Disaster Medicine and Public Health Preparedness

www.cambridge.org/dmp

Comparison of the Level of Disaster Preparedness Between Private and Government Hospitals in Saudi Arabia: A Cross-Sectional Study

Abdullah Saleh Alruwaili PhD[1,2], Md Shahidul Islam PhD[3] and Kim Usher PhD[3]

[1]Emergency Medical Services Program, College of Applied Medical Sciences, King Saud Bin Abdulaziz University for Health Sciences, Al Ahsa, Saudi Arabia; [2]King Abdullah International Medical Research Center, Al Ahsa, Saudi Arabia and [3]School of Health, University of New England, Armidale, NSW, Australia

Original Research

Cite this article: Alruwaili AS, Islam MS, Usher K. Comparison of the level of disaster preparedness between private and government hospitals in Saudi Arabia: a cross-sectional study. *Disaster Med Public Health Prep*. **17**(e335), 1–10. doi: https://doi.org/10.1017/dmp.2023.1.

Keywords:
bioterrorism; communicable diseases; disaster preparedness

Corresponding author:
Abdullah Saleh Alruwaili,
Email: ruwailia1@yahoo.com.

Abstract

Objective: The objective of this study was to describe and compare almost all the components of disaster preparedness between private and government hospitals in the Eastern Province of the Kingdom of Saudi Arabia, using the World Health Organization's (WHO) checklist.

Methods: We assessed and compared the disaster preparedness between government and private hospitals in Province, using the 10-key component WHO checklist in a descriptive cross-sectional study. Of 72 hospitals in the region, 63 responded to the survey.

Results: All 63 hospitals had an HDP plan and reported having a multidisciplinary HDP committee. In all responding hospitals, HDP was acceptable in most indicators of preparedness; however, some hospitals to some extent fell short of preparedness in surge capacity, equipment and logistic services, and post-disaster recovery. Government and private hospitals were generally comparable in disaster preparedness. However, government hospitals were more likely to have HDP plans that cover WHO's "all-hazard" approach, both internal and external disasters, compared to private hospitals.

Conclusion: HDP was acceptable, however, preparedness in surge capacity, equipment and logistic services, and post-disaster recovery fell short. Government and private hospitals were comparable in preparedness with regards to all indicators except surge capacity, post-disaster recovery, and availability of some equipment.

In recent times, countries around the world have faced enormous problems arising from disasters.[1] Disasters are sudden events arising from natural or manmade interventions with substantial consequences which adversely affect human lives and property.[2,3] Globally, natural disasters affected more than 3 million families and cost over $500 billion in the past 2 decades.[4] Disasters significantly impacted economic infrastructures of afflicted communities and overwhelmed health-care systems with huge numbers of victims. Approximately 68.5% of all economic losses globally are attributable to adverse effects of disasters on human lives and property between 2005 and 2017.[3] Statistics show that approximately 3.4 billion people live in natural disaster hot spots and natural hazards displace 24 million people each year.[3]

Given the regularity of disasters and their accompanying impact on human health, it is crucial for hospitals to sufficiently prepare to ensure that disaster situations are adequately managed when they occur.[1,4] Following disasters, local hospitals and emergency departments (EDs) are often overcrowded and overwhelmed.[5] Moreover, hospitals can be damaged by disasters or experience major incidents like a fire outbreak, power outage, or telecommunication breakdown[6,7] that can result in a marked decrease in hospital functioning ability. As a result, patients' lives and continuity of care for surrounding communities may be endangered by serious disruptions to hospital activities and impact staff availability.

The World Health Organization (WHO) has expressed concerns about effective disaster management and has recommended hospital disaster preparedness (HDP) in countries around the world.[8,9] HDP comprises knowledge development and capacity building in every facet of the hospital to effectively receive and deal successfully with the negative consequences associated with potential disasters.[10] While many countries have stepped up public awareness to adequately prepare hospitals for disasters, evidence suggests these preparations are inadequate and more needs to be done in the Middle Eastern countries.[11–13]

HDP has been in existence in Middle East countries for some time, as the region has a long history of enduring various disasters. The Kingdom of Saudi Arabia (KSA) in recent times, has become a typical region for natural and/or human-made hazards and these disasters continue to affect a large number of people when they occur. Recent disasters coupled with discovery of the novel MERS-CoV near Makkah,[14] posed a considerable challenge for the Ministry of Health

(MOH) and they have set up proactive preventive measures to handle disasters including stopping the spread of infectious viruses. Vulnerability to disaster emphasizes the need to improve all-hazard disaster preparedness among hospitals.

Countries in the Middle East including KSA are no exception to public awareness campaigns to adequately prepare hospitals for disasters, and many efforts are being made to ramp up HDP.[11–13] Similar to the other parts of the world,[15–20] several studies have suggested that hospital preparedness for disasters in Middle East countries may be inadequate.[11–13] Moreover, studies conducted in KSA have demonstrated need for more practical training and management as well as investment in personnel capacity and other valuable resources to enhance hospitals' preparedness to adequately respond to disasters.[21–24]

The HDP plan remains an integral component of emergency management system and usually requires coordination with various external agencies. These plans are policy documents designed to be exercised regularly as part of regional preparedness to test connectivity between hospitals and to evaluate the region's ability to function as well-integrated systems during disasters.[25] All hospitals are required by the MOH, KSA, to create their own disaster preparedness plans which are expected to meet safety requirements set by the Civil Defense (CD). Moreover, the MOH requires that HDP plans are accredited by either The Joint Commission (TJC; Oakbrook Terrace, IL)[26] or The Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI)[27] in addition to accreditation from the CD. Thus, there appears be a lack of unified standards for HDP plans, as hospitals may be accredited with different standards.

Health care in the KSA is delivered primarily through a publicly funded health system accounting for 80% of the health care provided in the country. The remaining 20% of health-care delivery in the KSA is provided by the private sector.[28] However, a policy to privatize publicly funded health-care institutions has been implemented in KSA. According the policy-makers, the privatization of public hospitals will help speed up decision-making, reduce the government's annual expenditure on health care, and improve health-care services including swift and adequate responses to disasters.[28,29] While several aspects of disaster preparedness among hospitals in KSA have been studied,[21–24] no or little is known about differences in preparedness of private and government hospitals to disasters.

