Open Access Publish Free

http://jept.ir
doi:10.34172/jept.1836

Journal of Emergency Practice and Trauma
J Emerg Pract Trauma 2025;11(1):39-46

Original Article

# Design and Validation of an Instrument for Assessing the Preparedness of Hospital Emergency Departments in Response to Disasters and Emergencies: A Mixed-Method Qualitative Study

**Farzad Rahmani[1], Masoumeh Abbasabadi Arab[2], Samira Shasti[3], Ali Jafari-Khounigh[4], Faramarz Delfarah[5], Javad Babaei[6], Abazar Fathollahzadeh[6,1*]**

[1]Health Services Management Research Center, Tabriz University of Medical Sciences, Tabriz, Iran
[2]Prehospital Emergency Medicine Research Center, National Emergency Organization, Tehran, Iran
[3]National Emergency Organization, Tehran, Iran
[4]Road Traffic Injury Research Center, Tabriz University of Medical Sciences, Tabriz, Iran
[5]Emergency and Trauma Research Center, Tabriz University of Medical Sciences, Tabriz, Iran
[6]Department of Health in Disaster and Emergencies, Tabriz University of Medical Sciences, Tabriz, Iran

**Received:** October 17, 2025
**Accepted:** May 5, 2026
**ePublished:** June 7, 2026

***Corresponding author:**
Abazar Fathollahzadeh,
Email: fabazar7@gmail.com

**Citation:** Rahmani F, Abbasabadi Arab M, Shasti S, Jafari-Khounigh A, Delfarah F, Babaei J, et al. Design and validation of an instrument for assessing the preparedness of hospital emergency departments in response to disasters and emergencies: a mixed-method qualitative study. J Emerg Pract Trauma 2025;11(1):39-46. doi:10.34172/jept.1836

## Abstract

**Introduction:** Hospitals are among the critical infrastructures of society that must continue to provide services under all circumstances. Hospital safety is one of the essential components of disaster and emergency management, and its observance enhances hospital preparedness and maintains its structure and function during crises. To assess the level of readiness and performance of hospitals in dealing with disasters and emergencies, it is necessary to identify and extract the key indicators of hospital preparedness. Therefore, this study aimed to develop and validate a checklist for assessing the preparedness of hospital emergency departments in responding to disasters and emergencies.

**Methods:** This qualitative study was conducted using a mixed-method approach at Tabriz University of Medical Sciences in 2024–2025. In the first stage, articles related to hospital emergency preparedness in disasters were identified through searches in databases, including Science Direct, Google Scholar, Medline, Web of Science, EMBASE, PubMed, SID, and Magiran. Dimensions and criteria of the preparedness checklist were extracted from these studies. In the second stage, based on the findings from the literature review and expert opinions, a preparedness assessment checklist was developed. To verify content validity, the opinions of 22 experts in the field of disaster and emergency management were obtained and CVI (Content Validity Index) and CVR (Content Validity Ratio) were calculated. To determine reliability, the intraclass correlation coefficient (ICC) was used, and to determine internal consistency reliability, the Cronbach coefficient alpha (Cronbach's alpha) was calculated for each factor and the entire instrument.

**Results:** Through qualitative content analysis, a total of 85 items were initially extracted. After reviewing overlaps and evaluating content validity, the number of items was reduced to 79. The results indicated that all items had acceptable CVR values, confirming their appropriateness. Moreover, the CVI values for all items were above 0.79, indicating satisfactory content validity. Reliability testing yielded a Cronbach's alpha coefficient of 0.83 and an intra-class correlation coefficient (ICC) of 0.82 in the test–retest analysis, confirming the instrument's internal consistency and stability.

**Conclusion:** The developed checklist is a valid and reliable tool for assessing the preparedness of hospital emergency departments in dealing with disasters and emergencies. Utilizing this instrument enables managers and policymakers to identify strengths and weaknesses within their emergency departments and take corrective measures to enhance preparedness. Furthermore, it provides a standardized tool for benchmarking and harmonizing hospital emergency preparedness at the national level.

**Keywords:** Hospitals, Preparedness, Disasters, Hospital preparedness, Emergency service

## Introduction

Hospitals are among the most critical centers for delivering healthcare services during disasters and emergencies. One of the key objectives of the third millennium development

program is to safeguard healthcare facilities, especially hospitals. As primary organizations involved in disaster response, hospitals are considered essential infrastructures that must remain operational and accessible both during and after disasters. In many communities, hospitals and major healthcare centers carry greater importance than other vital facilities and hold significant symbolic, political, and social value for society (1). However, due to the lack of established management structures and insufficient emphasis on training programs and preparedness activities, these healthcare centers are vulnerable to multiple risks and functional disruptions. Consequently, hospital preparedness is a fundamental component of disaster management strategies and should be guided by standardized protocols (2).

