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Implementing mobile health applications in disaster zones: A systematic literature review

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Authors:
Sinothando Bacela[1]
Olutoyin Olaitan[2]

Affiliations:
[1]Department of Public Administration, Faculty of Management and Public Administration Sciences, Walter Sisulu University, Butterworth, South Africa

[2]Department of Applied Informatics and Mathematical Sciences, Faculty of Science, Engineering and Technology, Walter Sisulu University, Alice, South Africa

Corresponding author:
Olutoyin Olaitan,
oolaitan@wsu.ac.za

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Background: Mobile health (mHealth) applications have emerged as powerful tools in healthcare delivery, particularly in disaster zones where infrastructure is compromised and conventional health systems are disrupted. Their ability to provide remote access, real-time communication and data-driven decision support makes them especially valuable in resource-constrained settings.

Objectives: This systematic review analyses the current landscape of mHealth applications deployed in disaster settings, focusing on their categories, implementation challenges, governance frameworks and effectiveness in supporting victims and healthcare providers.

Method: Peer-reviewed studies published between 2010 and 2025 were systematically screened and analysed according to application type, operational outcomes, governance mechanisms and contextual challenges. Findings were synthesised to identify patterns of effectiveness, barriers to implementation and governance gaps.

Results: Four main categories of mHealth tools were identified: emergency medical services, health surveillance systems, resource coordination platforms and telemedicine solutions. Evidence indicates that these applications enhance disaster response by improving triage, outbreak monitoring, supply coordination and remote consultation. Persistent challenges include poor connectivity, limited interoperability, the absence of standardised protocols, weak governance and sustainability issues.

Conclusion: mHealth applications show considerable potential to strengthen healthcare delivery in disaster zones but require robust governance and sustainable implementation strategies to realise this potential.

Contribution: The review contributes to the growing evidence on digital health in humanitarian crises and proposes a conceptual governance framework to guide policymakers, healthcare providers and developers in optimising mHealth use in disaster management.

Keywords: mobile health; mHealth; disaster response; emergency management; digital health; humanitarian technology; disaster recovery; health systems.

Introduction

Disasters, whether natural or human-made, pose significant challenges to healthcare delivery systems worldwide. The immediate aftermath of disasters often results in disrupted healthcare infrastructure, limited access to medical resources and increased demand for healthcare services (World Health Organization [WHO] 2019). In such contexts, several approaches to healthcare delivery have been used in disaster situations, including traditional face-to-face medical services, radio communication systems and eHealth platforms. While these approaches provide essential support, they are often limited by slow communication, dependence on physical infrastructure, and lack of real-time data-sharing. In contrast, mobile health (mHealth) offers a more flexible and accessible solution, as it enables real-time communication, remote patient monitoring and rapid dissemination of health information through mobile devices. This makes mHealth particularly effective in disaster contexts where healthcare systems are disrupted and immediate response is required. Several studies have demonstrated the positive impact of mHealth technologies in improving healthcare delivery, particularly in resource-constrained and disaster-prone settings. For example, mHealth applications have been shown to improve access to healthcare services by enabling remote consultations and reducing the need for physical travel (Abaza & Marschollek 2017). During the COVID-19 pandemic, mHealth tools were widely used for symptom tracking, contact tracing, and public health communication, which enhanced the efficiency of healthcare systems (WHO 2020). Furthermore, studies indicate

that mHealth interventions can improve patient outcomes by supporting treatment adherence, health education and continuous monitoring among patients with chronic conditions such as heart failure (Son, Lee & Lee 2020). These findings highlight the growing role of mHealth as an effective tool in strengthening healthcare systems and supporting disaster response and recovery. Mobile health (mHealth) is defined as 'medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs) and other wireless devices' (WHO 2011). In recent years, mHealth has emerged as a promising approach to addressing healthcare challenges in disaster zones. The potential of mHealth applications has been increasingly recognised by health systems, governmental agencies and international organisations for supporting frontline health workers and improving healthcare delivery in developing countries (Agarwal et al. 2015). The implementation of mHealth applications in disaster contexts encompasses both the use of existing mHealth technologies and their adaptation to support healthcare delivery during and after disaster events. This process presents unique challenges related to infrastructure, governance, interoperability and sustainability (Agarwal et al. 2015). Understanding these challenges and identifying effective strategies to address them is crucial for maximising the potential of mHealth applications in disaster response and recovery. This systematic literature review (SLR) aims to provide a critical analysis of the current landscape of mHealth applications deployed in disaster zones to assist victims and healthcare providers. The review examines the types of applications used, their implementation challenges, governance frameworks and effectiveness in various disaster contexts. By synthesising the existing literature, the review aims to identify knowledge gaps and propose a conceptual framework for effective mHealth governance in disaster zones. mHealth innovations can also function as health-system-strengthening tools when they are integrated with existing service-delivery and information systems (Labrique et al. 2013).

Aim: To systematically analyse the extant literature on the global evidence on mHealth use in disaster zones.

Objectives

The objectives were:

- To systematically identify and categorise mHealth applications used in disaster zones based on studies published between 2010 and 2025.
- To examine the key barriers affecting the implementation of mHealth applications in disaster-affected settings.
- To assess existing governance frameworks guiding the use of mHealth technologies in disaster zones.
- To evaluate the reported effectiveness of mHealth applications in disaster response and recovery, and to propose a governance framework to support their sustainable use.

Research methods and design

Study design

Scope and study design

This study adopted an SLR design to synthesise evidence on the use of mHealth applications in disaster zones. The review addressed four objectives: to identify and categorise mHealth applications used in disaster contexts, examine implementation barriers, assess governance frameworks and evaluate reported effectiveness in disaster response and recovery. The review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2009/2020 guidelines (Moher et al. 2009), which provide a structured framework for transparent reporting of the rationale, methods and findings of systematic reviews. Preferred Reporting Items for Systematic Reviews and Meta-Analyses recommendations were specifically used to guide the formulation of eligibility criteria, development of the search strategy, multi-stage screening, documentation of exclusions and reporting of included studies in both narrative and diagrammatic form.

Reporting guideline and protocol

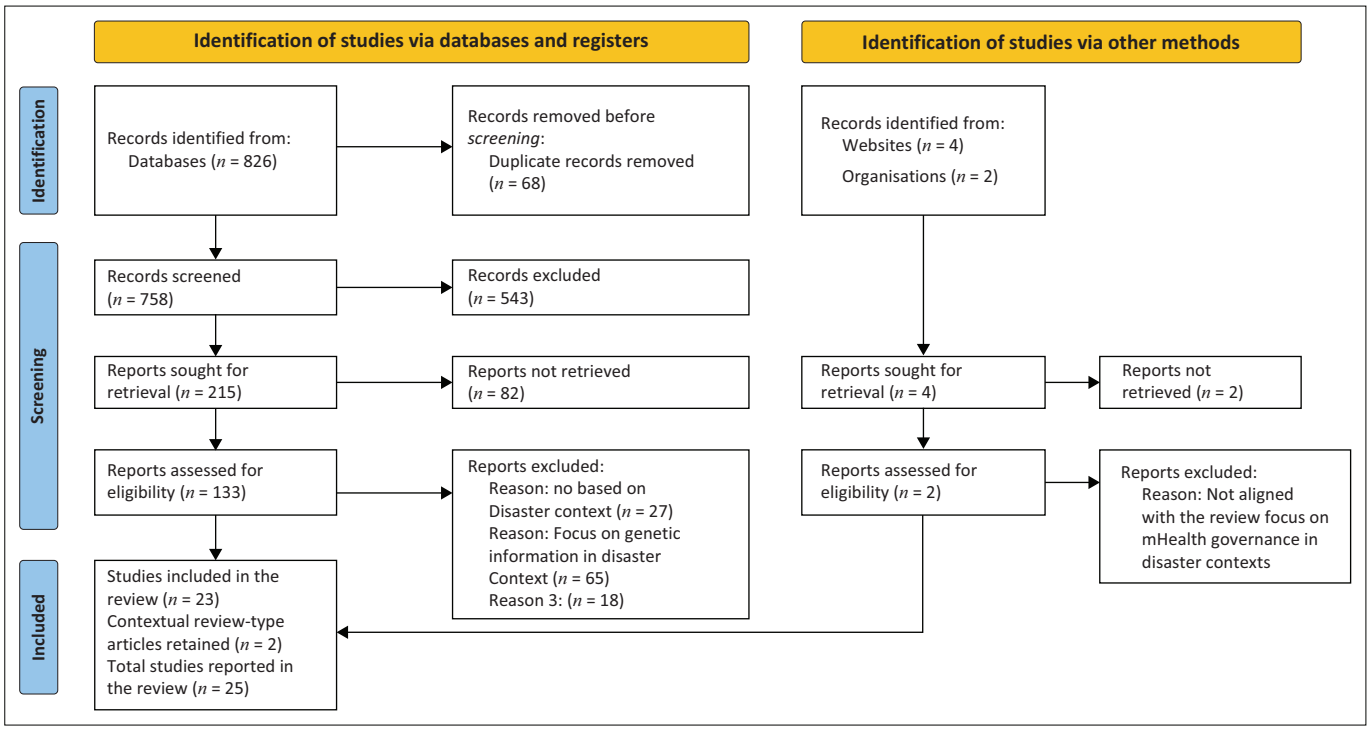
The review followed the PRISMA statement. In line with PRISMA guidance, the main methodological decisions (information sources, eligibility criteria, screening stages, data items and synthesis approach) were defined a priori and applied consistently. The overall identification, screening, eligibility and inclusion process is summarised in a PRISMA flow diagram (Figure 1), which reports the number of records at each stage and the reasons for full-text inclusion.

