

## Research Paper

# Comprehensive Disaster Risk Management Standards for Hospitals



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## ABSTRACT

**Background:** Hospitals play an important role in protecting the health and survival of people during disasters. Despite the development of risk management programs worldwide in recent years, hospital preparedness in disasters is low and one reason for that is the lack of hospital standards for disaster preparedness. This study aims to develop hospital accreditation standards for hospital disaster risk management based on national and international experiences.

**Materials and Methods:** We used a mixed-method explanatory sequential approach. At first, a comparative study was conducted and the disaster risk management (DRM) hospital standards were extracted from 10 selected countries, namely the United States, Canada, Australia, Malaysia, India, Thailand, Egypt, Turkey, Saudi Arabia, and Denmark. Standards were analyzed according to the DRM life cycle and the most comprehensive framework was chosen. For national experiences, purposeful semi-structured interviews were conducted with 22 experts in disastrous events in the country and continued until the saturation stage. In addition, Graneheim and Landman's contractual content analysis method was used for data analysis. After combining international standards and national experiences, the proposed standards were introduced and the content validity index and content validity ratio were done by 25 experts.

**Results:** Differences were observed in the quality and quantity of the selected countries' DRM standards. The national accreditation standards of the United States, Australia, and Canada had comprehensive standards and covered all aspects of the disaster risk management cycle. A total of 27 standards from the International Standards Review and 31 standards from interviews were added (a total of 58 standards). The content validity results of the standards were within acceptable limits. After editing and determining the measurement criteria, the final standards were introduced.

**Conclusion:** This study introduces comprehensive DRM standards based on international and national documents and experiences that can be useful for policymakers and accreditation organizations in both developed and developing countries for hospital evaluation. This is also useful for hospitals as a roadmap for promoting preparedness in disasters.

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## 1. Introduction

Disasters have always been a part of life and cause social and economic problems for the people and governments. Between 2001 and 2020, an average of 347 natural disasters have occurred in the world. In 2021, this amount has increased to 432 incidents and the amount of economic damages amounted to 252 billion dollars, which is nearly 100 billion dollars more than the average of the last two decades. About 40% of these accidents, 49% of deaths and 66% of people affected by accidents were the share of the Asian continent in 2021 [1]. As a developing country in Asia, Iran is also exposed to various types of natural and man-made disasters [2].

Hospitals contribute to the well-being of the community. They play important roles in protecting the health and survival of people during disasters. Hence, hospitals are expected to create a safe environment for patients, visitors, and staff, maintain their effective performance, and provide healthcare services to casualties during and after disasters. Therefore, hospitals' preparation for natural disasters is essential [3].

According to studies, Iranian hospitals' preparedness ranges from low to moderate [4, 5]. Insufficient hospital disaster risk management (DRM) standards are an important reason for hospitals' low preparedness in the face of disasters [6]. In most countries, after failing to experience responding to disasters, they have developed standards and programs to improve hospital preparedness. The United States, a pioneer country in hospital accreditation, has been accredited since 1917. Following the events of September 11, 2001, and the unwillingness of hospitals to provide timely services to injured subjects, the Joint National Accreditation Commission set the development of standards for disaster risk management in hospitals [7]. Canada and Australia are among the leading countries in accreditation and started hospital accreditation in 1953 and 1957, respectively. After the events of September 11, 2001 and the outbreak of severe acute respiratory syndrome (SARS) in 2003, Canada paid more attention to hospital preparedness for disasters and made changes to hospital accreditation standards [8]. In Japan, after the Hanshin/Awaji earthquake on January 17, 1995, with a magnitude of 7.3, a total of 6434 people were killed and more than 43,000 people were injured. The main reason for the high death rate in this disaster was a defect in the national emergency medical system. In 1996, the Ministry of Health, Labor, and Welfare of the Government of Japan launched the "National Disaster

Medicine System" in the country which consisted of 4 components (disaster-based hospitals, medical information system, air relief, and emergency response teams) and standards for He compiled their deployment [9]. Research shows that these changes to the standards have considerably contributed to the progress of emergency management in hospitals [10, 11].

