

Original Research

Cite this article: Alruwaili A, Islam MS, Usher K (2022) Hospitals disaster preparedness and management in the eastern province of the kingdom of Saudi Arabia: a cross-sectional study. *Disaster Med Public Health Prep* 16: 1038–1045. doi: <https://doi.org/10.1017/dmp.2020.484>.

First published online: 5 April 2021

Keywords:

disaster preparedness; hospitals; Eastern province; emergency management; Saudi Arabia

Corresponding author:

Abdullah Alruwaili,
Email: Ruwailia1@yahoo.com.

This article has been updated since its original publication. See <https://doi.org/10.1017/dmp.2022.247>.

Hospitals Disaster Preparedness and Management in the Eastern Province of the Kingdom of Saudi Arabia: A Cross-sectional study

Abdullah Alruwaili^{1,2}, Md Shahidul Islam¹ and Kim Usher¹

¹University of New England School of Health, Armidale, NSW, Australia and ²College of Applied Medical Sciences, King Saud bin Abdulaziz University for Health Sciences, Al-Ahsa, Saudi Arabia

Abstract

Objective: The current study was conducted to assess disaster preparedness of hospitals in the Eastern region of Saudi Arabia.

Methods: A descriptive cross-sectional study of all hospitals in the Eastern Region of KSA was conducted between July 2017 and July 2018. The included hospitals were selected using convenience sampling. The questionnaire was distributed together with an official letter providing information about the aim and objectives of the study as well as ethical issues guiding their participation in the exercise.

Results: All the included hospitals had a disaster plan that was completely accessible by all staff members. About 70% of the included hospitals established an educational program on disaster preparedness once per year. Assessment of hospital disaster preparedness was conducted using disaster drills in 62 (n= 98%) of the hospitals. However, only 9.5% of the hospitals had post-disaster recovery assistance programs like counseling and support services.

Conclusion: Most hospitals involved in this study had sufficient resources for disaster management; however, the overall effectiveness of hospitals' disaster preparedness was slight to moderate. Some recommendations to improve hospitals' disaster preparedness should be proposed, including improved staff training and testing, better communications and safety procedures, and adoption of a holistic approach for disaster management.

Introduction

Disasters are emergency events that overwhelm the resources of the region or location in which it occurs, resulting in substantial human suffering, loss of life, and severe economic harm.¹ Disaster preparedness and management refer to the measures taken before a disaster, aiming to minimize life loss, critical services disruption, and damage when the disaster occurs.² Thus, preparedness for disasters should be an integral part of the normal development plan of communities and countries.

Hospitals provide essential primary emergency healthcare to the victims of disasters to ensure their recovery.³ Extensive research has been focused on the preparedness level of hospitals for disasters. In Switzerland, about 82% of hospitals had a plan for responding to catastrophic events.⁴ Another study in Singapore reported that 75.3% of health care workers felt that the institution was ready for a disaster incident.⁵ In contrast, studies in the USA stated that hospitals were mostly unprepared for disasters.^{6,7}

In the Middle East, disaster preparedness of hospitals has been rated as inadequate despite the region experiencing many disasters.⁸⁻¹¹ Improper preparation of hospitals may be due to ambiguity about the roles and duties of individuals or groups, ineffective communication, absence or inadequate planning, deficient training of personnel, and hospitals not aligning with the community disaster response plans.⁶⁻¹²

Saudi Arabia has faced tremendous problems arising from disasters over the last 3 decades, which were linked to floods, building collapse, religious rituals, modernization, water-borne diseases, and technology-induced disasters.^{13,14} Evaluation of hospital preparedness for such emergency events is of great importance. According to the Central Board for Accreditation of Healthcare Institutions (CBAHI) in 2015, there were approximately 72 private and government hospitals of which over 80% were not accredited in Eastern Saudi Arabia.¹⁵ As the level of disaster preparedness of the hospitals in Eastern Saudi Arabia is currently not known, there is an urgent need to ascertain the level of preparedness for disasters, which could occur without warning. Identification of the degree of hospitals' preparedness in this region of Saudi Arabia can be used to develop effective strategies for managing potential catastrophes. Such knowledge can guide policy-makers in the hospital setting to come up with actions towards strengthening

