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Assessment and development of hospital emergency preparedness plan in response to COVID-19 pandemic in Alexandria University Hospitals

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ABSTRACT

Background: The COVID-19 ongoing pandemic is one of the deadliest pandemics in history. It has put a significant strain on healthcare systems and frontline healthcare workers. This study attempted to assess and develop the emergency preparedness of hospitals affiliated to Alexandria University.

Methods: A quasi-experimental design was conducted in three phases; the pre-intervention assessment using a hospital emergency response checklist, then awareness intervention was implemented to provide information on emergency preparedness followed by post-intervention assessment after a six-month period following the first phase using the same checklist.

Results: The pre-intervention assessment showed that four hospitals had a good overall preparedness level (75% or more preparedness level), while the rest of the hospitals (7 hospitals) demonstrated a fair overall preparedness level (50%–<75%).

All the individual domains have demonstrated a good or fair to good preparedness levels except the recovery domain, which was fair, and the command and control domain, which was poor in the majority of the studied hospitals. The intervention awareness program has led to a significant statistical change in the command and control as well as human resources domain. However, the post-intervention scores of command and control domain remained poor in the majority of the studied hospitals.

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1. Introduction

Since December 2019, the world has been in the grip of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the disease it causes, coronavirus disease 2019 (COVID-19), which was initially identified in Wuhan, China [1,2], and has been declared a pandemic by the World Health Organization (WHO) on March 11 2020 [3].

As of October 2021, there have been more than 243 million confirmed cases of COVID-19 including 4.94 million deaths reported worldwide to the WHO [4].

In Egypt, COVID-19 has claimed the lives of over 18,000 out of 323,000 confirmed cases among the Egyptian population [5].

These numbers have left no doubt that the pandemic is putting huge pressure on health systems around the world as seen by overcrowded hospitals and exhausted physicians and nurses struggling to save lives with limited resources [6]. This troubling situation creates a necessity for assessment of health system preparedness in order to implement changes to healthcare delivery based on the lessons learnt during the pandemic [7].

Hospital preparedness for epidemics requires the following: [7–9]

- Adequate command and control, which require the hospitals to establish and implement a Hospital Emergency Risk Management Program as well as an emergency response plan, to ensure effective management of the risks of different emergencies including epidemics. Also, hospital staff should be fully aware of and well trained to carry out their roles in preparing for and responding to different emergencies.
- The internal and external communication lines required for coordination of the overall response to an emergency should be functioning effectively.
- An adequate infection prevention and control program, adequate triage and surveillance systems as well as adequate laboratory services in order to deal with the challenges of an epidemic.
- The capacity to cope with the extra health demands from the epidemic as well as the ability to ensure the continuity of essential health services at the same time as coping with an epidemic through adequate surge capacity.

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- Proper logistics management to ensure sufficient amounts of the needed resources.
- Proper human resources management to satisfy the physical, mental, emotional, and social requirements of hospital staff and their families.
- Adequate essential support services to ensure the safety of the hospital, its occupants, uninterrupted delivery of safe food and water and nutritional services, provision of laundry, cleaning services, and waste management services as well as safe effective mortuary services.

This study aims at assessment and development of the emergency preparedness in hospitals affiliated to the University of Alexandria to allow decision-makers to formulate appropriate policies and procedures, determine priorities, allocate proper resources, and implement improvements to ensure that these hospitals are adequately prepared for potential emergency situations.

2. Subjects and methods

2.1. Study design

The study used a quasi-experimental design involving a pre- and post-intervention assessment of hospital emergency preparedness. The study was conducted in three phases: First phase: the pre-intervention assessment using a hospital emergency response checklist; Second phase: awareness intervention was implemented to provide information on how the studied hospitals can fulfill their role in emergency preparedness; and Third phase: the post-intervention assessment was conducted after a six-month period following the first phase using the same checklist.

2.2. Study setting

The study was conducted in all hospitals affiliated to the University of Alexandria including The Main University hospital, El-Shatby Alexandria University Maternity Hospital, El-Shatby Alexandria University Children's Hospital, El-Hadra University Hospital, El-Mowassat University Hospital, Smouha Emergency and accidents' University Hospital, Smouha Children's University Hospital, Borg El-Arab University Hospital, The New University Hospital, The one day services center, and The students' University Hospital.