The history of disaster management standards in Iran dates back to the time of the development of national accreditation standards in 2010. Previously, in the hospital evaluation system, having a crisis committee in the hospital and a description of its duties sufficed. In 2012, accreditation standards addressed the hospital preparedness program, including the existence of the incident command system, how to call the team in the event of a disaster, and the implementation of annual exercises and staff training. In the changes in accreditation standards in 2014, disaster risk assessment in the hospital was added [12].

New approaches to international forums and changing attitudes from disaster management to disaster risk management require the development of standards in all aspects of the disaster risk management cycle, including prevention and mitigation, preparedness, response, and recovery [3].

Given the importance of a comprehensive DRM program in hospitals, there is a need to develop comprehensive standards for DRM programs in Iranian hospitals. As a result, this study is conducted to develop hospital accreditation standards for DRM.

## 2. Materials and Methods

We used a mixed-method approach in this study. At first, a comparative study was conducted and the latest hospital DRM standards of selected countries, including the United States, Canada, Australia, Malaysia, India, Thailand, Egypt, Turkey, Saudi Arabia, and Denmark were retrieved and reviewed. The data were then compared with Iran's standards. These countries were pioneers in hospital accreditation and their standards were approved by the International Society for Quality in Health Care. The United States, Australia, Canada, and Denmark are among the leading countries in terms of accreditation. Turkey, Egypt, and Saudi Arabia were selected according to the geographical conditions of the region. Malaysia, India, and Thailand are among the first developing countries to be certified by the International Association for Quality in Health.

The research team placed the standards and metrics according to their type in a table containing 4 stages of the disaster management cycle. The standards and metrics of each axis of the disaster management cycle were carefully reviewed. Duplicate items were removed and similar items were merged closer. Finally, comprehensive standards and metrics for disaster risk management were selected.

For national experiences, purposeful semi-structured interviews were conducted with 22 hospital DRM experts to identify further DRM standards and criteria. Interviewees in this study were experts in disasters and all had professional knowledge of disasters or experience in disaster management. Table 1 demonstrates the interview's demographic. The main themes in the interview guide for study participants included indicators of hospital preparedness, key barriers to providing effective health care to casualties, the role of the top manager in disaster management, and coordination and communication between healthcare facilities, local authorities, and other organizations. Interviews began with simple, general questions, gradually progressing to more specific and directed questions. The duration of the interviews was 60-90 min. All interviews were recorded and transcribed and then content analysis was done. Participants' satisfaction, maintaining the confidentiality of information, and having the right to withdraw from the study at any time were among the principles of research.

Data analysis was performed by the contractual content analysis method and following the inductive method simultaneously with data collection and based on Granheim and Landman's approach in 5 steps [13].

In the first step, the whole interview was implemented verbatim immediately after each interview and compared with the original file to ensure its accuracy. In the second step, the whole text was reviewed for a general understanding of its content. In the next step, the semantic units were labeled appropriately and the initial coding was done. The semantic units were words, sentences, or paragraphs that had relevant aspects in terms of content and context. Data management was performed using the MAXQDA software, version 12. In the fourth step, by performing continuous comparisons and considering similarities and differences, similar primary codes were classified into more general classes. Based on interview results, the national DRM standards were developed by the research team. Finally, considering the selected DRM standards of countries and Iranian experts, a list of hospital DRM standards was combined and developed. The content validity of

the standards (content validity index, content validity ratio) was evaluated by 25 experts. The questionnaires were sent to specialists via email and the answers were collected. The results were analyzed and finalized.

### 3. Results

The selected countries used different titles to name the main and sub-axes of standards related to disaster risk management, such as hospital preparedness, disaster planning, and emergency management. The hospital accreditation model in most countries is functional and disaster risk management standards exist as an independent axis or integrated with one or more main axes. For example, these standards in Denmark and

the US National Accreditation was expressed as an independent axis. In Saudi Arabia, Egypt, and the US, the international accreditation was included in the "Facility Management and Safety" axis. In India, standards are set in terms of "Patient Care" and "Facility Management and Safety." In Thailand, standards are referred to as "Process Management," "Emergency Management," "Emergency Preparedness," and "Physical Environment Safety." In some countries, such as Australia, Malaysia, Denmark, and Saudi Arabia, standards for domestic and foreign events were designed separately.