Information sources and search strategy

A comprehensive database search was conducted to identify empirical studies on mHealth applications used in disaster, emergency or humanitarian contexts. The following electronic databases were searched: PubMed, Scopus, Web of Science, IEEE Xplore and Google Scholar. The search covered publications from January 2010 to May 2025, a period that aligns with the rapid global expansion of digital health and mHealth. Search strings combined terms related to mHealth in disaster and humanitarian settings, using Boolean operators and database-specific adaptations. An example of the core search string was:

'mHealth' OR 'mobile health' OR 'mobile applications' OR 'smartphone applications' AND 'disaster' OR 'emergency' OR 'crisis' OR 'humanitarian' OR 'natural disaster' OR 'man-made disaster'.

Where appropriate, truncation and synonyms were adapted to each database's indexing terms to maximise sensitivity. To enhance completeness, the database search was supplemented by manual screening of reference lists of all included studies and relevant review articles, as recommended in PRISMA for using multiple information sources. Google Scholar was included in the database search



Source: Adapted from Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T., Mulrow, C.D. et al., 2020, 'Mapping of reporting guidance for systematic reviews and meta-analyses generated a comprehensive item bank for future reporting guidelines', *Journal of clinical epidemiology* 118, 60–68. https://doi.org/10.1371/journal.pmed.1003583

FIGURE 1: Preferred Reporting Items for Systematic reviews and Meta-Analyses flow diagram of study selection process.

to ensure that important grey literature, organisational reports and white papers were captured.

Eligibility criteria

Eligibility criteria were specified a priori and applied in accordance with PRISMA guidance on clearly defining inclusion and exclusion criteria. The review focused on primary empirical studies, while a small number of review-type papers were retained solely for contextual and conceptual purposes and were not included in the core evidence base.

Inclusion criteria

Studies were included if they met all the following criteria:

- **Population and/or setting:** Reported on the use of mHealth applications in disaster, emergency, crisis or humanitarian contexts, including natural disasters (e.g. earthquakes, floods, cyclones), conflict-related emergencies, or health-related disasters such as epidemics and pandemics.
- **Intervention:** Described mHealth tools supported by mobile phones, smartphones, tablets, or other wireless devices, used for functions such as emergency triage, surveillance, supply chain coordination, telemedicine or other disaster-related health services.
- **Outcomes and/or focus:** Provided empirical evidence (quantitative, qualitative or mixed-methods) on implementation, outcomes, challenges, governance or effectiveness of mHealth in disaster contexts.
- **Study type:** Peer-reviewed journal articles, full conference papers or scholarly book chapters.
- **Language and timeframe:** Published in English between January 2010 and May 2025.
- Contextual review-type sources.

In addition to the primary empirical studies, a small number of systematic reviews, scoping reviews and related synthesising papers were retained as contextual sources to inform the conceptual framing, refine search terminology and position this review relative to existing evidence syntheses. These contextual articles were not included in the primary evidence synthesis and were reported separately from the empirical study set.

Exclusion criteria

Studies were excluded if they:

- Focused only on technical design, architecture or prototypes without application or evaluation in a disaster setting.
- Described mHealth interventions outside disaster or emergency or humanitarian contexts, such as routine primary care or non-disaster chronic disease management.
- Were editorials, commentaries, opinion pieces, letters, conference abstracts or non-peer-reviewed reports without empirical data when considered for inclusion as core SLR evidence.
- Did not provide sufficient detail to determine how mHealth was used in disaster response or recovery.

These criteria reflect PRISMA's requirement to specify study and report characteristics used for eligibility, including population, intervention, context, study design, language and time period.

Study selection process

The study selection process followed the four PRISMA stages: identification, screening, eligibility and inclusion.

- **Identification:** All records retrieved from database searches were exported into a shared folder for management and deduplication. A total of 826 records were identified through database searches. After the removal of 68 duplicate records, 758 unique database records remained for screening. In addition, six records were identified through other sources (four from websites and two from organisational repositories). Of these, four records proceeded to screening, while two were not retrieved.
- **Screening:** Titles and abstracts of the 758 database records and four records from other sources were screened against the eligibility criteria. Records that clearly did not relate to mHealth or telemedicine in disaster or humanitarian contexts were excluded at this stage (n = 543), leaving 215 records for full-text retrieval.
- **Eligibility:** Full texts were successfully retrieved for 133 of the 215 records, while 82 records could not be obtained. The 133 retrieved articles were assessed in full against the inclusion and exclusion criteria. A total of 110 articles were excluded at this stage for reasons such as not being based on disaster contexts, focusing on generic disaster information without mHealth components or lacking empirical data.
- **Inclusion:** Twenty-three primary empirical studies met all eligibility criteria and were included in the qualitative synthesis. In addition, two review-type articles (a systematic review and a scoping or related review) were retained as contextual sources to inform background and conceptual framing but were not treated as primary evidence in the main synthesis. This resulted in a total of 25 studies reported in the PRISMA diagram, comprising 23 empirical studies and 2 contextual review-type articles.

The number of records at each stage, together with the reasons for exclusion during full-text assessment, is presented in the PRISMA flow diagram (Figure 1), which visually maps the identification, screening, eligibility and inclusion stages.

Study population and sampling approach

In this review, the study population comprised peer-reviewed empirical articles reporting on the use of mHealth or telemedicine in disaster response, recovery or preparedness across diverse settings. The sampling approach was purposive at the study level, based on the systematic application of pre-defined eligibility criteria to all records identified through the search strategy. Of the studies progressing to full-text assessment, 23 empirical investigations satisfied all inclusion criteria and formed the core sample for qualitative synthesis. Two additional review-type papers were purposefully retained to enrich the conceptual and contextual interpretation of findings; these were analysed separately and not pooled with the empirical evidence. This distinction between empirical and contextual sources is consistent with PRISMA's emphasis on clearly reporting the number and type of included studies and how they were selected. The 23 empirical studies included in this review were published between 2010 and 2025, with the majority published from 2018 onwards, reflecting the accelerating growth of mHealth research in disaster contexts. Geographically, studies were concentrated in low- and middle-income countries (LMICs). Disaster types represented included natural disasters such as earthquakes, floods, cyclones and typhoons, health-related disasters including epidemics and pandemics and conflict-related emergencies. In terms of intervention category, health surveillance systems and emergency medical services (EMS) applications were the most frequently studied, followed by telemedicine solutions and resource coordination platforms. Study designs were predominantly observational, case-based or implementation-focused, with a smaller number of systematic or scoping reviews retained as contextual sources.

Quality appraisal

In keeping with guidance that systematic reviews should systematically search for, appraise and synthesise research evidence, we undertook a structured quality appraisal of all included peer-reviewed studies. Because the review encompassed diverse empirical designs (quantitative, qualitative and mixed-methods), we used a brief, standardised critical appraisal checklist guided by tools such as the Critical Appraisal Skills Programme (CASP) checklists (Long, French & Brooks 2020) and the Mixed-Methods Appraisal Tool (MMAT) (Hong et al. 2018). The checklist covered core methodological domains commonly recommended for study-level appraisal:

- Clarity of research aims and questions.
- Appropriateness of study design to the stated aims.
- Sampling and recruitment strategy.
- Rigour and transparency of data collection.
- Adequacy and transparency of data analysis.
- Consideration of bias and confounding
- Reporting of limitations and ethical issues.

Each study was independently appraised by two reviewers; disagreements were resolved through discussion and, where necessary, by consulting a third, independent reviewer, as recommended to reduce authors' bias until a consensus was reached on all papers that qualified for inclusion in the study. Consistent with methodological guidance that quality assessment in many narrative syntheses is primarily used to inform interpretation rather than act as an absolute exclusion criterion, no studies were excluded solely based on appraisal scores. Instead, quality ratings were used to weight the contribution of individual studies when synthesising evidence on application types, operational outcomes, governance mechanisms and contextual challenges, with lower-quality studies treated more cautiously in the narrative and inferences about effectiveness, barriers and governance gaps.

