

Barriers and Facilitators Toward Disaster Knowledge, Skills, and Preparedness among Emergency Medical Services in Saudi Arabia

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EMS: Emergency Medical Services
NGHA: National Guard Health Affairs
MOH: Ministry of Health

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Abstract

Introduction: Disasters pose significant challenges globally, affecting millions of people annually. In Saudi Arabia, floods constitute a prevalent natural disaster, underscoring the necessity for effective disaster preparedness among Emergency Medical Services (EMS) workers. Despite their critical role in disaster response, research on disaster preparedness among EMS workers in Saudi Arabia is limited.

Study Objective/Methods: The study aimed to explore the disaster preparedness among EMS workers in Saudi Arabia. This study applied an explanatory sequential mixed-methods design to explore disaster preparedness among EMS workers in Saudi Arabia, focusing on the qualitative phase. Semi-structured interviews were conducted with 15 EMS workers from National Guard Health Affairs (NGHA) and Ministry of Health (MOH) facilities in Riyadh, Dammam, and Jeddah. Thematic analysis was conducted following Braun and Clarke's six-step process, ensuring data rigor through Schwandt, et al's criteria for trustworthiness.

Findings: The demographic characteristics of participants revealed a predominantly young, male workforce with varying levels of experience and educational backgrounds. Thematic analysis identified three key themes: (1) Newly/developed profession, highlighting the challenges faced by young EMS workers in acquiring disaster preparedness; (2) Access to opportunities and workplace resources (government versus military), indicating discrepancies in disaster preparedness support between government and military hospitals; and (3) Workplace policies and procedures, highlighting the need for clearer disaster policies, training opportunities, and role clarity among EMS workers.

Conclusion: The study underscores the importance of addressing the unique challenges faced by EMS workers in Saudi Arabia to enhance disaster preparedness. Recommendations include targeted support for young EMS professionals, standardization of disaster training across health care facilities, and improved communication of disaster policies and procedures. These findings have implications for policy and practice in disaster management and EMS training in Saudi Arabia.

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Introduction

The United Nations Office for Disaster Risk Reduction (UNDRR; Geneva, Switzerland) has reported over 22,000 disasters since 1900. There were 7,348 disasters from 2000 through 2019 that have affected more than 4.2 billion people globally.^{1,2} The burden of disasters varies by nation and region. However, the most common natural disasters in Saudi Arabia are floods, which account for seven out of ten significant disasters.^{3,4} Disasters in Saudi Arabia have caused more than 4,600 deaths, adversely affected approximately 32,000 people, and incurred USD\$4.65 billion worth of damages since 1980.⁵ Consequently, the World Health Organization (WHO; Geneva, Switzerland) emphasizes the importance of disaster preparation to enhance health care worker responses to disasters.⁶

In Saudi Arabia, every hospital is mandated to have a disaster plan in place as part of their emergency preparedness and response protocols.⁷ These plans are essential for coordinating responses to various types of emergencies, including natural disasters, mass casualties, and



other critical incidents.^{7,8} The frequency of familiarizing Emergency Medical Services (EMS) workers (paramedics) with these policies and the specifics can vary based on local regulations and hospital policies. Generally, EMS workers are trained regularly to ensure they are familiar with disaster plans and emergency protocols. This training typically includes drills.⁹ Emergency Medical Services workers in Saudi Arabia are critical front-line responders who are dispatched to manage disasters. These EMS workers are educated on best practices and approaches to respond to and mitigate disasters of various types, contexts, and magnitudes.^{10,11} Saudi Arabian EMS workers are also paramedics who provide ambulance services to the civilian population. The profession of EMS workers is young in Saudi Arabia (20 years old) and has only recently been open to female members since 2020.¹²⁻¹⁴

There are mandatory courses and training programs for EMS workers in Saudi Arabia to ensure they are adequately prepared to respond to emergencies and provide high-quality care. These courses are designed to cover a range of essential skills and knowledge areas pertinent to emergency services. Some of the mandatory courses and certifications for EMS workers in Saudi Arabia typically include Basic Life Support (BLS), Advanced Cardiac Life Support (ACLS), and Prehospital Trauma Life Support (PHTLS).¹⁵ These courses are typically mandated by the Saudi Commission for Health Specialties (SCFHS; Riyadh, Saudi Arabia) and other relevant health authorities.¹² All EMS workers are required to regularly renew their certifications and participate in continuing education to maintain their competencies and stay current with best practices in emergency medical care.¹⁰ Despite these recent developments, there are still limited courses offered for EMS workers in Saudi Arabia regarding disasters preparedness.⁵