Table 2 shows the characteristics of DRM standards in selected countries. The highest number of DRM standards was related to US National Accreditation Standards with 12 standards and 113 standards, and the lowest was related to Turkish and Thai hospital accreditation standards with 1 standard and 3 standards.

Selected countries had different approaches to developing DRM standards based on the disaster cycle. All countries except Denmark, in the prevention and mitigation phase, had standards and metrics in the areas of operational planning, budgeting, risk assessment, and vulnerability. The United States (national), Australia, Canada, and Malaysia had good standards in the preparation and response phase.

Staff training and practice have been mentioned in the standards of all countries as one of the main pillars of increasing hospital readiness. In terms of recovery, only the American, Australian, and Canadian national accreditation standards include a service continuity plan and have not been considered in other countries. Table 3 shows the observance of these standards in selected countries. After analyzing international standards by the research team, 27 standards were proposed as DRM standards.

By analyzing the interview data, 252 initial codes were extracted. Information was divided into 6 categories (leadership, scientific management, secure infrastructure, learning and training, capacity building, preparedness for response, resilience hospital outcome) and 29 sub-categories (sub-themes). Key points in the national development of standards based on expert opinion included commitment and support of senior hospital managers, hospital coordination planning with the Relief and Community Organization, emphasis on an all-risk approach in DRM planning, risk assessment, and vulnerability (hazard vulnerability assessment). Emphasis was placed on the safety of hospital infrastructure and its resilience, funding of risk management programs, information management, capacity building, support and motivation of staff, and volunteer management. The interviewees also believed that standards, processes, and

outcomes should be considered in the development of standards, which is one of the basic principles in the development of world accreditation standards [14]. Implementation of risk management programs will ultimately lead to effects on the hospital, staff, and the community. Incidents and program changes are based on the lessons learned that will lead to sustainable development. Table 4 summarizes the main and secondary topics resulting from the interviews with experts.

Interviews with DRM experts added 31 standards to international standards. Finally, the research team developed 58 standards in 8 categories: management and leadership, risk assessment and planning (as structural standards) prevention and mitigation, preparedness, response and recovery (as process standards), and key performance results as output standards. For the validity of the proposed standards, they were sent to 25 specialists

**Table 1.** Demographic characteristics of interviewees

Variables	Demographic Variables	No. (%)
Gender	Male	14(63.6)
	Female	8(36.4)
Age (y)	30-39	10(45.5)
	40-49	11(50)
	50 or older	1(4.5)
Occupation	Academic	7(31.8)
	Disaster management center in universities of medical sciences	7(31.8)
	The emergency department in the Ministry of Health	3(13.6)
	Secretary of the disaster risk management committee in hospitals	5(22.7)
Work Experience in Disaster Risk Management (y)	5-10	13(59.1)
	11-15	6(27.3)
	15-20	3(13.6)
Education	Bachelor of Science	2(9.0)
	Master of Science	5(22.7)
	Doctor of Medicine	3(13.6)
	PhD, Health in Disasters and Emergencies	4(18.2)
	PhD, Management of Health Services	3(13.6)
	Emergency Medicine specialist	3(13.6)
	Post-Doc, Health in Disasters and Emergencies	2(9.0)

Table 2. Disaster risk management standards in selected countries

Country	Thailand	India	Denmark	Turkey	Saudi Arabia	Egypt	Malaysia	Canada	Australia (National)	United States (Inter-National)	United States (National)
Model of evaluation	Functional	Functional	Functional	Functional	Functional and departmental	Functional and departmental	Functional and departmental	Functional	Functional	Functional	Functional
Year	2006	2015	2012	2015	2015	2014	2013	2016	2015	2014	2012
Title	Emergency readiness and management	Plan for epidemics, emergencies, and disaster	Preparedness	Emergency management	Internal and external emergency	Emergency / disaster management	Disaster plan	Prepare the organization for disaster and emergency	Disaster management	Disaster preparedness	Emergency management
No. of standard	1	2	2	1	2	2	2	1	1	1	12
No. of criteria	3	5	15	3	7	4	11	11	9	5	113