Table 1. Demographic data of the participants and hospitals' general information

| Demographic | | Number | Percentage |
|---------------------------------------|------------------------------------|--------|------------|
| Gender | Female | 6 | 9.5% |
| | Male | 57 | 90.5% |
| Age | 31-40 | 19 | 30.2% |
| | 41-50 | 36 | 57.1% |
| | over 50 | 8 | 12.7% |
| Position/title | Head of disaster committee or unit | 29 | 46.0% |
| | Head of Emergency department | 9 | 14.3% |
| | Hospital Director/manager | 25 | 39.7% |
| Years of experience | >20 | 7 | 11.1% |
| | 11-15 | 20 | 31.7% |
| | 16-20 | 31 | 49.2% |
| | 6-10 | 5 | 7.9% |
| level of education | Bachelor's degree | 30 | 47.6% |
| | Master's degree | 31 | 49.2% |
| | PhD | 2 | 3.2% |
| Hospital's general information | | | |
| Type of hospital | Government | 37 | 58.7% |
| | Private | 26 | 41.3% |
| Level of hospital | Primary | 5 | 7.9% |
| | Secondary | 48 | 76.2% |
| | Tertiary | 10 | 15.9% |
| Number of employees | >2000 | 5 | 7.9% |
| | 1-1000 | 46 | 73.0% |
| | 1001-2000 | 12 | 19.0% |
| Number of beds | >500 | 2 | 3.2% |
| | 201-500 | 14 | 22.2% |
| | 100-200 | 18 | 28.6% |
| | 50-99 | 24 | 38.1% |
| | 1-49 | 5 | 7.9% |
| Number of beds in emergency | >20 | 8 | 12.7% |
| | 16-20 | 10 | 15.9% |
| | 11-15 | 16 | 25.4% |
| | 6-10 | 15 | 23.8% |
| | 1-5 | 14 | 22.2% |
| Number of beds in ICU | >20 | 8 | 12.7% |
| | 16-20 | 9 | 14.3% |
| | 11-15 | 14 | 22.2% |
| | 6-10 | 12 | 19.0% |
| | 1-5 | 20 | 31.7% |

the readiness of their hospitals for disasters whenever they occur. Therefore, the current study was conducted to assess disaster preparedness of the hospitals in the Eastern region of Saudi Arabia.

Methods

The STROBE (Strengthening the Reporting of Observational Studies in Epidemiology Statements) guidelines were followed in reporting this cross-sectional study.¹⁶

Study Design and Population

This was a descriptive cross-sectional study of all hospitals (n = 72 hospitals) in the Eastern Region of Saudi Arabia between July 2017 and July 2018. The included hospitals were selected using convenience sampling.

Data Collection

Before data collection, ethical approval was obtained from the Human Research Ethics Committee at the University of New England (HE17-155) and the Ministry of Health, Saudi Arabia (IRB00010471). The questionnaire was taken to the targeted hospitals accompanied by a facilitating letter from the Ministry of health in Saudi Arabia as well as a cover letter stating the importance of the study and providing information about the aim and objectives of the study as well as ethical issues guiding their participation in the exercise. Every hospital was required to appoint a department director who would be responsible for organizing the completion of the survey. For those questionnaires with inconsistent and/or incomplete responses, 1 or 2 follow-up visits or telephone calls were made to ensure completeness and consistency as well as the improvement of response rate. Each returned

Table 2. Disaster plan and emergency command and control

| Emergency command and control system | | Number | Percentage |
|---|-----------|--------|------------|
| Presence of Incident Command System ICS | Yes | 50 | 79.4% |
| Presence of Designated Command Centre DCC | Yes | 40 | 63.5% |
| Presence of alternate location for Command Centre | Yes | 11 | 17.5% |
| Designated emergency coordinator at all times | Yes | 62 | 98.4% |
| Presence of disaster management unit | Yes | 6 | 9.5% |
| Policies guiding disaster preparedness management | Yes | 61 | 96.8% |
| Hospital staff know the disaster preparedness management | Yes | 27 | 42.9% |
| Disaster plan | | Number | Percentage |
| Presence of disaster plan | Yes | 63 | 100.0% |
| Presence of disaster planning committee | Yes | 43 | 68.3% |
| Presence of multidisciplinary disaster planning committee | Yes | 44 | 69.8% |
| The hospital staff consulted in preparing the disaster plan | Yes | 20 | 31.7% |
| Disaster plan available in all departments | Yes | 38 | 60.3% |
| Hospital staff have access to the disaster plan | Yes | 63 | 100.0% |
| How can the staff access the disaster plan | Email | 7 | 11.1% |
| | Hard Copy | 52 | 82.5% |
| | Internet | 4 | 6.3% |
| Hospital's disaster plan covers WHO's 'all-hazard' approach | Yes | 12 | 19.0% |
| Disaster plan covers both internal and external disasters | Yes | 57 | 90.5% |

questionnaire was carefully checked for its consistency and completeness. The data from returned questionnaires were then transferred into a database for analysis. A total of 72 hospitals were surveyed and 63 hospitals responded with a response rate of 87.5%.