Today, hospital safety and maintenance are critical components of healthcare management, carrying significant economic, human, and ethical implications. Adhering to these principles in hospitals—environments highly vulnerable to various incidents—enhances effectiveness, efficiency, and productivity, ultimately producing positive outcomes for patients, staff, and stakeholders (3, 4).

Iran's geography and climate make it highly susceptible to disasters, including floods, earthquakes, and accidents. These events often overwhelm hospital systems. Lack of disaster planning, unprepared hospitals, and inadequate staff training can cause irreparable damage to the healthcare system. Studies indicate low emergency and disaster preparedness among Iranian hospitals (5, 6).

Every year, hundreds of hospitals and other healthcare facilities worldwide are either destroyed or rendered non-functional due to natural disasters (7). When hospitals sustain damage during such events, their ability to provide essential healthcare services is compromised, leading to a secondary crisis. Therefore, maintaining hospital functionality during disasters is crucial. Hospital safety holds significant social, health, and economic value (8). The destruction or inoperability of hospitals—especially in the absence of alternative healthcare facilities—can invoke feelings of insecurity and social instability (9). A study conducted between 2005 and 2006 on hospital safety in the United Kingdom documented 1487 major and 10,426 minor injuries caused by safety deficiencies (10). In Iran, significant damage to medical facilities was observed during the 2012 earthquake, notably in Bam, as well as in hospitals in Ahar, Heris, and Varzeghan. One contributing factor to these damages is the lack of comprehensive hospital standards for disaster preparedness and response (11).

Therefore, hospitals must have a pre-developed operational plan for effective crisis response. The absence of such a plan can lead to increased disorder and confusion (9). Past experiences in Iran have shown that managing the consequences of disasters remains a major challenge for healthcare administrators. The national disaster management system has continuously faced serious difficulties (12, 13). Various studies (5, 14, 15) have addressed this issue. For instance, Abbasabadi et al. examined accreditation standards related to disaster risk management in hospitals and reported that the status of disaster management, especially in border regions, is not satisfactory. The main weaknesses identified included a lack of scientifically developed preparedness and response plans, limited awareness of national guidelines, insufficient training and drills, non-structural vulnerabilities, and inadequate infrastructures. Strengthening hospital safety and resilience, improving managerial and staff knowledge and skills, and continuously reviewing and upgrading standards based on emerging challenges were proposed as key strategies to enhance hospital preparedness (13).

In recent years, one of the most significant developments affecting managerial systems has been the implementation of evaluation and performance monitoring frameworks. Today, various tools and methods are used to measure organizational performance, and when applied properly and continuously, they improve efficiency and effectiveness (16). One of these tools is the design and development of checklists, which can serve as practical instruments for large-scale performance monitoring of healthcare centers.

Since no comprehensive checklist has yet been developed in Iran to assess hospital emergency departments' preparedness for disasters, this study was designed to develop and validate a comprehensive assessment tool for evaluating the preparedness of hospital emergency departments in disaster situations. Using this standardized and reliable tool as a unified national framework would enable precise and effective assessment of emergency departments across the country and facilitate strategic planning to improve their disaster preparedness.

## Methods

This was a qualitative study with a mixed-method approach conducted at Tabriz University of Medical Sciences from October 2024 to August 2025 after approval by the ethics committee (IR.TBZMED.REC.1403.328). In this study, a tool was designed to assess the preparedness of hospital emergency departments in accidents and disasters.

The first stage of the study was conducted as a scoping review. At this stage, the review was conducted over a 15-year period from 2010 to 2024. In order to obtain as much relevant literature as possible, we used a broad search strategy. The international databases PubMed, Scopus, and Web of Science, as well as the Google Scholar search engine, were used to find articles and scientific sources for this study. Search keywords included MeSH terms and common keywords related to the subject under study, including "Preparedness," "Emergency response," "Disasters," "Emergency Department," "Hospital Preparedness," "Response to disasters," "Hospital Preparedness Checklist," "Emergency Hospital Preparedness," "Emergency Preparedness," and "Hospital Preparedness Tools." The inclusion criteria included all studies conducted in the field of hospital emergency preparedness in disasters in Persian and English, and the

exclusion criteria included studies published before 2010 and sources without full text.

In the second stage, through interviews with experts in this field, localized criteria for hospital preparedness were identified. At this stage, 22 experts in this field (Table 1) were selected and unstructured interviews were conducted with them. The data were recorded with informed consent and analyzed through conventional qualitative content analysis so that the different dimensions of the checklist were extracted as an initial draft using the extracted dimensions and other studies. To develop the conceptual framework, individuals who had sufficient information and experience in the field of the phenomenon in question were selected. For this purpose, purposive sampling was used in the qualitative section, and to obtain a wider range of data, professors from emergency medicine, nursing, general practitioners, specialist physicians, disaster and emergency health, and health services management were selected.

To determine the validity of the assessment tool for hospital emergency department readiness in response to incidents and disasters, content validity and face validity methods were used. The purpose of content validity is to ensure the tool's ability to measure the concept it claims to assess (17).