The present study is part of a larger research which aims to investigate the disaster preparedness of hospitals in the Eastern Province of KSA and to further examine the differences in disaster preparedness between government and private hospitals using a survey adapted from the WHO National Health Sector Emergency Preparedness and Response Tool and Hospital Emergency response checklist.[8,9]

Methods

Study Design and Population

This was a descriptive cross-sectional study of all hospitals ($n = 72$ hospitals) in the Eastern Province of KSA.

Data Collection

Ethical approval to conduct the study was received from the MOH, KSA (IRB00010471), and the University of New England Human Research Ethics Committee (HE17-155). The questionnaire delivered to all hospitals was accompanied by a facilitating letter from the MOH as well as a cover letter stating the importance, aims and objectives of the study and ethical issues related to participation in the study. Each hospital had designated a department director who was responsible for coordinating the questionnaire completion. Each returned questionnaire was carefully reviewed for its completeness and consistency. The data from returned questionnaires were then transferred into a database for analysis. A total of 63 of 72 hospitals in the region responded to the survey representing a response rate of 87.5%.

Study Questionnaire

We adopted the survey from the WHO National Health Sector Emergency Preparedness and Response Tool and Hospital Emergency response checklist.[8,9] The questionnaire consists of 12 sections and 93 closed-ended questions. The reliability and validity of the survey were assessed in the literature.[30] The rate of test-retest reliability ranged between 0.711 and 0.899. 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) hospital disaster communication; (5) education and training; (6) triage; (7) surge capacity; (8) hospital logistics, equipment, and supplies; (9) monitoring and assessing HDP; (10) safety and security; (11) postdisaster recovery; and (12) assessment of HDP indicators.

Data Analysis

Descriptive statistics were used to describe the characteristics of participating hospitals and responding personnel. Responses to questions were analysed as continuous data and presented as means and standard deviation (SD). The t-tests were used to compare mean responses between private and government hospitals. In addition, responses were dichotomized into binary variable and presented as frequencies and percentages. Cross tabulations with the χ^2 statistic were used to compare proportions of responses between private and government hospitals. All statistical analysis were conducted using Statistical Package for Social Scientists (SPSS), version 25 and $P < 0.05$ was considered statistically significant for all tests.

Results

Hospitals' Characteristics

A response rate of 87.5% was obtained from responses from 63 hospitals. A large proportion of the hospitals (76.1%) were secondary hospitals. Forty-six (73%) hospitals had 1-1000 employees. Twenty-four (38%) had 50-99 beds, 18 (28.6%) had 100-200, whereas only 2 hospitals had bed capacity of greater than 500. Approximately 68.3% of hospitals have an average of 1-30 admissions per day. The number of intensive care beds ranged from 1 to 15 in 73% of hospitals in the Eastern province. Emergency bed capacity appears to be almost equally spread across a wide range of 1-20 beds among hospitals. Most hospital representatives were males, aged 41-50 y, more likely to hold the position of head of disaster committee/unit or hospital director/manager and had 16-20 y of experience (Table 1).

Command and Control

The incident command system (ICS) was available in 79.4% of the hospitals. Forty hospitals (63.5%) have a place designated as disaster command center (DCC), and less than 20% had alternate locations for DCC. Nearly all hospitals (98.4%) have a designated

https://doi.org/10.1017/dmp.2023.1 Published online by Cambridge University Press

Table 1. Hospital characteristics

		Government Hospitals		Private Hospitals		
		Number	Percentage	Number	Percentage	P value
Teaching/Non-teaching hospital	Non-teaching	35	94.6%	26	100.0%	0.22
	Teaching	2	5.4%	0	0.0%	
Level of hospital	Primary	1	2.7%	4	15.4%	0.08
	Secondary	28	75.7%	20	76.9%	
	Tertiary	8	21.6%	2	7.7%	
Number of employees	1-1000	26	70.3%	20	76.9%	0.59
	1001-2000	7	18.9%	5	19.2%	
	>2000	4	10.8%	1	3.8%	
Number of beds	1-49	1	2.7%	4	15.4%	0.11
	50-99	14	37.8%	10	38.5%	
	100-200	9	24.3%	9	34.6%	
	201-500	11	29.7%	3	11.5%	
	>500	2	5.4%	0	0.0%	
Average no. of admission/day	1-10	16	43.2%	11	42.3%	0.07
	11-30	6	16.2%	10	38.5%	
	>30	15	40.5%	5	19.2%	
Average no. of outpatients/day?	1-50	2	5.4%	1	3.8%	0.86
	51-100	12	32.4%	10	38.5%	
	>100	23	62.2%	15	57.7%	
Number of beds in emergency	1-5	8	21.6%	6	23.1%	0.14
	6-10	7	18.9%	8	30.7%	
	11-15	9	24.3%	7	26.9%	
	16-20	5	13.5%	5	19.2%	
	>20	8	21.6%	0	0.0%	
Number of beds in ICU	1-5	9	24.3%	11	42.3%	0.12
	6-10	7	18.9%	5	19.2%	
	11-15	7	18.9%	7	26.9%	
	16-20	7	18.9%	2	7.7%	
	>20	7	18.9%	1	3.8%	

emergency coordinator all the time, whereas policies guiding disaster preparedness management existed in almost all hospitals.

Disaster Plan and Communication

The disaster plan was reported as available and readily accessible to every staff in all hospitals surveyed. Most hospitals indicated that disaster plans covered both internal and external disasters (90.5%; $n = 57$) but only 19% ($n = 12$) had plans to cover the WHO all-hazard approach. We found that hospital staff in both settings had access to the disaster plan mostly as a hard copy. More than 80% of staff in both hospital settings could access the disaster plan by hard copy. Only 19% of disaster plans in both hospital settings covered the WHO "all-hazard" approach and government hospitals were more likely to have a disaster plan that covered the WHO "all-hazard" approach compared to private hospitals ($P = 0.01$). A statistically significant difference in coverage of disaster plans to both internal and external disasters was observed between government and private hospitals ($P = 0.002$). Government hospitals were more likely to have a disaster plan to cover both internal and external disasters than private hospitals (Table 2).