Given the increasing frequency and impact of disasters globally and within Saudi Arabia, the rationale for this study lies in addressing the gaps in disaster preparedness among EMS workers. The main issues include the need for a consensus on the most effective training methods, limited relevance and frequency of disaster education, and insufficient research on the topic.¹⁶ This study aims to identify the barriers and facilitators toward disaster knowledge, skills, and preparedness among EMS in Saudi Arabia. The significance of this study is underscored by the critical role EMS workers play in disaster management and the potential to save lives and reduce harm through better preparation and training.¹⁷ However, despite these recent developments, EMS workers in Saudi Arabia face several challenges in disaster preparedness. To date, a paucity of research explores disaster preparedness among EMS workers in Saudi Arabia.^{11,18} By exploring the barriers and facilitators toward disaster preparedness, this research seeks to develop recommendations that can be implemented to strengthen disaster preparedness, which will ultimately improve the EMS workers' disaster response.

Methods

Design

This study used an explanatory sequential mixed-methods design to examine disaster preparedness among EMS workers in Saudi Arabia. The quantitative phase of the study involved a cross-sectional survey to assess the current level of disaster preparedness among EMS workers. The survey included structured questions that aimed to quantify the knowledge, skills, and preparedness of EMS workers in Saudi Arabia. It also gathered data on the availability and frequency of disaster training programs, the

resources available for disaster response, and their perceived effectiveness. The survey was distributed to a representative sample of EMS workers across various regions in Saudi Arabia (Riyadh, Jeddah, and Dammam) to ensure a diverse and comprehensive dataset.

The qualitative phase, which this paper focuses on, employed a qualitative descriptive approach to identify the barriers and facilitators toward disaster knowledge, skills, and preparedness among EMS in Saudi Arabia. Semi-structured interviews were conducted to allow the researchers to gain insight through participants' responses, to seek clarification, to take field notes, and to deeply explore the disaster preparedness of EMS workers in Saudi Arabia.¹⁹ This approach further allowed participants to freely express their field experience related to disaster preparedness.²⁰ This study followed the consolidated criteria for reporting qualitative research (COREQ) checklist to report the study.²¹

This study used a semi-structured interview protocol, which had a list of six questions to initiate the interviews (Supplementary File 1; available online only). The interview questions were designed and informed by the results of the quantitative survey to help the researchers better understand the EMS workers' facilitators and barriers related to disaster preparedness.

Population and Sample

This study used purposive sampling to recruit 15 EMS workers with at least one year of experience at the National Guard Health Affairs (NGHA; Riyadh, Saudi Arabia) or Ministry of Health (MOH) in Riyadh, Dammam, and Jeddah to ensure that the participant had undergone disaster training or experienced disasters.²² No restrictions were placed on gender, age, or any other demographic variables. Twenty-three participants agreed to participate in this study, but due to lack of availability, only 15 interviews were completed. The sample was selected from an estimated population of 2,000 EMS workers in the six hospitals included in the study. The recruitment for this study took place in a cross-sectional study where participants were asked to leave their details at the end of a survey if they wished to participate in this study.

Pilot Testing

A pilot test for the semi-structured interviews was conducted prior to the main data collection to ensure the clarity and effectiveness of the interview questions. This pilot test involved a small group of EMS workers who were not part of the main study sample. Feedback from the pilot test indicated that the interview protocol was clear and comprehensive, and the test passed without requiring significant modifications. The successful pilot test ensured that the interview questions were well-understood by participants and effectively captured the necessary information for the study.