In the present study, for qualitative content validity, 15 experts were asked to qualitatively review the checklist content and provide their feedback. For this purpose, the researcher provided the designed tool along with an explanatory sheet to the mentioned experts. During the qualitative content review, the experts (expert panel) were requested to evaluate the tool based on criteria such as adherence to grammatical rules, use of appropriate words, placement of items in their proper positions, and appropriate scoring. They were then asked to give feedback so that necessary revisions could be made.

For quantitative content validity, the Content Validity Ratio (CVR) and content validity index (CVI) were calculated (18). CVR was used to ensure the necessity of each question, and CVI was used to confirm the relevance of the items.

To determine the content validity of the questionnaire, the tool was sent to 15 purposively selected experts in related fields at Tabriz University of Medical Sciences. They were asked to evaluate each item based on a three-point scale: "Essential," "Useful but not essential," and "Not necessary." Then, the responses were calculated according to the following formula:

$$R = \frac{ne - N/2}{N/2}$$

In this context, *ne* is the number of experts who rated the item as "essential," and *N* is the total number of experts (15 individuals). According to Lawshe's table for 15 evaluators, if the calculated ratio was less than 0.49, the item was removed; otherwise, it was retained in the tool (19).

The content validity index (CVI) for each item was determined based on the relevance of each question using a 4-point scale: 1 (Not relevant), 2 (Somewhat relevant), 3 (Relevant), and 4 (Highly relevant). Similarly, the simplicity of each item was rated from 1 (Complex) to 4 (Very simple), and the clarity was rated from 1 (Not clear) to 4 (Completely clear).

The CVI score was computed by dividing the number of experts who gave the item a rating of 3 or 4 by the total number of experts. A score of 0.79 was considered the minimum acceptable value.

- Items with a CVI greater than 0.79 were retained without change.
- Items with a CVI between 0.70 and 0.79 were revised.
- Items with a CVI less than 0.70 were removed (20).

Qualitative and quantitative methods were used to assess face validity. for qualitative face validity, face-to-face interviews were conducted with 10 individuals from the target population. During these interviews, the difficulty level, appropriateness, and ambiguity of the items were examined. Based on their feedback, minor revisions were made to the questionnaire. In the next step and to reduce or remove inappropriate items and determine the importance of each item, the quantitative method of item impact score was used. For this purpose, 10 experts and

**Table 1.** Demographic and social characteristics of participants in the study

| Demographic characteristics | Number (%) | Demographic characteristics | Number (%) |
|---|---|---|---|
| Age | | Gender | |
| 30–39 | 10 (45.5%) | Male | 14 (63.5%) |
| 40–60 | 12 (54.5%) | Female | 8 (36.5%) |
| Work experience (years) | | Workplace | |
| 5–10 | 6 (27.3%) | Hospital Emergency Department | 7 (31.8%) |
| 10–15 | 11 (50%) | University Disaster and Emergency Management Center | 7 (31.8%) |
| 15–20 | 3 (13.6%) | Hospital Emergency Department, Ministry of Health | 3 (13.6%) |
| 20–30 | 2 (9.1%) | Hospital Disaster Management Committee Secretary | 5 (22.7%) |
| Educational level | | | |
| PhD in Health Services Management | 3 (13.6%) | Master's degree | 7 (31.8%) |
| Emergency medicine specialist | 3 (13.6%) | General practitioner | 3 (13.6%) |
| Cardiology specialist | 2 (9%) | PhD in Disaster and Emergency Health | 4 (18.2%) |

specialists were asked to rate the importance of each item on a 5-point Likert scale "Completely important" (score 5), "Important" (score 4), "Moderately important" (score 3), "Slightly important" (score 2), and "Not important at all" (score 1). The impact score for each item was calculated using the following formula:

Impact Score = Importance × Frequency (percentage)

Items with an impact score equal to or greater than 1.5 were considered appropriate. Since all obtained impact scores for the items were greater than 1.5 (mean score: 4.69), all items were retained for further analysis.

Reliability of the instrument was assessed using internal consistency and test–retest stability methods. Cronbach's alpha coefficient was calculated to determine internal consistency, which reflects the degree of interrelatedness among items measuring the same construct. A minimum alpha value of 0.70 was considered acceptable (21). For test–retest reliability, the intraclass correlation coefficient (ICC) was computed to evaluate the stability of the instrument over time. The ICC indicates the level of agreement between two measurements of the same variable in the same sample at two different times (22). To assess this, the validated questionnaire was administered twice to 32 participants in East Azerbaijan Province, with a two-week interval between administrations. The results were then analyzed to determine the instrument's stability.