Education and Training

The current survey showed that all the government and private hospitals surveyed have an education and training program on disaster preparedness, and there was no statistically significant difference between them regarding average time of training on disaster preparedness, assessment of knowledge of staff, and orientation to the HDP plan.

Triage

We observed that triage was available and conducted in all government and private hospitals. Disaster triaging is mostly conducted by a nurse specialist in government hospitals and more likely to be conducted by a medical doctor in private hospitals ($P < 0.001$). In addition, all hospitals in both settings have triage guidelines and dedicated forms for triaging. A significant proportion of hospitals in both settings have triage hospital training and triage areas for receiving mass casualties (Table 3).

Surge Capacity

The majority (76.2%; $n = 48$) of the hospitals had designated care areas for patient anticipated overflow and approximately 46% ($n = 29$) had additional sites to accommodate patient overflow during a disaster. Thirty-three hospitals (52.4%) had contingency plans to prioritize or cancel nonessential services and a large proportion of hospitals (85.7%; $n = 54$) had adequate number of health-care professionals to manage patient overflow during disasters. Only 3 (4.8%) of the hospitals had ability to call staff from

https://doi.org/10.1017/dmp.2023.1 Published online by Cambridge University Press

Table 2. Disaster plan and emergency command and control system

		Government Hospitals		Private Hospitals		
		Number	Percentage	Number	Percentage	*P* value
Presences of ICS	Yes	29	78.4%	21	80.8%	0.12
Presences of DCC	Yes	24	64.9%	16	61.5%	0.32
Presences of alternate location for DCC	Yes	8	21.6%	3	11.5%	0.22
Designated emergency coordinator all over the time	Yes	36	97.3%	26	100.0%	0.39
Policies guiding disaster preparedness management	Yes	36	97.3%	25	96.2%	0.79
Presences of disaster plan	Yes	37	100.0%	26	100.0%	–
Presences of disaster committee	Yes	25	67.6%	21	80.9%	0.88
Presences of multidisciplinary disaster planning committee	Yes	23	62.4%	21	80.9%	0.63
Disaster plan available in all departments	Yes	27	72.9%	11	42.3%	0.37
Hospital staff have access to the disaster plan	Yes	37	100.0%	26	100.0%	–
How can the staff access the disaster plan	Email	4	10.8%	3	11.5%	0.04
	Hard Copy	30	81.1%	22	84.6%	
	Internet	3	7.7%	1	3.8%	
Hospital's disaster plan covers WHO "all-hazard" approach	Yes	11	29.7%	1	3.8%	**0.01**
Disaster plan cover both internal and external disasters	Yes	37	100.0%	20	76.9%	**0.002**

Table 3. Communication, triage, education and training

		Government Hospitals		Private Hospitals		
		N	%	N	%	*P* value
Method to communicate the staff during a disaster	Radios	1	2.7%	3	11.5%	0.24
	Public announcement	29	78.4%	19	80.8%	
	Overhead Announcement	4	10.8%	2	7.7%	
	Phone/SMS	3	5.4%	2	7.7%	
Updated staff contacts database	Yes	35	94.6%	24	92.3%	0.71
Dedicated public information officers	Yes	7	18.9%	5	19.2%	0.97
Back-up communication systems	Yes	26	70.0%	11	40.3%	0.26
Education and training programme	Yes	37	100.0%	26	100.0%	–
Average time of training on disaster preparedness	Once in a year	25	67.6%	19	73.1%	0.42
	Once in 6 months	2	5.4%	3	11.5%	
	Occasionally	10	27.0%	4	15.4%	
Presences of assessment disasters and disaster response plans to staff	Yes	37	100.0%	26	100.0%	–
Assessment of knowledge of staff	Drilling	36	97.3%	26	100.0%	0.39
	Examination	1	2.7%	0	0.0%	
Orientation to the hospital disaster preparedness	Yes	28	75.7%	19	73.1%	0.81
Triage conduction	Yes	37	100.0%	26	100.0%	–
Person responsible for undertaking triage	Doctor	4	10.8%	14	53.8%	<0.001
	Nurse Specialist	33	89.2%	12	46.2%	
Triage training	Yes	36	97.3%	25	96.2%	0.48
Triage guidelines	Yes	35	94.6%	26	100.0%	–
Triage forms	Yes	37	100.0%	26	100.0%	–
Triage area for mass casualties	Yes	26	70.3%	17	66.4%	0.68

other hospitals, though the majority (76.2%) had agreements with other hospitals to transfer patients during surge situations. A temporary morgue was available in 19 (30%) of the hospitals. We observed that, 25 (39.7%) of the hospitals can treat 6-10 patients in the emergency room every hour, whereas more than half (50.7%; $n = 32$) can perform 1-5 operations in per 12 h. Government hospitals were more likely to have additional sites to accommodate patient overflow and agreements to transfer patients with other hospitals in case of disaster ($P = 0.04$ and $P < 0.001$, respectively) compared with private hospitals.

Logistics, Equipment, and Supplies

All hospitals had a back-up generator and storage tanks to handle surge situations during disasters. In addition, an updated inventory of all equipment, supplies and pharmaceutical products was

https://doi.org/10.1017/dmp.2023.1 Published online by Cambridge University Press

