NURSING-LED DIGITAL HEALTH STRATEGIES IN DISASTER SETTINGS: A SCOPING REVIEW

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ABSTRACT

Background: Communities in disaster-prone areas face significant challenges in maintaining health resilience, particularly among vulnerable populations (children, older adults, and low-income households). Digital strategies offer innovative solutions for timely access to information, monitoring, and education. However, their implementation, particularly those involving nursing education, leadership, and practice, remains insufficiently explored. This scoping review aims to identify, evaluate, and synthesize nursing-led digital health strategies implemented in disaster settings, with an emphasis on nurses' roles in leadership, education, and practice. **Methods:** This scoping review examined nursing-led or nursing-involved digital health strategies implemented globally in disaster settings using studies from 2016 to 2025. Studies published in English were retrieved from PubMed, ScienceDirect, and Scopus using keywords such as "nurse," "digital," and "disaster." **Results:** Ten studies revealed the use of digital health strategies such as telehealth, mobile applications, digital triage tools, and virtual learning platforms to support preparedness, response, and recovery in disaster setting. Nurses were actively involved in education, remote care, and psychosocial support, though few studies highlighted their leadership in technology implementation. Simulation-based learning and messaging apps showed promise in enhancing disaster knowledge and coordination. However, challenges included limited digital infrastructure, inconsistent training, and unclear nursing roles in digital health integration. **Conclusions:** Nursing-led digital health strategies play a vital role in disaster contexts, enabling effective care delivery and information dissemination. Strengthening nurses' digital capacity and leadership, supported by policy and infrastructure, is crucial for sustainability. Further research should explore adaptive, nurse-driven digital solutions tailored to rural and resource-limited settings.

Keywords: *nurse, digital, disaster*

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Introduction

In recent decades, the global landscape has experienced an alarming increase in the frequency, scale, and severity of disasters. Natural hazards such as earthquakes, floods, volcanic eruptions, typhoons, and climate-related crises have intensified due to environmental degradation and climate change (United Nations Office for Disaster Risk Reduction, 2024; World Meteorological Organization, 2023). These disasters have profound implications for public health, particularly in disaster-prone regions of Asia, including Indonesia, the Philippines, Bangladesh, and

Nepal (Labrague et al., 2017). As one of the most disaster-prone countries in the world, Indonesia experiences frequent volcanic eruptions, tsunamis, floods, and landslides, placing millions at risk of displacement, food insecurity, and disrupted access to essential health services (World Meteorological Organization, 2023).

Within the broader spectrum of disaster-related health challenges, maintaining population health becomes a critical challenge, particularly for vulnerable groups such as children, older adults, individuals with chronic conditions, and low-income households (Scrymgeour et al., 2020). Disasters disrupt health infrastructure, limit access to care, and increase risks of both communicable and non-communicable diseases. In this context, health resilience—the ability of individuals and communities to withstand, adapt to, and recover from health-related shocks—has emerged as a priority area for disaster preparedness and response (Şermet Kaya & Erdoğan, 2025).

Amid these challenges, the digital transformation in healthcare has opened new opportunities to strengthen health systems' responsiveness and adaptability. In Indonesia and other Asian countries, the adoption of digital health technologies has been accelerated by mobile connectivity and health sector innovation (McKenna et al., 2025). Digital strategies such as mobile health (mHealth) applications, telehealth services, electronic surveillance systems, and virtual education platforms can facilitate timely, cost-effective, and contextually relevant interventions during emergencies (Emaliyawati et al., 2021). These technologies offer the potential to overcome geographical barriers, facilitate real-time data-driven decision-making, support remote service delivery, and promote health literacy throughout disaster phases (Zhang et al., 2024).

Nurses play a pivotal role in operationalizing these digital interventions within disaster contexts. As front-line health professionals embedded in communities, nurses contribute not only to clinical care, but also to public health education, psychosocial support, coordination of emergency response, and leadership in culturally competent care delivery (Veenema et al., 2016). In Indonesia, where nurses constitute a substantial portion of the healthcare workforce, their leadership is essential for ensuring that digital solutions are not only technologically sound but also socially acceptable and culturally responsive (Reedy et al., 2022).

Despite increasing interest in digital health for disaster response, there remains a gap in the literature that holistically examines how nurses lead and integrate digital strategies in disaster-prone communities. Most existing studies either focus on technological systems or general health outcomes, without isolating the nursing-led, context-specific strategies that support health resilience. This scoping review aims to identify, evaluate, and synthesize nursing-led digital health strategies implemented in disaster settings,

with an emphasis on nurses' roles in leadership, education, and practice.

