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## RESEARCH ARTICLE

### Emergency Department Preparedness toward a Future Pandemic: Safety Management Response Pyramid

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#### Abstract:

##### Background:

Hospitals and other healthcare facilities play a crucial role in national and local responses to emergencies, such as communicable disease outbreaks. In our region, hospital management has established mechanisms for developing and implementing a hospital emergency safety management program, which is designed to ensure the effective management of the risks of internal and external emergencies, including pandemics.

##### Aim:

To assess and explore the preparedness of the emergency departments in Saudi Arabia at tertiary hospitals toward a future pandemic.

##### Methods:

A cross-sectional survey was conducted at tertiary hospitals. One hundred forty healthcare providers who are working in the emergency department were surveyed, and the response rate was 75% (105).

##### Results:

Participants were predominately female (60 (57.1%)), with a bachelor's degree (72 (68.6%)) and had more than 10 years of experience in their profession (46 (43.8%)). The study revealed that, namely, the junior emergency department staff were poorly trained on average all areas of pandemic preparedness. Healthcare providers reported that the highest implemented measures related to safety/ infection control, emergency department management, and response were, respectively: support N95 respirator fit testing (2.77 (SD = 0.44)), infection prevention techniques (2.85 (SD = 0.39)) and provide criteria for patient assessment (2.72 (SD = 0.51)). On the other hand, the lowest implemented measures were for a unit pandemic safety plan, palliative care, and determined alternate transport resources with a mean of 2.04 (SD = 0.75), 2.22 (SD = 0.83), and 2.19 (SD = 0.80) respectively.

##### Conclusion:

The findings of this study support the need for formalized pandemic preparedness training, developing a pandemic safety plan to protect the community and healthcare professionals, improving palliative care during and after the pandemic, and defining strategies to allocate healthcare resources.

**Keywords:** COVID 19, Emergency department, Pandemic, Preparedness, Management, Health care facilities.

#### Article History

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## 1. INTRODUCTION

The pandemic of COVID-19 has globally interrupted the healthcare system. Many countries, including Saudi Arabia,

forcefully encounter an emergency crisis during the COVID-19 pandemic. COVID-19 was defined by the World Health Organization (WHO) as “a respiratory infectious disease caused by a newly discovered coronavirus (Novel Coronavirus

(2019-nCoV)”. Fever, general malaise, dry cough, shortness of breath, sore throat, aches, and pain are some of the symptoms that COVID-19 can produce, which require urgent healthcare [1, 2].

The care for COVID-19 cases depends on symptomatic treatment, supportive care, and hospital emergency preparedness to deal with a huge number of infected cases at the same time [3]. The COVID-19 patient may experience alarming symptoms due to poor symptom management, lack of safety, poor emergency response, and a nonspecialized environment, which is reflected in the quality of care [4].

The emergence and reemergence of infectious diseases with different strains are now more than ever considered threats to public healthcare systems. Safety and infection control measures will take place to control [5]. During the recurrent waves of the pandemic, a large part of the hospital failed to follow the crisis preparedness measures against the COVID-19 pandemic [6]. These measures are categorized into safety and infection control measures, Emergency Department (ED) management measures, and response measures [7]. These three measures were integrated into the pyramid of preparedness for a future pandemic (Safety Management Response pyramid).

In order to easily understand the safety management response concept, we should know the definition of safety. A popular definition of safety is the lack of incidents and accidents. The goal of safety management is to ensure that accidents and incidents are maintained to a minimum, or to a minimum that is practically feasible. As a result, safety management must begin with instances where there is an absence of safety, and strangely, safety is measured by counting instances where it fails rather than by instances where it succeeds. This results in a reactive strategy that is built on responding to things that go wrong or are identified as risks—things that could go wrong [8, 9]. Accordingly, the safety management response pyramid in the ED refers to the preparedness to face a pandemic with minimum accidents and incidents through checking the three measures: safety and infection control, ED management, and response measures [7].