## Results

### *Questionnaire Development*

Initially, terms and concepts related to hospital preparedness (relevant MeSH terms) were extracted through a comprehensive literature review. Searches were conducted in international and Iranian databases covering the period 2003–2023. Redundant concepts were removed, and similar concepts were merged. Core domains were identified, and preliminary items were formulated for each domain. To enrich content, 22 subject-matter experts from cardiology, emergency medicine, disaster and emergency health, general medicine, nursing, and management participated in two specialized panels. Through group discussions, additional items were proposed. The resulting initial questionnaire comprised 83 items across 13 domains.

### *Face Validity*

To assess face validity qualitatively, face-to-face interviews were conducted with 10 individuals from the target population. Their feedback was obtained regarding the level of difficulty, relevance, and ambiguity of the items. Based on their suggestions, minor modifications were made to the questionnaire. In the next step, to assess face validity quantitatively and to reduce or eliminate inappropriate items and determine the importance of each item, the "item impact score" method was used. For this purpose, 10 experts evaluated each item based on its level of importance. The impact score for each item was calculated using the following formula: Impact Score = Importance × Frequency (%). Items with an impact score equal to or greater than 1.5 were considered appropriate. Given that the impact scores for all items—except for four questions—were greater than 1.5 (mean score: 4.69), 79 items were retained for further analysis.

### *Content Validity*

To determine content validity, both qualitative and quantitative methods based on expert judgment were employed. In the qualitative assessment, interviews were conducted with 10 specialists in emergency medicine, nursing, and emergency medical services. They were asked to evaluate the questionnaire based on criteria such as adherence to Persian grammar rules, use of appropriate terminology, relevance and importance of the items, their placement in the correct domain, and the scoring method. Their feedback was incorporated into the questionnaire. In the quantitative assessment, content validity ratio (CVR) results indicated that all items achieved acceptable CVR scores and were therefore deemed appropriate. Furthermore, content validity index (CVI) results showed that all items had CVI scores above 0.79, confirming their appropriateness. The CVR and CVI results for the questionnaire items are presented in Table 2.

### *Reliability*

To assess the internal consistency of the questionnaire, Cronbach's alpha coefficient was calculated. An alpha value of ≥ 0.70 was considered satisfactory (23). Based on this criterion, the Cronbach's alpha for the entire questionnaire was 0.83. To evaluate the stability of the questionnaire, a test–retest reliability assessment was conducted by re-administering the questionnaire to 32 participants over a two-week interval, and the intra-class correlation coefficient (ICC) was calculated (24). The test–retest reliability for the overall questionnaire was 0.82, with subscale values ranging from 0.71 to 0.92.

## Discussion

The present study aimed to design a comprehensive, scientific, and practical checklist to assess the readiness and operational capacity of hospital emergency departments (EDs) during disasters and emergencies. Based on the results of the study and the opinions of experts in the field of emergencies and disasters, there are many components that are effective in the emergency preparedness of hospitals. In the present study, 79 indicators effective in the preparedness of hospitals were identified. After discussion and review, they were categorized into 17 domains. Most of these domains were in the functional and emergencies management fields, and the remaining domains are related to non-structural issues.

One of the most significant domains identified was increasing ED capacity, which encompasses physical space, equipment, and human resources. Capacity in emergencies is a fundamental element of disaster preparedness programs and can assist hospital managers in preparing for the reception of a large number of

**Table 2.** Results of content validity assessment (CVI and CVR) of the hospital emergency preparedness assessment checklist for emergencies and disasters