2.3. Data collection

2.3.1. Study tool

Data were collected by the researcher using a Hospital emergency preparedness checklist, which was adapted from the WHO Hospital readiness checklist for COVID-19 [10] and the Comprehensive Hospital Preparedness

Checklist for Coronavirus Disease 2019 (COVID-19) of the CDC (Center for Disease Control and prevention) [11] by adding some questions from the latter to the former as follows: 5 items were added to the command and control domain, 3 items to the infection prevention and control domain, 3 items to the communication domain, and the 5 items of the recovery domain.

Data obtained included:

- (1) Description of the studied hospitals.
- (2) Data related to hospital emergency preparedness including the following domains:

- Command and control (three items for the Incident Management System +7 other items).
- Surge capacity (eight items).
- Infection prevention and control including practices related to operating rooms (18 items+ 7 separate items for infection control regarding operating on COVID-19 patients).
- Triage (13 items).
- Human resources (10 items).
- Continuity of essential health services and patient care (three items).
- Surveillance system (seven items)
- Communications (internal and external) (11 items).
- Logistics and management of supplies (four items).
- Laboratory services (five items).
- Essential support services (four items)
- Recovery (five items)

The score of each item ranged from 0 to 2. If the item is present and functioning, it was given a score of two. If the item is pending/inadequate/present but not functioning, it was given one. If the item is not present/not done, it was given zero.

As regard the Incident Management System, it includes the presence of a complete activated emergency response plan, the presence of a complete trained Incident Command Team, and the presence of an adequate Emergency Coordination Center (ECC). These three items are part of the items included in the command and control domain. However, these are presented separately because of their importance.

2.4. The awareness intervention strategy

- The program was one session for every hospital held one week after the first assessment.
- The attendees included hospital staff consisting of Hospital director or deputy director, some physicians, some nurses including infection control nurse, safety and security officer, one or more of the Logistics staff, Finance chef, Human

services director and Personnel from the laboratory and/or radiology and/or pharmacy representing ancillary services as well as a facilitator (the researcher) and two supervisors.

- Each session lasted about 2 hours and took place in private halls in the studied hospitals.
- The purpose of this program is to provide information on how the studied hospitals can fulfill their role in emergency preparedness, emphasizing that most of the actions required to prepare for epidemics apply or can be adapted to other emergencies, such as mass casualties due to transport crashes, geological or chemical disasters, and so on.
- The intervention was a prepared curriculum based on the WHO guide for hospital preparedness for epidemics [8] delivered in the form of power point and printed material.
- This curriculum included guidelines for preparedness and response activities regarding the studied domains.
- Assessment of the impact of this program was intended to be after a six-month period (post-intervention survey).

2.5. Data analysis

- The monthly Bed Occupancy (in Table 1) was calculated using the following formula: $\text{Bed Occupancy/month} = \frac{\text{Total number of inpatient days in a month}}{(\text{Available beds} \times \text{Number of days (30)})} \times 100$
- Because the number of items in the different domains was not equal, a percent score for each domain was calculated and categorized as follows: poor (<50%), fair (50% – <75%), and good ($\geq 75\%$). Then, the overall preparedness level for each hospital was calculated by summation of the raw scores of all domains and categorized in the same way as individual domains.

- Statistical analysis was performed using SPSS (Statistical Package for Social Sciences) version 22 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, version 22.0.Armonk, NY: IBM Corp). Variables were presented using numbers and percent for qualitative variables and mean and standard deviation for quantitative variables. The appropriate test of statistical significance (Wilcoxon signed rank test) was used to compare the scores of the pre- and post-intervention assessment. A 0.05 level of significance was used for interpretation of results.

3. Results

Table 1 shows that the highest number of beds was in The Main University Hospital (1270). The hospitals with the highest average bed occupancy per month were El-Shatby Alexandria University Maternity Hospital and The Students' University Hospital (70% each). The highest number of Intensive Care Unit (ICU) beds was in The Main University Hospital (160 beds). The highest average number of isolations (for COVID-19 patients) per month was in The New University Hospital (60 isolations). All hospitals had microbiology laboratories except Smouha University Hospitals where the lab is present but not functioning.