In some cases, high management gave its approval for the use of COVID-19 measures because they thought they were efficient and simple to implement. However, because they impose additional constraints and reduce productivity, employees occasionally choose to disregard these measures and rules purposefully or accidentally [10, 11]. In order to ensure that their recommendations are considered during the decision-making process and lower the likelihood of unsuccessful implementation, organizations must interact closely with frontline staff in the ED [11].

According to Occupational Safety and Health Administration (OSHA), effective workplace emergency safety measures should give concise instructions and methods for reporting hazards and emergencies [12]. OSHA’s guidance includes a recommendation for an infectious disease prepare-

ness and response plan to reduce the adverse impact of a pandemic outbreak [13]. Moreover, ED is required to be prepared in both the short and long term to deal with crises and disasters. The COVID-19 pandemic has required a rapid review of several aspects of ED operations in preparation for a sustained response [14].

Many studies in response to the COVID-19 pandemic recommended the need to assess the ED preparedness measures toward any future events. Safety/ infection control measures aim to inhibit or hold the spread of infections in healthcare facilities and the public. All healthcare staffs need at least a straightforward understanding of infection control measures, principles, and practices [15, 16]. The ED is considered the frontline and the gate of any hospital. Training and education for the ED staff regarding pandemic safety plans is a vital need [17, 18]. Suspected cases of COVID-19 patients that need critical care support may present directly to the ED from the community, or other facilities [19]. Therefore, the ED staff should be provided with appropriate safety and infection control measures such as Personal Protective Equipment (PPE) and well-trained on how to implement a safety plan, use of COVID-19 equipments, and follow the policy and procedures of the emergency disaster plan effectively [18].

Furthermore, ED management measures focus on preparing healthcare providers to manage the pandemic risk. Studies revealed that the preparation of ED management measures should be consistent with international preparedness strategies and interventions. Additionally, the preparedness of emergency healthcare providers should adhere to professional standards [5, 20, 21].

Finally, because social and institutional responses to any pandemic are crucial, there is a need for ED response measures to ensure community safety toward the pandemic’s urgent response [22]. The COVID-19 pandemic raises the flag of whether the healthcare system is adequately prepared for the pandemic management [16, 23, 24]. Most of the literature addresses the need to fill the gap in ED preparedness in dealing with the COVID-19 pandemic [16, 19, 23, 25 - 27]. Moreover, the evaluation of preparedness plans was the key aspect of pandemic management *via* the drills, staff training, and reevaluation of implemented plans. The studies recommended that a pandemic safety plan is crucial for community health safety [16, 25, 28].

In Saudi Arabia, it is obvious that the lessons learned from Middle East Respiratory Syndrome Coronavirus (MERS-CoV) in 2012 accelerated the establishment of the Saudi Center for Disease Control and Prevention (SCDC). Many areas of improvement are yet required to support the country to be further prepared in the case of epidemics and pandemics. MERS epidemics improved Saudi Arabia to urge a high sense of warning to the healthcare system and crisis preparedness measures [29]. Limited evidence exists concerning the preparedness of ED response to the COVID-19 pandemic in Saudi Arabia. This study aimed to assess and explore the preparedness of ED in the Eastern Province of Saudi Arabia at tertiary hospitals toward a future pandemic.

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**2. MATERIALS AND METHODS**

**2.1. Study Design**

A descriptive cross-sectional design was used to assess and explore the preparedness of the ED at tertiary hospitals toward a future pandemic.

**2.2. Setting, Sample and Sampling**

The study was conducted from February 2021 to August 2021 at ED at tertiary hospitals in the Eastern Province of Saudi Arabia. These hospitals were established to provide three services: curative services, teaching services, and research. Healthcare providers who are working in the ED (140 participants) at tertiary hospitals in the Eastern Province of Saudi Arabia during the pandemic were eligible to participate. One hundred participants were needed depending on power = 0.80, alpha ( $\alpha$ ) = 0.05, and medium effect size = 0.25. Oversampling was utilized to minimize the dropout rate [30]. The response rate was 75% (105 participants).