Data extraction and data items

Data extraction was undertaken using a standardised extraction form developed by the authors to ensure consistent capture of variables across the included studies. For each study, the following data items were extracted:

- **Bibliographic details:** author(s), year of publication, country or region.
- **Context and disaster type:** natural disaster (e.g. earthquake, flood, cyclone), conflict-related emergency or health-related disaster (epidemic/pandemic).
- **mHealth application characteristics:** application category (EMS, health surveillance, resource coordination platforms, telemedicine), key features and target users (health workers, first responders, affected communities).
- **Implementation dimensions:** deployment setting, technological requirements (e.g. connectivity, devices) and integration with existing health systems.
- **Governance and policy aspects:** governance frameworks, regulatory considerations, data protection, interoperability and accountability arrangements.
- **Outcomes and effectiveness:** reported benefits (e.g. improved triage, faster response times, better outbreak-detection), challenges, barriers and sustainability issues. For the two contextual review-type papers, a reduced set of data items was extracted (scope, review type, main focus, and high-level conclusions) to support conceptual positioning but not included in the comparative synthesis of empirical outcomes. This level of specification aligns with PRISMA 2020 recommendations to list and define all data items extracted, including outcomes and other key variables. This level of specification aligns with PRISMA 2020 recommendations to list and define all data items extracted, including outcomes and other key variables.

Measures to minimise bias and enhance reproducibility

The review methods were designed to minimise bias and to be as reproducible as possible, consistent with PRISMA 2020 guidance on transparent reporting of systematic reviews. The research questions, eligibility criteria, databases to be searched and screening procedures were specified in advance and this guided all subsequent stages of the review. Comprehensive search strategies using predefined keywords and Boolean operators were developed for each database, and the full strategy for at least one database is reported in Appendix 1 Table 1-A1 to allow replication.

Records retrieved from all databases were imported into a reference manager and deduplicated before screening to reduce selection bias. Title and abstract screening, followed by full-text screening, were conducted independently by two reviewers using the same inclusion and exclusion criteria; disagreements were resolved through discussion and, where necessary, by consulting a third, independent reviewer, which is recommended to reduce authors' bias.

Data synthesis

As a result of the heterogeneity of study designs, disaster contexts, interventions and outcome measures, a narrative thematic synthesis was undertaken rather than a statistical meta-analysis (Braun & Clarke 2006, 2019), as adapted for systematic reviews by Lucas et al. (2007). The synthesis focused exclusively on the 23 empirical studies, with the two contextual review-type articles used only to triangulate and interpret emergent themes. The analytic process proceeded in several steps:

Categorisation of mHealth applications: Empirical studies were grouped into four main categories, EMS, health surveillance systems, resource coordination platforms and telemedicine solutions, based on the primary function of the application. Comparison of implementation challenges: Across categories and settings, we compared reported implementation challenges, including infrastructure constraints, connectivity and power-supply issues, interoperability limitations, governance and regulatory barriers, user adoption and usability concerns, and sustainability problems. Analysis of governance and policy arrangements: We synthesised how governance frameworks, regulatory instruments, data protection provisions and accountability arrangements were articulated or implied in the studies, with particular attention to gaps relevant to disaster-affected and low-resource contexts. Assessment of reported effectiveness: We analysed how mHealth interventions contributed to triage, outbreak monitoring, logistics and supply coordination, remote consultation, and broader health system performance during disasters, highlighting both demonstrated benefits and areas of equivocal or limited evidence. Identification of gaps and future directions: Finally, we mapped thematic gaps in the empirical evidence, including under-represented disaster types, regions, user groups, and governance issues, and drew on the contextual review-type papers to corroborate or extend these gaps at a higher level. This approach is consistent with PRISMA recommendations for reviews in which meta-analysis is not appropriate, requiring a clear description of the narrative synthesis methods and the rationale for adopting a qualitative, thematic approach.

Ethical considerations

This review relied exclusively on secondary analysis of data reported in publicly available, peer-reviewed publications and did not involve direct contact with human participants or animals. In line with institutional and journal norms for systematic reviews of published literature, formal ethics committee approval was not required. The review process adhered to principles of academic integrity, appropriate attribution and responsible citation of all included and referenced works, including transparent reporting of study selection and synthesis procedures as recommended by PRISMA 2020.

Results

Descriptive overview of included studies

The final sample comprised 23 empirical studies and two contextual review-type papers published between 2010 and 2025. Most empirical studies were conducted in LMICs, with a concentration in South and Southeast Asia, sub–Saharan Africa and the Middle East, and focused on natural disasters such as earthquakes, floods, cyclones and typhoons, alongside a smaller number related to epidemics and conflict-related emergencies. Across the empirical set, health surveillance systems and EMS applications were the most frequently reported interventions, followed by resource coordination platforms and telemedicine solutions, with a predominance of observational and implementation-focused study designs. The two contextual review-type articles retained to support the conceptual and contextual interpretation of the findings are summarised in Table 3.

Types of mHealth applications in disaster zones

The thematic analysis of the included studies identified four primary categories of mHealth applications used in disaster zones: EMS, health surveillance systems, resource coordination platforms and telemedicine solutions. These categories emerged from patterns observed across the selected studies and reflect the main ways in which mHealth technologies are applied in disaster response and recovery. This section presents the findings related to these categories, highlighting their key features, use cases, and examples as reported in the reviewed studies.

Objective 1

Emergency medical services applications (typology of mHealth tools, emergency medical services sub-type): Emergency medical services applications are designed to facilitate rapid assessment, triage and treatment processes. These applications often include features such as digital triage tools, clinical decision-support systems and electronic health records to support emergency care delivery (Määttä et al. 2023). Emergency medical services applications aim to enhance the efficiency and effectiveness of emergency medical response in disaster zones, where traditional healthcare infrastructure may be compromised. One notable example is the 'mTriage' application, which was deployed following the 2015 Nepal earthquake (Shrestha & Pathranarakul 2018). The application enabled emergency responders to quickly assess victims' conditions, prioritise care based on severity, and document treatments provided. The application also included offline functionality, allowing it to operate in areas with limited or no internet connectivity, a common challenge in disaster zones. Another example is the use of digital emergency-response systems during flood disasters in South Africa. These systems integrate GPS functionality to assist responders in locating victims, provide emergency-care protocols and facilitate communication between field responders and coordination centres, thereby improving coordination and response efficiency (Brown, Power & Conchie 2021; Ngcamu & Abrahams 2024). The importance of user-centred design in developing EMS applications for disaster contexts has been highlighted in the literature (Prasad et al. 2023). It is stated that EMS applications used in various disaster settings found that those designed with input from emergency responders were more likely to be adopted and used effectively during actual disasters. Key features that enhanced usability included intuitive interfaces, minimal data entry requirements and adaptability to different types of emergencies (Prasad et al. 2023).

Health surveillance systems (typology, surveillance sub-type): Health surveillance systems leverage mobile technology to collect, analyse and disseminate health data during and after disasters. These applications play a crucial role in monitoring disease outbreaks, tracking population health status and informing public health interventions in disaster-affected areas (Salazar 2021). Health surveillance applications typically include features for data collection, real-time analysis, visualisation and reporting. The 'Surveillance in Post Extreme Emergencies and Disasters' (SPEED) system, implemented in the Philippines following Typhoon Haiyan in 2013, exemplifies this category (Salazar 2021). Surveillance in Post Extreme Emergencies and Disasters enabled healthcare workers to report cases of epidemic-prone diseases via mobile phones, enabling early detection of potential outbreaks. The system processed data in real-time and supported syndromic surveillance during disaster response, improving the monitoring and management of public health risks in emergency situations. Following the 2022 KwaZulu-Natal floods, disease-outbreak monitoring and warning systems became increasingly important for strengthening healthcare resilience and emergency response in South Africa (Lynch et al. 2025). Disease Outbreak News (DONS) allowed community health workers to report suspected cases of waterborne diseases using a simple mobile interface. The application aggregated data geographically, enabling public health officials to identify hotspots and allocate resources accordingly. The system was credited with preventing major disease outbreaks by enabling rapid response to emerging clusters (Meckawy et al. 2022). Naderi and Shojaei (2023) identified key factors influencing the effectiveness of health surveillance systems in disaster settings, including data quality assurance, integration with existing health information systems, training of data collectors, and feedback mechanisms for information providers. The authors emphasised that effective surveillance systems should not only collect data but also transform it into actionable information to support timely decision-making during emergencies.

Resource coordination platform (typology, resource coordination sub-type): Resource coordination platforms use mobile technology to manage and optimise the allocation of healthcare resources during disasters. These applications facilitate the coordination of medical personnel, supplies, equipment and facilities, addressing the challenge of resource

scarcity that often characterises disaster zones (Agarwal et al. 2015). Resource coordination applications typically include features for inventory management, personnel tracking, facility status updates and request management. Resource-management systems have increasingly been used to support disaster-response coordination by enabling organisations to report resource needs, monitor available supplies and optimise relief distribution during flood emergencies. Collaborative logistics and optimisation models have demonstrated potential for improving resource allocation and coordination efficiency in disaster-management contexts (Rodríguez-Espíndola, Albores & Brewster 2018). Another example is the 'Medical Supply Chain' (MSC) application used following the 2019 Cyclone Idai in Mozambique and Zimbabwe (Khidhir 2024). Medical Supply Chain tracked the movement of essential medical supplies from international donors to affected communities, providing real-time visibility into the supply chain. The application included features for barcode scanning, inventory updates and delivery confirmation. Medical Supply Chain was credited with reducing supply chain disruptions and ensuring that critical medications reached remote communities (Khidhir 2024). Table 1 summarises the traceability matrix.