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Table 3. Disaster risk management standards based on disaster life cycle in selected countries

Country Element of Disaster Life Cycle	Thailand	India	Denmark	Turkey	Saudi Arabia	Egypt	Malaysia	Canada	Australia (National)	United States (Inter-National)	United States (National)
Mitigation											
Emergency management plan	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓
Hazard and vulnerability assessment	✓	✓	-	✓	✓	-	-	✓	✓	✓	✓
Recovery											
Business continuity	-	-	-	-	-	-	-	✓	✓	-	✓
Finance management	-	-	-	-	-	-	-	-	-	-	-

Country Element of Disaster Life Cycle	Thailand	India	Den- mark	Turkey	Saudi Arabia	Egypt	Malaysia	Canada	Australia (National)	United States (Inter- National)	United States (National)
Emergency operation plan	-	-	-	✓	✓	✓	✓	✓	✓	-	✓
Activation and non-activation plan	-	-	-	-	-	-	✓	✓	✓	-	✓
Staff calling	-	-	✓	-	✓	✓	✓	✓	✓	-	-
Surge capacity	-	✓	-	-	✓	✓	✓	✓	✓	✓	✓
Incident command system	-	-	✓	-	✓	-	✓	✓	-	-	✓
Early warning system	-	✓	-	✓	-	-	✓	-	✓	-	✓
Emergency operation center	-	✓	-	-	✓	-	-	-	-	-	-
Evacuation	✓	-	✓	-	✓	-	✓	-	✓	-	✓
Inter organization communication	-	-	-	-	✓	✓	✓	✓	✓	✓	✓
Resource management	-	-	-	-	-	-	-	-	✓	✓	✓
Safety and security	-	-	-	-	✓	-	✓	-	✓	✓	✓
Staff management	-	-	-	-	✓	-	✓	-	✓	✓	✓
Patient management	-	-	✓	-	-	-	✓	✓	✓	✓	✓
Volunteer management	-	-	-	-	-	-	-	-	✓	-	✓
Facility management	-	-	✓	-	-	✓	-	✓	✓	-	✓
Information management	-	-	-	-	-	-	✓	✓	-	-	✓
Exercise and training	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Program effectiveness	-	-	✓	-	-	✓	✓	✓	✓	✓	✓

**Table 4.** Research category and sub-category based on participants' experiences

Categories	Sub-category
Leadership	Commitment Supply funds Communication and partnership with society Support and Participation of staff in the DRM program Employee service compensation Motivate employees
Scientific management	Hospital risk assessment DRM planning based on risk assessment results Preparedness and response plan to all hazard Monitoring and the evaluation of plans
Safe infrastructure	Structural safety Non-structural safety Environment safety and security
Learning and training	Learning and training of staff and managers Simulated exercises Special team for CBRNE incident
Surge capacity	Staff and volunteers management Resource management Medical equipment
Preparedness for response	Activation early warning system Incident leveling and activation Managing casualties Information management Psychological support of staff and casualties
Resilient hospital consequence	Business continuity Lessons learned from disasters and improve programs Improve staff resiliency Improve staff knowledge, skill and attitude Improve healthcare services in disasters

DRM: disaster risk management; CBRNE: chemical, biological, radiological, nuclear, and explosives.

via email, and the answers were collected. The result of the content validity showed all standards (content validity index, content validity ratio) in the acceptable range. All content validity index scores are higher than 0.79, and the validity of the scale content is acceptable [15]. Based on the results, all standards have been accepted and there is no need to change or remove them (Table 5).