**2.3. Ethical Considerations and Data Collection**

This study was approved by the Institutional Review Board (IRB) of Imam Abdulrahman Bin Faisal University as well as tertiary hospitals (IRB: 2021-03-103). The guidelines of the Declaration of Helsinki were followed in this study. Before enrollment, potential participants, and researchers explain the purpose of the study and that participation in the study is voluntary. Furthermore, all participants were informed about the anonymity, confidentiality issue and the option of voluntary termination at any time without any repercussions on their current or future work. If the participant gives his consent; then he/she will be enrolled in the study and asked to fill out the required surveys. After IRB’s permission, the researcher seek permission from designated directors/ manager to conduct the study.

**2.4. Measurement**

At the time of consent, participants would complete a demographic sheet, a communicable disease pandemic preparedness questionnaire, and a rank-order importance listing of communicable disease pandemic educational topics.

Demographic characteristics of participants: these include questions related to age, gender, level of education, years of experience, professional title (specialty), and if they received any official training for pandemic preparedness.

A communicable disease pandemic preparedness

questionnaire was developed by the Health Care Coalition Influenza Pandemic Checklist in 2017 and the final version of this checklist was used in this study. The purpose of this planning tool is to help healthcare coalitions and their partners evaluate their level of preparedness for the communicable disease pandemic. It might also be applied to focus the reaction as a pandemic breaks out. This tool could be used by coalitions to spot any potential gaps in their cross-disciplinary preparedness for communicable disease pandemics [31]. The questionnaire includes three parts: part one includes 14 items regarding the current status of safety/infection control measures subscales, part two includes 10 items regarding ED management measures subscales, and part three includes 10 items regarding response measures subscales. The questionnaire subscales items were coded accordingly: 1 = Completed; 2 = In Progress; 3 = Not Started; as well part four was developed by researchers and include a rank-order importance listing of pandemic educational topics.

A pilot study was conducted to test the instrument’s psychometric properties and the time required to complete the questionnaire and clarity. Twenty participants completed the questionnaire within 10 to 15 minutes. Reliability revealed an alpha coefficient for each subscale: current status of safety/infection control measures, ED management measures, and response measures were (0.88, 0.87, and 0.91) respectively. For adaptation, cultural purpose modification was done in ED management measures subscales to be 10 items instead of 13 items, and the Reliability was checked and revealed an alpha coefficient of 0.87. The content validity of the questionnaire was reviewed by a panel of experts holding Ph.D.

**2.5. Data Analysis**

Data were analyzed using Statistical Package for Social Science (SPSS) for windows version 22. Descriptive statistics (mean, frequency, and standard deviation) were used to describe the sample characteristics.

**3. RESULTS**

A total of 140 questionnaires were distributed, and 105 (75%) were returned. The age of the majority of participants was more than 30 years old (68.6%). Participants were predominately female 60 (57.1%), with bachelor’s degree 72 (68.6%) and had more than 10 years of experience in the profession 46 (43.8%). However, the junior healthcare providers (less than 5 years of experience) were poorly trained 19 (59.4%) with regard to the preparedness for pandemic management as shown in Table 1.

**Table 1. Demographic characteristics of participants (N = 105).**

	N	%
<b>Age</b>	-	-
< 30 years old	33	31.4
> 30 years old	72	68.6
<b>Gender</b>	-	-
Male	45	42.9
Female	60	57.1

(Table 1) contd.....