The One day services center was excluded from the description because it is not intended for inpatient care (it serves outpatient clinics and surgical operations with discharge on the same day). Also, it does not have its own microbiology laboratory.

Table 2 illustrates the presence and functioning of different components of the Incident Management System (IMS) in the studied hospitals. The table shows that most of the studied hospitals had an Emergency Response Plan (72.73%). One fourth (25.0%) of these hospitals had an activated plan,

Table 1. Characteristics of the studied hospitals.

University hospitals	Beds' number	Average bed occupancy/month (%)	ICU beds	Average isolations/month	Presence of microbiology laboratory
The Main University Hospital	1270	40	160	50	Yes
El-Shatby Alexandria University Children's Hospital	248	40	33	5	Yes
El-Shatby Alexandria University Maternity Hospital	255	70	9	25	Yes
El-Hadara University Hospital	429	30	24	15	Yes
El-Mowassat University Hospital	148	60	22	15	Yes
Smouha Emergency and accidents' University Hospital	200	30	18	3	Yes
Smouha Children's University Hospital	294	40	14	10	Not functioning
Borg El-Arab University Hospital	80	60	6	3	Yes
The New University Hospital	44	60	16	60	Yes
The One day services center					Not functioning
The students' University Hospital	180	70	18	40	Yes

Table 2. The incident management system in the studied hospitals.

Components of the Incident Management System (IMS)	The studied hospitals (n = 11)	
	no.	%
The Emergency Response Plan		
Presence of an Emergency Response Plan (yes)	8.0	72.73
Activation and completeness of the plan (n = 8)		
Activated plan (yes)	2.0	25.0
Complete plan (yes)	1.0	12.5
Activated and complete (yes)	0.0	0.0
The Incident Command Team (n = 11)		
Presence of the team (yes)	6.0	54.55
Training and completeness of the team (n = 6)		
Trained (yes)	2.0	33.33
Complete (yes)	1.0	16.67
Trained and complete (yes)	1.0	16.67
The Emergency Coordination Center (ECC) (n = 11)		
Presence of the ECC	3.0	27.27
Adequacy (yes) (n = 3)	0.0	0.0

while only 12.5% had a complete plan and none of these hospitals (0%) had a plan that was both complete and activated.

Slightly more than half the studied hospitals (54.55%) had an Incident Command Team. One third of these hospitals (33.33%) had a trained team, while only 16.67% of them had a complete team that included all members. Only one hospital had a complete trained team (16.67%).

27.27% of the studied hospitals had Emergency Coordination Centers (ECCs). However, none of these ECCs were adequate.

Table 3 shows that four hospitals had a good overall preparedness level, while the rest of the hospitals demonstrated a fair overall preparedness level at the pre-intervention assessment.

The majority of studied hospitals had a poor level of command and control preparedness.

Most of the studied hospitals (seven hospitals) had a good level of communication preparedness, while the rest of the hospitals showed a fair preparedness level.

Most of the studied hospitals had fair levels of surge capacity preparedness, a good level of human resources preparedness, and a fair level of recovery preparedness.

Six of the studied hospitals had a good level of logistics preparedness, while the rest of the hospitals showed a fair preparedness level.

All the studied hospitals had a good level of infection prevention and control, triage, surveillance, continuity of essential services, and essential support services preparedness.

Four hospitals allowed operating on suspected or confirmed COVID-19 patients, and they all had a good level of infection control in operating rooms.

All the studied hospitals had a good level of laboratory services preparedness except The One day services center, which did not have a laboratory of its own.