#### 4. Discussion

Hospitals are affected by many factors and are always exposed to internal and external crises by being in a complex political, economic, social, and environmental system. The resilient hospital requires the commitment and support of managers, careful planning, structural safety, non-structural hospital, strong equipment and infrastructure, provision of resources and facilities in times of crisis (manpower, equipment, supplies, and medicine), and defined processes to provide quality and fair services in the event of disasters. The existence of hospital standards in DRM in three areas of structure, process, and consequence can be a guide for hospitals.

The result of this comparative study shows that the leading hospital accreditation countries, including the United States, Australia, and Canada, which operate under international law and the status of existing hospitals, appear to have more complete standards in DRM. Structural standards have less priority in their hospital accreditation standards and most standards are process and outcome.

Malaysia, India, and Thailand are among the first developing countries to have their hospital accreditation standards approved by the International Society for Quality in Health Care. The DRM standards in these countries are more focused on the preparation and response stage. In terms of prevention and reduction of the effect, only in Malaysian hospital standards, risk assessment and program development have been mentioned. In the field of recovery, the continuation of vital services, cost management, attention to employees, and their psychological recovery have been neglected.

**Table 5.** Proposed Disaster Risk Management Standards, Content Validity Index, and Content Validity Ratio Results

Row	DRM Axis	Standards	CVI	CVR
1	Management and Leadership	The hospital's leaders are involved in the development and implementation of the program and guidelines for disaster risk management.	1	1
2		The hospital's leaders have provided the resources needed to implement disaster risk management plans.	1	1
3		The hospital's leaders support people involved in the implementation of disaster risk management plans.	1	1
4		The hospital's leaders are partners with society stakeholders and other institutions.	0.97	1
5		The hospital's leaders are making social contributions to attract resources and volunteers.	0.95	1
6		The disaster risk management committee is held with the participation of senior hospital managers.	1	1
7		The hospital incident command system is defined.	1	1
8		The hospital command center is predicted in a safe place with a facility.	1	1
9	Risk Assessment	The hospital identifies and prioritizes internal and external hazards.	1	1
10		The vulnerability and capacity of hospitals were identified.	0.91	1
11		The hospital did a risk analysis.	1	1
12	Planning	The response plan to disasters has been developed with an all-hazards approach and with stakeholders' participation.	0.89	1
13		The disaster risk management plan has been developed in 4 stages of the disaster cycle with a special hazard (high probability occurrence).	0.94	1
14		Disaster risk management plans are monitored.	0.91	1
15		The effectiveness of disasters risk management plans is reviewed.	0.95	0.95
16	Prevention and Mitigation	The hospital has been safely built and maintained based on building safety standards.	0.95	1
17		The hospital carried out periodic assessments of the building's safety.	1	1
18		The hospital carried out actions for assessment, maintenance, and security of the infrastructure and facilities.	1	1
19		The hospital carried out actions for the assessment, maintenance, and safety of the electrical equipment.	0.94	1
20		Fire prevention and controls are implemented in the hospital.	1	1
21		The hospital provides a safe physical environment for the staff, patients, and visitors.	0.97	1
22		Security actions are implemented to prevent incidents of passive defense.	0.94	1
23		Incident reporting is performed in the hospital.	0.91	1
24	Preparedness	Staff is trained for their roles and responsibility in the DRM programs.	1	1
25		DRM programs are regularly trained.	1	1
26		Surge capacity is done in the physical space dimension.	1	1
27		Surge capacity is done in the staff dimension.	1	1
28		Surge capacity is done in the stuff dimension.	1	1
29		Surge capacity is done in the staff and care delivery dimension.	0.89	1
30		The early warning system has been designed and implemented.	0.91	1



