How prepared are health systems in low- and middle-income countries to provide rehabilitation in conflict and disaster response? A scoping review

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Abstract

Introduction Conflict and other disasters such as earthquakes or landslides result in traumatic injuries creating surges in rehabilitation and assistive technology needs, exacerbating pre-existing unmet needs. Disasters frequently occur in countries where existing rehabilitation services are underdeveloped, hindering response to rehabilitation demand surge events.

Aims The primary aim of this scoping review was to synthesize the evidence on the preparedness of health systems in low- and middle-income countries to respond with rehabilitation services and assistive technology to the demand associated with conflict and disaster situations. A secondary aim was to summarize related recommendations identified in the gathered literature.

Methodology A scoping review was conducted using the Arksey and O’Malley framework to guide the methodological development. The results are reported in accordance with PRISMA-ScR. Four bibliographic databases were used: CINHAL, Cochrane, Pubmed, Scopus and Key international organisations were also contacted. The search range was 2010–2022. Eligible publications were categorized for analysis under the six World Health Organization health systems building blocks.

Results Of the 27 studies included in the scoping review, 14 focused on service delivery, 6 on health workforce, 4 on health information systems and 3 on the leadership and governance building block. No study focused on financing nor assistive technology. This review collected the most frequently referenced recommendations for actions that should be taken to develop rehabilitation services in disasters. The most prominent recommendations were; the provision early and multi-professional rehabilitation, including the provision of assistive technology and psychological support, integrated community services; disaster response specific training for rehabilitation professionals; advocacy efforts to create awareness of the importance of rehabilitation in disasters; and the integration of rehabilitation into disaster preparedness and response.

Conclusion: The literature demonstrates that rehabilitation is poorly integrated into health systems disaster preparedness and response in low- and middle-income countries, largely due to low awareness of rehabilitation, undeveloped rehabilitation health systems and a lack of rehabilitation professionals, and disaster specific training for them. The paucity of evidence available hinders advocacy efforts for rehabilitation in disaster settings and limits the sharing of experiences and lessons learnt to improve rehabilitation preparedness and response. Advocacy efforts need to be expanded.

Background Conflict and other disasters such as earthquakes or landslides frequently result in traumatic injuries creating surges in rehabilitation and assistive technology needs (1), making accessing services difficult or impossible. These impacts can quickly overwhelm the health system's ability to provide rehabilitation (2-4). There can be significant and life changing consequences for those whose rehabilitation needs are unmet or delayed, leaving a legacy of disability for years to come (5-8).

The World Health Organization (WHO) defines rehabilitation as “A set of interventions designed to optimise functioning and reduce disability in individuals with health conditions in interaction with their environment” (9, 10) and considers rehabilitation as a key element of universal health coverage (11) as well as an essential component of emergency response (1, 6). The vital role and benefits of rehabilitation are well recognized in global rehabilitation disaster and emergency response guidelines from the highest authorities in health (10, 12-15). Early rehabilitation in disaster contexts has been shown to reduce disability and improve quality of life (7, 16, 17). Longer term, rehabilitation is a wise societal investment, supporting individuals to participate in education and employment (9).

Conflict and other disasters frequently occur in low- and middle-income countries (LMICs) where existing rehabilitation services may be underdeveloped (3, 18), due to a lack of resources and understanding of rehabilitation and its benefits. Without existing infrastructure and integrated services, these health systems are not well positioned to respond to rehabilitation demand surge events (19). Often, those in need of rehabilitation services do not receive them, or services are only available at a time and place that unsuitable to answer needs (20).

The speed of delivery, quality and effectiveness of rehabilitation interventions are greatly enhanced when preparedness plans are in place prior to any disaster to provide a framework for necessary considerations and actions (21, 22). The United Nations state that “preparedness refers to the knowledge and capacities developed by governments, professional response and recovery organisations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions” (23).

Some countries, such as Iran and Nepal, have had a disaster rehabilitation framework in place before a disaster occurred (8, 24). However, evidence to the extent of the preparedness of health systems in LMICs to effectively respond to the impact of disasters and conflict with
rehabilitation is scattered. An overview of the evidence is therefore essential to understand the current situation, learn from experiences, and develop consolidated recommendations that can inform the development of national disaster rehabilitation frameworks. This scoping review attempts to answer the research question of “How prepared are health systems in low- and middle-income countries to provide rehabilitation in conflict and disaster response?” The primary aim of this scoping review is therefore to synthesize the evidence on the preparedness of health systems in LMICs to respond with rehabilitation services and assistive technology to the demand associated with disasters and conflict situations. A secondary aim is to summarize recommendations about rehabilitation and assistive technology service provision in disasters and conflict identified in the gathered literature.

For the purpose of this study, only disasters that may result in trauma were included. Such disasters include earthquakes, tropical storms, tsunamis, volcanic eruptions, fires, explosions, building collapse, floods, conflict, terrorism, and mass casualty incidents. In this study, LMICs are defined according to the World Bank 2022 classification (25).

**Methods**

A scoping review assesses and synthesizes the available evidence on a particular topic (26). The Arksey and O’Malley framework (27) guided the methodological development. The framework describes five stages: 1) identifying the research question; 2) identifying relevant publications; 3) selecting the publications, 4) charting the data, and; 5) organizing, summarizing and reporting the results. To ensure methodological quality and transparency, the results are reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist (28).

**Search Strategy**

For each concept relevant to the research question, a list of search terms was developed (Table 1). The Medical Subject Headings (MeSH) database was searched to identify these. MeSH terms were used to narrow the search and to improve specificity. Field terms were used when key terms were not included under the MeSH headings. Four bibliographic databases were used: CINHAL, Cochrane, Pubmed and Scopus. See appendix 1 for details. A hand search of the reference lists of all eligible studies was completed to identify relevant publications not identified by the database searches.