Table 4 shows that three hospitals demonstrated no change in their percent scores. These hospitals were El-Shatby Alexandria University Children's Hospital, The New University Hospital, and The One day services center. On the other hand, the rest of the hospitals showed an increase in the percent scores of one or more domains as follows:

- The main university hospital has shown some improvement in the percent scores of command and control, surge capacity, infection prevention and control, continuity of essential services, and recovery domains.
- El-Shatby Alexandria University Maternity Hospital and El-Hadara University Hospital demonstrated an increase in the percent score of only one domain, the command and control domain.
- El-Mowassat University Hospital had three domains showing an increase in their percent scores, the infection prevention and control, triage and human resources domains.
- Smouha Emergency and accidents' University Hospital has demonstrated an increase in the percent scores of command and control and triage domains.
- Smouha Children's University Hospital demonstrated an increase in the percent score of command and control, surge capacity, infection prevention and control, and logistics domains.
- The Students' University Hospital demonstrated an increase in the percent score of only one domain, the human resources domain.

Table 5 shows that only two domains showed a significant difference between the pre- and post-intervention percent scores, command and control as well as human resources.

As regard the command and control, the pre-intervention percent scores had a median of 20.0 and an interquartile range from 10.0 to 25.0, while the post-intervention percent scores had a median of 25.0 and an interquartile range from 15.0 to 35.0. This difference was statistically significant where $Z = -2.124$ and $P = 0.027^*$.

Concerning the human resources domain, the pre-intervention percent scores had a median of 80.0 and an interquartile range from 75.0 to 85.0, while the post-intervention percent scores had a median of 85.0 and an interquartile range from 80.0 to 85.0. This difference was statistically significant where $Z = -2.00$ and $P = 0.046^*$.

Table 3. Level of preparedness of the studied hospitals based on the pre-intervention percent scores.

	Command and control	Infection prevention and control			Infection control regarding COVID-19			Continuity of essential services			Essential support services			Total score and category
		Surge capacity	Surge prevention	Infection control	Operating on COVID-19 patients	Triage	Human resources	Surveillance	Communications	Logistics	Laboratory services	Recovery		
The Main University Hospital	20.0	68.75	86.11	100.0	76.92	85.0	83.33	92.86	77.27	87.5	100.0	100.0	60.0	77.62
El-Shatby Alexandria University Maternity Hospital	Poor	Fair	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Fair	Good
El-Shatby Alexandria University Children's Hospital	30.0	62.50	97.22	100.0	84.62	80.0	100.0	92.86	77.27	62.5	100.0	100.0	60.0	80.0
El-Hadara University Hospital	Poor	Fair	Good	Good	Good	Good	Good	Good	Good	Fair	Good	Good	Fair	Good
El-Mowassat University Hospital	10.0	56.25	94.44	--	84.62	80.0	83.33	92.86	72.72	62.5	100.0	100.0	50.0	69.05
Smouha Emergency and Accidents' University Hospital	Poor	Fair	Good	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair	Fair
Smouha Children's University Hospital	20.0	81.25	97.22	92.86	84.62	90.0	100.0	92.86	72.72	75.0	100.0	100.0	80.0	81.90
Borg El-Arab University Hospital	Poor	Good	Good	Good	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good
The New University Hospital	25.0	56.25	91.66	--	80.77	70.0	83.33	92.86	77.27	62.5	100.0	100.0	50.0	69.05
The One day services center	Poor	Fair	Good	Good	Good	Fair	Good	Good	Good	Fair	Good	Good	Fair	Fair
The students' University Hospital	15.0	50.0	97.22	92.86	80.77	80.0	83.33	92.86	68.18	50.0	100.0	100.0	70.0	75.24
	Poor	Fair	Good	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair	Good
	10.0	50.0	94.44	--	84.62	90.0	100.0	92.86	77.27	62.5	100.0	100.0	60.0	70.95
	Poor	Fair	Good	--	Good	Good	Good	Good	Good	Fair	Good	Good	Fair	Fair
	65.0	68.75	100.0	--	--	80.0	100.0	92.86	81.81	87.5	100.0	100.0	70.0	69.04
	Fair	Fair	Good	--	--	Good	Good	Good	Good	Good	Good	Good	Fair	Fair
	15.0	87.5	94.44	--	92.31	75.0	100.0	92.86	77.27	75.0	100.0	100.0	60.0	74.92
	Poor	Good	Good	--	Good	Good	Good	Good	Good	Good	Good	Good	Fair	Fair
	10.0	62.5	88.88	--	80.77	75.0	100.0	92.86	72.72	62.5	--	--	60.0	63.81
	Poor	Fair	Good	--	Good	Good	Good	Good	Fair	Fair	100.0	100.0	Fair	Fair
	20.0	81.25	94.44	--	92.31	75.0	100.0	92.86	77.27	75.0	100.0	100.0	60.0	73.80
	Poor	Good	Good	--	Good	Good	Good	Good	Good	Good	Good	Good	Fair	Fair

Table 4. Level of preparedness of the studied hospitals based on the post-intervention percent scores.