Table 4. Surge capacity, logistics, equipment and supplies

		Government Hospitals		Private Hospitals		P value
		N	%	N	%	
Presences of designated care areas for patient overflow	Yes	30	81.1%	18	69.2%	0.27
Presences of additional sits to accommodate patient overflow during a disaster	Yes	21	56.8%	8	30.8%	**0.04**
Presences of designated area that can be used as temporary morgues during a disaster	Yes	14	37.8%	5	19.2%	0.11
Presences of plan to prioritize/cancel nonessential services	Yes	26	70.3%	7	26.9%	**0.001**
Presences of adequate number HCP to manage patient overflow	Yes	33	89.2%	21	80.8%	0.34
Availability of plan to call staff from other hospitals in case of disaster	Yes	1	2.7%	2	7.7%	0.36
Has agreements with other hospitals to transfer patients in case of disaster	Yes	34	91.9%	14	53.8%	**<0.001**
Number of patients can be treated in Emergency Room/hour (Hospital Treatment Capacity)	1-5	11	29.7%	8	30.8%	0.25
	6-10	12	32.4%	13	50.0%	
	11-15	12	32.4%	3	11.5%	
	16-20	2	5.4%	2	7.7%	
Number of operations can be done in Operation Room/12 hrs (Hospital Surgical Capacity)	1-5	17	45.9%	15	57.7%	0.36
	6-10	12	32.4%	9	34.6%	
	11-15	8	21.6%	2	7.7%	
Number of working ambulances	1-5	21	56.8%	26	100.0%	**0.001**
	6-10	13	35.1%	0	0.0%	
	11-15	3	8.1%	0	0.0%	
Presence of plans to fetch victims from the sites of disaster	Yes	35	94.6%	21	80.8%	0.08
Presence of updated inventory of all equipment, supplies and pharmaceuticals	Yes	37	100.0%	26	100.0%	–
Presence of contingency agreements with vendors to supply resources in case of disaster	Yes	35	94.6%	24	92.3%	0.71
Identification of physical space within the hospital for the storage and stockpiling of additional supplies	Yes	36	97.3%	22	84.6%	0.06
Presence of blood bank in the hospital	Yes	32	86.5%	20	76.9%	0.32
Presence of backup generators in the hospital	Yes	37	100.0%	26	100.0%	–
Presence of storage tanks	Yes	37	100.0%	26	100.0%	–
Presence of sufficient number of Stretchers	Yes	36	97.3%	26	100.0%	0.39
Presence of sufficient number of Wheelchairs	Yes	33	89.2%	24	92.3%	0.35
Presence of sufficient number of Cardiac monitors	Yes	32	86.5%	25	96.2%	0.67
Presence of sufficient number of Ventilators	Yes	36	97.3%	25	96.2%	0.19
Presence of sufficient number of X-ray machine	Yes	33	89.2%	23	88.5%	0.79
Presence of sufficient number of US machines	Yes	35	94.6%	26	100.0%	0.92
Presence of sufficient number of CT scan machines	Yes	3	8.1%	0	0.0%	0.22

available in all hospitals in the province. Majority of hospitals met logistical requirements of HDP except availability of sufficient computed tomography (CT) scan machines. Only 3 government hospitals had sufficient number of CT scan machine. None of the privately-owned hospitals had sufficient number of CT scan machines. Government and private hospital were comparable in meeting most of the parameters measuring level of logistics, equipment, and supplies except with number of working ambulances were government owned hospitals had more than private hospitals ($P = 0.001$) (Table 4).

Monitoring and Assessing Hospital Disaster Preparedness

Almost all hospitals evaluated in this study monitored preparedness for disasters using drills. Only 1 privately owned hospital monitored preparedness with disaster simulation exercises. Drills or simulation exercises were done yearly in majority of hospitals (85.7%; $n = 54$), and nearly all of them had conducted a disaster simulation exercises in the past 12 months (82.5%; $n = 52$). Disaster preparedness plan was reviewed on the average of 1 y for 98.4% ($n = 62$) of hospitals. No difference in proportions were observed in any of the parameters measuring how hospitals monitored and assessed disaster preparedness between government and private hospitals.

Safety and Security

Just over half (53.9%; $n = 34$) of the responding hospitals had been fenced. Of those, government hospitals were more likely to have been fenced compared with private hospitals. The difference in proportions between the 2 hospital settings was statistically significant ($P < 0.001$). Approximately two-thirds (68.3%; $n = 43$) of hospitals had a control system to regulate entry and exit to and from the hospital. Furthermore, government hospitals were more likely compared with private hospitals to have a control system installed to regulate entry and exit from the hospitals. We observed a statistically significant difference in proportions of the 2 hospital settings having control system to regulate entry and exit from the responding hospitals ($P = 0.009$). Only 6 hospitals had designated area for radioactive, biological, and chemical decontamination, and all were government facilities. None of the responding private hospitals had an area designated for radioactive, biological and

https://doi.org/10.1017/dmp.2023.1 Published online by Cambridge University Press

Table 5. Safety and security, post-disaster recovery and monitoring of hospital disaster preparedness

		Government Hospitals		Private Hospitals		
		N	%	N	%	P value
Monitoring the preparedness for disasters	Simulation exercises	0	0.0%	1	3.8%	0.22
	Drills	37	100.0%	25	96.2%	
Number of hospital disaster simulation exercises	Every 6 months	4	10.8%	4	15.4%	0.61
	Every 3 months	1	2.7%	0	0.0%	
	Every Year	32	86.5%	22	84.6%	
Conducting a disaster simulation exercises in the past 12 months	Yes	29	78.4%	23	88.5%	0.29
Assessment the effectiveness of disaster preparedness plan	Performance of disaster simulation exercises	0	0.0%	1	3.8%	0.23
	Performance of Drills	37	100.0%	25	96.2%	
Average reviewing the disaster preparedness plan	Once in 5 years	7	18.9%	5	19.2%	0.50
	Once in 2 years	3	8.1%	1	3.8%	
	Once in a year	25	67.6%	19	73.1%	
	Once in 6 months	2	5.4%	0	0.0%	
	Once in 3 months	0	0.0%	1	3.8%	
Presence of hospital fenced	Yes	27	73.0%	7	26.9%	**<0.001**
Control of entry and exit of the hospital	Yes	30	81.1%	13	50.0%	**0.009**
Presence of fire department	Yes	9	24.3%	6	23.1%	0.91
Presence of fire alarm system	Yes	37	100.0%	26	100.0%	–
Presence of area for radioactive, biological and chemical decontamination	Yes	6	16.2%	0	0.0%	**0.03**
Presence of isolation room?	Yes	31	83.8%	19	73.1%	0.30
Presence of personal protective equipment and precautions to be taken in the event of a possible infectious disease or when victims need decontamination	Yes	20	54.1%	8	30.8%	0.06
Presence of separate entry for contaminated patients into the emergency department	Yes	4	10.8%	0	0.0%	0.08
Presence of capturing lessons learned following disaster responses	Yes	37	100.0%	25	96.2%	0.22
The used method to capture lessons learned following disaster response	Meeting	37	100.0%	26	95.8%	–
Presences of post-disaster recovery assistance programme like counselling and support services	Yes	5	13.5%	1	3.8%	**0.03**
Presences of recognition of the service provided by staff, volunteers and other external personnel during disaster response and recovery	Yes	17	46.0%	11	42.5%	0.42