Table 1 Key concepts and their search terms

<table>
<thead>
<tr>
<th>Key concepts</th>
<th>Final search terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rehabilitation</td>
<td>Rehabilitation, rehabilitation and burn, wounds and injuries</td>
</tr>
<tr>
<td>Assistive products/technology</td>
<td>Assistive product, Assistive technology, assistive product, assistive technology devices, self-help devices</td>
</tr>
<tr>
<td>Disaster</td>
<td>Disaster, humanitarian, humanitarian response, humanitarian crisis, humanitarian intervention, humanitarian action, armed conflict, natural disaster, disaster and rehabilitation, relief work</td>
</tr>
</tbody>
</table>

To consider the grey literature, 16 rehabilitation lead or focal persons working at key international organisations were contacted by email requesting relevant publications. The organisations were: European Physiotherapy Association, Humanity & Inclusion, the International Committee of the Red Cross, Interburns, International Society for Prosthetists and Orthotists, Médecins Sans Frontières World Physiotherapy, World Federation of Occupational Therapy, and WHO. Rehabilitation lead or focal persons were asked to respond within two weeks, and one reminder email was sent. Additionally, their organisations’ websites were searched for relevant publications.

**Eligibility Criteria**

Eligible articles should fulfil the following inclusion criteria:

- mention to propose, implement or evaluate the delivery of rehabilitation and/or assistive technology services in disaster or conflict situations.
- have a health systems perspective.
- focus on LMICs, as defined by the World Bank (25).
- be a primary research study, government or organisation policy paper or report.
- have been published between 2010 and 2022 (2010 was chosen as first year for the eligible period this is when the Haiti earthquake occurred).
have been published in English and the full text was available.

Articles were excluded if they:

- were publications on pandemics, such as COVID-19 and Ebola, as these result in different rehabilitation needs on a much greater scale and are outside the scope of this review.
- were publications focusing on international emergency medical teams, military or short-term non-governmental organisations projects as these are not a part of a country's government financed health system.
- reported refugee interventions in high-income countries.
- were publications in non-disaster or non-conflict situations.
- were a scoping or systematic review, commentary or opinion articles from foreign teams or book chapters and conference presentations.
- reported only about psychological rehabilitation or emergency preparedness for persons with disabilities, such as preparing for evacuations and medications.

Additionally, methodologically poor studies describing conclusions that cannot be considered reliable, or only mentioning rehabilitation but not giving details, were excluded. Studies reporting prevalence information for health systems, such as prevalence of people requiring rehabilitation following a disaster, were only included if information was collected through a health system relevant survey, such as those conducted by an official body of the health system such as the ministry of health.

**Eligibility Assessment**

The four authors working in the field of policy and research on topic of rehabilitation in health systems were involved in the screening process (JG, RM, ALL, CS). Studies obtained from the database searches were uploaded to EndNote, a reference manager tool, and duplicates were removed. The remaining studies were then uploaded to Rayyan, a literature review platform, (29), for eligibility assessment. JG reviewed the titles and abstracts of all articles against the inclusion criteria twice. A fifth reviewer, blinded to the first author's decisions, reviewed 20% of the publications which were randomly selected from each year within the search period. A reconciliation meeting was held to discuss disagreements and agree upon the status of those studies with RM as moderator.

**Data Extraction and Synthesis of Results**

The extracted data included study characteristics such as year of publication, disaster event, country, aims, type of study, participants, findings regarding their intervention, activities or observations on rehabilitation and/or assistive technology in disaster preparedness or response, as well as any recommendations the authors made. JG categorized included articles into one of the six WHO rehabilitation health system building blocks (30) based on the studies' main focus to clearly present the evidence to answer the research question. The six building blocks are: service delivery, health workforce, health information systems, medical products such as assistive products, financing and leadership and governance. ALL reviewed the final categorization decisions, and disagreements were resolved in a reconciliation meeting. It is recognized that the building blocks are interlinked into health systems, and that eligible studies may touch on more than one block(31). A WHO publication specific to rehabilitation (32) was used to support the classification of the studies into each of the six building blocks.

**Results**

After removing duplicates, the database searches resulted in 27 included studies (Fig. 1). No further publication was identified through the grey literature search. The grey literature search and the contacting of key organisations focal persons yielded zero additional publications. Of the 16 individuals contacted, 7 replied by either sending their organisation's global guidelines, or by apologizing that their reports were unpublished and for internal use only. Three national Systematic Assessment of Rehabilitation Situation (STARS) reports were identified from the website searches, but these were excluded as they did not provide information on rehabilitation services in conflict or disaster situations.

**Overview of included studies**

The included studies were based on events in 11 countries: 9 from China, 4 from the Philippines, 2 each from Bangladesh, Haiti, India, Iran, and Nepal, and 1 each from Brazil, Nigeria, Pakistan and Turkey. Seventeen of the 27 studies described activities related to earthquakes, 6 were not focused on a specific disaster event, 2 were each related to landslides and typhoons. 20 studies described or evaluated response,
whilst 7 studies focused on preparedness. Most of the 27 studies were observational studies or case reports and some with data collection years after the event.

When classified according to the six building blocks of health systems, 14 studies focused on service delivery, followed by 6 on health workforce, 4 on health information systems and 3 on the leadership and governance building block (Tables 2–5). No study focused on the financing and assistive technology building blocks, despite these being mentioned in some of the studies that focused on other building blocks.

**Service delivery**

Most studies \( n = 15 \) focused on rehabilitation service delivery (Table 2). This is an expected finding, considering that rehabilitation need requests service provision, and disaster and conflict situations create demand. Of these, 11 studies were based on earthquakes, with 6 from China alone. Nine studies evaluated service delivery and 6 reported the implementation of services. Most studies made recommendations to develop and integrate rehabilitation into emergency preparedness and response.