	Command and control			Infection prevention and control		Infection control regarding COVID-19		Human resources		Continuity of essential services			Essential support services			Total score and category	
	Surge capacity	Prevention	Control	Operating on COVID-19 patients	Triage	Resources	Surveillance	Communications	Logistics	Laboratory services	Support services	Recovery	Score	Category			
The Main University Hospital	30.0	81.25	88.86	100.0	76.92	85.0	92.86	77.27	87.5	100.0	100.0	70.0	80.95	Good			
El-Shatby Alexandria University Maternity Hospital	Poor	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Fair	80.95	Good			
El-Shatby Alexandria University Children's Hospital	35.0	62.50	97.22	100.0	84.62	80.0	92.86	77.27	62.5	100.0	100.0	60.0	80.95	Good			
El-Hadara University Hospital	Poor	Fair	Good	Good	Good	Good	Good	Good	Fair	Good	Good	Fair	80.95	Good			
El-Mowassat University Hospital	10.0	56.25	94.44	--	84.62	80.0	92.86	72.72	62.5	100.0	100.0	50.0	69.05	Fair			
Smouha Emergency and Accidents' University Hospital	Poor	Fair	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair	69.05	Fair			
Smouha Children's University Hospital	25.0	81.25	97.22	92.86	84.62	90.0	92.86	72.72	75.0	100.0	100.0	80.0	82.38	Good			
Borg El-Arab University Hospital	Poor	Good	Good	Good	Good	Good	Good	Fair	Good	Good	Good	Good	70.48	Fair			
The New University Hospital	25.0	56.25	94.44	--	84.62	75.0	92.86	77.27	62.5	100.0	100.0	50.0	77.62	Fair			
The One day services center	Poor	Fair	Good	92.86	84.62	80.0	92.86	68.18	50.0	100.0	100.0	70.0	77.62	Fair			
The students' University Hospital	Poor	Fair	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair	77.62	Good			
	25.0	62.5	97.22	--	84.62	90.0	92.86	77.27	75.0	100.0	100.0	60.0	74.28	Fair			
	Poor	Fair	Good	--	Good	Good	Good	Good	Good	Good	Good	Fair	74.28	Fair			
	75.0	75.0	100.0	--	--	85.0	92.86	81.81	87.5	100.0	100.0	70.0	70.94	Fair			
	Good	Good	Good	--	--	Good	Good	Good	Good	Good	Good	Fair	70.94	Fair			
	15.0	87.5	94.44	--	92.31	75.0	92.86	77.27	75.0	100.0	100.0	60.0	74.92	Fair			
	Poor	Good	Good	--	Good	Good	Good	Good	Good	Good	Good	Fair	74.92	Fair			
	10.0	62.5	88.88	--	80.77	75.0	92.86	72.72	62.5	--	--	60.0	63.81	Fair			
	Poor	Fair	Good	--	Good	Good	Good	Fair	Fair	Good	Good	Fair	63.81	Fair			
	20.0	81.25	94.44	--	92.31	80.0	92.86	77.27	75.0	100.0	100.0	60.0	74.28	Fair			
	Poor	Good	Good	--	Good	Good	Good	Good	Good	Good	Good	Fair	74.28	Fair			

Table 5. Pre- and post-intervention assessment of hospital emergency preparedness domains.