Study Questionnaire

The survey was adapted according to the World Health Organization's (WHO) National Health Sector Emergency Preparedness and Response Tool and Hospital Emergency response checklist.^{17,18} The questionnaire consists of 12 sections and 93 closed-ended questions. A pilot study tested the questionnaire. External reliability and internal reliability were tested by test-retest and Cronbach's alpha (α) method, respectively. The data collected focused on the following 12 areas of interest: (1) hospital and physician demographic data; (2) command and control; (3) disaster plan; (4) communication; (5) education and training; (6) triage; (7) surge capacity; (8) hospital logistics, equipment and supplies; (9) monitoring and assessing hospital disaster preparedness; (10) safety and security; (11) post-disaster recovery; and, (12) assessment of hospital's disaster preparedness indicators.

Data Analysis

Descriptive statistics of continuous data were generated, including mean and standard deviation (SD). For dichotomous data, frequency counts and percentages, and crosstabs with the χ^2 statistic were calculated. Statistical significance was defined as $P < 0.05$ for all statistical tests. Data analysis was conducted using the statistical analysis software package SPSS (Statistical Package for Social Scientists) version 25 (IBM Corp, Armonk, NY).

Results

Demographic Data of the Participants and Hospitals' General Information

A total of 72 hospitals were surveyed, and 63 hospitals responded with a response rate of 87.5%. This study thus included 63

participants who responded on behalf of 62 hospitals. Of the participants who completed the survey, 90.5% were males and 9.5% females. About 57% of the participants were aged 41 to 50 years. Approximately 29 (46%) of them were heads of disaster units, 25 (39.7%) were hospital managers, and 9 (14.3%) were heads of emergency departments. Most of the participants were well-experienced with about 10 to 20 years of experience (80.9%).

About 58.7% of included hospitals were governmental, while the private hospitals represented 41.3% of the participating hospitals. Most of the hospitals were secondary (76.2%) and non-teaching (96.8%) hospitals. The employee numbers ranged from 1 to 1000 in 73% of the hospitals. The number of beds was 100 to 500 in 50.8% of hospitals. The average number of patient admissions per day was less than 10 in 42.9%, more than 30 in 31.7%, and 11-30 in 25.4% of the hospitals. This study revealed that 60.3% of the hospitals had more than 100 patients in the outpatient centers. About 12.7% of the included hospitals have more than 20 beds in both the ICU and the Emergency department (see Table 1).

Disaster Plan and Emergency Command and Control

All the included hospitals had a disaster plan that was accessible by all staff members. The disaster plan was available in all departments in only 60.3% of the included hospitals using a hard copy. In total, 69.8% of all hospitals had a multidisciplinary disaster planning committee. WHO's "all-hazard" approach was covered in the disaster plan of 19% of all included hospitals, and about 90.5% of hospitals covered both external and internal disasters in their plan. About 79.4% and 63.5% of the included hospitals had an Incident Command System (ICS) and Disaster Command Centre (DCC), respectively. However, only 17.5% of the included hospitals had the alternate location for Incident Command Centre. The proportion of designated emergency coordinator was 98.4% of the included hospitals (see Table 2).

Training and Education, Triage, Drills, and Communication

All hospitals conducted a triage and provided its guidelines and forms. Nurse specialists performed the triage in most hospitals