Mousavi et al. (2019) (33) iterated what other studies included in this scoping review also emphasized, that the delivery of rehabilitation services during disasters is highly dependent on the existing system, and that, in the absence of a strong rehabilitation system, service delivery during disasters will be inadequate. Taking Iran as an example, Mousavi et al (2019) (33) reported that a lack of policy hindered rehabilitation development with decision makers' limited knowledge of rehabilitation, a lack of an effective responsible rehabilitation body; weak disaster-related competencies; and under-prioritization of rehabilitation by government to be the greatest barriers towards developing rehabilitation services.

Describing reasons for a lack of rehabilitation services in disasters, Carvalho et al (2019) (34) posed that low demand for services can occur, not because the need does not exist, but because rehabilitation need can be repressed by competing personal needs, financial constraints to pay for services and transport, and lack of access and knowledge of the rehabilitation services available.

Uddin et al. (2021) (35) suggested that a barrier to implementing rehabilitation services for those with traumatic injuries sustained in the 2017 Bangladesh landslide was a lack of rehabilitation professionals and of training to provide rehabilitation services. The authors recommended that rehabilitation capacity be increased with task sharing and rehabilitation technical training integrated into the emergency response structure. Supporting this suggestion, Hotz et al. (2012) (36) recommended a train-the-trainer model to expand workforce capacity and capabilities, based on experiences in Haiti after the 2010 earthquake.

A commonly mentioned consideration for implementing rehabilitation services is that disasters add to the existing unmet need for rehabilitation, with studies in the review reporting a large proportion of individuals with pre-disaster need accessing rehabilitation services set up for disaster victims (3, 10).

Ali et al (2010) (40), Keshkar et al (2014) (38), Li et al (2019) (37), and Mousavi et al (2019) (39) evidenced the long-term need for assistive technology provision for those injured in earthquakes, and emphasized that AT provision, as part of rehabilitation interventions, are associated with outcomes such as better functioning and greater quality of life. The case report from the Philippines by Ganchoon et al (2018) (3) demonstrated that rehabilitation services can be effectively delivered within other relief and medical aid missions. Box 1 summarizes the recommendations from studies focusing on service delivery, with the top four most referenced recommendations being: 1) Early multi-professional rehabilitation (3, 37, 38, 40-43); 2) Assistive technology provision (3, 37-40); 3) Community-based rehabilitation provision (3, 41, 42), and; 4) Psychological support (38, 40, 43).

**Box 1** Summary of recommendations from the service delivery studies
• Early multi-professional rehabilitation (3, 37, 38, 40-43)
• Assistive technology provision (3, 37-40)
• Community based rehabilitation provision (3, 41, 42)
• Psychological support (38, 40, 43, 44)
• Effective pain relief (7, 41)
• Use of social media and patient education sheets to raise awareness of rehabilitation services available (3)
• Undertaking of an active search for people in need of rehabilitation and actions to ensure services are accessible (7, 34)
• Close collaboration between trauma surgical services and rehabilitation services (40, 45)
• Rehabilitation should be available with victim triage, assessment, at the scene, in district facilities, in mobile units and in hospitals (35)
• Home adaptations and other environmental barrier modifications, if needed (7, 42)
• Close relationships with local and international stakeholders to integrate rehabilitation response and improve future disaster responses and the allocation of resources (3)
• Expansion of workforce capacity and capabilities is essential (39), a train the trainer (36) model and task shifting (35) should be considered
• Special consideration and provision should be made for vulnerable populations or underserved rural areas to enable a rapid response (39, 42, 46)
• Empower and improve the rehabilitation capacity of the local community when designing a disaster response rehabilitation program (10)
• A professional volunteer recruitment database can hasten response (6)
• Organization needs to come from authority at the national level and advocacy work is needed to realize this (39, 47)
• Pre-disaster mapping of those who will need specific disability and rehabilitation services (46)