The analysis of the included studies also identified interoperability as a key subtheme within resource coordination platforms. In this review, interoperability is understood as a multi-level concept encompassing technical, syntactic, semantic and organisational dimensions. Technical interoperability refers to the basic ability of systems and devices to exchange data reliably using agreed communication protocols; syntactic interoperability (often termed structural interoperability) concerns the use of standardised data formats and message structures so that exchanged data can be parsed correctly; semantic interoperability denotes a shared understanding of the meaning of exchanged data, typically enabled through common terminologies and coding systems; and organisational interoperability relates to the governance, workflows and institutional arrangements that enable different organisations to use shared data effectively in joint decision-making. Across the resource coordination platforms and surveillance tools included in this review, most empirical work addressed technical and to a lesser extent, organisational interoperability, with fewer studies explicitly engaging with syntactic or semantic interoperability requirements. For example, Bjerge et al. (2016) highlighted the importance of information sharing and interoperability in disaster relief coordination. Their study showed that disaster management platforms capable of exchanging data across government agencies and humanitarian organisations improved coordination and resource management effectiveness. This reflects both technical interoperability, through system connectivity, and organisational interoperability, through collaboration between institutions. The findings suggest that limited interoperability can lead to fragmented information systems, reducing the overall efficiency of disaster response. To address this, the authors recommend the use of standardised data formats and application programming interfaces (APIs) to improve system integration and coordination.

Telemedicine solutions (typology, telemedicine sub-types): Telemedicine solutions leverage mobile technology to provide remote clinical services to disaster victims and healthcare providers. These applications address the challenge of limited access to specialised medical expertise in disaster zones, enabling remote consultations, guidance and support (Lokmic-Tomkins et al. 2023). Telemedicine applications typically include features for video consultations, store-and-forward communication, remote monitoring and clinical decision support. Telemedicine systems have increasingly been used to support healthcare delivery during disasters by connecting frontline healthcare workers with specialists at referral hospitals for remote consultations and clinical guidance. These systems may include features for the secure transmission of medical images, patient histories and vital-sign information, thereby supporting continuity of care and reducing pressure on healthcare facilities in disaster-affected areas (Lokmic-Tomkins et al. 2023; Subbhuraam & Panigrahi 2021). Additionally, remote consultation and telemedicine technologies are used during disaster responses to support frontline healthcare workers in managing complex injuries and coordinating specialist input. Video communication, medical-image sharing and remote procedural guidance can enhance trauma-care decision-making in resource-constrained emergency settings. Subbhuraam and Panigrahi (2021) identified key factors that influence the effectiveness

TABLE 1: Traceability matrix linking application types, included studies, exemplar mHealth tools, disaster contexts, governance gaps and reported effectiveness.

Application type	Studies (*n*)	Representative examples	Disaster context	Key governance gap	Reported effectiveness
EMS/triage	7	mTriage, digital triage and clinical decision-support tools	Earthquakes, floods, emergency response settings	Absence of cross-agency triage data standards	Improved triage accuracy, faster patient assessment, enhanced emergency coordination
Health surveillance	7	SPEED, mobile disease-surveillance systems	Typhoon Haiyan, flood and epidemic response settings	Data quality assurance, privacy and reporting governance	Earlier outbreak-detection, improved situational awareness, faster reporting
Resource coordination	4	Mobile logistics and resource-management platforms	Floods, humanitarian emergencies, supply-chain coordination	Limited semantic and organisational interoperability	Improved resource visibility, reduced duplication, enhanced coordination
Telemedicine	5	Teleconsultation and remote-care systems	Floods, earthquakes, remote disaster settings	Connectivity constraints, licensing and data-sharing challenges	Improved access to specialist care, reduced unnecessary referrals, continuity of care

Source: Petrică, A., Lawan, M.I., Jacob, A. & Dusserre, G., 2024, 'Enhancing interoperability and response coordination in disaster settings: A review of methodological frameworks and technique', *American Journal of Medical Science and Innovation* 3(2), 131–141. https://doi.org/10.54536/ajmsi.v3i2.3612

EMS, emergency medical services; SPEED, surveillance in post-extreme emergencies and disasters.

of telemedicine applications in disaster zones. These factors include bandwidth optimisation for low-connectivity environments, user interface simplicity, integration with existing clinical workflows and cultural acceptability.

Objective 2

Implementation challenges (key barriers affecting implementation): Despite the potential benefits of mHealth applications in disaster zones, the included studies' analyses identified several recurring implementation challenges. These challenges were grouped into four main themes: infrastructure limitations, user adoption barriers, data management issues and sustainability concerns. The following section presents these challenges as derived from the reviewed studies.

Infrastructure limitations: Infrastructure limitations are among the most significant challenges to implementing mHealth applications in disaster zones. Disasters often damage or destroy critical infrastructure such as telecommunications networks, power supplies and internet connectivity, which are essential for the operation of mobile applications (Agarwal et al. 2015; Lokmic-Tomkins et al. 2023). Even in areas where physical infrastructure remains intact, network congestion because of increased communication volume during disasters can impair the functionality of mHealth applications (WHO 2011). Studies have shown that disruptions to telecommunications infrastructure following disasters can significantly affect the performance of digital-health technologies by limiting connectivity, delaying information exchange and reducing access to healthcare services (Lokmic-Tomkins et al. 2023; Ndatshe et al. 2026). Power-supply disruptions and limited access to charging facilities have also been reported as barriers to the effective use of digital-health technologies in disaster settings (Lokmic-Tomkins et al. 2023). To address infrastructure limitations, several strategies have been proposed in the literature. These include the development of offline functionality that allows applications to operate without continuous internet connectivity (WHO 2011), the use of low-power-consumption designs to extend battery life (Magsi et al. 2021), and the deployment of temporary infrastructure such as portable cell towers and satellite communications (Salazar 2021). However, these strategies often increase the complexity and cost of mHealth applications, creating additional implementation barriers (Agarwal et al. 2015).

User adoption barriers: Agarwal et al. (2015) highlighted that limited digital literacy, inadequate training and unfamiliarity with mobile technologies can hinder the adoption of mHealth interventions among frontline healthcare workers in resource-constrained settings. These challenges may be amplified during disasters, where healthcare workers are required to operate under time pressure and difficult environmental conditions. Studies have identified cultural factors that influenced the adoption of mHealth applications in different disaster contexts. Applications that aligned with existing cultural practices and beliefs about healthcare were more readily adopted than those that conflicted with local norms. For example, studies have shown that mHealth applications that integrate traditional healing practices with conventional medicine tend to achieve higher acceptance among rural and culturally traditional communities. This is because such approaches align with local beliefs and healthcare practices, making users more willing to trust and use the technology (Adjekum et al. 2018). To address user adoption barriers, several approaches have been suggested in the literature. These include user-centred design processes that involve end-users in application development (Alanazi et al. 2025), and successful implementation of mHealth applications requires contextual training programmes that account for varying levels of digital literacy among healthcare workers and affected communities (Agarwal et al. 2015; Ngcamu & Abrahams 2024). The use of familiar interfaces and workflows can also help minimise the learning curve and improve usability. Demonstrating clear benefits while addressing privacy, trust and security concerns has been identified as important for promoting user adoption of digital health technologies (Onsongo & Kagotho 2024).

Data management issues: The analysis of the included studies identified data management as a major challenge affecting the implementation of mHealth applications in disaster zones. These challenges were mainly related to data quality, interoperability, privacy and security, and data governance. Several studies reported issues with data quality, particularly incomplete or inaccurate data collected during emergency situations (Ngcamu & Abrahams 2024). Data quality challenges were commonly attributed to user input errors, connectivity disruptions and the operational pressures associated with disaster response (Lynch et al. 2025; Ngcamu & Abrahams 2024). Interoperability was also identified as a key subtheme. In this context, interoperability mainly refers to the ability of different systems to exchange and use data across organisations. The reviewed studies highlighted challenges related to both technical interoperability (system connectivity) and syntactic interoperability (compatible data formats). For example, Patel (2019) found that many applications used incompatible data structures and communication protocols, leading to 'information silos'. This made it difficult to share patient and resource data across different platforms, resulting in duplication of work and reduced coordination (Ngcamu & Abrahams 2024). Privacy and security concerns were also frequently reported, especially given the sensitive nature of health data in disaster settings. Aljedaani and Babar (2021) found that a large proportion of mHealth applications lacked basic security features such as encryption and secure authentication. This increases the risk of data breaches and raises ethical concerns, particularly for vulnerable populations. To address these challenges, the reviewed studies suggested several strategies, including the use of standardised data formats, improved system integration and the development of stronger data governance frameworks (South Africa Department of Health 2015).