| Domain | Assessment Items | CVI | CVR |
|---|---|---|---|
| Environmental safety | Safety of floors, walls, windows, flooring, entrance and exit doors, etc., in the emergency department (ED) is ensured. | 1 | 1 |
| | Emergency exit doors are fire-, impact-, and smoke-resistant, open outward, and free of obstacles to crowd movement. | 1 | 1 |
| | All equipment, cabinets, shelves, and panels are fixed to walls or designated locations according to standards. | 1 | 1 |
| | ED storage areas are managed safely. | 1 | 1 |
| | Records of periodic inspections of surfaces, walls, and ED equipment show timely interventions to address deficiencies. | 1 | 1 |
| Facility and equipment safety | Safety in the use of medical gases in the ED is implemented according to the Ministry of Health guidelines. | 1 | 1 |
| | Electrical equipment safety (e.g., electrical panels, isolated panels in operating rooms, and specialized units) is established and adhered to. | 1 | 1 |
| | Guidelines for elevator use during fires or emergency evacuation are prepared. | 1 | 1 |
| | Records of periodic inspections of ED facilities and equipment show timely interventions. | 0.88 | 0.93 |
| Fire safety | Firefighting equipment (fire extinguishers, fire boxes, etc.) is clearly marked and accessible throughout all areas. | 1 | 1 |
| | Smoke/heat-sensitive fire detection and alarm systems are functional and in use. | 1 | 1 |
| | Safe and clearly marked evacuation routes are accessible at all times. | 0.91 | 0.94 |
| Security | Security measures, including physical structures, barriers, access control, locks, alarms, and CCTV in key ED areas, are in place. | 1 | 1 |
| | ED storage areas for medicines and equipment have security programs implemented. | 1 | 1 |
| | Safety programs for communication systems (computer networks, ED site, and HIS) are established, implemented, and updated. | 1 | 1 |
| Training and drills | Needs assessment and general training for all staff (at onboarding and during service) in disaster and hazard management are conducted annually according to a plan. | 1 | 1 |
| | ED nursing staff have completed START and JUMP START triage training. | 0.92 | 0.94 |
| | ED staff have undergone fire safety training and drills. | 1 | 1 |
| | Specialized training is provided for staff with key roles in incident management according to their duties. | 1 | 1 |
| | Selected clinical staff (team) have received CBRN decontamination and patient care training. | 1 | 1 |
| | ED staff and managers are aware of their performance expectations during crises. | 1 | 1 |
| | Drills involving physicians, managers, nurses, and other personnel are conducted annually. | 1 | 1 |
| | Drill outcomes are reviewed in debriefing sessions, and revisions are made if necessary. | 1 | 1 |
| Capacity expansion | Emergency preparedness and response plans are designed for mass casualty situations. | 1 | 1 |
| | Locations for patient care and alternative services during emergencies (patient rooms, corridors, inpatient wards, ED open spaces, etc.) are identified and documented. | 1 | 1 |
| | Space for emergency vehicles and equipment (ambulances, helicopter pads, etc.) is designated. | 1 | 1 |
| | ED staff are aware of changes in facility usage during disasters. | 1 | 1 |
| | Updated staff lists with contact numbers for mobilization are available. | 1 | 1 |
| | ED maintains an inventory of resources and assets required during disasters and their locations. | 1 | 1 |
| | ED has a plan to increase the number of ED beds during mass casualty incidents (MCIs). | 0.84 | 0.95 |
| | Medical equipment needed for additional ED beds and patient reception is available. | 1 | 1 |
| | Backup medical gases and suction equipment are provided. | 1 | 1 |
| | Ambulances, vehicles, and other resources for patient transport during incidents are available. | 1 | 1 |
| | Processes for the supply and replacement of resources during response and recovery through ED inventory are established and implemented. | 1 | 1 |
| | ED ensures backup resources are accessible and staff are trained to use them. | 1 | 1 |
| | Isolation rooms for epidemics are designated in the ED. | 1 | 1 |
| | Personal protective equipment (PPE) for staff and patients is available. | 1 | 1 |
| | ED can provide services (space, equipment, and staff) for up to 72 hours. | 0.88 | 0.93 |
| Early warning and response activation | Procedures for early warning systems for internal and external hazards are established. | 1 | 1 |
| | Reliable information sources for emergency operations are identified. | 1 | 1 |
| | Rapid reporting systems for unusual diseases, civil violations, sabotage, theft, and kidnapping are established. | 1 | 1 |
| | Procedures for warning communication within ED are available, and staff understand alerts. | 1 | 1 |
| | Indicators for initiating emergency response and responsible personnel are defined. | 1 | 1 |
| | ED activates HICS and response plans according to response activation guidelines. | 0.91 | 0.96 |
| | Staff mobilization is conducted according to activation levels. | 0.93 | 0.94 |
| | Procedures for rapid assessment (incident information, current ED status, and resource needs) are prepared. | 1 | 1 |

**Table 2.** Continued.

| Domain | Assessment Items | CVI | CVR |
|---|---|---|---|
| Patient management | Triage areas and patient entry/exit routes are defined, and staff are informed. | 1 | 1 |
| | Procedures for triage, admission, patient identification, tracking, and record-keeping are established. | 1 | 1 |
| | Contingency procedures for the HIS outage are defined. | 1 | 1 |
| | Tracking admitted patients and informing relatives of patient status is implemented. | 1 | 1 |
| | Patient records are stored securely and confidentially. | 0.9 | 0.91 |
| | Discharge and transfer procedures to other hospitals are defined. | 1 | 1 |
| Staff management | Roles and responsibilities of staff during emergencies are defined. | 1 | 1 |
| | Responsibilities of auxiliary staff and volunteers are defined. | 1 | 1 |
| | Staff fatigue prevention programs (shift rotation and self-care) are implemented. | 1 | 1 |
| | Attendance monitoring during incidents is conducted. | 1 | 1 |
| | Methods for monitoring staff and volunteer performance during emergencies (direct supervision, consultation, or reviewing medical records) are defined. | 1 | 1 |
| ED crowd management | Internal organization of the ED for safety and security is defined. | 1 | 1 |
| | Responsibilities of security agencies (police, local authorities, etc.) during disasters are coordinated with the ED. | 1 | 1 |
| | Access control and restrictions for ED buildings and premises during emergencies are defined. | 1 | 1 |
| | Independent ambulance entry/exit routes are defined to prevent congestion. | 1 | 1 |
| | Procedures for patient transfer to healthcare centers during emergencies are defined. | 1 | 1 |
| | Visitor crowd control procedures are defined. | 1 | 1 |
| | Identification procedures for staff and volunteers during emergencies are defined. | 1 | 1 |
| CBRNE incidents | Appropriate structures for CBRN decontamination are in place. | 1 | 1 |
| | Necessary medical equipment for bioterrorism (medications, diagnostic kits, and bags) is available. | 1 | 1 |
| | Isolation areas for radioactive, biological, and chemical incidents are provided. | 1 | 1 |
| | Hazardous waste management is monitored. | 1 | 1 |
| | Procedures for the collection and disposal of radioactive waste in ED are defined. | 1 | 1 |
| Evacuation | Indicators for the section or ED evacuation and the type of evacuation are defined and communicated. | 1 | 1 |
| | Patient evacuation equipment is available, and staff are trained to use it. | 1 | 1 |
| | Safe gathering areas for survivors are designated. | 1 | 1 |
| | Patient evacuation follows the "ED evacuation during incidents" guidelines. | 1 | 1 |
| Recovery plan | Returning to normal operations follows "response deactivation" guidelines. | 1 | 1 |
| | ED safety assessment (structural and non-structural) is conducted, and priorities are defined. | 1 | 1 |
| | Measures to replace lost resources (equipment, personnel, consumables, repairs, etc.) are implemented. | 1 | 1 |
| | Damage, casualties, and incident-related costs are accurately recorded and documented. | 1 | 1 |
| | Post-incident performance analysis identifies program weaknesses and corrective actions. | 1 | 1 |
| | Lessons learned from incidents are documented. | 1 | 1 |