Table 2 Summary of the service delivery results
<table>
<thead>
<tr>
<th>Title</th>
<th>Aims</th>
<th>Country</th>
<th>Disaster</th>
<th>Type of study</th>
<th>Participant group</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philippine academy of rehabilitation medicine emergency basic relief and medical aid mission project (November 2013-february 2014): The role of physiatrists in super typhoon Haiyan (3)</td>
<td>To describe the emergency basic relief and medical aid missions performed by physiatrists in response to Super Typhoon Haiyan.</td>
<td>Philippines</td>
<td>2013 typhoon Haiyan</td>
<td>Case report</td>
<td>Unknown number of rehabilitation doctors</td>
<td>Besides providing medical care, physiatrists functioned as mission team leaders, as community advocates, and other roles. Services included free consultation and treatment; medicines, and wound care supplies to 7255 patients, which included non-disaster related care.</td>
</tr>
<tr>
<td>Physical rehabilitation in the context of a landslide that occurred in Brazil (34)</td>
<td>To investigate the challenges in delivering rehabilitation to those injured in the 2011 landslide disaster.</td>
<td>Brazil</td>
<td>2011 landslide</td>
<td>Cross-sectional mixed method study</td>
<td>2326 hospital records and 27 interviews with 11 victims and 16 health professionals</td>
<td>Most rehabilitation services didn't identify a surge in demand post disaster, despite knowing demand existed. This was thought to be because the need was repressed by competing personal needs, financial constraints to pay for rehabilitation and transport, and lack of access and awareness of rehabilitation services, meaning referrals weren't made.</td>
</tr>
<tr>
<td>The outcomes and impact of a Post-Earthquake Rehabilitation Program in China: A Qualitative Study (10)</td>
<td>To analyze the outcomes and implications for a large-scale community based, post-earthquake rehabilitation program in Sichuan, China after the program had been operational for 5 years.</td>
<td>China</td>
<td>2008 Sichuan earthquake</td>
<td>Embedded qualitative case study</td>
<td>1,471 people who received rehabilitation services between July 2008 and June 2013.</td>
<td>75.4% patients sustained injuries related in the earthquake, and the remaining 24.54% were non-earthquake victims. 88.06% of service users felt the program helped them achieve their goals. The program achieved favorable results in enhancing functional independence in activities of daily living, physical status and psychosocial well-being of the service users. The program has been transferred to the local partner, with some changes.</td>
</tr>
<tr>
<td>Mobility, prosthesis use and health related quality of life of bilateral lower limb amputees from China</td>
<td>To report the rehabilitation outcomes (mobility, prosthesis use and quality of life) of 17 bilateral lower limb amputees sustained in China after the 2008 Sichuan earthquake</td>
<td>China</td>
<td>2008 Sichuan earthquake</td>
<td>Observational cross sectional</td>
<td>17 bilateral lower limb amputees sustained in China after the 2008 Sichuan earthquake</td>
<td>Results suggested that amputation level and knee joint salvage, prosthesis use and exercise</td>
</tr>
<tr>
<td>Study Title</td>
<td>Objectives</td>
<td>Country</td>
<td>Year</td>
<td>Study Design</td>
<td>Sample Size</td>
<td>Findings</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>the 2008 Sichuan earthquake (37)</td>
<td>Bilateral lower limb amputees from the Sichuan Earthquake</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The earthquake outcomes including mobility, adjustment and quality of life were associated with better rehabilitation outcomes for amputees.</td>
</tr>
<tr>
<td>Morbidity pattern and impact of rehabilitative services in earthquake victims of Kashmir, India (40)</td>
<td>To know the nature of the injuries, magnitude of disability, rehabilitative services provided, and service satisfaction.</td>
<td>India</td>
<td>2005 Kashmir earthquake</td>
<td>Retrospective observational study</td>
<td>266</td>
<td>12.33% of patients had spinal injuries and 32% of all those injured received assistive products, with 90% still in use at 1 year follow up. 97% of patients felt rehabilitation services were beneficial.</td>
</tr>
<tr>
<td>Epidemiology and the impact of early rehabilitation of spinal trauma after the 2005 earthquake in Kashmir, India (38)</td>
<td>To describe the epidemiology of spinal injury in the Kashmir Earthquake and to analyse the impact of 15 days of rehabilitation</td>
<td>India</td>
<td>2005 Kashmir earthquake</td>
<td>Descriptive observational case report</td>
<td>38</td>
<td>Provision of free assistive devices was the main rehabilitation intervention to prevent further spinal injuries. Psychotherapy and physiotherapy is important to maintain joint range and prevent contracture, and was deemed beneficial in the sample. 15 days of rehabilitation is not enough.</td>
</tr>
<tr>
<td>Developing a trauma critical care and rehabilitation hospital in Haiti: A year after the earthquake (36)</td>
<td>To describe project Medishare which provides rehabilitation services and training to Haitian healthcare professionals.</td>
<td>Haiti</td>
<td>2010 Haiti earthquake</td>
<td>Descriptive observational case report</td>
<td>NA</td>
<td>Daily patient care has been managed by Haitian medical staff as well as more than 2,400 international volunteers. Efforts continue for building workforce capacity, and the priority is training and education of the workforce.</td>
</tr>
<tr>
<td>Amputations of limbs during the 2005 earthquake in Pakistan: A firsthand experience of the author (48)</td>
<td>To audit the incidence of amputations of limbs in the 2005 Pakistan earthquake and their rehabilitation management.</td>
<td>Pakistan</td>
<td>2005 earthquake</td>
<td>Retrospective descriptive study</td>
<td>112 patients with amputations of upper and lower limbs.</td>
<td>Amputations accounted for 0.9% of total injuries and needed immediate rehabilitation for physical, psychological and occupational challenges which included prosthetic limb fittings.</td>
</tr>
<tr>
<td>2017 Bangladesh landslide: physical rehabilitation perspective (35)</td>
<td>To describe the impact on the population affected by the 2017 Bangladeshi landslide</td>
<td>Bangladesh</td>
<td>2017 Bangladesh landslide</td>
<td>Observational</td>
<td>Landslide survivors</td>
<td>Rehabilitation for traumatic injuries was limited due to a lack of staff.</td>
</tr>
</tbody>
</table>
landsides in southeastern Bangladesh

The NHV rehabilitation services program improves long-term physical functioning in survivors of the 2008 Sichuan earthquake: A longitudinal quasi-experiment (6)

To quantify the effectiveness of the NHV rehabilitation program as measured by the function of earthquake survivors

China 2008

A longitudinal quasi-experimental design with an intervention group and control group.

510 earthquake survivors

The NHV rehabilitation services significantly improved estimated Barthel index in both the early and late intervention groups compared to controls, demonstrating benefit from rehabilitation delivered nearly 1.5 years after injury.

Functional outcomes and health-related quality of life in fracture victims 27 months after the Sichuan earthquake (41)

To evaluate functional outcomes, health-related quality of life and life satisfaction in fracture victims 27 months after the 2008 Sichuan earthquake.

China 2008

A cross-sectional quasi-experimental study with 2 intervention groups and a control group.

390 fracture victims divided into early or late intervention groups, or a routine care control group

Activities of daily living and life satisfaction in the intervention groups were significantly improved compared to the control group.

Continuous post-disaster physical rehabilitation: a qualitative study on barriers and opportunities in Iran (39)

To outline the barriers and opportunities of disaster rehabilitation services in Iran.

Iran 2003 Bam and 2012 Varzaghan earthquakes

Observational

16 rehabilitation service providers, users and administration in the affected area of the two earthquakes

The main barriers to delivering disaster rehabilitation were found to be: decision makers low knowledge of rehabilitation, a lack of an effective responsible body; weak disaster-related competencies; and under-prioritization by government. Distribution of assistive devices was critical in affected areas.