Methods

A scoping review was conducted following the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) guidelines to systematically map and synthesize available evidence on nursing-led digital health strategies in disaster settings (Tricco et al., 2018). This methodological approach was chosen to explore the breadth of existing literature, clarify key concepts, and identify gaps related to nursing involvement and leadership in the use of digital technologies for disaster preparedness, response, and recovery (Arksey & O'Malley, 2005).

Studies were included if they were published between 2016 and 2025, written in English, and focused on digital health strategies implemented in the context of natural disasters, with explicit involvement of nurses in the design, leadership, implementation, or delivery of such interventions. Eligible studies comprised empirical research employing quantitative, qualitative, or mixed-methods designs. Articles were excluded if they were unrelated to natural disaster contexts, lacked a nursing or digital health component, or were non-empirical publications such as commentaries, editorials, or opinion papers.

A comprehensive search was conducted across three major electronic databases: PubMed, ScienceDirect, and Scopus. Keywords used included combinations of terms such as "nurse", "digital", and "disaster". The selection and extraction process were independently conducted by a single reviewer. Although this presents a limitation in terms of potential selection bias, a structured and transparent process was followed to ensure consistency.

The systematic search yielded 1198 articles. After removing duplicate articles, the reviewer screened 1055 articles based on the title and abstract. Following the eligibility criteria screening, there were 10 articles that met the inclusion criteria for the scoping review (Figure 1). Data extracted from eligible studies included authorship, year of publication, country of study, research design, specific nursing roles, and documented outcomes (Table 1).

In accordance with scoping review methodology, no formal critical appraisal of study quality was undertaken. However, the methodological clarity and relevance of each study were considered to ensure the credibility of findings. In future research, this scoping review will be expanded with the involvement of multiple reviewers to enhance reliability, reduce bias, and allow for more robust methodological appraisal.

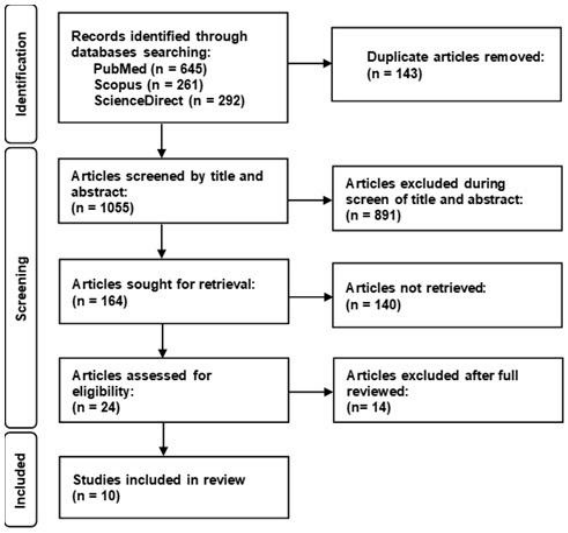

Figure 1. PRISMA Flow Diagram

Table 1. Nursing-led Digital Health Strategies Implemented in Disaster Settings

No.	Authors (Year of Published)	Country	Study Design	Aim(s)	Disaster Setting	Digital Health Strategies	Subjects	Key Findings
1	Nidaa Bajow et al. (2022)	Saudi Arabia	Scoping review	To explore and map the current state of the disaster education framework in Saudi Arabia	General disaster health management	Not specified	Health professionals involved in disaster responses	Lack of structured short- and mid-term disaster education. A proposed competency-based framework could enhance quality and consistency.
2	Eunice Gatinho Pires et al. (2025)	Portugal (Azores)	Cross-sectional	To identify factors determining nurses' preparedness for disasters	Climate change-related disasters in community health	Not specified	230 registered nurses	High theoretical knowledge but low practical competence. Education is needed in key areas; nurses play a strategic community role.
3	Tahereh Najafi Ghezeljeha et al. (2019)	Iran	Quasi-experimental	To assess impact of	Hospital-based disaster	Telegram-based virtual education	60 emergency nurses	Knowledge scores improved

				virtual social network education on nurse preparedness	prepared ness			significantly after intervention; virtual education is effective for disaster training.
4	Ruby Khan et al. (2025)	Not specified	Cross-sectional	To evaluate use, benefits, and challenges of digital health technologies (DHTs) in healthcare	General healthcare context	Mobile apps, EHR, diagnostic tools	500 healthcare professionals	63% noted effectiveness, but major challenges were lack of training and technical issues. Highlights infrastructure and support needs.
5	Aletha Ward et al. (2024)	Multinational	Scoping review	To explore primary healthcare (PHC) nurses' preparedness for climate events	Climate-related extreme weather events	Not specified	PHC nurses	Identified major gaps in training and system planning. Recommends capacity-building, leadership roles, and coordinated