Table 3. Training and education, triage, drills, and communication

| Communication | | Number | Percentage |
|--|--------------------|--------|------------|
| Method to communicate with the staff during a disaster | Radios | 3 | 4.8% |
| | Public system | 4 | 6.3% |
| | Overhead speakers | 50 | 79.4% |
| | Phone/SMS | 6 | 9.5% |
| Presence of updated staff contacts database | Yes | 59 | 93.7% |
| Presence of dedicated public information officers | Yes | 12 | 19.0% |
| Presence of back-up communication systems | Yes | 37 | 58.7% |
| Education and training | | Number | Percentage |
| Presence of education and training program | Yes | 63 | 100.0% |
| Average time of training on disaster preparedness | Occasionally | 14 | 22.2% |
| | Once in a year | 44 | 69.8% |
| | Once in six months | 5 | 7.9% |
| Presence of ways of assessing the knowledge of staff members about the disasters | Yes | 63 | 100.0% |
| Assessment of the knowledge of staff through the use of | Drilling | 62 | 98.4% |
| | Examination | 1 | 1.6% |
| New Staff orientation about disaster preparedness | Yes | 47 | 74.6% |
| Triage | | Number | Percentage |
| Triage conduction | Yes | 63 | 100.0% |
| Person responsible for undertaking triage | Doctor | 18 | 28.6% |
| | Nurse specialist | 45 | 71.4% |
| Triage hospital training | Yes | 61 | 96.8% |
| Presences of triage guidelines | Yes | 63 | 100.0% |
| Presences of triage forms | Yes | 63 | 100.0% |
| Presences of triage area for receiving mass casualties | Yes | 43 | 68.3% |
| Monitoring and assessing hospital disaster preparedness | | Number | Percentage |
| Monitoring the preparedness for disasters | Drills | 62 | 98.4% |
| | Examinations | 1 | 1.6% |
| Number of hospital disaster simulation exercises | Every 6 months | 8 | 12.7% |
| | Every 3 months | 1 | 1.6% |
| | Every Year | 54 | 85.7% |
| Conducting a disaster drill in the past 12 months | Yes | 52 | 82.5% |
| Average reviewing time for the disaster preparedness plan | Once in 2 years | 4 | 6.3% |
| | Once in 3 months | 1 | 1.6% |
| | Once in 5 years | 12 | 19.0% |
| | Once in 6 months | 2 | 3.2% |
| | Once in a year | 44 | 69.8% |

(71.4%). Besides, 96.8% of included hospitals provided training on triage, and 68.3% of them had a triage area for receiving mass casualties. All respondent hospitals established an educational program on the disaster preparedness that occurred once per year in 69.8%, twice per year in 7.9%, and occasionally in 22.2% of the participating hospitals. An assessment action plan was developed to assess staff knowledge either by drilling or formal examination in all included hospitals. Among all the hospitals, 74.6% were considered to have enough new staff orientation about disaster preparedness. The presence of public information officers and back-up communication systems were reported in about 19% and 58.7% of the included hospitals, respectively. Assessing hospital disaster preparedness was done using drills in 62 hospitals. Most of the hospitals (85.7%) performed a yearly hospital disaster drills and most performed an annual review of the disaster preparedness plan (69.8%) (see Table 3).

Surge Capacity, Logistics, Safety & Security, and Post-disaster Recovery

About 76.2% of the hospitals had designated care areas for patient overflow, while only 46% had additional area to accommodate patient overflow during a disaster. Furthermore, 30.2% had a designated area that can be used as temporary morgues during a disaster. Interestingly, 85.7% of the hospitals had adequate number of HCPs to manage patient overflow. Unfortunately, only 4.8% of the hospitals had the availability of calling staff from other hospitals in case of disasters. More than 70% of the hospitals had 1-5 working ambulances, and 20% of the hospitals had 6-10 working ambulances. All the hospitals had updated inventory of all equipment, supplies and pharmaceuticals and about 94% of them have contingency agreements with vendors to supply resources in case of disaster. Blood banks were found in 82.5% of the hospitals. All the hospitals

Table 4. Surge capacity, logistics, safety & security, and post-disaster recovery