CVI: content validity index; CVR: content validity ratio; ED: Emergency Department; CCTV: closed-circuit television; START and JUMP START: simple triage and rapid treatment; CBRNE: chemical, biological, radiological, nuclear, and explosives; MCI: mass casualty incidents; HIS: hospital information system; PPE: personal protective equipment

casualties (25). Sheikh Bardsiri et al.'s study also showed that capacity is an essential element in disaster preparedness programs. Increasing it can help health managers in hospitals take basic steps to improve and enhance hospital preparedness programs based on the components of emergency capacity (26).

Other key areas identified included the development of early warning systems, provision of reliable information resources, rapid reporting systems for unusual events, activation of response plans, staff mobilization, and rapid internal assessment processes. Studies indicate that these processes significantly enhance hospital readiness and elevate preparedness levels for disaster response (27).

Fire safety is another major challenge for hospital planners and staff. Essential elements include alarm systems, firefighting equipment, emergency evacuation routes, and adherence to related standards. Research shows that standardizing hospitals for fire safety can be challenging due to faulty equipment, improper storage of flammable materials, evacuation difficulties, and the need for staff training and equipment maintenance. Additionally, equipment such as sprinklers can reduce property damage by up to 75% during fires (28).

Environmental safety, including the safety of floors, walls, emergency exit doors, electrical equipment and installations, storage areas, and communication systems, was also identified as critical. Attention to non-structural safety plays an important role in protecting patients, staff, and hospital facilities (29, 30). Another study conducted by Ferreira et al. emphasized the need to increase awareness

and attention to the safety of structural elements (31), as Rahman et al.'s study also showed that in moderate seismic areas, the probability of non-structural damage may be greater than structural damage (32).

Staff training and drills were highlighted as another key domain. Disaster preparedness drills help identify weaknesses in plans and enhance effective emergency management (33). Within the staff management domain, clarifying responsibilities, providing training, and supporting personnel were essential factors. Studies have shown that human resources, training, and rapid response skills are among the most important determinants of hospital resilience during disasters (34,35).

The use of this checklist and indicators enables hospital managers and administrators to identify strengths and weaknesses in their EDs, address deficiencies, and enhance operational efficiency during disasters. It also provides higher-level authorities with a tool for standardizing EDs and guides policymakers in developing strategies to strengthen hospital preparedness.

## Study Limitations

This study had some limitations due to its exploratory nature. In the first part, which was conducted as a scoping review, the selection of articles may have been subject to some reviewer bias. To overcome this limitation, we involved multiple reviewers for selection and subsequent analysis.

## Conclusion

Overall, this study expands understanding of hospital preparedness tools and factors, contributing to the theoretical framework of hospital disaster readiness. The findings can inform the development of more comprehensive theories and models and improve practical measures to increase hospital preparedness, protect infrastructure, maintain service continuity, and ensure the safety of patients and staff during disasters.

### Acknowledgments

The authors would like to express their sincere appreciation to all those who contributed to this study, especially the data collectors, participants, and the esteemed disaster risk management coordinators at the healthcare centers of Tabriz University of Medical Sciences, Tabriz, Iran.