However, the findings show that implementing these solutions remains difficult because of the complex and resource-constrained nature of disaster environments.

Sustainability concerns: Sustainability concerns represent a significant challenge to the long-term impact of mHealth applications in disaster zones. These concerns include financial sustainability, technical maintenance, knowledge transfer and integration with existing health systems (Agarwal et al. 2015). There are additional challenges related to long-term funding, technical maintenance, institutional ownership and workforce capacity that may limit the continued operation of digital health interventions once emergency response funding ends (Agarwal et al. 2015; Lokmic-Tomkins et al. 2023). Studies have highlighted the challenges of integrating mHealth applications into existing health information systems in healthcare and disaster response settings. Applications developed for emergency response often operate in parallel with routine systems, creating additional workload for healthcare workers and complicating coordination and long-term recovery processes (Agarwal et al. 2015; Gastaldi & Horlait 2022; Lokmic-Tomkins et al. 2023). To address sustainability concerns, several approaches have been suggested in the literature. These include the development of business models that ensure financial sustainability beyond initial donor funding (South African Department of Health 2015), capacity-building programmes that transfer technical skills to local stakeholders, and design approaches that consider long-term integration with existing health systems from the outset. Clear transition plans from emergency deployment to routine operation have been identified as an important factor in supporting the long-term sustainability and integration of mHealth applications beyond the immediate disaster-response phase (Agarwal et al. 2015; Lokmic-Tomkins et al. 2023) Table 2 provides a summary of the implementation challenges and the corresponding studies.

Objective 3

Governance frameworks (existing governance frameworks for mHealth in disaster zones): Effective governance is crucial for maximising the benefits and mitigating the risks associated with mHealth applications in disaster zones. Governance frameworks provide the structures, processes, and policies that guide the development, deployment, integration and use of mHealth applications in these complex environments (Gastaldi & Horlait 2022). This section examines existing governance frameworks and proposes key components for a comprehensive governance model tailored to disaster contexts.

Existing governance models: The literature reveals a fragmented landscape of governance models for mHealth in disaster zones. While some countries have national eHealth or mHealth strategies that provide overarching guidance, these often lack specific provisions for disaster contexts, highlighting the need for tailored frameworks that address the unique challenges of mHealth deployment in emergencies (Komi et al. 2021). For example, South Africa's National MHealth Strategic Framework (2015–2019) outlines key principles for mHealth implementation, such as interoperability, security and sustainability; however, it does not explicitly address the unique challenges of disaster response and recovery (Brown et al. 2021; Ngcamu & Abrahams 2024). International organisations such as the WHO have developed guidelines for the use of digital health technologies in emergencies, emphasising the importance of coordination, ethical considerations and evidence-based interventions. However, these guidelines often lack the specificity and enforcement mechanisms necessary to ensure consistent and effective governance at both the national and local levels. A study by Komi et al. (2021) reviewed governance frameworks for mHealth in LMICs and found that most frameworks focused on technical standards and data privacy, with less attention paid to issues such as equity, community engagement and long-term sustainability. The authors emphasised the need for more comprehensive governance models that address the broader social, economic and ethical implications of mHealth applications, particularly in vulnerable populations, such as those affected by disasters.

Key components of a disaster-specific governance framework: Based on the literature review and analysis of existing models, a comprehensive governance framework for mHealth in disaster zones should include the following key components:

Leadership and coordination: Clear leadership and coordination mechanisms are essential to ensure a coherent and effective mHealth response during disasters. This includes establishing a designated lead agency responsible for overseeing mHealth activities, defining roles and

TABLE 2: Summary of implementation challenges and supporting studies.

Challenge theme	Description	Number of studies	Supporting studies
Infrastructure limitations	Issues related to connectivity, power supply and network disruptions	7	WHO (2011); Agarwal et al. (2015); Salazar (2021); Lokmic-Tomkins et al. (2023); Magsi et al. (2021); Ndatshe, Mokhele & Jakoet-Salie (2026)
User adoption barriers	Limited digital literacy, resistance to technology, cultural factors	7	Agarwal et al. (2015); Aboye, Simegn and Aerts (2024); Onsongo and Kagotho (2024), Alanazi et al. (2025), Adjekum, Blasimme and Vayena (2018)
Data management issues	Data quality, interoperability, privacy and security concerns	5	Patel (2019), Lynch et al. (2025); Aljedaani and Babar (2021); Ngcamu and Abrahams (2024) South Africa Department of Health (2015)
Sustainability concerns	Funding, maintenance, integration and long-term viability	4	Agarwal et al. (2015); Gastaldi and Horlait (2022); Lokmic-Tomkins et al. (2023).

Source: Adapted from Damanik, B., Anwar, S., Osonuga, A.A. & Lee, M.J., 2025, 'Bridging the digital divide in disaster nursing: A systematic review of ai and telehealth adoption in low-resource settings', *Journal of Intelligent Computing and Health Informatics* 6(2), 95–107. https://doi.org/10.26714/jichi.v6i2.17329

Note: Please see the full reference list of the article, Bacela, S. & Olaitan, O., 2026, 'Implementing mobile health applications in disaster zones: A systematic literature review', *South African Journal of Information Management* 28(1), a2122. https://doi.org/10.4102/sajim.v28i1.2122, for more information.

WHO, World Health Organization.

responsibilities for different stakeholders (e.g. government, non-governmental organisation [NGOs], private sector), and creating platforms for inter-agency collaboration and information sharing (South Africa Department of Health 2015).

Legal and regulatory frameworks: Robust legal and regulatory frameworks are needed to address issues such as data privacy, security, liability and intellectual property in the context of mHealth applications used during disasters. These frameworks should be flexible enough to accommodate the rapidly evolving nature of technology while providing adequate protection for users and data (Agarwal et al. 2015).

Technical standards and interoperability: Common technical standards and interoperability protocols are crucial for ensuring that different mHealth applications can exchange data and work together seamlessly. This includes standards for data formats, communication protocols and APIs (Gastaldi & Horlait 2022). Adherence to these standards can prevent the development of fragmented and duplicative systems and facilitate the integration of mHealth applications with existing health information systems.

Ethical guidelines and community engagement: Ethical guidelines are needed to address the unique ethical challenges posed by mHealth applications in disaster zones, such as informed consent, data ownership and equitable access. These guidelines should be developed through a participatory process that involves affected communities, healthcare providers and other stakeholders (South Africa Department of Health 2015). Community engagement is also critical to ensuring that mHealth applications are culturally appropriate, meet users' needs, and are adopted and used effectively.

Capacity building and sustainability: Capacity-building initiatives are needed to ensure that local stakeholders have the skills and resources to develop, deploy and maintain mHealth applications in disaster zones. This includes training programmes for healthcare workers, technical support for application developers and strategies for ensuring financial and operational sustainability beyond initial donor funding (Lokmic-Tomkins et al. 2023)

Monitoring and evaluation: Robust monitoring and evaluation (M&E) frameworks are needed to assess the effectiveness, efficiency and impact of mHealth applications in disaster zones. Monitoring and evaluation frameworks should include clear indicators, data collection methods and reporting mechanisms to inform ongoing improvements and ensure accountability (Agarwal et al. 2015).

Objective 4

Effectiveness of mHealth applications (reported effectiveness in disaster response and recovery): Assessing the effectiveness of mHealth applications in disaster zones is complex, as it involves multiple dimensions, including impact on health outcomes, efficiency of healthcare delivery, user satisfaction and cost-effectiveness. The literature provides mixed evidence on the effectiveness of mHealth applications, with some studies reporting significant benefits while others highlight limitations and unintended consequences.

Impact on health outcomes: Several studies have reported positive impacts of mHealth applications on healthcare delivery in disaster settings. Mobile-based clinical decision support systems have been associated with improved triage accuracy, patient monitoring, and clinical information management during emergencies (Case, Morrison & Vuylsteke 2012). Similarly, telemedicine applications used in emergency and prehospital care have supported remote consultations, enhanced medical decision-making and reduced unnecessary hospital transfers and admissions (Kim et al. 2020; Thomson et al. 2025). However, the evidence base remains limited, and several reviews have noted the need for more rigorous evaluation studies to determine the long-term impact of mHealth interventions on patient-level outcomes in disaster settings (Agarwal et al. 2015; Lokmic-Tomkins et al. 2023). The authors attributed this to methodological limitations in existing studies, such as small sample sizes, lack of control groups and short follow-up periods.