| Surge capacity | | Number | Percentage |
|---|-------|--------|------------|
| Presence of designated care areas for patient overflow | Yes | 48 | 76.2% |
| Presence of extra seats to assist patient overflow during a disaster | Yes | 29 | 46.0% |
| Presence of designated areas that can be used as temporary morgues during a disaster | Yes | 19 | 30.2% |
| Presence of a plan to prioritize/cancel nonessential services | Yes | 33 | 52.4% |
| Presence of adequate number of HCP to manage patient overflow | Yes | 54 | 85.7% |
| Availability of calling staff from other hospitals in case of disaster | Yes | 3 | 4.8% |
| Logistics, equipment, and supplies | | Number | Percentage |
| Number of working ambulances | 1-5 | 47 | 74.6% |
| | 11-15 | 3 | 4.8% |
| | 6-10 | 13 | 20.6% |
| Have updated inventory of equipment, supplies, and pharmaceuticals | Yes | 63 | 100.0% |
| Presence of contingency agreements with vendors to supply resources in case of disaster | Yes | 59 | 93.7% |
| Identification of physical space within the hospital for the storage and stockpiling of additional supplies | Yes | 58 | 92.1% |
| Presence of blood bank in the hospital | Yes | 52 | 82.5% |
| Presence of backup generators in the hospital | Yes | 63 | 100.0% |
| Safety and security | | Number | Percentage |
| Presence of hospital fence | Yes | 34 | 54.0% |
| Control of entry and exit of the hospital | Yes | 43 | 68.3% |
| Presence of fire department | Yes | 15 | 23.8% |
| Presence of area for radioactive, biological, and chemical decontamination | Yes | 6 | 9.5% |
| Presence of isolation room? | Yes | 50 | 79.4% |
| Presence of separate entry for contaminated patients into the emergency department | Yes | 4 | 6.3% |
| Post disaster recovery | | Number | Percentage |
| Structures to capture lessons learned following disaster responses | Yes | 62 | 98.4% |
| Presence of post-disaster recovery assistance program like counseling and support services | Yes | 6 | 9.5% |
| Presence of recognition of the service provided by staff, volunteers and other external personnel during disaster response and recovery | Yes | 28 | 44.4% |

have backup generators and storage tanks. Regarding hospital safety and security, more than 50% of the hospitals have a fence. Also, about 23.8% had a fire department, and 9.5% reported having an area for radioactive, biological, and chemical decontamination. A total of 62 hospitals reported attempts to capture lessons learned following disaster responses in the form of meetings. Unfortunately, only 9.5% of the hospitals have post-disaster recovery assistance programs like counseling and support services (see Table 4).

Assessment of Hospitals' Disaster Preparedness Indicators

The mean score of hospital command and control was 2.92 (\pm 1.1), 3.13 (\pm 1.07) for hospital disaster plan effectiveness (moderate effectiveness), 2.65 (\pm 0.74) for hospital disaster communication, 2.87 (\pm 0.73) for education and training of staff, and 2.72 (\pm 0.89) for hospital triage effectiveness (slight effectiveness). The mean of overall hospital disaster preparedness showed a slight to moderate hospital preparedness (mean = 2.99 \pm 1.04) (see Table 5).

Discussion

This cross-sectional study was conducted to assess disaster preparedness of hospitals in the Eastern region of Saudi Arabia. Overall, it showed that the majority of hospitals had sufficient resources for disaster management such as specialized staff, triage and surge capacity, specific policies, and staff communication database

(although some aspects were defective); However, the overall effectiveness of hospitals' disaster preparedness was slight to moderate. These results highlight the need for further improvements in the hospitals' disaster preparedness capacity in the examined area.

In a recent integrative review by Alruwaili, *et al.*,¹⁹ the authors found 19 studies that reported hospitals' disaster preparedness in the Middle East. The majority of these studies (13) found the level of preparedness for disasters in the assessed hospitals to be very poor, poor, or moderately effective; only 6 studies ranked their hospitals as well or very well-prepared for disasters. The findings from the literature review therefore support the findings of the study reported here. The studies reported in the literature review cited the lack of contingency plans and inadequate availability of resources as the main factors responsible for impaired disaster preparedness. In addition, the literature review highlighted the lack of published research on hospital disaster preparedness in the Middle East, especially in relation to Saudi Arabia where there were only 2 previous published studies.¹⁹

In the current study, 79.4 and 63.5% had ICS and DCC, respectively. Moreover, 96.8% of hospitals had policies to guide disaster preparedness management; However, only 42.9% of hospitals had staff awareness about those policies. Another study by Aladhrai *et al.* in Yemen found the preparedness level of 7 out of the 11 included hospitals was unacceptable based on disaster management guidelines.²⁰ In Iran, Djalali, *et al.* found that disaster preparedness was poor, using determinants that included information management, local databases, and disaster handling procedures.