	N	%
-	-	-
<b>Education Level</b>	-	-
Diploma degree	11	10.5
Bachelor's degree	72	68.6
Higher degree	22	21
<b>Professional Experience</b>	-	-
< 5 years	32	30.5
5-10 years	27	25.7
> 10 years	46	43.8
<b>Professional Title</b>	-	-
Emergency Medical Service Specialist	15	14.3
Nurse	56	53.3
Physician	34	32.4
<b>Receive Training in Preparedness</b>	-	-
<b>Professional Experience &lt; 5 Years</b>	-	-
Yes	13	40.6
No	19	59.4
<b>Professional Experience 5-10 Years</b>	-	-
Yes	17	63
No	10	37
<b>Professional Experience &gt; 10 Years</b>	-	-
Yes	31	67.4
No	15	32.6

### 3.1. ED Preparedness toward COVID – 19 Pandemics

Preparedness measures toward COVID – 19 pandemic as

perceived by healthcare providers are grouped into three main categories: Safety/ infection control measures, ED management measures, and response measures and presented in Table 2.

**Table 2. Preparedness measures toward COVID – 19 pandemics as perceived by healthcare providers. (N = 105).**

Category	Mean	Std. Deviation
<b>Safety / Infection Control Measures</b>		
Support N95 respirator fit testing for all hospital employees.	2.77	0.44
Monitor availability of N95 respirators/ powered air-purifying respirators (PAPR) and other infection control supplies.	2.70	0.50
Develop guidance for staff monitoring for signs of illness (including self-reporting, self-quarantine, and start/end of shift evaluation) and create a mechanism for reporting both illness and absenteeism by using SBAR (Situation, Background, Assessment, Recommendation) documentation style.	2.65	0.57
Develop a return-to-work post-illness policy for healthcare workers.	2.65	0.62
Provide staff education about COVID-19 infection control and update policies as required.	2.51	0.64
Develop an emergency plan (e.g., Standard precautions, training needs, equipment's) if appropriate levels of respiratory protection are unavailable (Plan- B).	2.47	0.67
Encourage hospital units to plan for staff access to medical care for themselves and their families.	2.47	0.71
Watch and alert medical supply members to supply shortages. Make recommendations on possible alternatives to shortages.	2.40	0.63
Determine an emergency plan for at-risk staff (e.g., pregnant, other defined risk groups) including job expectations and potential alternate roles and locations.	2.36	0.77
Prepare guidelines for conservative and re-use of N95 respirators/powered air-purifying respirators (PAPR) if severe shortages are coming up.	2.22	0.71
Develop a hospital pandemic safety plan and assign a safety officer to modify it as required.	2.15	0.72
Evaluate the need for family support to enable staff to work (e.g., childcare).	2.14	0.85
Provide information for family care plans that are designed to guide caregivers through providing the important details about childcare, school, medical care, and family activities.	2.07	0.87
Develop a unit pandemic safety plan and assign a safety officer to modify it as required.	2.04	0.75
<b>Emergency Department Management Measures</b>		
Emphasize hand and respiratory hygiene and other infection prevention techniques through education, policies, signage (symbols to communicate a message), and easy availability of supplies.	2.85	0.39
Determine how suspect cases will be isolated from other waiting patients and during ED care.	2.80	0.43
Develop referral plans for patients that do not need emergency care.	2.65	0.57

(Table 2) contd.....

Category	Mean	Std. Deviation
Determine the screening process and location before entry to ED.	2.57	0.66
Develop care plans that reduce the number of staff caring for suspect/confirmed cases and protocolize care.	2.56	0.62
Develop environmental services room decontamination and waste stream plans (waste management plan).	2.40	0.70
Adjust daily nursing expectations/duties as required to meet demand.	2.37	0.67
Assure the specific needs of pediatric and at-risk populations are addressed in surge (increase infected cases) capacity planning.	2.36	0.68
The availability of a stress management plan that provides information about stress responses, resilience, and available professional mental health/behavioural health resources for patients and families.	2.30	0.76
Develop palliative care plans for implementation when needed for terminally ill patients.	2.22	0.83
<b>Response Measures</b>		
Provide criteria for patient assessment and emphasis on appropriate infection control precautions per hospital guidance.	2.72	0.51
Develop/provide patient information sheets on homecare for COVID-19 -like illness including usual clinical symptoms and course, infection prevention, treatment, and when to seek additional medical care.	2.50	0.75
Develop criteria for managing prehospital denial of transport by EMS personnel for COVID-19 -like illness and other patients.	2.44	0.69
Determine indicators and procedures for changing staff shifts and team arrangements.	2.35	0.72
Determine necessary changes to record-keeping including the use of templates.	2.31	0.78
Evaluate available staff vs. available transport units to determine the ability to meet other non-transport missions (e.g., community paramedicine, EMS personnel staffing alternate care locations, or providing hospital support).	2.30	0.77
Develop/provide patient information sheets for other conditions that may be left without transport if the service volume suggests a relevant need (e.g., minor injuries).	2.29	0.76
Develop procedures for implementing 'batch' home transports for stable patients (inside the province).	2.24	0.79
Develop procedures for implementing the closest hospital transport (inside the province).	2.21	0.78
Determine alternate transport resources and procedures to utilize them, e.g., private ambulances, wheelchairs, and buses.	2.19	0.80