Rehabilitation specialists could play a role in triage and proper immobilization of injured limbs.

Evaluation of functional outcomes of physical rehabilitation and medical complications in spinal cord injury victims of the Sichuan earthquake (42)

To characterize spinal cord injuries from the 2008 Sichuan earthquake and evaluate their functional outcomes following rehabilitation

China 2008

A prospective observational cohort study

51 spinal cord injured earthquake victims from 3 hospitals

Ambulation, wheelchair mobility and ADL were significantly improved with rehabilitation. 35.3% of patients achieved at least moderate activity of daily living independence and 90.2% regained...
### Responding to the health and rehabilitation needs of people with disabilities post-Haiyan (46)

To describe the activities to increase access to rehabilitation for people with disabilities and with injuries post-Haiyan.

**Philippines**

**2014 typhoon Haiyan**

**Descriptive field investigation report**

- 2998 individuals needing rehabilitation and assistive devices
- 50 prostheses and 320 mobility aids were provided to people with new injuries or pre-existing disabilities. Having detailed pre-disaster data of estimations and profiles of people with disabilities would have improved the response.

### Factors affecting functional outcome of Sichuan earthquake survivors with tibial shaft fractures: a follow-up study (43)

To analyse the functional recovery of earthquake survivors with tibial shaft fractures in Sichuan, China.

**China**

**2008 Sichuan earthquake**

**Observational**

- 174 ambulatory earthquake survivors with tibia shaft fractures
- Functional recovery was positively associated with rehabilitation intervention (odds ratio 5.3 (95% confidence interval 2.38–11.67)

### Workforce

Six studies focused on rehabilitation workforce (Table 3) from 6 countries, 1 responding to an earthquake and the others not based on a specific disaster. Overall, the included studies show that the rehabilitation workforce has little experience in disaster preparedness and response due to a lack of training and awareness of professionals in their role in disaster response.

*Habib et al (2014) (49)* found only three occupational therapists in Bangladesh who had disaster response experience in national or international non-governmental organizations. From the professional organizations register, *Ching et al (2019) (50)* found only 24 occupational therapists with disaster response experience in the Philippines, who mostly had experience providing mental health support to the pediatric population. These findings by *Ching et al (2019) (50)* contradict an earlier policy study by *Duque et al (2013) (44)*, classified under the leadership and governance category, describing the process and challenges faced to produce the national Philippines disaster preparedness and response plan for occupational therapists. In the aforementioned plan, key recommendations to support workforce development in disaster preparedness and response were made, which, 5 years on, appeared to have been minimally implemented.

The included articles link the lack of rehabilitation workers’ experience in disasters to little understanding by the workforce of the role they can play. In a Nigerian survey, *Ojukwu et al (2019) (7)* found that only 68.7% of physiotherapists acknowledged their potential role in disaster management. Conversely, in the only eligible study involving rehabilitation nurses, *Kalanlar et al (2021) (45)* surveyed nurses in a single hospital in Turkey and found that whilst most respondents felt they had a role to play in disaster response, 72% of the nurses had no experience of disaster work, and 94% felt that they need training in disaster rehabilitation.

*He et al (2011) (51)* described the implementation of a program to teach basic rehabilitation skills to rapidly increase rehabilitation capacity for earthquake victims, and suggests it could rapidly increase rehabilitation capacity in future emergencies. However, the program outcomes, costs, implementation challenges, and sustainability were not described. Box 2 summarizes recommendations of studies focusing on workforce with the top 3 most referenced recommendations listed foremost: 1) entry level and post graduate practical training to develop disaster management knowledge and skills (50) (7) (45) (51); 2) professionals and their organisations should be involved in shaping disaster policy and advocacy (7, 47, 49), and 3) creating an awareness of the role of rehabilitation disaster among the public and other healthcare professionals (7) (50) (47).

## Box 2 Summary of recommendations from the workforce studies

- 1) entry level and post graduate practical training to develop disaster management knowledge and skills
- 2) professionals and their organisations should be involved in shaping disaster policy and advocacy
- 3) creating an awareness of the role of rehabilitation disaster among the public and other healthcare professionals
- Entry level and post graduate practical training to develop disaster management knowledge and skills (50) (7) (45) (51)
- Professionals and their organizations should be involved in shaping disaster policy and advocacy (7, 47, 49)
- Create an awareness of the role of rehabilitation disaster among the public and other healthcare professionals (7) (50) (47)
- Focus on rural areas and services in primary health and community care (7) (47)
- Establishing of government policies on the integration of rehabilitation in disaster management (7)
- Funding to employ rehabilitation workers in government facilities (47)
- Mental health support training (50)