								prepared ness.
6	Qianmei Zhong et al. (2025)	China	Cross-sectional	To assess psychological capital of disaster nurse reservists	Public health and natural disasters	Not specified	330 disaster reservist nurses	Psychological capital influenced by training, burnout, and recognition. Recommends strategies to build resilience and identity.
7	Chih-Chun Hsiao et al. (2024)	Likely Taiwan or China	Quasi-experimental	To evaluate immersive cinematic escape room (ICER) effectiveness for disaster training	Natural disasters	Immersive cinematic escape room	115 nurses	ICER significantly improved disaster preparedness and self-efficacy. Recommended for nurses with no prior training.
8	Scrymgeour et al. (2020)	Australia & New Zealand	Qualitative	To explore nurses' readiness and response to disasters	Natural hazards in healthcare facilities	Not specified	15 nurses	Strong commitment despite barriers. Recommends ecological model-based training to

								enhance adaptive capacity.
9	L.J. Labrague et al. (2017)	Various	Systematic review	To examine nurses' disaster preparedness levels	General disaster response	Not specified	Nurses (17 studies)	Nurses often unprepared; training and experience enhance preparedness. Supports policy and education reforms.
10	Senay Sermet Kaya et al. (2024)	Turkey	Descriptive	To assess disaster nursing competencies post-earthquake	Earthquake-prone areas	Not specified	207 nurses	Competence correlated with preparedness and training. Belief alone insufficient; training crucial for competency.

Results

A total of 10 eligible studies were included in this scoping review. These studies represented diverse disaster contexts, including natural disasters (e.g., floods and earthquakes), public health emergencies (e.g., pandemics), and mass casualty incidents. The findings are categorized into four domains: digital health strategies in disaster settings, nurses' roles in leadership, education, and clinical practice.

Digital Health Strategies in Disaster Settings

The included studies reported various digital interventions aimed at supporting disaster preparedness, response, and recovery. Strategies encompassed mobile applications for flood alerts and self-protection (e.g., SAFE) in low-resource settings, digital triage tools for mass casualty incidents, and online telehealth services to deliver remote care (Khan et al., 2025). Simulation-based digital learning environments (e.g., virtual escape rooms) and e-learning platforms were frequently used to enhance disaster readiness and decision-making among nursing personnel (Hsiao et al., 2024). Messaging apps such as Telegram were utilized to rapidly disseminate information and facilitate team coordination during disaster events (Najafi Ghezeljeh et al., 2019).

Nurses' Leadership in Digital Health Interventions

Despite evidence of nurse participation in digital health initiatives, few studies identified nurses as leaders in the design or implementation of these technologies. In most cases, nurses served as end-users or facilitators rather than strategic decision-makers (Khan et al., 2025). (Najafi Ghezeljeh et al., 2019) reported that nurses successfully led virtual social network–based education programs using Telegram to improve disaster preparedness knowledge. Similarly, (Hsiao et al., 2024) demonstrated that nurses were instrumental in designing and applying immersive cinematic escape room (ICER) simulations to enhance preparedness and self-efficacy. These leadership roles were more likely to occur when nurses had prior experience in disaster management or held educational or administrative positions (Pires et al., 2025; Ward et al., 2024).

Educational Roles and Digital Competency Development

Several studies focused on the integration of digital platforms into nursing education and training for disaster preparedness. Gamified learning models and simulation-based modules demonstrated positive outcomes in improving digital literacy, disaster knowledge, and self-efficacy (Hsiao et al., 2024). For example, the use of virtual escape rooms significantly increased student engagement and critical thinking. Similarly, virtual social networks like Telegram proved effective in improving emergency nurses' knowledge of disaster preparedness (Najafi Ghezeljeh et al., 2019). However, gaps remained in formal digital health training, particularly among nurses in lower-resourced settings or primary care. A lack of standardized curricula and institutional support were commonly cited barriers (Bajow et al., 2022; Ward et al., 2024).

Clinical Practice and Implementation Challenges

Nurses actively used digital health tools to deliver care during disaster scenarios, including remote triage, psychological first aid, and monitoring via telehealth platforms (Scrymgeour et al.,

2020; Zhong et al., 2025). These interventions were particularly valuable in situations where physical access to healthcare facilities was limited. Nevertheless, multiple implementation challenges were identified, including insufficient infrastructure, unclear role expectations, limited internet access, and variability in nurses' digital proficiency (Khan et al., 2025; Ward et al., 2024). Additionally, studies noted that while nurses generally recognized the importance of digital preparedness, many lacked the confidence or institutional support to independently apply digital solutions in disaster settings (Labrague et al., 2017; Şermet Kaya & Erdoğan, 2025).