Table 5. Assessment of hospitals' disaster preparedness indicators

| 1 (very effective) to 5 (very ineffective) | Effectiveness | Number | Percentage | Mean (SD) |
|---|---------------|--------|------------|---------------------|
| Command and control | 1 | 3 | 4.8% | 2.22 (\pm 1.126) |
| | 2 | 26 | 41.3% | |
| | 3 | 14 | 22.2% | |
| | 4 | 13 | 20.6% | |
| | 5 | 7 | 11.1% | |
| Disaster plan | 1 | 2 | 3.2% | 2.13 (\pm 1.07) |
| | 2 | 20 | 31.7% | |
| | 3 | 15 | 23.8% | |
| | 4 | 20 | 31.7% | |
| | 5 | 6 | 9.5% | |
| Communication | 1 | 4 | 6.3% | 2.65 (\pm 0.744) |
| | 2 | 20 | 31.7% | |
| | 3 | 33 | 52.4% | |
| | 4 | 6 | 9.5% | |
| Education and training for disaster | 1 | 20 | 32.3% | 2.87 (\pm 0.735) |
| | 2 | 31 | 50.0% | |
| | 3 | 10 | 16.1% | |
| | 4 | 1 | 1.6% | |
| Hospital triage | 1 | 5 | 8.2% | 2.72 (\pm 0.897) |
| | 2 | 19 | 31.1% | |
| | 3 | 26 | 42.6% | |
| | 4 | 10 | 16.4% | |
| | 5 | 1 | 1.6% | |
| Surge capacity | 1 | 2 | 3.2% | 3.51 (\pm 1.243) |
| | 2 | 17 | 27.0% | |
| | 3 | 8 | 12.7% | |
| | 4 | 19 | 30.2% | |
| | 5 | 17 | 27.0% | |
| Hospital logistics, equipment, and supplies | 1 | 17 | 27.0% | 2.25 (\pm 0.983) |
| | 2 | 20 | 31.7% | |
| | 3 | 19 | 30.2% | |
| | 4 | 7 | 11.1% | |
| Monitoring and assessing hospital disaster preparedness | 1 | 1 | 1.6% | 3.16 (\pm 0.67) |
| | 2 | 7 | 11.1% | |
| | 3 | 36 | 57.1% | |
| | 4 | 19 | 30.2% | |
| Safety and security | 1 | 4 | 6.3% | 3.08 (\pm 1.09) |
| | 2 | 16 | 25.4% | |
| | 3 | 21 | 33.3% | |
| | 4 | 15 | 23.8% | |
| | 5 | 7 | 11.1% | |
| Post-disaster recovery | 1 | 0 | 0.0% | 4.21 (\pm 0.78) |
| | 2 | 2 | 3.2% | |
| | 3 | 8 | 12.7% | |
| | 4 | 28 | 44.4% | |
| | 5 | 25 | 39.7% | |
| Effectiveness of the overall hospitals' disaster preparedness | 1 | 1 | 1.6% | 2.99 (\pm 1.038) |
| | 2 | 16 | 25.4% | |
| | 3 | 18 | 28.6% | |
| | 4 | 20 | 31.7% | |
| | 5 | 8 | 12.7% | |

These findings highlight the need to improve the education and awareness of hospital staff about disaster preparedness plans and policies. Another related finding was that all hospitals had educational programs on disaster preparedness and an assessment action plan. However, among these hospitals, only 74.6% had enough staff orientation about the disaster preparedness.²¹

The current study showed a moderate level of education and training of staff about disaster preparedness. These results correspond with the findings by Al-Thobaity and colleagues, the authors reported a moderate level of knowledge about disaster preparedness among nurses in Saudi Arabia. The interviewed nurses perceived themselves as not well-prepared for disasters and expressed willingness to improve their knowledge and skills in this regard.²² In another study by Bajow, *et al.*, the authors concluded that the evaluated hospitals suffered from a lack of training and management during disasters, despite the existence of tools and indicators that could be used to assess hospitals.²³ These studies, along with other studies published from the Middle East, suggest that personnel involved in disaster management (including physicians, nurses, safety officers, and paramedics) should receive more training and testing to enhance their disaster preparedness.^{10,20,24}

Generally, the hospitals in this study reported sufficient resources for triage and surge capacity. For example, all hospitals performed triage with clear guidelines. In addition, 96.8% of the included hospitals provided training on triage, and 68.3% had a triage area for receiving mass casualties. These numbers reflect adequate triage preparedness, but there is still room for improvement. A similar study in Tanzania reported that only 10 of 25 hospitals had a designated triage area, and only 8 (32%) provided routine training for triage personnel.²⁵ Another study in Iran showed that the triage system was used in all included studies.²⁶ The current study showed that 76.2% of the hospitals had designated care areas for patient overflow, and 30.2% had designated areas that can be used as temporary morgues during a disaster. The aforementioned Tanzanian study cited that 80% of their hospitals had a contingency area to provide care in emergency situations, while only 8.3% had a temporary morgue to accommodate patient overflow.²⁵

