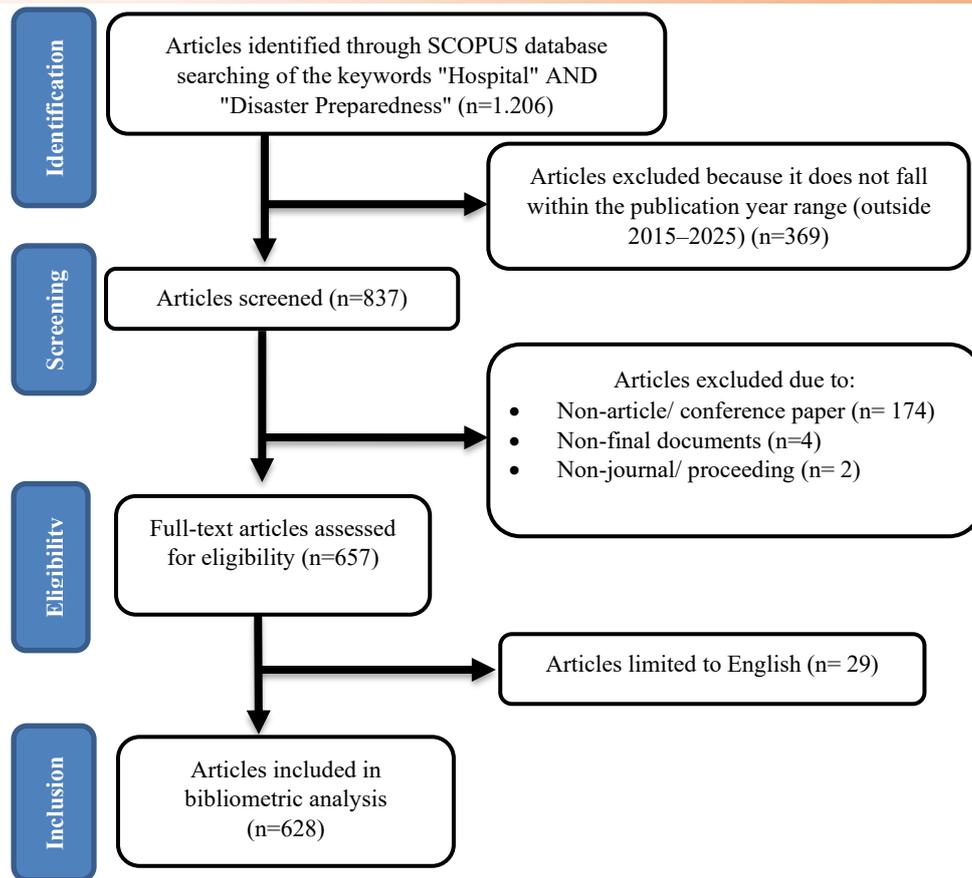


Fig 1. PRISMA Flow Diagram of Study Selection
Source: Processed by Author 2025

The search strategy employed two core keywords (“hospital” AND “disaster preparedness”) to maintain a broad, conceptually inclusive scope across disciplines and avoid premature exclusion of relevant studies using diverse terminologies. Prior testing of additional or more specific keyword combinations substantially reduced the number of retrievable records and risked producing a dataset too small for robust bibliometric analysis. Methodological guidance in bibliometrics suggests that very small datasets (e.g., fewer than ~200 publications) may yield unstable results, whereas larger datasets are preferable for reliable trend and network mapping [21]. To mitigate potential omissions, manual relevance screening was conducted during the eligibility phase. This limitation was partly addressed through manual relevance screening of titles, abstracts, and selected full texts to ensure that included articles explicitly focused on hospital-based disaster preparedness, resilience-related aspects, and empirical, conceptual, or policy-relevant contributions, with non-hospital studies excluded. Additional limitations include restriction to the Scopus database and English-language publications, possible omissions due to the limited keyword strategy, and the descriptive nature of bibliometric analysis, which identifies research trends and thematic patterns rather than evaluating the methodological quality of individual studies.