Table 3 Summary of the workforce results
<table>
<thead>
<tr>
<th>Title</th>
<th>Aims</th>
<th>Country</th>
<th>Disaster</th>
<th>Type of study</th>
<th>Target group</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation, roles, and responsibilities of Filipino occupational therapists in disaster preparedness, response, and recovery (50)</td>
<td>To describe the roles, responsibilities and work of Filipino occupational therapists in disaster management</td>
<td>Philippines</td>
<td>Non-specific</td>
<td>Descriptive cross-sectional</td>
<td>24 occupational therapists with experience working in disasters</td>
<td>The roles most frequently performed were encouraging social interactions among survivors, providing mental health services to survivors and attending trainings in disaster response.</td>
</tr>
<tr>
<td>Knowledge, practices and perceived barriers of physiotherapists involved in disaster management: a cross-sectional survey of Nigeria-based and trained physiotherapists (7)</td>
<td>To investigate the knowledge, practices and perceived barriers regarding the role of physiotherapists in disaster management among Nigeria-based and trained physiotherapists.</td>
<td>Nigeria</td>
<td>Non-specific</td>
<td>Descriptive cross-sectional</td>
<td>50 registered physiotherapists with at least 1 year of work experience</td>
<td>68.7% of physiotherapists acknowledged their potential role in disaster management, but only 6.7% had experience, with 90% citing a lack of established government policies on the integration of physiotherapists into disaster management as a barrier. Involvement of physiotherapy during disasters is limited by financial, workforce, equipment, training, awareness and resource constraints.</td>
</tr>
<tr>
<td>Rehabilitation nurses’ opinions on disaster rehabilitation services, their training needs and perceptions of preparedness for disasters (45)</td>
<td>To assess rehabilitation nurses’ perceptions of disaster preparedness and response, and to identify rehabilitation nurses’ training needs.</td>
<td>Turkey</td>
<td>Non-Specific</td>
<td>Descriptive cross-sectional</td>
<td>50 female rehabilitation nurses</td>
<td>Participants mostly agreed that rehabilitation nurses have a role in disaster response, but 72% of them had no experience of disaster work and 94% felt that they need training in disaster rehabilitation. 90% were eager to receive training on this topic.</td>
</tr>
<tr>
<td>Occupational therapy role in disaster management in Bangladesh (49)</td>
<td>To investigate the numbers and role of occupational therapists who have worked in disaster management in Bangladesh.</td>
<td>Bangladesh</td>
<td>Non-specific</td>
<td>Observational</td>
<td>3 occupational therapists who had disaster response experience</td>
<td>There are very few OTs working in disaster management in Bangladesh. The 3 participants who respond</td>
</tr>
</tbody>
</table>
The Urgent Rehabilitation Technique Education Program for Wenchuan earthquake (51)  
To describe the activities of the specialist forum for the patients injured in the earthquake  
China  Wenchuan 2008 earthquake  Case report  1500 hospital workers in the most earthquake prone areas  
The short-term program developed covered the basic clinical technical trainings in physiotherapy, occupational therapy, prosthetics and orthotics to rapidly upscale rehabilitation service capacity for earthquake victims.

Physiotherapy in Haiti: A qualitative study exploring local clinicians’ perspectives (47)  
To describe the strengths, weaknesses, opportunities and threats to the development of physiotherapy Haiti after the 2010 earthquake  
Haiti  2010 earthquake  Descriptive study  4 physiotherapists and 1 rehabilitation technician  
Respondents identified the lack of funding to be the main barrier: funding to create employment opportunities for rehabilitation professionals, and for the population to be able to access affordable physiotherapy services.

Health information systems

Three studies from 2 countries fulfilled the criteria for the health information systems category (Table 4), all of them relating to earthquakes. Evidence shows that disasters can result in significant disability (52) and a significant need for rehabilitation, assistive technology, and community modifications due to environmental barriers or earthquake damage (53, 54). Box 3 summarizes recommendations of studies focusing on health information systems with the most referenced recommendation being that provision of early and appropriate rehabilitation, which includes psychological support and assistive technology, is essential.

**Box 3 Summary of recommendations from the included health information systems studies**

- **Provision of early and appropriate rehabilitation with psychological support (52-54)**
- **Assistive technology and splints must be provided for (53) (54)**
- **Focus on vulnerable populations needing specialist care, such as the elderly and children (53)**
- **Community functional rehabilitation services (54)**
- **Education and advocacy on the role of rehabilitation (54)**
- **Capacity for patient home visits, environmental modifications and equipment (54)**
<table>
<thead>
<tr>
<th>Title</th>
<th>Aims</th>
<th>Country</th>
<th>Disaster</th>
<th>Type of study</th>
<th>Target group</th>
<th>Findings</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impairment and functional status of people with disabilities following Nepal earthquake 2015 (52)</td>
<td>To investigate the disability status of earthquake survivors a year after the earthquake.</td>
<td>Nepal</td>
<td>2015 earthquake</td>
<td>Observational cross-sectional survey</td>
<td>29 persons with disability in the Bahunepati area</td>
<td>The average percentage score of disability, calculated by the WHODAS 2.0 scoring guidelines was an average of 56%. One year after the earthquake, the number of people with disabilities was few, but the level of disability among them was high.</td>
<td>Evaluation</td>
</tr>
<tr>
<td>Epidemiological analysis of trauma patients following the Lushan earthquake (53)</td>
<td>To analyze the earthquake injury characteristics and treatments.</td>
<td>China</td>
<td>2013 Lushan earthquake</td>
<td>Observational study</td>
<td>2010 patients admitted to hospitals with earthquake related injuries</td>
<td>70.5% patients had limb dysfunction. For 60% of these, rehabilitation records could be found and the median time to start rehabilitation was 1 week and the median duration was 3 weeks. 508 patients required assistive technology devices</td>
<td>Implementation</td>
</tr>
<tr>
<td>Rehabilitation needs of the survivors of the 2013 Ya’an earthquake in China (54)</td>
<td>To determine the physical, functional and psychosocial rehabilitation needs of those injured</td>
<td>China</td>
<td>2013 Ya’an earthquake</td>
<td>Observational survey</td>
<td>143 survivors with lower limb and spinal fractures</td>
<td>74.8% required rehabilitation, 44.8% needed splints and 45.5% needed home modifications. There was a high need for assistive devices and home and community modifications due to environmental barriers or earthquake damage.</td>
<td>Implementation</td>
</tr>
</tbody>
</table>

**Leadership and governance**

Three policy studies from Iran, Nepal and the Philippines were categorized under leadership and governance (Table 5), all documenting professional organisations’ attempts to develop national rehabilitation disaster preparedness plans. These studies suggest that disaster preparedness and response activities are likely driven from the ‘bottom up’ in the absence of policy, and indicate a possible lack of awareness of rehabilitation in disasters at national coordination levels.