### Authors' Contribution

Conceptualization: Farzad Rahmani
Data curation: Masoumeh Abbasabadi Arab
Formal analysis: Abazar Fathollahzadeh
Investigation: Samira Shasti
Methodology: Farzad Rahmani
Project administration: Masoumeh Abbasabadi Arab
Resources: Faramarz Delfarah
Software: Javad Babaei
Supervision: Farzad Rahmani
Validation: Ali Jafari-Khounigh
Visualization: Masoumeh Abbasabadi Arab
Writing–original draft: Abazar Fathollahzadeh

### Competing Interests

None.

### Data Availability Statement

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

### Ethical Approval

This study was conducted with the approval of the Ethics Committee of Tabriz University of Medical Sciences (IR.TBZMED.REC.1403.328), and with the formal introduction of the researcher to the officials of the Emergency Medical Services in East Azerbaijan Province and the emergency departments of hospitals affiliated with Tabriz University of Medical Sciences. Informed written consent was obtained from all participants for the interviews and audio recordings. Participants were assured that all their information would remain confidential. The principles of anonymity and the right to withdraw from the study at any time were fully observed.

### Funding

None.

### References

1. Bissell RA, Pinet L, Nelson M, Levy M. Evidence of the effectiveness of health sector preparedness in disaster response: the example of four earthquakes. Fam Community Health 2004;27(3):193-203. doi:10.1097/00003727-200407000-00006
2. Nekoie-Moghadam M, Kurland L, Moosazadeh M, Ingrassia PL, Della Corte F, Djalali A. Tools and checklists used for the evaluation of hospital disaster preparedness: a systematic review. Disaster Med Public Health Prep 2016;10(5):781-8. doi:10.1017/dmp.2016.30
3. Müller-Leonhardt A, Mitchell SG, Vogt J, Schürmann T. Critical Incident Stress Management (CISM) in complex systems: cultural adaptation and safety impacts in healthcare. Accid Anal Prev 2014;68:172-80. doi:10.1016/j.aap.2013.12.018
4. Adhikari R, Tocher J, Smith P, Corcoran J, MacArthur J. A multi-disciplinary approach to medication safety and the implication for nursing education and practice. Nurse Educ Today 2014;34(2):185-90. doi:10.1016/j.nedt.2013.10.008
5. Rahmanian F, Abbasi B, Bolvardi E, Maleki F, Habibzadeh SR, Foroughian M, et al. The level of disaster preparedness of Iranian hospitals; a systematic review. Iran J Emerg Med 2021;8(1):e13. doi:10.22037/ijem.v8i1.34424
6. Asefzadeh S, Rajaee R, Ghamari F, Kalhor R, Gholami S. Preparedness of Iranian hospitals against disasters. Biotechnol Health Sci 2016;3(3):e35073. doi:10.17795/bhs-35073
7. Abbasabadi-Arab M, Miadfar J, Yousefian S, Mobini A, Mehran Amin S. Assessing hospital safety index in the Iranian hospitals. Health Emerg Disasters Q 2023;8(4):235-44. doi:10.32598/hdq.8.4.208.2
8. Ahangar A, Mohammadi F, Tehrani-Banihashemi SA, Joulani M, Safarani S, Nojomi M. The effects of COVID-19 on financial-economic and performance efficiency of hospitals. Med J Islam Repub Iran 2023;37:43. doi:10.47176/mjiri.37.43
9. Samei B, Babaie J, Tabrizi JS, Sadeghi-Bazargani H, Azami Aghdash S, Derakhshani N, et al. Exploring hospitals' functional preparedness effective factors in response to disasters: a qualitative study in a lower middle-income country. BMC Health Serv Res 2024;24(1):197. doi:10.1186/s12913-024-10630-y
10. Janssen I, Shepard DS, Katzmarzyk PT, Roubenoff R. The healthcare costs of sarcopenia in the United States. J Am Geriatr Soc 2004;52(1):80-5. doi:10.1111/j.1532-5415.2004.52014.x
11. Abbasabadi M, Khankeh HR, Mosadeghrad AM. Designing of disaster risk management accreditation standards in Iranians hospitals. Int J Qual Health Care 2018 Sep;30(Suppl 2):45-6. doi:10.1093/intqhc/mzy167.67