chemical decontamination. Similarly, 4 hospitals had separate entry for contaminated patients into the ED and all of those are government hospitals. Less than half of the hospitals (44.4%; $n = 28$) had personal protective equipment and precautions to be taken in the event of a possible infectious disease or when victims need decontamination. Moreover, those hospitals were more likely to be government health-care facilities compared to private hospitals ($P = 0.06$). Our results showed that all parameters measuring safety and security of hospitals in readiness for disasters were comparable between government and private hospital settings, except availability of hospital fence, entry and exit control, and area for radioactive, biological, and chemical decontamination ($P < 0.001$, $P = 0.009$, and $P = 0.03$, respectively).

Postdisaster Recovery

Nearly all ($n = 62$; 98.4%) organized meetings to capture lessons drawn from disaster responses. We did not observe any differences between government and private hospitals. A postdisaster recovery assistance programs were available in only 6 hospitals, of which 5 were government hospitals ($P = 0.03$). Less than half (44.4%; $n = 28$) of the responding hospitals showed recognition for service provision by staff, volunteers, and other external personnel in disaster response and recovery. And we observed comparable proportions between government and private hospitals ($P = 0.42$) (Table 5).

Comparative Assessment of Government and Private Hospitals in Disaster Preparedness

We ranked the assessment of HDP indicators on a scale of 1 (very effective) to 5 (very ineffective). Our results demonstrate that almost all indicators of HDP were ranked moderately effective except surge capacity and postdisaster recovery. No statistically significant differences were seen between government and private hospitals regarding ranking of assessments of any of the hospital's disaster preparedness indicators in the analysis (Table 6).

Discussion

This study represents 1 of the most comprehensive surveys of hospital disaster preparedness in the Middle East region of KSA, a region with considerable rates of natural and manmade disasters and emergencies.[1] Whereas hospital preparedness is critical to proper response and management of disasters as well as minimizing adverse impacts,[14] the current study demonstrated that

https://doi.org/10.1017/dmp.2023.1 Published online by Cambridge University Press

Table 6. Comparison of level of disaster preparedness between government and private hospitals

		Government Hospitals			Private Hospitals			
		#	%	Mean (SD)	#	%	Mean (SD)	P value
Effectiveness of hospital command and control	1	3	8.1%	2.8 (±1.14)	0	0.0%	3.1 (±1.11)	0.11
	2	14	37.8%		12	46.1%		
	3	7	18.9%		7	26.9%		
	4	10	27.0%		3	11.5%		
	5	3	8.1%		4	15.4%		
Effectiveness of hospital disaster plan	1	2	5.4%	3.1 (±1.15)	0	0.0%	3.2 (±0.95)	0.13
	2	13	35.1%		7	26.9%		
	3	7	18.9%		8	30.7%		
	4	11	29.7%		9	34.6%		
	5	4	10.8%		2	7.7%		
Effectiveness of hospital communication	1	4	10.8%	2.5 (±0.76)	0	0.0%	2.8 (±0.67)	0.20
	2	12	32.4%		8	30.7%		
	3	19	51.3%		14	53.8%		
	4	2	5.4%		4	15.4%		
Effectiveness of hospital education and training	1	14	38.9%	2.7 (±0.69)	6	23.1%	3.1 (±0.77)	0.07
	2	18	48.6%		14	53.8%		
	3	5	13.9%		5	19.2%		
	4	0	0.0%		1	3.8%		
Effectiveness of the hospital triage	1	3	8.6%	2.5 (±0.85)	2	7.7%	2.9 (±0.91)	0.21
	2	14	40.0%		5	19.2%		
	3	17	45.9%		11	42.3%		
	4	2	5.7%		8	30.8%		
	5	1	2.9%		0	0.0%		
Effectiveness of the hospital surge capacity	1	2	5.4%	3.3 (±1.37)	0	0.0%	3.7 (±0.99)	0.54
	2	13	35.1%		4	15.4%		
	3	4	10.8%		4	15.4%		
	4	7	18.9%		12	46.2%		
	5	11	29.7%		6	23.1%		
Effectiveness of the hospital logistics, equipment and supplies	1	12	32.4%	2.1 (±1.05)	5	19.2%	2.3 (±0.89)	0.09
	2	11	29.7%		9	34.6%		
	3	9	24.3%		10	38.5%		
	4	5	13.5%		2	7.7%		
Effectiveness of the monitoring and assessing hospital disaster preparedness	1	1	2.7%	3.1 (±0.72)	0	0.0%	3.2 (±0.61)	0.21
	2	5	13.5%		2	7.7%		
	3	21	56.8%		15	57.7%		
	4	10	27.0%		9	34.6%		
Effectiveness of the hospital Safety and Security	1	4	10.8%	2.8 (±1.26)	0	0.0%	3.3 (±0.74)	0.11
	2	13	35.1%		3	11.5%		
	3	9	24.3%		12	46.2%		
	4	5	13.5%		10	38.5%		
	5	6	16.2%		1	3.8%		
Effectiveness of the hospital post-disaster recovery	1	2	5.4%	4.1 (±0.88)	0	0.0%	4.51 (±0.51)	0.11
	2	8	21.6%		0	0.0%		
	3	15	40.5%		13	50.0%		
	4	12	32.4%		13	50.0%		
Effectiveness of the overall hospitals' disaster preparedness	1	1	2.7%	3.2 (±1.13)	0	0.0%	3.3 (±0.89)	0.32
	2	11	29.7%		5	19.2%		
	3	10	27.0%		8	30.8%		
	4	9	24.3%		11	42.3%		
	5	6	16.2%		2	7.7%		

https://doi.org/10.1017/dmp.2023.1 Published online by Cambridge University Press

the level of preparedness among hospitals in the Eastern province of KSA was moderately sufficient, with some degree of variability across indicators and between government and private hospitals.