Ardalan et al (2016) (55) described the process of developing a comprehensive disaster preparedness plan for rehabilitation in Iran and identified that information sharing, advocacy in the media, workforce education, and availability of funding were the best methods for improving stakeholders’ participation and collaboration in formulating a rehabilitation disaster plan. Inadequate basic services provided by unqualified staff had the greatest negative impact on formulating a rehabilitation disaster response plan. Reflecting on the 2015 earthquake, the Nepal physiotherapy association (8) made recommendations for future disaster response planning and concluded that the immediate activation of the pre-established rehabilitation subcluster played a key role in coordinating the earthquake response and then implementing a long-term rehabilitation strategy that included community services for those in remote locations or who had lost their
homes. They emphasized that coordination and strong leadership are essential for effective response, and that professional associations should be consulted. Box 4 summarizes recommendations of studies focusing on leadership and governance with the most referenced recommendations listed being: 1) Advocacy on the role of rehabilitation professionals (44) (55) (8) and 2) rehabilitation professionals and community health workers should be involved in drafting of disaster response plans (8, 44, 55).

**Box 4** Summary of recommendations from the leadership and governance results

- **Advocacy on the role of rehabilitation professionals (44) (55) (8)**
- **Rehabilitation professionals and community health workers should be involved in drafting of disaster response plans (8, 44, 55)**
- Government policy makers should be involved in formulating rehabilitation disaster plans to ensure integration of rehabilitation into overall disaster response (44, 55)
- Acute trauma rehabilitation should be incorporated into undergraduate rehabilitation courses, with a particular focus on spinal injuries and amputees, triaging of patients, first aid, and; application of plaster casts (8, 44)
- Each organisation should be given extensive pre and post disaster tasks to avoiding misunderstandings and improve coordination (44, 55)
- A system should be developed to evaluate the implementation any rehabilitation plan, using valid and reliable indicators (55)
- Early establishment of a rehabilitation subcluster to support disaster response (8)
- General systems strengthening is imperative (8)
- Allocation of funds for disaster training (44)

**Table 5** Summary of the leadership and governance results
<table>
<thead>
<tr>
<th>Title</th>
<th>Aims</th>
<th>Country</th>
<th>Event</th>
<th>Type of study</th>
<th>Participants</th>
<th>Findings</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responding to physical and psychological health impacts of disasters: case study of the Iranian disaster rehabilitation plan (55)</td>
<td>To report the process of developing a comprehensive pre-disaster plan for physical and psychological rehabilitation Iran.</td>
<td>Iran</td>
<td>Non-specific</td>
<td>Case report</td>
<td>80 health disaster experts working in 34 governmental and nongovernmental organizations.</td>
<td>Sharing information, education, workforce training and funding were identified as the best methods of improving stakeholders’ participation and collaboration in formulating a disaster plan. Inadequate basic services with unqualified staff had the greatest negative impact.</td>
<td>Policy</td>
</tr>
<tr>
<td>The role of physical therapists in the medical response team following a natural disaster: Our experience in Nepal (8)</td>
<td>To describe the PT role in the response, and recommendations for future planning.</td>
<td>Nepal</td>
<td>2015 earthquake</td>
<td>Case report</td>
<td>Nepal Physiotherapy Association</td>
<td>The immediate activation of the pre-established rehabilitation subcluster played a key role in coordinating the earthquake response and implementing a long-term rehabilitation strategy that included community services for those in remote locations, or who had lost their homes. Coordination and strong leadership are essential at all levels. National associations are well placed to support both national and local planning.</td>
<td>Policy</td>
</tr>
<tr>
<td>Development of a national occupational therapy disaster preparedness and response plan: the Philippine experience (44)</td>
<td>To describe the process to produce the national occupational therapy Philippine disaster preparedness and response plan and to document the challenges of the task.</td>
<td>Philippines</td>
<td>Non-specific</td>
<td>Descriptive report</td>
<td>Occupational therapists, community development workers and organizations of persons with disabilities.</td>
<td>A national workshop took place and a disaster response plan and framework were produced to highlight the role occupational therapists should play in disaster response, and plans made to incorporate them into disaster response and to build up workforce capacity.</td>
<td>Policy</td>
</tr>
</tbody>
</table>
Discussion

This scoping review synthesised the evidence on the preparedness of health systems in LMICs to respond with rehabilitation services and assistive technology to the demand associated with conflict and disasters situations. Additionally, we summarized recommendations about rehabilitation provision identified in the gathered literature. The body of literature was found to be rather small, and the findings of the included 27 studies demonstrate that literature on rehabilitation integration in disaster response and preparedness in LMICs is limited across all health systems building blocks. Studies focusing on service delivery were the most cited of all the building blocks, perhaps a result of requests for evaluation and achievement reporting.

Importantly, the results are not indicative of a lack of need for rehabilitation services and assistive technology in disasters, but rather of the lack of widely available literature published in English on the topic, or a lack of access to it. It has been suggested that the scarcity of literature highlights the gap between service delivery and evaluation of interventions, and that further research is needed on measurement strategies, accountability mechanisms, and patient-centered approaches in humanitarian settings (57). The paucity of evidence hinders advocacy efforts for rehabilitation in disaster settings and limits the sharing of experiences and lessons learnt to improve rehabilitation preparedness and response.

The substantial number of studies (n = 17) published on earthquakes could be due to the large media and political attention earthquakes receive, possibly making them more attractive for researchers and easier to gain funding and support for. Most studies (15) addressed service delivery, what is expected considering that rehabilitation need requests service provision, and disaster and conflict situations create demand. Additionally, our searches indicate that there is a lack of data collected on the need for rehabilitation in disasters, and consequently, there is a lack of evidence to support investing resources and actions to develop rehabilitation response plans. The four most prominent recommendations were: the provision of early and multi-professional rehabilitation, including assistive technology, psychological support, and integrated community services; disaster response specific training for rehabilitation professionals; advocacy efforts to create awareness of the importance of rehabilitation in disasters, and; the integration of rehabilitation into disaster preparedness and response.