12. Daneshmandi M, Nezamzadeh M, Zareiyan A. Assessment the preparedness of selected hospital to deal with disasters in Tehran. Mil Caring Sci 2014;1(1):28-35. doi:10.18869/acadpub.mcs.1.1.28
13. Abbasabadi M, Khankeh HR, Mosadeghrad AM, Biglarian A. Comprehensive disaster risk management standards for hospitals. Health Emerg Disasters Q 2023;8(2):95-106. doi:http://dx.doi.org/10.32598/hdq.8.2.208.1
14. Basiri A, Abbasi Farajzadeh M, Belal M, Heidaranlu E. Improving the non-structural preparedness of the selected hospital based on the FOCUS-PDCA1 model: action research. BMC Emerg Med 2024;24(1):109. doi:10.1186/s12873-024-01006-w
15. Parchami M, Mirzaei M, Kalatpour O. Identification and analysis of critical activities of fire department for residential fire scenarios using task and training requirements analysis methodology. J Occup Hyg Eng 2020;7(1):41-50. doi:10.52547/johe.7.1.41
16. Nordstrom K, Zun LS, Wilson MP, Stiebel V, Ng AT, Bregman B, et al. Medical evaluation and triage of the agitated patient: consensus statement of the American Association for Emergency Psychiatry Project BETA Medical Evaluation Workgroup. West J Emerg Med 2012;13(1):3-10. doi:10.5811/westjem.2011.9.6863
17. Waltz C, Strickland OL, Lenz E. Measurement in Nursing and Health Research. Springer Publishing Company; 2016. doi:10.1891/9780826170620
18. Boparai JK, Singh S, Kathuria P. How to design and validate a questionnaire: a guide. Curr Clin Pharmacol 2018;13(4):210-5. doi:10.2174/1574884713666180807151328
19. Lawshe CH. A quantitative approach to content validity. Pers Psychol 1975;28(4):563-75. doi:10.1111/j.1744-6570.1975.tb01393.x
20. Martin D. Statistical methods for health care research. Physiother Res Int 2004;9(1):55-6. doi:10.1002/pri.300
21. Tsagris M, Frangos C. Cronbach: Cronbach's Alpha. CRAN: Contributed Packages. The R Foundation; 2020. doi:http://dx.doi.org/10.32614/CRAN.package.Cronbach
22. Martin D. Statistical methods for health care research. Physiother Res Int 2002;7(3):188-9. doi:http://dx.doi.org/10.1002/pri.255
23. Cronbach LJ. Coefficient alpha and the internal structure of tests. Psychometrika 1951;16(3):297-334. doi:10.1007/BF02310555
24. Streiner DL, Norman GR, Cairney J. Health Measurement Scales: A Practical Guide to Their Development and Use. Oxford: Oxford University Press; 2024. doi:10.1093/med/9780199685219.001.0001
25. Sheikhbardsiri H, Raeisi AR, Nekoei-Moghadam M, Rezaei F. Surge capacity of hospitals in emergencies and disasters with a preparedness approach: a systematic review. Disaster Med Public Health Prep 2017;11(5):612-20. doi:10.1017/dmp.2016.178
26. Faccincani R, Della Corte F, Sesana G, Stucchi R, Weinstein E, Ashkenazi I, et al. Hospital surge capacity during Expo 2015 in Milano, Italy. Prehosp Disaster Med 2018;33(5):459-65. doi:10.1017/s1049023x18000742
27. Qassemi F, Khankeh HR, Delshad V, Hosseini M. The effects of implementing and activating the early warning system on the preparedness of Sari Imam Khomeini hospital (RH) in disasters and incidents. Health Emerg Disasters Q 2016;2(1):19-24. doi:10.18869/nrip.hdq.2.1.19
28. Donohoe P. Hospitals are increasingly dangerous places. BMJ 2003;326(Suppl S6):0306178b. doi:10.1136/sbmj.0306178b
29. Alruwaili A, Islam S, Usher K. Disaster preparedness in hospitals in the Middle East: an integrative literature review. Disaster Med Public Health Prep 2019;13(4):806-16. doi:10.1017/dmp.2018.138
30. Hasan MK, Nasrullah SM, Quattrocchi A, Arcos González P, Castro-Delgado R. Hospital surge capacity preparedness in disasters and emergencies: a systematic review. Public Health 2023;225:12-21. doi:10.1016/j.puhe.2023.09.017
31. Ferreira MA, Meroni F, Azzaro R, Musacchio G, Rupakhety R, Bessason B, et al. What scientific information on the seismic risk to non-structural elements do people need to know? Part 1: compiling an inventory on damage to non-structural elements. Ann Geophys 2021;64(3):SE321. doi:10.4401/ag-8412
32. Obando Zegarra R, Arévalo-Ipanaqué JM, Aliaga Sánchez RA, Cernuda Martínez JA, Delgado Echevarría JC, Arcos González P. Disaster preparedness and hospital safety in state hospitals in Lima (Peru). Prehosp Disaster Med 2023;38(5):601-5. doi:10.1017/s1049023x23006179
33. Abualenain J, Alhajaji R, Alsulimani L. A systematic review of the efficacy of full-scale simulation exercises in enhancing hospital disaster preparedness. J Med Law Public Health 2024;4(3):419-46. doi:http://dx.doi.org/10.52609/jmlph.v4i3.133
34. Samsuddin NM, Takim R, Nawawi AH, Syed Alwee SN. Disaster preparedness attributes and hospital's resilience in Malaysia. Procedia Eng 2018;212:371-8. doi:10.1016/j.proeng.2018.01.048
35. Bray J. Navigating the crisis: strategies for addressing healthcare staffing shortages. American Journal of Healthcare Strategy 2024;1(2):13-8. doi:10.61449/ajhcs.2024.3