A striking finding of this study is the lack of post-disaster recovery assistance programs like counselling and support services; only 9.5% of the evaluated hospitals had similar programs. In all 63 hospitals, the method used to capture lessons learned following disaster response was meetings. Generally, the disaster recovery phase is rarely addressed in hospitals' disaster plans.²⁷ This study highlights the need to develop clear post-disaster recovery plans that are well-integrated within the hospital disaster preparedness policies.

Other weak spots were detected in the disaster preparedness systems in the evaluated studies. For example, only 19% of hospitals covered the WHO All Hazard approach, which is beneficial to have a holistic approach to disaster management.²⁸ Moreover, public information officers and back-up communication systems were present in about 19%, and 58.7% of the included hospitals, respectively. In terms of safety preparations, only 23.8% of the evaluated had a fire department, and only 9.5% had an area for radioactive, biological, and chemical decontamination.

Only 12.7% of hospitals had beds exceeding 20 for both the ICU and emergency departments. Such lack of sufficient beds may be an indication that in most of the hospitals, a disaster event may be overwhelming. Enough facilities are vital to ensure all the patients would have the best quality of care during surges associated with disaster events.²⁹ It is shown those disaster preparedness capacities depending on the ownership as well as their respective levels. For

instance, public hospitals were demonstrated to have more resources; from higher numbers of staff to adequate medical equipment compared to private hospitals.²⁶ Unsurprisingly, this was due to the access to funds from the government compared to private hospitals that relied on owners' funding.²⁴ Similarly, the different level hospitals, i.e., primary, secondary and tertiary were shown to differ in their capabilities, with the secondary and tertiary levels being more equipped for handling diverse health issues including having more qualified and highly experienced medical professionals.³⁰

Based on the findings of the present analysis, as well as previous studies published from Middle Eastern countries, some recommendations can be drawn. These recommendations include (1) routine training for personnel involved in hospital disaster management, (2) using drills and practical exercises to assess staff preparedness,^{10,19,20,24} (3) developing highly functional ICS to improve response timeline and accountability,^{9,31} (4) engagement of external stakeholders and the communities in developing disaster preparedness programs,^{23,32} and (5) improvement of the communication system between administrative and clinical staff.²⁰

In conclusion, the majority of hospitals had sufficient resources for disaster management; however, the overall effectiveness of hospitals' disaster preparedness was slight to moderate. Some recommendations to improve hospitals' disaster preparedness should be proposed, including improved staff training and testing, better communications and safety procedures, and adoption of a holistic approach for disaster management.

References

1. Tucker C. Social media, texting play new role in response to disasters: Preparedness, communication targeted. *The Nation's Health*. 2011;41(4):1–18.
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):781–788.
3. Khorram-Manesh A, Hedelin A, Ortenwall P. Hospital-related incidents; causes and its impact on disaster preparedness and prehospital organisations. *Scand J Trauma Resusc Emerg Med*. 2009;17:26.
4. Dami F, Yersin B, Hirzel AH, Hugli O. Hospital disaster preparedness in Switzerland. *Swiss Med Wkly*. 2014;144:w14032.
5. Lim GH, Lim BL, Vasu A. Survey of factors affecting health care workers' perception towards institutional and individual disaster preparedness. *Prehosp Disaster Med*. 2013;28(4):353–358.
6. Kaji AH, Lewis RJ. Hospital disaster preparedness in Los Angeles County. *Acad Emerg Med*. 2006;13(11):1198–1203.
7. Baack S, Alfred D. Nurses' preparedness and perceived competence in managing disasters. *J Nurs Scholarsh*. 2013;45(3):281–287.
8. Najafbagy R. Crisis management, capabilities and preparedness: The case of public hospitals in Iran. *World Hosp Health Serv*. 2010;46(4):7–12.
9. Yarmohammadian MH, Atighechian G, Shams L, Haghshenas A. Are hospitals ready to response to disasters? Challenges, opportunities and strategies of Hospital Emergency Incident Command System (HEICS). *J Res Med Sci*. 2011;16(8):1070–1077.
10. Al Khalailah MA, Bond E, Alasad JA. Jordanian nurses' perceptions of their preparedness for disaster management. *Int Emerg Nurs*. 2012;20(1):14–23.
11. Morabia A, Benjamin GC. The refugee crisis in the Middle East and public health. *Am J Public Health*. 2015;105(12):2405–2406.
12. Manley WG, Furbee PM, Coben JH, *et al.* Realities of disaster preparedness in rural hospitals. *Disaster Manag Response*. 2006;4(3):80–87.
13. Alshehri SA, Rezguy Y, Li H. Public perception of the risk of disasters in a developing economy: The case of Saudi Arabia. *Nat Hazards*. 2013; 65(3):1813–1830.
14. Al-Majed AA, Adebayo AR, Hossain ME. A sustainable approach to controlling oil spills. *J Environ Manage*. 2012;113:213–227.