Data Collection

Before starting each interview, the researcher reconfirmed the details of the study to participants and the voluntary nature of their participation. The researcher adhered to the interview guide in conducting the interviews. All the interviews were conducted in English and audio recorded through the online Zoom platform (Version: 5.7.1; Zoom Video Communications, Inc.; San Jose, California USA) with the consent of the participants. The interviews continued until thematic saturation was reached.^{23,24} All the interviews were conducted from May through August 2021, with each interview lasting between 40 and 50 minutes.

Data Analysis

All interviews were transcribed verbatim to ensure the participants' views, meanings, and discussions were neither missed nor changed during the transcription process.²⁵ All the participants had the chance to review a copy of their interview transcripts and provide their feedback. However, only one participant provided feedback on their script.

Data were analyzed using Braun and Clarke's²⁶ six-step process: (1) familiarize oneself with the data through reading the transcripts; (2) generate initial codes and labels to represent essential features of the data related to the study questions; (3) search for themes from the generated codes and categories by identifying concepts and ideas that inform the semantic content of the data; (4) review and refine themes for consistency and accuracy for both levels (coded extract, entire data set); (5) determine a description and name the final themes represented in the results; and (6) conduct the qualitative data interpretation and present the final report.

The researchers followed Schwandt, et al's²⁷ five criteria for trustworthiness to achieve data rigor in qualitative research: (1) confirmability; (2) dependability; (3) credibility; (4) authenticity; and (5) transferability.

Protection of Human Participants

This study was approved by the Human Research Ethics Committee (HREC) at the University of Newcastle (UoN; H-2020-0350), the NGHHA (SP20/497/R), and the Saudi MOH (20-116E). The study researchers followed the ethical standards established by the National Health and Medical Research Council (NHMRC; Canberra ACT Australia) and the Australian Research Council (ARC; Canberra ACT Australia).²⁸ All participants were informed about the study aim, objective, the voluntary nature of their participation, and their right to withdraw without any consequences.

Findings

Participant Demographic Characteristics

A total of 15 interviews were completed. Of these participants, 11 were male and four were female. This ratio of male and female workers was consistent with industry employment trends in Saudi Arabia. Most participants were aged between 25-29 years (67%; n = 10) with one-to-six years of experience (87%; n = 13). Almost three-quarters of the participants held a bachelor's degree (67%; n = 10) and worked in a government hospital (73%; n = 11). All EMS workers worked 48 hours per week. Table 1 shows the participants' demographic details.

Thematic Analysis

Three themes were derived from the analysis: (1) Newly/developed profession; (2) Access to opportunities and workplace resources (government versus military); and (3) Workplace policies and procedures. A code number was used from P1 to P15 in place of the participants' names to ensure their privacy. The addition of a letter to the code number indicates the sex of the participant (M: male; F: female).

Themes Coding—The coding tree provides a structured representation of the coding process, illustrating how initial codes are grouped into broader themes. Initial codes are specific labels assigned to distinct pieces of data that capture essential elements related to the research questions. The initial codes included “lack of experience,” “access to educational opportunities,” “standardized

Characteristics		N (%)
Gender	Male	11 (73%)
	Female	4 (27%)
Age	25–29	10 (67%)
	30–35	5 (33%)
Experience	1–6 years	13 (87%)
	7–12 years	2 (13%)
Education Level	Bachelor's Degree	10 (67%)
	Master's Degree	5 (33%)
Type of Facility	Government Hospitals	11 (73%)
	Military Hospitals	4 (27%)

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Table 1. Demographics Table

Theme	Category	Code
Factors Affecting Preparedness	• Experience Level	• Lack of experience • Seniority and exposure
	• Educational Opportunities	• Access to literature and materials • Participation in workshops and seminars
Standardization and Policy Issues	• Training Curriculum	• Non-standardized training • Unique hospital policies
	• Location Impact	• Military vs. civilian hospitals • Disaster plan involvement
Perceived Skill Levels	• Age and Seniority	• Relationship between age and skills • Access to training over time

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Table 2. Themes Emerged from Data Analysis

training,” and “location impact.” Related codes were grouped into broader categories. For example, “lack of experience” and “access to educational opportunities” fell under the category of “Factors Affecting Preparedness.” Categories were further synthesized into overarching themes that captured the essence of the data. For instance, “Factors Affecting Preparedness” and “Standardization and Policy Issues” were themes that emerged from the data analysis. This is as indicated in Table 2.