3. Results and Discussion

3.1. Results

The bibliometric analysis conducted using Scopus Analytics and VOSviewer provides a comprehensive and quantitative overview of publications related to hospital disaster preparedness. A total of 628 articles meeting the inclusion criteria were analyzed based on publication year,

country, affiliation, journal source, document type, field of study, and funding sponsor. The publication rate peaked in 2022, with 91 papers, followed by 89 in 2025, 86 in 2023, 78 in 2021, and 66 in 2024. Earlier years saw fewer than 50 papers, likely reflecting an increased focus on health system resilience and disaster preparedness following the COVID-19 pandemic (see Supplement 1). Institutional contributions were led by Karolinska Institutet (15 papers), Università degli Studi del Piemonte Orientale and Monash University (14 each), King Saud University (13), and Harvard University (12), with other institutions producing fewer than 10 papers. The distribution of publications by year and institution is shown in the Supplement 2. This pattern suggests that research in this field remains concentrated among major academic institutions, with limited involvement from hospitals or specialized disaster management centers.

Figure 2 illustrates the distribution of publications by country, with the United States leading with 197 papers, followed by Australia and Turkey, each with 48, Iran with 45, and Saudi Arabia with 44. Other countries contributed fewer than 10 papers each. This pattern suggests that research is primarily concentrated in nations with robust research capacities, while the West Asian region is increasingly contributing to advancements in health sciences.

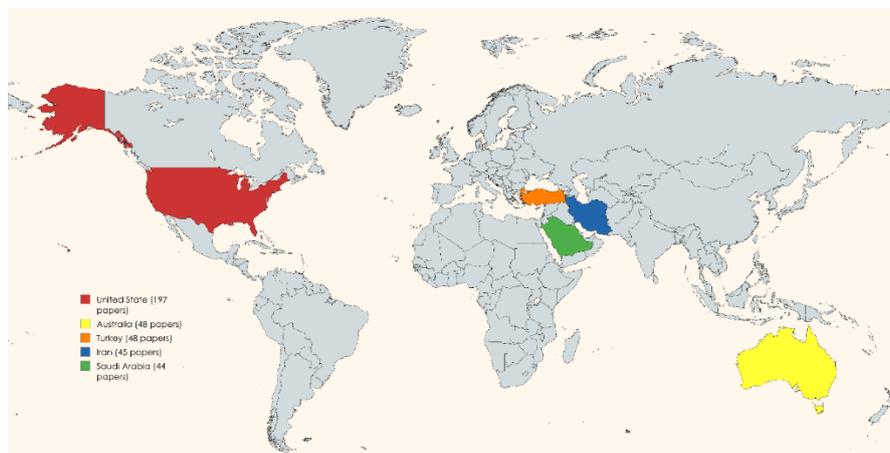


Fig 2. Top-Contributing Countries in the Context of Hospital and Disaster Preparedness Publications (2015–2025)

Source: Scopus database; visualization using mapchart.net

“Disaster Medicine and Public Health Preparedness” is the leading publication source, with 79 papers, showing a notable increase from 2022 to 2023. This is followed by the “International Journal of Disaster Risk Reduction” (25 papers) and “Prehospital and Disaster Medicine” (21 papers), while other journals contributed fewer than 20 papers (see Supplement 3). The data indicates that research on hospital disaster preparedness is predominantly generated in high-income countries, despite a growing, but still limited, number of contributions from developing nations and the West Asian region.

The National Institutes of Health (NIH) published the most papers, with 7, followed by the CDC, Japan Society for the Promotion of Science, King Saud University, and the National Health and Medical Research Council, each with 6 (see Supplement 4). Other institutions contributed fewer than five papers. This pattern reflects that funding for hospital disaster preparedness is primarily concentrated in high-income countries, while contributions from low- and middle-income countries (LMICs) and global development organizations, such as the WHO and the Global Fund, are limited. These disparities suggest that this field has not yet achieved global funding priority and underscore the need for more equitable, cross-sector financing to support context-specific evidence and innovation in LMIC settings.

literacy and a culture of readiness; and (4) cross-country disaster experiences, underscoring the value of global collaboration and intersectoral partnerships for system-wide resilience.