Service Delivery

The literature categorised under service delivery stressed the vital role of early rehabilitation and long-term rehabilitation and assistive technology needs for victims, while underlining that emergency provision can only be successfully provided if developed rehabilitation services already exist in the health system. Furthermore, areas commonly already a weak point in the general rehabilitation health system, access to psychological support and community rehabilitation services were also strongly recommended as part of service delivery emergency response. The literature highlighted that underdeveloped rehabilitation services limit effective emergency response, and suggested that the existing unmet rehabilitation need, coupled with the new disaster need and subsequent media and political attention received, could provide a catalyst for the development of sustainable rehabilitation services, if advocacy efforts strong (6).

Workforce

Developing the rehabilitation workforce is fundamental to any disaster response (56). A significant barrier to providing rehabilitation services in disasters is the lack of trained rehabilitation professions (7, 57). This review’s findings agree with the wider body of literature demonstrating poor awareness by professionals of the role they can play in disasters, and a lack of training (58). Rehabilitation 2030 (30) and the Sustainable development goal 3C (59) call for a substantial increase in health financing, recruitment, development, training and retention of the health workforce. More specifically, WHO calls for the expansion of rehabilitation workforce production and the strengthening of regulations and quality assurance mechanisms to upscale accessibility to quality rehabilitation services (60).

Health Information Systems

The very limited evidence categorised under the health information systems building block is a symptom of the magnitude of challenges faced when attempting to collect quality data in disaster situations, when the focus is on saving lives in chaotic, austere situations (61). Poor medical record keeping, the lack of assessment tools (58) and evidence on best practice in disaster contexts presents another barrier (62). The challenge in conducting rigorous trials and collect data in complex and surprise disaster settings cannot be underestimated, and support and resources are needed to facilitate such projects. This may explain why there were no studies found on conflict, where the rehabilitation need is high and safety uncertain (63).
Assistive Technology

Our searches found no study focused on assistive technology in disaster contexts, but 7 of the 27 included studies recommended the provision of assistive technology. The absence of focused literature is surprising given the high and growing levels of unmet need for assistive technology during crises (62). This finding may be due to assistive technology sometimes being an afterthought of rehabilitation and lacking quality and appropriate prescription (64). Provision of assistive technology in disaster contexts is limited by the lack of guidance on how to identify assistive technology needs in environments with little or no existing systems for provision (62). However, it is encouraging that evidence of the need and provision of assistive technology in disaster contexts is emerging, and is supported by the United Nations Convention on the Rights of Persons with Disabilities formalizing the legal requirement to provide assistive technology to those who need it (65).

Financing

It was unsurprising that this review found no studies that even mentioned the financing of rehabilitation or assistive technology in disaster contexts. Poor awareness of rehabilitation and assistive technology means that the development of services are rarely a government priority. Too often no coordination mechanisms or responsible officer exist, and consequently financing is limited or absent (66, 67).

Leadership

Finally, the literature presents efforts in Iran, Nepal and the Philippines to create rehabilitation disaster response frameworks. However, the success, acceptability, and viability of progress with implementing these frameworks is yet to be evaluated in subsequent literature.

The secondary aim of the review was to summarize recommendations identified in the gathered literature. Early, multi-professional rehabilitation with assistive technology provision, that expanded into community services and included psychological support for patients were frequently recommended as priority areas for service delivery. Training for rehabilitation professionals to prepare them for disaster work was also highlighted often as a priority need. Strong advocacy efforts to create awareness of the need, and importance of rehabilitation in disasters, and the need of including rehabilitation in health strategy disaster preparedness and response, were consistently recommend across studies.

In summary, the results from this scoping review suggests the following 4 priority areas for policy implications; the provision of early and multi-professional rehabilitation, including assistive technology, psychological support, and integrated community services; disaster response specific training for rehabilitation professionals; advocacy efforts to create awareness of the importance of rehabilitation in disasters, and; the integration of rehabilitation into disaster preparedness and response. There are several resources (12–15, 30) and communities such as the WHO World Rehabilitation Alliance available to assist with implementing these recommendations.

Limitations of this Review

Relevant studies may have been missed from this review as only studies available in English could be considered, and not all reports may be publicly available. Relevant work may be in progress but not yet published, and in some instances, resources may not be available to publish articles providing details on activities. It would have been relevant to include country disaster management plans, but their identification could have been difficult, and they would have been likely to be either not be publicly available or, are published in languages other than English. Where rehabilitation services are yet to be developed within health system, rehabilitation is unlikely to feature in disaster management plans.

Conclusion

The findings of this systematic review demonstrate that rehabilitation is poorly integrated into health systems disaster preparedness and response in LMICs, largely due to low awareness of rehabilitation, undeveloped existing rehabilitation health systems, as well as a lack of rehabilitation professionals, and disaster specific training for them. The lack of evidence, demonstrating the rehabilitation and assistive technology need, and effective responses in disasters, is limiting advocacy efforts and the development of services in disasters. Reporting on the need and evaluation of responses to disasters from the field is essential for preparing feasible and meaningful preparedness plans.

Disasters can be an opportunity to develop rehabilitation within national health systems, but advocacy efforts are needed. The main recommendations collected in this review suggest priority areas of actions to develop rehabilitation services in disasters.

Declarations
Ethics approval and consent to participate – Not Applicable

Availability of data and materials – The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Consent for publication – Not Applicable

Competing interests – All The authors declare no competing interests

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JG, RM, ALL and CS wrote and reviewed the manuscript.

JG and RM planned the search strategy, eligibility checks, data extraction and data synthesis.

ALL reviewed the analysis.

JG conducted the search, eligibility checks, data extraction and data synthesis.

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Figures
Figure 1

PRISMA 2020 flow diagram (28)