Note: \* Std. Deviation: Standard Deviation.

### 3.2. Safety/infection Control Measures

The overall mean of the safety/ infection control subscale was 2.40 (SD = 0.63). Healthcare providers reported that the highest implemented measures related to safety/ infection control were "support N95 respirator fit testing for all hospital employees" with employees with a mean of 2.77 (SD = 0.44). Healthcare providers reported poorly implemented measures for supply shortage management [2.40 (SD = 0.63)], emergency plans for at-risk staff [2.36 (SD = 0.77)], guidelines for conservative and reuse of N95 respirators [2.22 (SD = 0.71)], hospital pandemic safety plan [2.15 (SD = 0.72)], family support to enable staff to work [2.14 (SD = 0.85)], family care plans toward the vulnerable people like children care [2.07 (SD = 0.87)], and unit pandemic safety plan [2.04 (SD = 0.75)] as shown in Table 2.

### 3.3. ED management Measures

The overall mean of the ED subscale was 2.51 (SD = 0.64). Healthcare providers reported that the highest implemented measures related to ED management were "emphasized on hand and respiratory hygiene and other infection prevention techniques through education, policies, signage, and easy availability of supplies" with a mean of 2.85 (SD = 0.39). Healthcare providers reported poorly implemented plans of waste management [2.40 (SD = 0.70)], adjusting daily nursing expectations and duties [2.37 (SD = 0.67)], how to handle a potentially overwhelming influx at-risk population patients [2.36 (SD = 0.68)], stress management [2.30 (SD = 0.76)], and palliative care for terminally ill patients [2.22 (SD = 0.83)] as shown in Table 2.

### 3.4. Response Measures

The overall mean of the response subscale was 2.36 (SD = 0.68). Healthcare providers reported that the highest implemented measures related to response measures were "provide criteria for patient assessment and emphasis on appropriate infection control precautions per hospital guidance supplies" with a mean of 2.72 (SD = 0.51). Healthcare providers reported poorly implemented measures of team arrangement [2.35 (SD = 0.72)], determine necessary changes to record-keeping [2.31 (SD = 0.78)], availability of staff and the readiness of transport units [2.30 (SD = 0.77)], develop/provide patient information sheets for other conditions that may be left without transport [2.29 (SD = 0.76)], develop procedures for implementing 'batch' home transports for stable patients [2.24 (SD = 0.79)], develop procedures for implementing closest hospital transport [2.21 (SD = 0.78)], and determine alternate transport resources and procedures [2.19 (SD = 0.80)] as shown in Table 2.

### 3.5. Ranking of Educational needs toward Pandemics

The ranking of educational needs toward the pandemic is presented in Table 3. Healthcare providers reported that the highest-ranking of educational topic during the pandemic was "safety/ infection control of communicable diseases" (34.3%). Moreover, healthcare providers reported that the other next most important highest-ranking educational topics were proactive planning for an emerging disaster (18.1%), developing care plans for communicable disease epidemics (17.1%), and how to prepare an emergency plan (plan B) in case of shortage in supplies (9.5%).