As part of the accreditation process, the TJC or Saudi Central Board for Accreditation of Healthcare Institutions, requires all hospitals to have written disaster plans and conduct drills on a regular basis to assess hospital readiness for disaster situations. All hospitals surveyed in this study demonstrated compliance to accreditation requirements.[26,27] In addition, the current study found that disaster plans were present in majority of all responding hospitals and readily accessible in hard copies to every staff and had a multidisciplinary disaster planning committee. Congruent to the findings of the present study, a previous cross-sectional study conducted in Makkah[21] showed that only 1 responding hospital did not have a disaster plan. Additionally, our findings are similar to that of a Riyadh study conducted by Bin Shalhoub et al.,[24] which found that all 13 hospitals involved in the survey had disaster plans and disaster preparedness committees. The authors reported that approximately 92% of responding hospitals had disaster plans which covered both internal and external disasters, while more than half of them had agreements with other hospitals to accept patients during disasters. Importantly, while the current study found a substantial number of the hospitals to have agreements with other hospitals to accept patients during disasters, these numbers significantly varied between government and private hospitals with private hospitals less likely to have such agreements in place. The reasons for this phenomenon are unclear but could be plausibly due to near perfect communication and collaboration that usually exist between government facilities compared to private hospitals. In addition, government hospitals mostly have centralized management and could easily facilitate such activities in disaster situations. While there could be a few exceptions, the present study showed that government hospitals did not differ significantly from private hospitals with regards to most of the parameters measuring hospital preparedness for disasters. The MOH's supervision of both private and governmental hospitals with the same standards could plausibly explain the comparable outcomes in both hospital settings.

The WHO recommends disaster plans to cover all hazards for hospitals in readiness for disasters.[8,9] In this study, only a third (19%; $n = 12$) of responding hospitals had plans covering the WHO all-hazard approach. Our finding is consistent with that of several previous studies.[15,16,21] A study assessing hospitals in 4 regions in China showed that most hospitals were short of fundamental elements of preparedness.[15] Also, a Canadian study evaluating hospitals' preparedness for disasters showed a shortfall in disaster plans for chemical, biologic, radiation, nuclear, or explosion events.[16] On the contrary, a survey of hospitals in Makkah, KSA, demonstrated that more than 70% of responding hospitals had comprehensive disaster plan which covers all-hazards approach to disaster response and management.[21] However, this study surveyed only 17 hospitals; thus, the findings may not be representative of the situation in the entire country.

Surge capacity is critical in disaster preparedness and WHO recommends enhanced capacities of hospitals to respond to disasters.[8,9] The current study ranked the surge capacity as either very, moderately, or slightly effective with less than 50% of responding hospitals. This finding is congruent with a previous study conducted to evaluate emergency preparedness of hospitals in the Middle East.[12] However, our reported estimate was much higher than those of Higgins et al.[31] and Kaji and Lewis,[32] which found the surge capacity of 27% and 29%, respectively. A possible explanation for this observation could be the use of multiple item check list in the present study and that of the study of Mahdaviazad and Abdolahifar.[12] compared with use of single question examining surge capacity in previous studies authored by Higgins and Kaji and Lewis.[31,32] Importantly, surge capacity were comparable between government and private hospitals in the present study; an observation similar to the findings of an Iranian study which compared disaster preparedness among teaching and private hospitals.[12] The MOH's same or similar yardstick for assessment of eligibility for accreditation for both government and private hospitals could possibly explain this phenomenon.

In the present study, a large proportion of the responding hospitals have adequate level of preparedness in the domains of training and education for disaster readiness. This observation is in sharp contrast with the findings of a previous study conducted in KSA which reported weaknesses in the disaster preparedness particularly in training and education of hospital staff.[24] One of such studies found that no orientations and workshops or training to assist staff awareness of hospital preparedness were conducted in the responding hospital. Also, our results were similar to the findings of the study authored by Bajow and Alkhalil[23] which investigated HDP in Jeddah area. They reported that hospitals in the Jeddah area had tools and indicators for hospital preparedness; however, they found a lack of training to prepare staff for disasters. The findings and comparisons with the previous studies demonstrates that, in the past few years, there has been some improvement in disaster preparedness particularly in areas of education and training about disaster management.

Triage is an important component of daily emergency care and disaster management.[8,9,33] In our survey, a triage system was available and mostly conducted by nurse specialist in all responding hospitals. However, triage was more likely to be conducted by a medical doctor in private compared with government hospitals ($P < 0.001$). In addition, all hospitals in both settings have triage guidelines/protocols and dedicated forms for triage. Furthermore, nearly all providers involved in triage had received training while a significant proportion of hospitals in both government and private settings had triage area designated for receiving mass casualties during disasters. Similar findings have been reported by prior studies.[12,21] In a study authored by Al-Shareef et al., triage protocols were available in more than half of surveyed hospitals[21] while more than 70% of responding hospitals had designated triaging areas for handling mass casualties.[12] Conversely, less than one-third of providers involved in triage had received training in a study conducted in Tanzania.[34] In disaster events, the mass influx of casualties in hospitals are likely to overwhelm an already stretched hospital staffs and providers more likely to be drawn from clinical care areas to either attend to family members or certain key individuals in the society involved in the disaster.[25] Validated triage protocols and training are vital to ensure effective care and appropriate resource utilization during disasters. It is, therefore, clear that lack of a well-defined and organized system could lead to major problems managing disasters. While outbreaks of infectious diseases have become ubiquitous globally, it is imperative to have an appropriate triage and management guideline/protocol for not only infectious diseases but all-hazard situations.