Row	DRM Axis	Standards	CVI	CVR
31		The activation of disaster risk management plans is done according to the incident level.	1	1
32		Communication systems are predicted in and out of the hospital to be appropriate for the disaster situation.	0.97	1
33		The process of admitting casualties was done during the disasters.	1	1
34		The process of admitting, treating, discharging, and referring casualties was done during the disasters.	1	1
35		Dead body management of casualties is done.	1	1
36		The staff performs their duties according to the roles and responsibilities assigned at the time of disasters.	1	1
37	Response	Facilities and working conditions are provided for staff and volunteers.	1	1
38		Supervision of employees and volunteers was performed.	0.91	1
39		Hospital resources and assets are managed during disasters.	0.91	1
40		The hospital communicates with the community/media during a disaster.	1	1
41		Patient information is managed during a disaster.	0.92	1
42		The hospital provided a secure environment during a disaster.	0.98	1
43		Patient evacuation is done safely.	1	1
44		Hospital safety is provided through controlling actions and health plans.	1	1
45			The hospital continues vital services during disasters based on the business continuity plan.	0.93
46		The hospital returns to normal condition according to guidelines.	0.93	1
47		Post-disaster reconstruction takes place in the hospital.	0.95	1
48	Recovery	Finance management is done during and after a disaster.	1	1
49		The hospital provides support services and mental health to casualties and their families.	1	1
50		The hospital provides support services and mental health to staff and their families.	1	1
51		The hospital's performance analysis was done after the disasters.	1	1
52		Revision of plans and post-action corrections were done based on hospital experiences.	0.91	1
53		The hospital can transfer from normal to disaster conditions and vice versa.		
54	Key Performance Results	The implementation of disaster risk management programs has led to the maintenance and promotion of the organization's activities.	0.97	1
55		The implementation of disaster risk management programs has led to the maintenance and promotion of the competency of staff.	0.91	1
56		The implementation of disaster risk management programs has provided staff safety.	0.85	1
57		The implementation of disaster risk management programs has led to health promotion for casualties.	0.89	1
58		The implementation of disaster risk management programs has led to the maintenance and promotion of society's health.	0.91	1

The results of this study indicate that in developed countries, DRM accreditation standards have a complete standard, and in developing countries, including Iran, there is a need to review and develop DRM standards in the areas of preparedness, response, and recovery. Most of the standards in these countries are derived from the standards of leading countries in accreditation. Standards are often structural and less attention has been paid to prevention, mitigation, and recovery, which indicates the prevailing attitude of disaster management over DRM in these countries.

This research introduced 58 standards in 8 axes (management and leadership, risk assessment, planning, prevention and mitigation, preparedness, response, recovery, and key performance results) using international and national experiences. Nirupama identified 7 domains as key elements of a comprehensive DRM: 1) threat recognition, risk and vulnerability identification; 2) risk analysis and assessment; 3) risk control options, structural, non-structural, cost/benefit analysis; 4) strategic planning, economic, political, and institutional support considerations; 5) response, recovery, reconstruction, rehabilitation; 6) knowledge management, sustainable development; and 7) resilience building, community participation [16]. Zhong developed a hospital resilience conceptual framework consisting of 4 criteria, including redundancy, robustness, rapidity, and resourcefulness, and then developed hospital standards [17].

### Management and leadership

Management and leadership play key roles in DRM. The commitment of senior hospital managers, participation and support, allocation of resources to run programs, and the development of community participation programs are important for the success of the DRM program. Senior managers need to pay more attention to the DRM prevention phase and strengthen the safety of the hospital environment. Numerous studies have shown a significant relationship between hospital managers' knowledge and hospital readiness and more knowledgeable managers had more prepared hospitals for disasters [18, 19]. Hospitals need a good structure for DRM, such as the DRM committee, the incident command system, and the hospital command center. In addition, a suitable communication relationship should be established with the community's relief organizations [20].

The hospital's ability to provide the best medical care to the injured in a disaster depends on its ability to coordinate effectively with other organizations and service providers [21].

### Risk assessment

Risk assessment is a process to identify potential hazards and analyze what could happen if a hazard occurs, determining appropriate control measures to eliminate or reduce the impact of hazards [22]. Implementing the control measures can lead us to develop an emergency management program. Risk assessment should not be limited to the prevention and reduction of the DRM cycle. The complex should cover the entire disaster life cycle, including preparedness, response, and recovery, especially in cascade events [23].