Theme 1: Newly/Developed Profession—EMS workers are the frontline health care responders in a disaster. However, the EMS field in Saudi Arabia is a developing profession with a young workforce. This means that backing is required from the Saudi Arabian government to support young EMS workers to increase their knowledge, skills, and preparedness for disasters:

The first and most important struggle for us is that our profession is new and requires huge government investment. This includes structural,

financial, and educational support. We are young and need to learn a lot to increase our preparedness for disasters (P7: M. Page 2, L 13-15).

Other participants concurred over this point and stated that being young with a low experience limited their exposure to disasters. This decreased their sense of preparation:

For me, I worked now more than three years. Still, I feel I'm not prepared because I haven't responded to any disasters through my working years. This is why I need real experience in disasters to increase my preparedness and know how to respond to crises (P14: M. Page 4, L 20-22).

Older participants supported this perspective as they expressed how they were more likely to have experience responding to disasters as they had more years working as an EMS. They reported that working as an EMS positively contributed to their knowledge and skill levels related to disaster preparedness:

The more I practice my job, the more I feel prepared and confident. I believe my experience contributed positively to my knowledge, skills, and how prepared I feel. Working in endless emergency scenarios daily developed my abilities to solve problems, communicate more effectively, and act correctly in most cases (P10: M. Page 1, L 27-30).

Another participant reported that responding to daily incidents increased their preparedness for disasters. This preparedness was developed by levels either by learning from the experience itself, or engaging with leaders in the field:

...// I worked as a full-time paramedic //.. and there was a massive volume of cases, including mass-causality incidents. So, I believe the exposure to such incidents allowed me to elevate my skills as well as my knowledge either by learning from the experience itself or exposing to leaders in the field, who have better experience compared to me when it comes to disaster preparedness and management (P12: M. Page 1, L 17-23).

Largely, EMS workers need proper preparedness to handle emerging disasters. The study participants believed that different factors influenced their preparedness levels for disaster response. These included their previous disaster response experience, education, and training level. Other participants felt prepared but reported that they needed to participate in more training and education activities to increase their preparedness:

Different factors influence our disaster preparation, like disaster experience, education, and skills level. I feel ok, but I think the number of skills and knowledge I have are not enough and I need more training and courses in this particular area to increase my preparedness (P12: M. Page 1, L 23-26).

Theme 2: Access to Opportunities and Workplace Resources (Government versus Military)—Hospitals in Saudi Arabia operate differently from one place to another. This appears to play an increasingly vital role in influencing their workers' preparedness levels. Various resources and opportunities are necessary to support the workers to increase their disaster preparation. Some participants felt that their workplace had effectively prepared them for disaster:

I am working in a military facility, and I felt it helped me be confident about my preparedness for disasters. My workplace runs disaster lectures, drills, and exercises regularly. These opportunities increased my preparedness for disaster (P11: M. Page 5, L 22-24).

Access to different types of education and training opportunities increased military EMS workers' preparedness level. Other participants stated that sustained support from the workplace is essential to achieve good preparedness levels. However, education, training, and development resources are not consistent across

hospitals in Saudi Arabia, and these opportunities were limited in the government hospitals:

I'm still experiencing some difficulty when it comes to disaster preparedness because I have no idea if we have a preparedness unit in the hospitals or not. I have been working for almost two years and haven't been in any kind of drill or exercise. I have attended only one disaster lecture, and I think they were doing it for the records because I did not get much from it. You are asking me if I am prepared, so the answer is no or maybe not as I was expected (P3: M. Page 1, L 15-20).

These concerns became barriers for EMS workers in relation to increasing their preparedness levels in the workplace. Most participants highlighted the same solution to overcoming these barriers:

I think if my workplace conducts more courses or lectures on disasters will increase our knowledge, they can make it mandatory. All the workers have to attend because we all have to know about disasters, and if there are any workers who don't have the knowledge, they will not be ready to respond to disasters. Also, make these courses available to all workers (P9: F. Page 5, L 31-36).