15. **Fouad D.** Over 83% of hospitals in EP 'not approved' for practice. <https://www.arabnews.com/saudi-arabia/news/713866>. Accessed June 15, 2016.
16. **von Elm E, Altman DG, Egger M, et al.** The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: Guidelines for reporting observational studies. *Int J Surg.* 2014;12(12):1495–1499.
17. **World Health Organization (WHO).** *Global Assessment of National Health Sector Emergency Preparedness and Response.* Geneva: World Health Organization. 2008;11–39.
18. **World Health Organization (WHO).** *Hospital emergency response checklist:* 2011. Copenhagen. Accessed July 15, 2017.
19. **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):806–816.
20. **Aladhrai SA, Djalali A, Della Corte F, Alsabri M, El-Bakri NK, Ingrassia PL.** Impact of the 2011 revolution on hospital disaster Preparedness in Yemen. *Disaster Med Public Health Prep.* 2015;9(4):396–402.
21. **Djalali A, Castren M, Khankeh H, et al.** Hospital disaster preparedness as measured by functional capacity: A comparison between Iran and Sweden. *Prehosp Disaster Med.* 2013;28(5):454–461.
22. **Al Thobaity A, Plummer V, Innes K, Copnell B.** Perceptions of knowledge of disaster management among military and civilian nurses in Saudi Arabia. *Australas Emerg Nurs J.* 2015;18(3):156–164.
23. **Bajow NA, Alkhalil SM.** Evaluation and analysis of hospital disaster preparedness in Jeddah. *Health.* 2014;6(19):2668–2687.
24. **Adini B, Laor D, Hornik-Lurie T, Schwartz D, Aharonson-Daniel L.** Improving hospital mass casualty preparedness through ongoing readiness evaluation. *Am J Med Qual.* 2012;27(5):426–433.
25. **Koka PM, Sawe HR, Mbaya KR, et al.** Disaster preparedness and response capacity of regional hospitals in Tanzania: A descriptive cross-sectional study. *BMC Health Serv Res.* 2018;18(1):835.
26. **Shojaei P, Maleki MR, Bagherzadeh R.** Studying preparedness in teaching hospitals affiliated to Iran University of Medical Sciences. *Disaster Prevention and Management.* 2009;18(4):379–387.
27. **Richter PV.** Hospital disaster preparedness: Meeting a requirement or preparing for the worst? *Healthc Facil Manag Ser.* 1997;1–11.
28. **Lindell MK.** Disaster studies. *Current Sociology.* 2013;61(5-6):797–825.
29. **Tang R.** *Evaluation of hospital preparedness for public health emergencies in Sichuan (China).* 2015: PhD thesis, Queensland University of Technology.
30. **Adini B, Goldberg A, Laor D, Cohen R, Bar-Dayyan Y.** Factors that may influence the preparation of standards of procedures for dealing with mass-casualty incidents. *Prehosp Disaster Med.* 2007;22(3):175–180.
31. **Sobhani G, Khammarnia M, Hayati R, Ravangard R, Heydari AR, Heydarvand S.** Investigation of the preparedness level of the hospitals against disasters in Bandar Abbas, Iran, in 2012. *J Pak Med Assoc.* 2014;64(5):506–509.
32. **Fares S, Femino M, Sayah A, et al.** Health care system hazard vulnerability analysis: An assessment of all public hospitals in Abu Dhabi. *Disasters.* 2014;38(2):420–433.