Efficiency of healthcare delivery: mHealth applications have been shown to improve the efficiency of healthcare delivery in disaster zones by streamlining workflows, reducing administrative burden and optimising resource allocation. Mobile-based systems can facilitate faster communication, improve information sharing and support more effective coordination of healthcare resources during disaster response operations (Agarwal et al. 2015; Rodríguez-Espíndola et al. 2018). However, some studies have also reported that mHealth applications, particularly those deployed in disaster management contexts, can create new inefficiencies if they are not properly designed or implemented. Poorly designed digital-health systems may create additional workload for healthcare workers if usability, workflow integration and system reliability are not adequately considered during implementation (Lokmic-Tomkins et al. 2023) The authors emphasised the importance of user-centred design and rigorous testing to ensure that mHealth applications enhance, rather than hinder, healthcare delivery efficiency.

User satisfaction: Studies have shown that user satisfaction is generally higher when mHealth applications are perceived as useful, easy to use and responsive to the needs of healthcare workers and affected communities. User-centred design approaches and adequate training have been identified as important factors supporting user acceptance and satisfaction (Agarwal et al. 2015; Lokmic-Tomkins et al. 2023). For example, a study by Agarwal et al. (2015) found that healthcare workers who participated in co-design workshops for a mobile triage application reported significantly higher satisfaction with the final product compared to those who did not participate. However, user satisfaction can also be influenced by external factors such as infrastructure

limitations and a lack of technical support. Infrastructure limitations, connectivity challenges, and insufficient technical support may negatively affect user experiences and reduce satisfaction with mHealth applications in disaster settings (Lokmic-Tomkins et al. 2023).

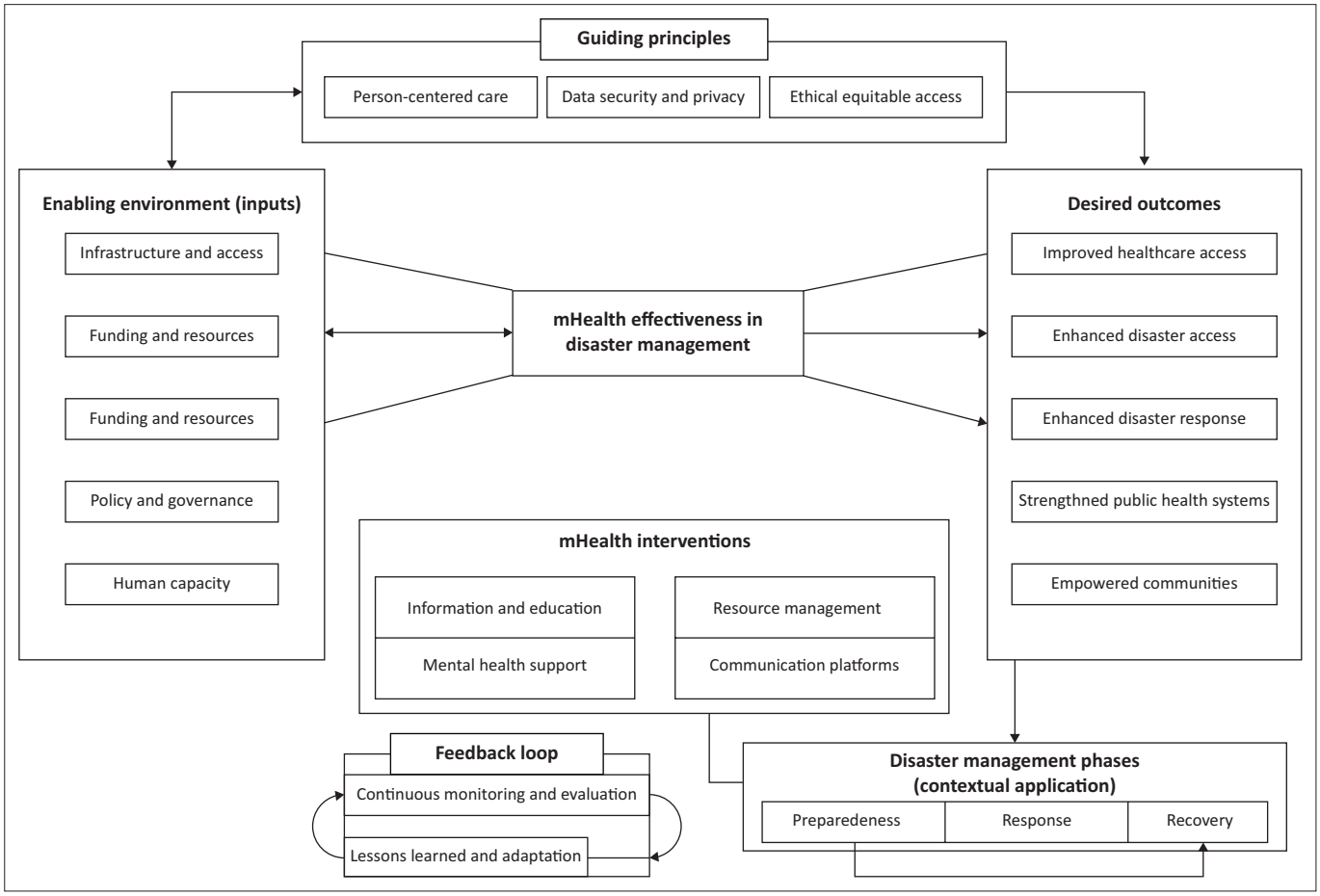
Cost-effectiveness: Evidence on the cost-effectiveness of mHealth applications in disaster zones remains limited and sometimes inconclusive. While digital-health and resilience initiatives have demonstrated potential to improve healthcare coordination, preparedness and service delivery during extreme weather events and disasters (Lynch et al. 2025), the implementation of such systems may require substantial investment in technology, infrastructure, training and organisational support, particularly in resource-constrained settings. The authors cautioned that the findings may not be generalisable to other contexts because of variations in healthcare costs and disease burden. The next section proposes a conceptual framework to address the identified shortcomings and improve the effectiveness of mHealth applications in disaster zones.

Conceptual framework for effective mHealth governance in disaster zones

Building on analyses of existing governance models, implementation challenges and effectiveness assessments, this section proposes a conceptual framework for effective mHealth governance in disaster zones. This framework, illustrated in Figure 2, integrates key governance components, contextual factors and desired outcomes to provide a holistic approach to mHealth deployment in humanitarian crises.

Explanation of the conceptual framework

The conceptual framework for the effectiveness of mHealth in disaster management is a dynamic system designed to optimise the use of mHealth applications in crisis situations. The framework proposes an enabling environment that encompasses essential elements, including strong policy and governance, reliable infrastructure and access, sufficient human capacity, sustainable funding and resources, and established trust and ethical standards. These foundational components create the conditions necessary for the effective deployment of mHealth interventions. The mHealth interventions encompass communication platforms, data and monitoring capabilities, information and education initiatives, resource management tools and mental health support services. These processes are implemented across the various phases of disaster management, preparedness, response and recovery, providing a contextual framework for their application throughout the disaster lifecycle. The framework



Source: Bacela, S. & Olaitan, O., 2026, 'Implementing mobile health applications in disaster zones: A systematic literature review', *South African Journal of Information Management* 28(1), a2122. https://doi.org/10.4102/sajim.v28i1.2122

FIGURE 2: Conceptual framework for effective mHealth governance in disaster zones.

seeks to achieve several desired outcomes, including improved healthcare access, enhanced disaster response, strengthened public health systems, empowered communities and reduced vulnerability. Supporting the entire framework are guiding principles such as person-centred care, innovation for impact, interoperability and digital health equity. These principles ensure that mHealth solutions remain ethical, effective and centred on the needs of users. A critical feedback loop fosters continuous improvement and adaptability. This loop involves ongoing monitoring and evaluation, incorporation of lessons learned, and the generation of research and evidence. Through this iterative process, insights derived from real-world experiences and new knowledge inform policy adjustments, capacity-building and technological advancements. In doing so, the system is regularly refined, allowing mHealth solutions to evolve in response to the changing challenges of disaster management. This proposed governance framework emphasises a multi-stakeholder approach, with collaboration among government agencies, healthcare providers, technology developers, NGOs, academic institutions and affected communities. It also highlights the importance of adapting governance strategies to the specific context of each disaster, considering factors such as the type of disaster, the affected population, and available resources. The framework emphasises a dynamic and iterative approach to mHealth governance. Contextual factors should be continuously assessed, and governance components should be adapted as needed to achieve desired outcomes. Feedback loops from M&E processes are essential for informing these adaptations and ensuring continuous improvement. Furthermore, the framework highlights the importance of a multi-stakeholder approach that involves collaboration among government agencies, healthcare providers, technology developers, NGOs, academic institutions and affected communities. Each stakeholder group has a unique role to play in shaping and implementing effective mHealth governance. For instance, governments are responsible for establishing enabling policy environments and providing oversight. Healthcare providers are key to ensuring that applications meet clinical needs and are integrated into service delivery. Technology developers contribute expertise in designing and building robust and user-friendly applications. Non-governmental organisations often play a crucial role in implementation and community engagement, particularly in hard-to-reach areas. Academic institutions can contribute through research, evaluation, and capacity-building. Finally, the active involvement of affected communities is paramount to ensure that mHealth solutions are relevant, acceptable and sustainable. This conceptual framework provides a comprehensive roadmap for developing and implementing effective mHealth governance strategies in disaster zones. By addressing both the core governance components and the specific contextual factors, stakeholders can work towards maximising the potential of mHealth to improve health outcomes and strengthen health system resilience in the face of disasters.