Table 1. Thematic Cluster within Research on Hospital and Disaster Preparedness

Theme of Focus	Cluster Colour	Keywords
Hospital Emergency Management and System Preparedness	Red (Cluster 1) Yellow (Cluster 4)	Hospital, emergency, crisis, response, hospital preparedness, hospital disaster preparedness, perception, evaluation, implementation, earthquake, nurse, qualitative study
Pandemic, Resilience, and Health Workforce	Green (Cluster 2) Purple (Cluster 5)	COVID, pandemic preparedness, hospital resilience, healthcare worker, management, practice, factor, effect, lesson, perspective, resilience
Education, Training, and Behavioral Preparedness	Orange (Cluster 7) Brown (Cluster 8) Pink (Cluster 9)	Knowledge, attitude, preparedness, assessment, awareness, disaster education, self-efficacy, physician, health professional, implication, cross-sectional study
Global and Cross-country Disaster Experiences	Blue (Cluster 3) Cyan (Cluster 6) Light Green (Cluster 10)	Disaster response, mass casualty, model, impact, China, Malaysia, Thailand, Nepal, public hospital, emergency department, chemical incident

3.2. Discussion

The results of this study indicate that Publications on hospital disaster preparedness increased markedly after 2020, reflecting the global imperative to strengthen health system resilience following the COVID-19 pandemic [22,23]. The pandemic exposed widespread vulnerabilities in healthcare delivery, especially concerning resource limitations, service disruptions, and inadequate training, thereby underscoring the importance of capacity building, organizational resilience, and proactive risk management to enhance preparedness for future crises [24]. Beyond reflecting research growth, this trend suggests a policy shift in hospitals toward institutionalizing disaster preparedness as a core governance function, particularly in strengthening workforce capacity, organizational resilience, and continuity of essential services.

The dominance of the United States and leading institutions such as Karolinska Institutet and Harvard University highlights the strong influence of research capacity and funding on productivity in hospital disaster preparedness research [25]. In contrast, contributions from developing countries remain limited due to weak health systems, insufficient funding, restricted access to scientific resources, limited collaboration, and gaps in governance, expertise, training, and disaster planning [26–28]. Although many COVID-19 referral hospitals have reached advanced infection prevention and control standards, further improvements in surveillance, workforce capacity, and facility readiness are still needed to enhance service resilience [29]. From a policy perspective, these findings emphasize the importance of developing context-specific preparedness policies in low- and middle-income countries, including Indonesia, supported by bibliometric evidence to prioritize scalable strategies, workforce development, and governance mechanisms aligned with national health system capacity and disaster risk profiles.

The predominance of medical and nursing disciplines confirms hospitals' central role in emergency response and health system continuity. To function as safe hospitals, facilities must remain operational before, during, and after disasters through resilient infrastructure, secure supply chains, and a protected, well-trained workforce [30,31]. Despite increasing multidisciplinary engagement, technology-related themes remain underrepresented, indicating a policy and research gap in integrating digital solutions into hospital preparedness. Strengthening governance for digital tools, such as early warning systems, telemedicine, and electronic health records, can enhance adaptive capacity, provided that ethical standards, data protection, and workforce readiness are adequately addressed [32,33].

Our findings highlight that health promotion plays a critical role in hospital disaster preparedness by strengthening leadership, workforce competence, and organizational learning.

While staff training and volunteer engagement enhance readiness [34], patient empowerment and participation remain limited, particularly during pandemics [35]. Digital health innovations can support these promotive strategies by improving communication and access to information, although implementation challenges persist in resource-limited settings, underscoring the need for multisector collaboration [36–39]. These insights suggest that embedding health promotion strategies within hospital preparedness can translate global frameworks into locally responsive actions, supporting both institutional resilience and community-level engagement.