Key enablers of successful digital health strategies across the included studies included nurses' digital literacy, community engagement, adequate technological infrastructure, and effective multisectoral collaboration—particularly among healthcare institutions, technology developers, and local stakeholders (Khan et al., 2025; Ward et al., 2024). Studies emphasized the value of tailored training and institutional support in fostering nurses' confidence and competency in using digital tools during disasters (Hsiao et al., 2024; Najafi Ghezeljeh et al., 2019; Şermet Kaya & Erdoğan, 2025).

Nevertheless, several implementation barriers were consistently reported. These included limited internet access, especially in rural or resource-constrained areas; inconsistent availability of digital equipment; and inadequate training or guidance for nurses (Khan et al., 2025; Ward et al., 2024). Additionally, a lack of standardized protocols and insufficient integration of digital health into existing disaster preparedness frameworks impeded scalability and sustainability (Bajow et al., 2022; Labrague et al., 2017).

Discussion

This scoping review demonstrates the pivotal role of nursing-led digital health strategies in strengthening healthcare delivery during disasters. The reviewed studies highlighted a variety of digital interventions such as telehealth platforms, mobile applications, online training programs, and electronic surveillance tools (Hsiao et al., 2024; Najafi Ghezeljeh et al., 2019). These initiatives were deployed across diverse geographic and sociopolitical contexts, responding to natural disasters, conflict situations, and pandemics (Şermet Kaya & Erdoğan, 2025; Xue et al., 2020). Digital tools were commonly utilized for disseminating health information, supporting clinical decision-making, enabling remote monitoring, and ensuring the continuity of care in crisis situations (Khan et al., 2025; Ward et al., 2024). Nurses emerged not only as implementers but also as strategic leaders in the planning and execution of these interventions (Navarro Martínez & Leyva-Moral, 2024; Reedy et al., 2022; Veenema et al., 2016). Their responsibilities extended to system design, coordination with stakeholders such as health authorities and developers, and advocacy for policy integration. In many instances, nurses led program planning, clinical protocol development, and the incorporation of digital technologies into standard disaster response systems—an indication of their expanding leadership roles, particularly in resource-limited settings (Pires et al., 2025; Zhang et al., 2024; Zhong et al., 2025).

Moreover, digital education and capacity building featured prominently across the studies, with nurses spearheading remote learning initiatives for healthcare

workers, volunteers, and the public. These programs employed mobile learning applications, web-based platforms, and social media to enhance knowledge in disaster preparedness, hygiene practices, and basic care provision (Bajow et al., 2022; Najafi Ghezeljeh et al., 2019; Nejadshafiee et al., 2020). In clinical practice, nurses used digital tools for triage, teleconsultation, and follow-up, especially in hard-to-reach regions and during the COVID-19 pandemic (Al Thobaity, 2024; Cariaso-Sugay et al., 2021). They also played essential roles in digital surveillance for real-time data collection to inform local health responses (Khan et al., 2025; Lokmic-Tomkins et al., 2023). Across these interventions, key enablers of success included adequate digital literacy among health workers and communities, reliable technological infrastructure, and effective multisectoral collaboration involving governments, tech developers, and non-governmental organizations (Navarro Martínez & Leyva-Moral, 2024; Veenema et al., 2016; Ward et al., 2024). However, recurring challenges were noted, such as limited internet access in rural areas, insufficient digital training, inadequate funding, and the lack of integration with national disaster preparedness frameworks (Scrymgeour et al., 2020; Zhong et al., 2025). Few studies addressed gender sensitivity or cultural adaptation in their approaches, indicating gaps in equity and contextual responsiveness (Şermet Kaya & Erdoğan, 2025; Xue et al., 2020).

Overall, the findings underscore the strategic importance of empowering nurses to lead and sustain digital health innovations in disaster-prone settings. To enhance scalability and sustainability, digital health interventions must be embedded within formal disaster risk reduction frameworks, with nurses actively involved in their development and governance. Strengthening nurses' digital competencies through targeted training, supportive policies, and robust research infrastructure is essential. Future research should evaluate the long-term impacts of these strategies on community resilience, examine culturally grounded co-design approaches, and develop standardized tools to assess the effectiveness and sustainability of nursing-led digital health interventions in disaster contexts.

Conclusion

This scoping review underscores the critical role of nursing-led digital health strategies in enhancing healthcare delivery during disasters. The integration of telehealth platforms, mobile applications, digital education tools, and electronic surveillance systems has enabled nurses to maintain essential services, disseminate timely information, and support clinical decision-making in crisis settings, particularly among vulnerable groups. Nurses' involvement in education, data management, triage, and psychosocial support reflects strong adaptability and leadership. Strengthening nurses' digital competencies and leadership, along with policy support, is essential to enhance the sustainability and impact of digital health in disaster preparedness and response. Further research is needed to explore how digital health strategies can be effectively adapted and sustained in rural and resource-limited settings, particularly through empowering nurses as frontline digital health leaders in disaster preparedness.

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