Safety and security for staff are also necessary to enable care for patients during disasters.[8,9] Just over half (53.9%; $n = 34$) of the responding hospitals had been fenced and of those, government hospitals were more likely to have been fenced compared to private hospitals. Two-thirds (68.3%; $n = 43$) of responding hospitals had

https://doi.org/10.1017/dmp.2023.1 Published online by Cambridge University Press

a control system to regulate entry and exit to and from the hospital. Furthermore, government hospitals were more likely compared with private health-care facilities to have a control system installed to regulate entry and exit from the hospitals. While all responding hospitals had fire alarm systems installed, only 23.8% ($n = 15$) of them had fire department within the premises of the hospitals. It is noteworthy that, a prior study reported similar findings indicating majority of responding hospitals had been fenced to control entry and exit of patients from the hospital during disasters but few had fire alarm systems installed calling more efforts to improve level of preparedness.[34]

The present survey found an overwhelming majority of hospitals without designated areas for radioactive, biological, and chemical decontamination. This was worse among private hospitals where none had designated areas to contain radioactive, biological, and chemical decontamination. Similarly, only 4 hospitals had separate entry for contaminated patients into the ED. Our present study shares similarities with a previous study[21] which reported only 5 hospitals with decontamination areas in their disaster plans and only 4 hospitals with decontamination areas located outside the ED. Also, we observed that less than half of the hospitals (44.4%) had personal protective equipment. This observation is comparable to estimates of previous study which found 43% of hospitals to have some level of personal protective equipment.[21] Taken together, our results showed that all parameters measuring safety and security of hospitals in readiness for disasters were comparable between government and private hospital settings, except availability of hospital fence, entry and exit control, and area for radioactive, biological, and chemical decontamination.

Postdisaster recovery is 1 of the key components of HDP recommended by WHO.[8,9] This remains an important path to full recovery to routine clinical care and readiness for future disasters. Majority of hospitals organized meetings to capture lessons drawn from disaster responses and this approach did not vary between government and private hospitals. However, there was a significant short fall in postdisaster recovery assistance programs in both hospital settings but far worse among private hospitals compared to government hospitals. Recognition for service provision by staff of hospitals, volunteers, and other personnel is critical to motivating many after response to disasters. In the present study, less than half of the responding hospitals had means of showing recognition for service provision by staff, volunteers, and other external personnel in disaster response and recovery. This was comparable between government and private hospitals.

Most hospitals were sufficiently prepared for disasters with regards to equipment and logistic services. A major short fall observed was availability of sufficient number of CT scan machines. Sufficient CT scan machines were available in only a few government hospitals and none in privately owned hospitals. While the present study partly agrees with findings of prior studies, estimates of preparedness in equipment and logistic services were far greater than previous studies.[12,34,35] However, preparedness among hospitals in logistic services in the present study (>80%) was greater than that of prior studies (~65%).[35] We found a few or none of the responding hospitals to have sufficient CT scan machines in readiness for disaster response. This is consistent with a prior study authored by Koka et al. in which none of the regional hospitals had CT scans to combat disasters when they occur.[34] This can cause a large delay or inadequate patient care in event of a disaster and limit the capacity to care for critically injured patients.

Strengths and Limitations

The present study represents one of the most comprehensive studies to evaluate KSA hospital preparedness for disasters. Second, this study surveyed the largest number of hospitals with regard to disaster preparedness to date. Also, the present study provides an important addition to the sparse literature on disaster preparedness on different hospital settings in KSA.

Nevertheless, our study has several limitations. The lack of standard instrument for assessment of hospital preparedness in previous studies made comparisons of our findings with existing literature difficult, as the tools used to assess the level of preparedness across other studies varied. The present study is a cross-sectional one evaluating data requested from the hospital representatives. While attempts were made to review disaster plans during evaluation, the data were self-reported and are, thus, subject to reporting bias.

Conclusions

Among government and private hospitals, preparedness was comparable in all indicators except with postdisaster recovery and availability of equipment such as CT scan machines. In particular, most hospital disaster plans in the province lacked coverage of the WHO all-hazards approach to disaster management. Government hospitals were more likely to have a disaster plans cover WHO "all-hazard" approach to disaster compared with private hospitals. To create and sustain an acceptable level of preparedness for dealing with disasters, there is the need to identify deficiencies in the key components of disaster preparedness among hospitals and establish assessment programs with measurable/quantifiable criteria with continuous efforts to periodically assess level of preparedness of hospitals in the province.

References

1. **Alruwaili A, Islam S, Usher K.** Disaster preparedness in hospitals in the Middle East: an integrative literature review. *Disaster Med Public Health Prep*. 2019;13:806-816. doi: 10.1017/dmp.2018.138
2. **Lurie L, Manolio T, Patterson AP, *et al.*** Research as a part of public health emergency response. *N Engl J Med*. 2013;368(13):1251-1255.
3. **United Nations Office for Disaster Risk Reduction**. Global assessment report on disaster risk reduction 2019. Accessed April 20, 2020. https://gar.undrr.org/
4. **Arab M, Zeraati H, Akbari Haghighi F, *et al.*** A study on the executive managers' knowledge and performance, and their hospitals preparedness against earthquake events and their relationships at public hospitals (affiliated by Tehran University of Medical Sciences (TUMS) 2005-2006). *J Health Adm*. 2009;11:7-14.
5. **Schneider SM, Gallery ME, Schafermeyer R, *et al.*** Emergency department crowding: a point in time. *Ann Emerg Med*. 2003;42:167-172. doi: 10.1067/mem.2003.258
6. **Salamati P, Kulatunga U.** The challenges of hospital disaster managers in natural disaster events. Proceedings of the 5th International Conference on Disaster Management and Human Health: reducing risk, improving outcomes. Seville, Spain. 2017.
7. **Dami F, Carron PN, Yersin B, *et al.*** University hospital struck deaf and silent by lightning: lessons to learn. *Disaster Med Public Health Prep*. 2015;9:440-443. doi: 10.1017/dmp.2015.40
8. **World Health Organization (WHO)**. *Global assessment of national health sector emergency preparedness and response*. Geneva: World Health Organization. 2008;11-39. Accessed January 21, 2023. https://www.who.int/publications/i/item/global-assessment-of-national-health-sector-emergency-preparedness-and-response

https://doi.org/10.1017/dmp.2023.1 Published online by Cambridge University Press