Domain		Pre-intervention percent scores	Post-intervention percent scores	Wilcoxon signed ranks test
Command and control	Mean± SD	21.81 ± 15.70	27.72 ± 17.93	Z = - 2.214 P = 0.027*
	Median	20.0	25.0	
	IQR	10.0–25.0	15.0–35.0	
Surge capacity	Mean± SD	65.91 ± 12.92	68.75 ± 12.81	Z = -1.857 P = 0.063
	Median	62.5	62.5	
	IQR	56.25–75	56.25–81.25	
Infection prevention and control	Mean± SD	94.19 ± 4.02	94.94 ± 3.48	Z = -1.732 P = 0.083
	Median	94.44	94.44	
	IQR	91.67 – 97.22	94.44–97.22	
Infection prevention and control regarding operating on COVID-19 patients	Mean± SD	35.06 ± 48.70	35.06 ± 48.70	Z = 0.00 P = 1.000
	Median	0.0	00.0	
	IQR	0.0–92.86	0.0–92.86	
Triage	Mean± SD	76.58 ± 25.83	77.28 ± 25.99	Z = -1.414 P = 0.157
	Median	84.62	84.62	
	IQR	80.77 – 84.62	80.77 – 84.62	
Human resources	Mean± SD	80.0 ± 6.32	81.36 ± 5.52	Z = -2.000 P = 0.046*
	Median	80.0	85.0	
	IQR	75.0–85.0	80.0 – 85.0	
Continuity of essential services	Mean± SD	93.94 ± 8.41	95.45 ± 7.79	Z = -1.000 P = 0.317
	Median	100.0	100.0	
	IQR	83.33–100.0	83.33–100.0	
Surveillance	Mean± SD	92.86 ± 0.0	92.86 ± 0.0	Z = 0.00 P = 1.000
	Median	92.86	92.86	
	IQR	92.86 – 92.86	92.86 – 92.86	
Communication	Mean± SD	75.62 ± 3.68	75.62 ± 3.68	Z = 0.00 P = 1.000
	Median	77.27	77.27	
	IQR	72.72 – 77.27	72.72 – 77.27	
Logistics	Mean± SD	69.32 ± 11.68	70.45 ± 11.56	Z = -1.00 P = 0.317
	Median	62.5	62.5	
	IQR	62.5 – 75.0	62.0–75.0	
Laboratory services	Mean± SD	90.91 ± 30.15	90.91 ± 30.15	Z = 0.00 P = 1.000
	Median	100.0	100.0	
	IQR	100.0–100.0	100.0–100.0	
Essential support services	Mean± SD	98.86 ± 3.77	98.86 ± 3.77	Z = 0.00 P = 1.000
	Median	100.0	100.0	
	IQR	100.0–100.0	100.0–100.0	
Recovery	Mean± SD	62.73 ± 9.05	63.64 ± 9.24	Z = -1.00 P = 0.317
	Median	60.0	60.0	
	IQR	60.0 – 70.0	60.0 – 70.0	

*Statistically significant at $p < 0.05$.

IQR: Inter-Quartile Range

The numbers in the table are average for all hospitals before and after the intervention.

4. Discussion

In the present study, 72.73% of the studied hospitals had Emergency Response Plans. Different findings were reported by Ingrassia et al. [12] where all the studied hospitals had adopted a disaster management plan, all of which were appropriately developed by an authorized hospital committee.

As regards the Incident Command Teams, the present study showed that 54.55% of the studied hospitals had Incident Command Teams. Meanwhile, the study by Norman D et al. [13] found that 27.3% of the studied health facilities had disaster response teams.

These differences can be related to provision of training, integration of knowledge and expertise into a practical framework for coordinating emergency response, the will of the administrative bodies, and the presence of a powerful supervisory authority to regularly evaluate the degree of emergency preparedness in the different hospitals.

The overall pre-intervention percent scores of preparedness of the studied hospitals in the present study indicated that four hospitals had a good overall preparedness and the rest had a fair overall preparedness.

These findings are in agreement with the findings of Ingrassia et al. [12], while contrasting the findings of Khan et al. in Saudi Arabia [14] which reported a low preparedness level in all of the studied hospitals.

The differences in hospitals' preparedness can be explained by their degree of success in adopting standardized guidelines and implementing strategies of emergency preparedness as well as allocation of financial resources.