**Table 3. Ranking of the educational topics towards the pandemics of communicable diseases (N= 105).**

Communicable Disease Pandemic Educational Topics	N	%
Safety / Infection Control of communicable disease epidemics.	36	34.3
Proactive planning, in which leaders anticipate and take steps to address worst-case scenarios, is the first link in the chain to reducing morbidity, mortality, and other undesirable effects of an emerging disaster.	19	18.1
Develop care plans for communicable disease epidemics.	18	17.1
How to prepare an emergency plan (plan B) in case of a shortage in supplies.	10	9.5
Develop palliative care plans for communicable disease epidemics patients and their families.	6	5.7
The principles of Crisis Standards of Care (CSC).	6	5.7
Patient assessment and reassessment priorities.	5	4.8
The screening process of communicable disease epidemics.	3	2.9
Develop /provide patient information sheets and communication pathways.	2	1.9
<b>Total</b>	<b>105</b>	<b>100%</b>

#### 4. DISCUSSION

Providing care in the ED for patients and their families with communicable diseases can be stressful for healthcare providers [25]. They may be inadequately trained to manage the process. In addition, preparedness and response efforts toward a future pandemic are necessary for community safety [28]. Therefore, this study aimed to assess and explore the process of preparedness of ED in Saudi Arabia at tertiary hospitals toward a future pandemic.

The process of preparedness in hospitals can be complicated. Healthcare providers who have chosen to work in ED settings may face difficulties associated with how to handle the overwhelming influx of at-risk patients during the COVID-19 pandemic. As well as whether the healthcare system is adequately prepared for pandemic management [16, 23]. Understanding the current status of preparedness in hospitals toward the COVID-19 pandemic might lead to improving patient safety and outcome. Achieving patient safety might happen *via* support effective responses to actual occurrences, and ongoing proactive reduction of risk [5, 16, 20, 25].

In our study, healthcare providers in the ED, namely the junior (professional experience less than 5 years), reported inadequate training in all measures of the pandemic preparedness process compared to more expert workers. This finding is consistent with Chanie *et al.* (2021) study in which junior healthcare providers reported a low level of pandemic preparedness by 3.4 times than the senior ones [24]. Several reasons may explain this finding, including the informal pandemic preparedness training (*i.e.*, through personal and clinical experiences), and strong dependence on trial and error in learning to care for high-risk patients [16]. Also, hands-on training showed a limited effect in improving the healthcare worker to deliver appropriate and safe care for risky patients [32]. Together, these findings explore the need for standardized and continuous training within a hospital-based pandemic preparedness program, particularly for junior workers.

Safety and infection control measures are a practical, evidence-based approach that prevents patients and healthcare workers from being harmed by avoidable infections. Effective Infection prevention and control requires constant action at all levels of the healthcare system, including policymakers,

facility managers, health workers, and those who access health services [33]. The healthcare professionals in our study reported being inexperienced in implementing the hospital pandemic safety plan and supply management during the pandemic. This may be partially related to feeling less competent, which often leads to work-related burnout, inadequacy, and discomfort [34, 35]. Our results indicated that the education and training of pandemics preparedness were inadequate and included in the top nine educational topics prioritized by the healthcare professionals according to their needs as shown in Table 3. Safety and infection control guidelines, development of disaster plan, development of care plan in case of disaster, and supply management were also among the top educational topics that were prioritized by the study participants (34.3%, 18.1%, 17.1%, and 9.5%) respectively. These findings are consistent with Al Baalharith, and Pappiya, (2021) study in which healthcare providers reported that they need adequate pandemics preparedness training to improve their knowledge of prevention, control, and management [16].