Discussion

How our findings sit alongside prior reviews

Our four-category typology EMS/triage, health surveillance, resource coordination, telemedicine is broadly consistent with Alanazi et al. (2025), who likewise distinguished triage, surveillance, and remote-care application classes in their *JMIR mHealth and uHealth* review, and with Lokmic-Tomkins et al. (2023), whose systematic review of disaster-management systems clustered tools along similar operational lines. Where our review departs is in (1) explicitly carving out resource coordination platforms as a distinct fourth category. Alanazi et al. (2025) treated logistics as a sub-feature of EMS rather than a stand-alone class. The review also departs in (2) reporting a higher prevalence of sub-Saharan African deployments, where prior reviews were dominated by Asian and high-income settings (Komi et al. 2021). This regional re-balancing is one of the empirical contributions of the present review. On governance, our findings of a fragmented landscape of national strategies in some countries, international guidance from the WHO, but a paucity of disaster-specific frameworks, are convergent with Komi et al. (2021), who reached the same conclusion for LMICs. Our contribution is to advance from description to prescription by proposing a six-component conceptual governance framework that is explicitly disaster-tuned rather than a generic mHealth model. Likewise, prior work has catalogued barriers and facilitators of mHealth adoption during COVID-19 (Lokmic-Tomkins et al. 2023). Our work shows that the same adoption barriers (cultural, infrastructural, data-related) recur across natural, conflict-related and health-emergency disasters, suggesting a generalisable barrier structure rather than pandemic-specific friction. Two divergences are worth flagging. Firstly, prior reviews have reported positive evidence regarding the effectiveness and potential efficiency gains of selected mHealth tools in disaster response contexts (Yarmohammadian, Safdari & Tavakoli 2015); however, our synthesis is more cautious because only a limited number of empirical studies included formal cost–benefit analyses, highlighting an important evidence gap rather than a direct contradiction. Secondly, where earlier studies have often treated interoperability as primarily a technical issue, our analysis suggests that the principal constraints in disaster settings are frequently semantic and organisational in nature rather than network-layer limitations. This finding has important implications for the design of governance and coordination mechanisms (Gastaldi & Horlait 2022). Regarding implementation challenges, our findings are broadly consistent with prior reviews but provide greater geographic and thematic granularity. Zakerabasali et al. (2021) identified infrastructure, digital literacy and cultural factors as principal barriers to mHealth adoption, and our synthesis confirms all three across the four application categories. Where our review extends this literature is in the specific salience of power-supply constraints (as distinct from connectivity) for EMS and telemedicine applications in sub-Saharan African and South Asian settings, and in the

prominence of sustainability as a binding post-disaster constraint, a dimension that COVID-19-focused reviews such as Jain et al. (2023) were less well-positioned to capture, given the comparatively sustained funding environment of pandemic response. The finding that 80% of mHealth initiatives reviewed by Agarwal et al. (2015) failed to sustain operations beyond initial funding cycles is mirrored in our sample, reinforcing that sustainability is a structural rather than incidental problem. On effectiveness, our synthesis aligns with the finding that mHealth tools consistently improve process-level outcomes (data collection speed, triage throughput, supply-chain visibility) but that evidence on patient-level health outcomes remains limited and methodologically weak. Our review extends this finding in two ways (Yarmohammadian et al. 2015). Firstly, by disaggregating effectiveness across four application categories, we show that health surveillance systems have the most consistent evidence base (anchored by multi-country deployments such as SPEED and DONS with measurable outbreak-detection improvements), whereas resource coordination platforms have the weakest, partly because effectiveness metrics vary substantially across deployments and are rarely standardised. Secondly, our inclusion of sub-Saharan African deployments surfaces a pattern not prominent in prior reviews: applications adapted for low-bandwidth, offline-first operation consistently outperform those designed for higher-resource environments, suggesting that contextual fit is as important a predictor of effectiveness as technical design quality. This contextual adaptation argument represents a distinctive empirical contribution of the present review. The findings underscore the significant potential of mHealth to transform healthcare delivery in humanitarian crises, while also highlighting the complex array of challenges that must be addressed to fully realise this potential. The categorisation of mHealth applications into EMS, health surveillance, resource coordination and telemedicine solutions provides a useful typology for understanding the diverse ways in which mobile technology is being leveraged in disaster contexts. Each category addresses specific needs and offers unique functionalities, from rapid patient triage and disease outbreak detection to efficient supply chain management and remote specialist consultations. The examples from various disaster settings, including those in South Africa, illustrate the practical application and tangible benefits of these tools. However, the widespread and effective deployment of these applications is consistently hampered by recurring implementation challenges. Infrastructure limitations, particularly around connectivity and power, remain a fundamental barrier in many disaster-affected regions. User adoption issues, stemming from factors such as digital literacy, cultural considerations and the perceived burden of new technologies during high-stress situations, also pose significant hurdles. Furthermore, data management concerns, including quality, interoperability, privacy and security, are critical and often inadequately addressed. Finally, the long-term sustainability of mHealth initiatives, encompassing financial, technical and institutional aspects, is a major concern that frequently undermines the lasting impact of promising interventions. The review of governance frameworks reveals a need for more robust, comprehensive and disaster-specific models. While national eHealth strategies and international guidelines offer some direction, they often lack the specificity and enforcement mechanisms required to address the unique demands of disaster zones. The proposed conceptual framework for mHealth governance in disaster zones attempts to address this gap by integrating essential governance components (leadership, legal/regulatory aspects, technical standards, ethics, capacity-building and M&E) with a keen sensitivity to contextual factors and a clear focus on desired health and system outcomes. This framework emphasises a multi-stakeholder, adaptive and iterative approach, which is crucial for navigating the dynamic and complex nature of disaster environments. The assessment of effectiveness indicates that while mHealth applications can lead to improvements in process measures and, in some cases, health outcomes, the evidence base is still developing. Methodological rigour in evaluation studies needs to be strengthened to provide more definitive conclusions about the impact and cost-effectiveness of these interventions. An understanding of effectiveness requires looking beyond simple health metrics to consider user satisfaction, system efficiencies and broader societal impacts. Several gaps and areas for future research have emerged from this review. Firstly, there is a need for further research on the long-term impact and sustainability of mHealth applications in disaster recovery phases, moving beyond the immediate response. Secondly, comparative studies evaluating different types of mHealth applications for similar purposes in diverse disaster contexts would be valuable for identifying best practices and transferable lessons. Thirdly, research focusing on the specific needs and challenges of vulnerable populations within disaster zones, such as children, the elderly and individuals with disabilities, is crucial for ensuring equitable access and benefit from mHealth interventions. Fourthly, further investigation is needed into effective models for public-private partnerships to develop and deploy mHealth solutions for disasters, leveraging the strengths of both sectors. Finally, the ethical implications of using artificial intelligence and big data analytics in mHealth applications in disaster settings warrant careful exploration to ensure responsible, responsive innovation.

Conclusion

Mobile health applications offer transformative potential for enhancing healthcare delivery and health system resilience in disaster zones. While the promise is significant, realising it requires a concerted effort to address the multifaceted challenges identified.

Theoretical implications

The findings of this review converge with and extend four streams of theory. Firstly, the Unified Theory of Acceptance and Use of Technology (UTAUT-2; Venkatesh,

Thong & Xu 2012) is supported: performance expectancy, effort expectancy, social influence and facilitating conditions all surface as drivers of mHealth uptake in the synthesised studies, but our findings extend UTAUT-2 by foregrounding contextual moderators specific to disaster settings, such as infrastructure collapse, security and trust in responder agencies. We believe that these factors warrant explicit incorporation into the model for crisis contexts. Secondly, the Information Systems Success Model (DeLone & McLean 2003) provides a defensible lens for the effectiveness findings in this paper: system quality, information quality and service quality each emerged as determinants of net benefit (e.g. faster triage, fewer stock-outs). However, our results suggest that the model's 'use' construct must be re-interpreted as 'use under duress' in disaster settings, where intermittent use, offline operation and surge use are the norm rather than the exception. Thirdly, our governance findings align with the Multi-Level Governance perspective (Liesbet & Gary 2003): effective mHealth governance is shown to be neither purely national nor purely transnational but jurisdictionally layered, consistent with the framework's central claim. Fourthly, the dual emphasis on semantic and organisational interoperability that was identified resonates with sociotechnical systems theory (Sawyer & Jarrahi 2014; Trist 1981), reinforcing that successful mHealth deployment is a joint optimisation problem across technical and social subsystems rather than a purely technological one.