### Planning

Planning for a hospital's long-term success is also important. A comprehensive hospital disaster plan should consider all hazards, all stages of DRM, and all hospital levels. The hospital's DRM plan must be fully implemented, practiced, and reviewed regularly. Resources for implementing the DRM plan should be provided to lower managers and employees.

### Preparedness

Preparedness is the knowledge and capacity created by governments, recovery organizations, communities, and individuals to effectively anticipate, respond, and improve possible, overwhelming potentially dangerous events or areas [22]. This includes various items, such as early warning systems, surge capacity, response strategies, disaster exercises, and training. Surge capacity is defined as the ability of an organization to expand rapidly and increase services in response to disasters [22]. Providing support services plays a key role in the success of hospitals in disasters. Hospitals with more accurate support programs were more successful in responding to disasters [11]. An early warning system is the first part of every response plan. The Sendai framework for disaster risk reduction 2015-2030, an early warning system was considered an important special purpose [24]. As one of the main requisites of hospital preparedness, personnel education and training is the only dimension that was inserted by all of the selected countries. Training methods that can be used include maneuvers, practical drills, and facing actual events. Simulated exercises are more effective in strengthening and improving the preparedness of the organization and employees in response to accidents and disasters as they put the person in a similar situation [25].

## Response phase

The response phase refers to immediate, continuous activities, programs, and tasks, for example. Activation of the incident command system, triage, and management casualties, staff and volunteer management, resource management, information management, safety, and security. Good planning before the event, coordination, and allocation of efficient resources are important for the success of the response phase [26]. The management of the volunteers (including the identification, evaluation, and supervision of their performance) in disasters is also of great importance. In the American national standards, 2 standards and 18 measures are dedicated to the specialized and ordinary volunteers and these tasks are discussed fully in these standards. In the Australian standards, there is a brief reference to a plan for the management of the volunteers; however, other studied countries have neglected this dimension. Informing the public is an essential component that must be addressed in the response plans. Volunteer medical personnel have their concerns as well. Accordingly, standards and protocols should also be devised for organizing this group of personnel.

## Recovery

Recovery includes the restoration, reconstruction, and improvement of facilities, livelihoods, and living conditions of the affected communities. Recovery was a higher priority in the development of standards. In this phase, the continuation of service jobs is considered only in the accreditation criteria of the pioneer countries. In addition, paying attention to staff and improving their mental health is one of the dimensions of sustainable development.

## Key performance results

Key performance results measure the hospital's performance in response to disasters using output, outcome and impact key performance indicators. A systematic review study shows a lack of post-disaster evaluations [27]. The Nirupama DRM model introduces resilience building, community participation, sustainable development, and knowledge management as key performance indicators [16]. Improving staff resiliency, improving staff knowledge, skill, and attitude, improving healthcare services in disasters, hospital resiliency, and maintenance and promotion of society's health are the most important key performance in DRM planning.

## 5. Conclusion

The development and implementation of DRM standards are essential to improve hospitals' preparedness. This article introduced valid and comprehensive DRM standards for hospitals. These standards are based on the all-hazard approach, the disaster life cycle, laws, and documents international; therefore, it does not depend on the specific culture and structure of the country. Accordingly, it can be used for developing DRM hospital standards in other countries. In addition, these standards can be used by policymakers and accreditation managers of the Ministry of Health, and accreditation institutions to develop DRM standards. Qualitative improvement and continuous standards evaluation are important issues in the development and promotion of hospital preparedness in disasters. Therefore, it is necessary to create structures, education, and culture to implement these standards in hospitals and apply research to identify executive challenges in hospitals and develop the standards based on the analysis of the results of these studies.

## Ethical Considerations

### Compliance with ethical guidelines

There were no ethical considerations to be considered in this research.

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### Authors' contributions

Conceptualization and Supervision: Hamidreza Khankeh; Methodology: Ali Mohammad Mosadeghrad; Investigation, Writing—original draft, and Writing—review & editing: Masoumeh Abbasabadi-Arab; Data analysis: Akbar Biglarian.

### Conflict of interest

The authors declare no conflict of interest.

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