Healthcare providers reported poor implementation of waste management plans, adjustment of daily nursing expectations and duties, surge capacity planning, stress management, and the plan of palliative care for terminally ill patients. These results were in concordance with Kalantary, *et al.*'s (2021) study that reported a huge increase in the daily waste generation rate during the pandemic; therefore, changes in plans of waste management are necessary to lower the risk of infection transmission [36]. Previous studies recommended that surge capacity planning should be reviewed and updated to prepare for a future pandemic [18, 19]. Most of the literature emphasizes the importance of adjusting daily nursing duties, stress management, and palliative care during and after the pandemic [4, 5, 16, 23, 37]. The results explained the importance of the key members of the ED operations leadership team formulating together the unit safety plan to provide regular updates to the staff on how to face any future pandemics.

Finally, as the COVID-19 pandemic has starkly revealed, responding to crises also takes a serious mental health toll on healthcare professionals at all levels. Throughout the crisis, many of them did not feel protected, supported, safe, or prepared. The pandemic has revealed the critical importance of

protecting the mental health and well-being of healthcare professionals in the ED, to respond to any emergency effectively, safely, and with equity at the forefront [38].

Consistent with earlier studies [5, 18, 19], our results highlighted that the highest implemented response measures were “provide criteria for patient assessment and emphasis on appropriate infection control precautions per hospital guidance supplies”. These studies recommend strict application strategies of screening and PPE guidelines on both patients and staff, as defined by the hospital and the Centers for Disease Control and Prevention (CDC). This can be explained by the recommendation of OSHA to use a method called the “hierarchy of controls” when evaluating methods to reduce workplace hazards. The best controls involve removing the hazard rather than relying on worker behaviours, such as following procedures or using PPE to reduce their exposure [13].

On the other hand, our study revealed that there were poorly implemented measures of team arrangement, record-keeping, transport resources and procedures. Most of the literature emphasizes the importance of defining strategies to allocate healthcare resources, 'batch' home transport for cured patients, and team arrangement [5, 22, 39 - 41].

## 5. LIMITATIONS OF THE STUDY

Despite the importance of the study, several limitations were evident and must be considered when interpreting the results. First, the sample was selected using convenience sampling; so, the readiness status of emergency departments among individuals who did not complete the survey may not be totally representative of those who did. As a result, the study's implications are less likely to be generalized. Furthermore, this study was restricted to one region in Saudi Arabia, limiting the findings' external validity. Future research should include additional studies with a larger sample size recruited from other regions and hospital settings. More descriptive studies are still needed to gain a comprehensive understanding of the quality of preparedness toward pandemics, barriers, and facilitators to providing care in Saudi Arabia's emergency departments.

## CONCLUSION

This study indicates that healthcare providers were poorly trained, on average in all areas of the pandemic preparedness measures due to informal training. Therefore, formal repetitive structured training programs are highly recommended to enhance the preparedness of healthcare providers and systems toward any future pandemic. Moreover, this study revealed that the lowest implemented measures were unit pandemic safety plan, palliative care, and alternate resources. Our findings recommended the need for developing a pandemic safety plan to protect the community and healthcare professionals, focus on palliative care during and after a pandemic, and define strategies to allocate healthcare resources. Further research for emergency department preparedness toward future pandemics is indicated.

## LIST OF ABBREVIATIONS

- OSHA = Occupational Safety and Health Administration  
 PAPR = Powered air-purifying Respirators  
 CSC = Crisis Standards of Care

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The ethical approval was taken from Imam Abdulrahman Bin Faisal University as well as tertiary hospitals (IRB: 2021-03-103), which granted permission to conduct this study.

## HUMAN AND ANIMAL RIGHTS

No animals were used for studies that are base of this research. All the humans used were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2013.

## CONSENT FOR PUBLICATION

Informed consent was obtained from the participants in this study after explaining the purpose of the study and assurance of the subject about the anonymity, confidentiality issues and the option of voluntary termination at any time without any repercussions on their current or future work.

## STANDARDS OF REPORTING

STROBE guidelines and methodologies were followed for this study.

## AVAILABILITY OF DATA AND MATERIALS

The data sets used during the current study can be provided by the corresponding author [S. A], upon reasonable request.

## FUNDING

None.

## CONFLICT OF INTEREST

The authors declare no conflicts of interest, financial or otherwise.

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