Practical and policy implications

For policymakers, the most actionable implication is that disaster-specific mHealth governance should be codified in national disaster-management acts rather than left to general eHealth strategy documents that do not anticipate crisis conditions. The proposed six-component framework operationalises this: leadership, legal regime, technical standards, ethics and community engagement, capacity-building, and monitoring and evaluation. For ministries of health in sub-Saharan Africa, the region most represented in our included studies, the study recommends pre-positioning licensing arrangements for telemedicine across provincial and national borders so that response is not delayed by jurisdictional licensing checks during the first 72 h of a disaster. Policymakers should also foster multi-stakeholder collaboration by creating and supporting platforms that bring together government entities, NGOs, private sector technology providers, academic institutions and community representatives to ensure a coordinated and effective mHealth response. For healthcare providers and humanitarian organisations, the practical implication is to embed validated mHealth tools into standard operating procedures and pre-disaster drills rather than treating them as ad hoc surge tools. For technology developers, the implication is to design for offline-first operation, low-bandwidth fallback and language localisation, and to publish interoperability artefacts under open licences to lower the integration cost for downstream responder agencies. For funders, they should fund 5–7-year sustainability envelopes rather than discrete deployment grants, since our review found that sustainability, and not initial deployment, is the binding constraint on long-term impact. Furthermore, healthcare providers and organisations should integrate validated mHealth tools into their disaster preparedness and response plans, embedding these tools into standard operating procedures, and conduct regular training and simulation exercises for their staff. They must champion user-centred design and contextual adaptation by actively participating in the design, testing, and refinement of mHealth applications to ensure these tools are user-friendly, meet clinical needs, and are appropriate for the local context and user capabilities. Healthcare organisations need to prioritise data quality and security by implementing robust protocols for data collection, management and protection. This ensures the reliability of the information and safeguards patient privacy, in line with ethical guidelines and legal requirements. For researchers, the implication is twofold: (1) the absence of randomised or quasi-experimental evaluations in our search window is a methodological gap that should be addressed by pre-registered hybrid implementation-effectiveness designs in the next wave of evaluations; and (2) the under-representation of mental-health-focused mHealth tools in disaster settings warrants targeted primary research, given the documented psychosocial burden of disasters. Researchers and academic institutions are also urged to conduct rigorous evaluations of mHealth interventions, including randomised controlled trials when feasible, to generate strong evidence on their health, system and economic impacts in disaster settings. They should investigate implementation science approaches to better understand the factors that facilitate or hinder the successful scale-up and sustainability of mHealth applications across diverse disaster contexts. Additionally, exploring emerging technologies such as artificial intelligence, the Internet of Things, and blockchain must be done responsibly, with careful consideration of ethical implications and a commitment to a human-rights-based approach to enhance mHealth capabilities for disaster management. Technology developers and the private sector have a crucial role in designing mHealth applications optimised for low-resource and challenging environments. These applications should function effectively

TABLE 3: Contextual review-type sources retained in the Preferred Reporting Items for Systematic reviews and Meta-Analyses total (N = 2).

Number	Author(s)	Title	Publication	Year	Review type	Role in the review
24	Alanazi et al.	Emergency Medical Services in Hospitals: Bridging Acute Response and Comprehensive Care – A Systematic Review	*Vascular and Endovascular Review*	2025	Systematic review	Hospital emergency medical services; healthcare settings
25	Aboye, G.T., et al.	mHealth in Sub-Saharan Africa	*Journal of Global Health Reports*	2023	Scoping review	Retained to support contextual interpretation of implementation and regional patterns; not treated as primary empirical

Note: Please see the full reference list of the article, Bacela, S. & Olaitan, O., 2026, 'Implementing mobile health applications in disaster zones: A systematic literature review', *South African Journal of Information Management* 28(1), a2122. https://doi.org/10.4102/sajim.v28i1.2122, for more information.

under low-bandwidth conditions, offer offline capabilities, be power-efficient and feature intuitive interfaces that require minimal training. Emphasising interoperability and adherence to open technical standards is vital to enable seamless data exchange between different mHealth systems and integration with national health information systems. Developers should also engage in ethical and sustainable partnerships, collaborating with humanitarian organisations and local stakeholders to create mHealth solutions that are contextually appropriate, ethically sound, and supported by clear plans for long-term sustainability and local ownership. Funding agencies and donors need to support long-term sustainable mHealth initiatives by shifting funding models beyond initial development and deployment to include ongoing maintenance, local capacity-building and integration into health systems. They should promote evidence-based investments by prioritising funding for mHealth interventions that demonstrate effectiveness and align with national health and disaster management priorities. Moreover, encouraging innovation and knowledge sharing is essential, supporting initiatives that foster new developments in mHealth for disasters and facilitate the exchange of best practices, lessons learned, and open-source solutions across regions and organisations. Based on the findings of this review, it is important that these frameworks are integrated seamlessly with broader national disaster management and health system strategies. Investing in resilient infrastructure must be a priority, particularly in disaster-prone areas, to ensure the reliable operation of mHealth applications. This includes strengthening telecommunications and power infrastructure and exploring the deployment of rapidly deployable emergency communication systems. In conclusion, mHealth applications are indispensable tools in the modern disaster management toolkit. By addressing the identified challenges through robust governance, collaborative action, and continuous innovation, the global community can harness the full potential of mHealth to save lives, alleviate suffering and build more resilient health systems in the face of ever-increasing disaster risks. The journey requires commitment, investment and a shared vision for a future where technology effectively serves humanity in its most vulnerable moments.

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Competing interests

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CRediT authorship contribution

Sinothando Bacela: Conceptualisation, Data curation, Project administration, Visualisation, Writing – review & editing. Olutoyin Olaitan: Conceptualisation, Formal analysis, Methodology, Supervision, Writing – original draft, Writing – review & editing. All authors reviewed the article, contributed to the discussion of results, approved the final version for submission and publication, and take responsibility for the integrity of its findings.

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Data availability

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

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Appendix starts on the next page →

Appendix 1

TABLE 1-A1: Empirical studies included in the systematic review (N = 23).

Number	Author(s)	Title	Publication	Year	Study design or method	Context or country
1	Shrestha, B. and Pathranarakul, P.	Nepal government's emergency response to the 2015 earthquake: A case study	*Disaster Medicine & Public Health Preparedness*	2018	Case study	Nepal
2	Abaza, H. and Marschollek, M.	mHealth application areas and technology combination	*Methods of Information in Medicine*	2017	Review article	Global
3	Ngcamu, B.S. and Abrahams, G.	The preparedness plans and early warning systems during flood disasters in South Africa	In *The Palgrave Handbook of Language and Crisis Communication in Sub-Saharan Africa*	2024	Book chapter; qualitative/conceptual discussion of disaster preparedness and communication systems	South Africa
4	Salazar, M.A.	Syndromic surveillance for governance in health emergencies and disaster risk management in the Philippines	Doctoral dissertation	2015	Case study	Discussed the use of the SPEED syndromic surveillance system in the Philippines
5	Dlamini, S.Z. and Khumalo, N.P.	Disease outbreak notification during floods	*African Health Sciences*	2024	Case report	Eswatini
6	Naderi, M.A. and Shojaei, A.	Mobile health surveillance effectiveness	*Iranian Journal of Public Health*	2022	Systematic review	Global South
7	Khidhir, S.N.K.	Digitalization of humanitarian supply chain: Opportunities and challenges for humanitarian organizations	Doctoral dissertation, LCC International University	2024	Conceptual dissertation on digital humanitarian logistics	International context
8	Bjerge, B., Clark, N., Fisker, P. and Raju, E.	Interoperability in disaster response platforms	*PLoS ONE*	2016	Case-based Study	International
9	Lokmic-Tomkins, Z., et al.	Lessons learned from natural disasters around digital health technologies and delivering quality healthcare	*International Journal of Environmental Research and Public Health*	2023	Review study on digital health technologies in disaster settings	Natural disaster and healthcare contexts / international
10	Lynch, M., et al.	Warning system for Extreme weather events, Awareness Technology for Healthcare, Equitable delivery, and Resilience (WEATHER) Project: A mixed methods research study protocol	*Climate*	2025	Mixed-methods study protocol	South Africa
11	WHO	Definitions of disasters and emergencies	WHO Report	2019	Literature-informed report	Global
12	Komi, L.S., et al.	A conceptual framework for telehealth integration in conflict zones and post-disaster public health responses	*ICONIC Research and Engineering Journals*	2021	Conceptual Framework Study	Conflict zones and post-disaster public health settings; developing and emergency-affected regions
13	Vassilakopoulou, P., et al.	Organizational factors in digital health implementation	*International Journal of Medical Informatics*	2024	Systematic review	Europe

Note: Please see the full reference list of the article, Bacela, S. & Olaitan, O., 2026, 'Implementing mobile health applications in disaster zones: A systematic literature review', *South African Journal of Information Management* 28(1), a2122. https://doi.org/10.4102/sajim.v28i1.2122, for more information.

SPEED, surveillance in post extreme emergencies and disasters.