9. **World Health Organization**. *Hospital emergency response checklist: an all-hazards tool for hospital administrators and emergency managers*. World Health Organization. Regional Office for Europe, 2011. Accessed January 21, 2023. https://apps.who.int/iris/handle/10665/349374
10. **Kaji AH, Langford V, Lewis RJ.** Assessing hospital disaster preparedness: a comparison of an on-site survey, directly observed drill performance, and video analysis of teamwork. *Ann Emerg Med.* 2008;52:195-201.e12. doi: 10.1016/j.annemergmed.2007.10.026
11. **Al Khalaileh MA, Bond E, Alasad JA.** Jordanian nurses' perceptions of their preparedness for disaster management. *Int Emerg Nurs.* 2012;20:14-23. doi: 10.1016/j.ienj.2011.01.001
12. **Mahdaviazad H, Abdolahifar GR.** Assessing hospital disaster preparedness in Shiraz, Iran 2011: teaching versus private hospitals. *Am J Disaster Med.* 2013;8:65-73. doi: 10.5055/ajdm.2013.0112
13. **Zaboli R, Sajadi HS.** Assessing hospital disaster preparedness in Tehran: lessons learned on disaster and mass casualty management system. *Int J Health Syst Disaster Manag.* 2014;2:220. doi: 10.4103/2347-9019.144405
14. **Lu L, Liu Q, Du L, *et al.*** Middle East respiratory syndrome coronavirus (MERS-CoV): challenges inidentifying its source and controlling its spread. *Microbes Infect.* 2013;15:625-629. doi: 10.1016/j.micinf.2013.06.003
15. **Li X, Huang J, Zhang H.** An analysis of hospital preparedness capacity for public health emergency in four regions of China: Beijing, Shandong, Guangxi, and Hainan. *BMC Public Health.* 2008;8:319. doi: 10.1186/1471-2458-8-319
16. **Kollek D.** Canadian emergency department preparedness for a nuclear, biological or chemical event. *Can J Emerg Med.* 2003;5:18-26. doi: 10.1017/S148180350000806X
17. **O'Sullivan TL, Dow D, Turner MC, *et al.*** Disaster and emergency management: Canadian nurses' perceptions of preparedness on hospital front lines. *Prehosp Disaster Med.* 2008;23:s11-s19. doi: 10.1017/s1049023x00024043
18. **Manley WG, Furbee PM, Coben JH, *et al.*** Realities of disaster preparedness in rural hospitals. *Disaster Manag Response.* 2006;4(3):80-87. doi: 10.1016/j.dmr.2006.05.001
19. **Fung OW, Loke AY, Lai CK.** Disaster preparedness among Hong Kong nurses. *J Adv Nurs.* 2008;62:698-703. doi: 10.1111/j.1365-2648.2008.04655.x
20. **Hammad KS, Arbon P, Gebbie K, *et al.*** Nursing in the emergency department (ED) during a disaster: a review of the current literature. *Australas Emerg Nurs J.* 2012;15:235-244. doi: 10.1016/j.aenj.2012.10.005
21. **Al-Shareef AS, Alsulimani LK, Bojan HM, *et al.*** Evaluation of hospitals' disaster preparedness plans in the Holy City of Makkah (Mecca): a cross-sectional observation study. *Prehosp Disaster Med.* 2017;32:33-45. doi: 10.1017/S1049023X16001229
22. **Mohammad AGA, Ali AM, Ahmad AA.** Assessment the effectiveness of preparedness for relative constant factors in environmental disaster management: a case study from Riyadh City, Saudi Arabia. *J Environ Prot (Irvine, Calif).* 2016;7(6):926-933. doi: 10.4236/jep.2016.76082
23. **Bajow NA, Alkhalil SM.** Evaluation and analysis of hospital disaster preparedness in Jeddah. *Health (Irvine Calif).* 2014;6(19):2668-2687. doi: 10.4236/health.2014.619306
24. **Bin Shalhoub AA, Khan AA, Alaska YA.** Evaluation of disaster preparedness for mass casualty incidents in private hospitals in central Saudi Arabia. *Saudi Med J.* 2017;38:302-306. doi: 10.15537/smj.2017.3.17483
25. **Hick JL, Hanfling D, Cantrill SV.** Allocating scarce resources in disasters: emergency department principles. *Ann Emerg Med.* 2012;59:177-187. doi: 10.1016/j.annemergmed.2011.06.012
26. **Alsalem MM, Alghanim SA**. An assessment of Saudi hospitals' disaster preparedness. *Eur J Environ Public Health*. 2021;5(2):em0071.
27. **Fouad D. Over** 83% of hospitals in EP 'not approved' for practice. Accessed June 15, 2016. https://www.arabnews.com/saudi-arabia/news/713866
28. **Walston S, Al-Harbi Y, Al-Omar B.** The changing face of healthcare in Saudi Arabia. *Ann Saudi Med.* 2008;28(4):243-250. doi: 10.5144/0256-4947.2008.243
29. **Almalki M, Fitzgerald G, Clark M.** Health care system in Saudi Arabia: an overview. *East Mediterr Health J.* 2011;17(10):784-793.
30. **Alruwaili A, Islam MS, Usher K.** Hospitals disaster preparedness and management in the Eastern Province of the Kingdom of Saudi Arabia: a cross-sectional study. *Disaster Med Public Health Prep.* 2022;16(3):1038-1045.
31. **Higgins W, Wainright C, Lu N, *et al.*** Assessing hospital preparedness using an instrument based on the Mass Casualty Disaster Plan Checklist: results of a statewide survey. *Am J Infect Control.* 2004;32(6):327-332. doi: 10.1016/j.ajic.2004.03.006
32. **Kaji AH, Lewis RJ.** Hospital disaster preparedness in Los Angeles County. *Acad Emerg Med.* 2006;13(11):1198-1203. doi: 10.1197/j.aem.2006.05.007
33. **Merin O, Miskin IN, Lin G, *et al.*** Triage in mass-casualty events: the Haitian experience. *Prehosp Disaster Med.* 2011;26:386-390. doi: 10.1017/S1049023X11006856
34. **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. doi: 10.1186/s12913-018-3609-5
35. **Malaki MR, Shojaei P.** Hospitals preparation in disasters: security. 2007. Accessed January 21, 2023. https://www.sid.ir/paper/130083/en