Data from the current study showed that the majority of the studied hospitals had poor command and control preparedness level at the pre-intervention assessment. This finding is consistent with the finding of Khan A et al. [14] where they demonstrated an unacceptable level of command and control (corresponding to poor) in the studied hospitals. These findings could be related to the presence and functioning of the Incident Management System, which is the core of the command and control domain.

Expanded surge capacity is essential to meet the extra demand for clinical care during a potential emergency. In the present study, the pre-intervention percent scores indicated a fair to good surge capacity preparedness.

These results were similar to the findings reported by Ingrassia et al. [12] and Khan A et al. [14] where they both reported moderate surge capacity preparedness.

Data from the current study indicate that the human resources domain has shown a good preparedness level in the majority of hospitals, whereas the logistics domain has demonstrated a fair to good preparedness level; meanwhile, the findings of Hojat M [15] demonstrated a moderate level of preparedness as regard both human resources and logistics.

Monitoring adherence to infection prevention and control (IPC) measures is an essential part of the response to epidemics/pandemics. The findings of the pre-intervention assessment have shown a good IPC preparedness level at all the studied hospitals. This finding is inconsistent with that reported by a study conducted in Egypt in 2018 [16] to evaluate the preparedness level of Ismailia city hospitals and primary healthcare centers, where the infection control preparedness was moderate in hospitals and low in primary healthcare centers.

This disparity is attributed mainly to the availability of personal protective equipment and the difference in provision of training and supervision to the staff.

As regard the triage domain, the present study revealed a good level of triage preparedness at all the studied hospitals. A similar finding was reported by Ingrassia et al. [12] where the majority of the studied hospitals showed a sufficient level of preparedness to perform triage. The reported findings are most probably related to providing triage space, trained medical personnel, and all necessary resources.

Concerning the surveillance domain, the present study found a good level of surveillance preparedness at all the studied hospitals. A different finding was reported by Tiruneh et al. [17] where most of the studied hospitals demonstrated poor surveillance preparedness. This difference may be related to the level of training of health personnel responsible for surveillance activities, the level of supervision over these activities as well as the adequacy of laboratory services where the current study found a good level of laboratory services in the majority of the studied hospitals, whereas Tiruneh et al. [17] reported a poor level of laboratory services preparedness.

A well-planned hospital emergency response plan should have mechanisms to provide and maintain essential hospital services and the resources needed for the continuity of these vital services.

Communication mechanisms are one of the biggest challenges facing by healthcare systems during emergencies. The findings of the present study revealed fair to good communication preparedness. This finding is inconsistent with the finding of Tiruneh A. et al. [17] where the majority of the studied hospitals had poor communication preparedness. This difference could be related to availability of different communication

means and the ease of communication between the staff inside the facility and between the facility and other facilities or authorities.

The present study found that only two domains demonstrated a significant change after the intervention, command and control and human resources.

Similar findings were reported in the study by Khan A et al. [14] and Beyramijam M et al. [18] while contrasting the finding of Delshad V et al. [19] where the intervention program failed to achieve a significant change in these domains.

This difference may be related to how the studied hospitals could benefit from these programs by translating the knowledge gained into a genuine effort to develop and upgrade their preparedness regarding these domains as well as the feasibility of conducting a change, i.e., some changes need extra financial resources and/or time and/or collaboration and agreements.

4.1. Limitations of the study

The time constraint was the main challenge faced in this study where hospital emergency preparedness would have been better if more time was available (more than 6 months) especially when considering the fact that the study was conducted at the time when the pandemic was overburdening the health system of the studied hospitals.

5. Conclusion and recommendation

The pre-intervention assessment has shown that the overall preparedness level of the studied hospitals was fair to good. The awareness intervention program has succeeded in inducing a significant change in command and control as well as human resources domains. However, the command and control domain was still poor in the majority of the studied hospitals.

Based on the findings of the current study, the main recommendations include establishing complete Emergency Response Plans or development of the existing plans and activation of these plans according to the time and/or geographic proximity of the situation, establishing complete well-trained Incident command teams or development of the existing teams, deploying medical supplies upon activation of the Emergency Response Plan and planning for enough stock, developing adequate recovery plans as part of the Emergency Response Plan, and considering the appropriate timing for its activation.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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