The thematic analysis identified four major research clusters: hospital emergency management and system preparedness, emphasizing strengthened protocols, surge capacity, adaptive infrastructure, and healthcare worker protection [40,41]; pandemic, resilience, and health workforce, highlighting organizational adaptability, continuous training, and psychosocial support in response to vulnerabilities exposed by COVID-19 [42,43]; education, training, and behavioral preparedness, demonstrating the role of simulation-based capacity building in improving staff competence and readiness [44]; and global and cross-country disaster experiences, which underscore shared learning and transnational collaboration to enhance collective resilience and resource optimization [45,46]. Together, these clusters indicate that hospital disaster preparedness is a continuous, learning-oriented process rather than a linear effort.

Taken together, these thematic clusters indicate that hospital disaster preparedness should be implemented through integrated policy packages that combine emergency governance, workforce resilience, continuous education, cross-sector collaboration, and preparedness indicators embedded in routine management systems. From a health promotion perspective, the findings reflect a post-COVID-19 shift toward resilience and health system strengthening, positioning hospitals as platforms for empowerment, education, and participatory risk reduction. Training, capacity development, and technological innovations such as AI-based early warning systems and telemedicine can enhance preparedness and resilience, provided that equity, ethics, and digital readiness, particularly in Low- And Middle-Income Countries (LMICs), are adequately addressed.

The bibliometric findings show that hospital disaster preparedness research can inform practical policies and health promotion strategies, particularly in Indonesia and other Low- And Middle-Income Countries (LMICs). The emphasis on emergency management, workforce preparedness, and education highlights the importance of regular simulations, continuous training, and standardized protocols. Meanwhile, post-COVID-19 resilience trends call for a shift toward adaptive preparedness, integrating health promotion, psychosocial support, and organizational learning. Unequal global research contributions further stress the importance of strengthening national research capacity and developing context-specific guidelines that balance global priorities with local resource constraints. From a health promotion perspective, the focus on education and behavior underscores hospitals' role in enhancing health literacy, risk communication, and community engagement to support equitable and sustainable preparedness systems.

The main strength of this study is its comprehensive bibliometric approach, using the reputable Scopus database and visual analyses (VOSviewer and Scopus Analytics), which provide an overview of publication trends, thematic development, collaboration networks, and knowledge progression in hospital disaster preparedness over the past decade. Thematic clustering also identifies priority research areas and opportunities for international collaboration. However, this study has several limitations. First, the analysis was restricted to English-language publications indexed in Scopus, potentially excluding relevant studies from other databases or non-English sources, particularly from LMICs. Second, bibliometric analysis identifies publication patterns and thematic trends but does not assess methodological quality or contextual effectiveness. Finally, keyword thresholds and indexing variations may underrepresent emerging or niche topics, including advanced digital

technologies. Overall, the findings indicate that hospital disaster preparedness should be operationalized as a continuous governance process that integrates emergency management, workforce resilience, health promotion, and adaptive learning, rather than as a reactive response limited to crisis periods.

4. Conclusion

This study synthesizes global research trends on hospital disaster preparedness over the past decade through a resilience- and health promotion-oriented lens, revealing a shift toward system-level preparedness that emphasizes workforce capacity, organizational learning, and governance in response to recent global crises. From a health promotion perspective, hospital disaster preparedness should be understood as a continuous, integrated process that extends beyond emergency response to include capacity building, education, and cross-sector collaboration. The synthesis also highlights persistent gaps in technological integration and unequal research contributions across global contexts, particularly in low- and middle-income countries. Taken together, these findings underscore the need to move beyond descriptive preparedness frameworks toward resilience-oriented strategies that strengthen workforce capacity, foster inclusive research partnerships, and integrate appropriate, ethically grounded technologies into hospital governance.

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Author Contributions

MA conceived and designed the study. MA and HIP conducted the data analysis and drafted the initial manuscript. FP, N, CA, EL, and MAS provided critical review and substantial input to improve the intellectual content. All authors read and approved the final version of the manuscript submitted for publication.

Conflict of Interest

The authors declare that there are no potential conflicts of interest, either financial or non-financial, that could influence the interpretation of the results of this study. The entire research process and manuscript preparation were conducted independently without any commercial interests or influence from any particular party.

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