Participants also highlighted the importance of these learning activities for their preparedness levels and expected their hospitals to conduct them regularly:

Hospitals should do departmental drills monthly to check each department preparedness level, and this will help us to find out the gap and build up our emergency operation plan (P15: F. Page 2, L 12-14).

Theme 3: Workplace Policies and Procedures—Most participants reported that their workplaces did not have clear disaster policies and procedures for EMS workers:

Unfortunately, in my day-to-day work, we do not have a clear disaster protocol. This does not mean there is no protocol at all, but it means people who works in the field do not know about these protocols. The field management officers may know or have copies of the protocol, but not the paramedics and the EMTs [emergency medical technicians] (P10: M. Page 9, L 3-6).

This lack of clarity often led to EMS workers seeking direction from their supervisor in regard to how to respond during larger-scale critical incidents:

Actually, there is no clear policy and procedures in the paramedic department. You always have to ask the supervisors or the old employees how work goes in such case[s], which always causes a delay in the response or even makes you make some mistakes (P3: M. Page 9, L 8-10).

The participants believed it was important for all EMS workers to know where to find the disaster response plan and to be familiar with its contents before an emergency arose:

All the EMS workers have to be familiar with the disaster policy and procedure. We have to know where to find these plans, what does it include, and how to apply them during the response (P6: M. Page 10, L 1-4).

Some participants were familiar with their disaster policies and procedures. However, these plans were difficult to apply during a disaster:

I think disaster policy and procedures are good to some extent, but when it comes to applying that in real world, there comes the challenges (P1: M. Page 9, L 17-18).

This participant further explained the reasons that hindered the implementation of the policies and procedures:

Implementing what is written is the toughest part for many reasons, like people in charge of carrying them out are not trained enough in that specific

subject matter (lack of qualified personnel and subject matter expert). Also, people who are in charge of these have a lot of responsibilities, which does not leave enough attention to disaster management (P1: M. Page 9, L 19-22).

As a result, the participants felt there was a lack of understanding of disaster policies and procedures:

Yes, we do have a policy and procedure. I don't know them. Like I didn't see them or have read the regulations. But I think that the disaster preparedness unit has some official regulations and policies, but they didn't explain them to us (P3: M. Page 9, L 34-36).

The participants reported that failing to explain the disaster policies and procedures to them on orientation day was a contributing factor for their lack of preparedness:

The main reason for our misunderstanding of the disaster policy and procedure at our hospitals is that they didn't explain it to us at orientation. So, we don't know if our hospital has a policy or not (P12: M. Page 9, L 20-22).

Participants suggested that their workplace could improve their disaster policies and procedures by having a clear policy and acquainting workers with specific regulations when they were first hired:

If we want to promote disaster response, we will first have to write a clear policies and procedures [document] that will facilitate the EMS [workers] day by day work and included the disaster regulations. Second, make sure that the staff understand [the] policies when they [are] first hired in the department (P3: M. Page 9, L 12-15).

Other participants suggested that it may be helpful to outline a plan and tasks for assigned roles in a card system or small notebook for frequent incidents, such as motor vehicle crashes, including necessary contact information, and to have it updated regularly:

Our hospital responds to frequent emergencies like motor crash accidents, and I imagine the easiest way to remember our roles and the hospital's important contact information is to highlight in a small card or notebook. This will help to standardize our response and decrease the mistakes (P6: M. Page 10, L 12-15).

Discussion

All study participants were aged between 25-35 years and most had less than seven years of experience. This younger demographic has a significant impact on the profession's effectiveness, knowledge, and skills regarding disasters. Alshammari, et al¹⁸ conducted a national study on EMS workers in Saudi Arabia and found that the EMS profession predominantly involves younger workers under 35 years old. This is because universities in Saudi Arabia begun to teach EMS bachelor's degrees after 2007.¹⁸ Therefore, most participants stated that their lack of experience decreased their preparedness for disasters. This was not reported by their older colleagues who reported that their knowledge and skill levels increased with years of experience. Thus, the year of experience as an EMS worker was seen by participants to be related to their perceived skill level for disasters. The study findings demonstrated that EMS workers gained better access to educational opportunities with having more seniority in the service. For example, senior EMS workers have more exposure to literature, materials, workshop, and seminars. Therefore, it appears that access to these opportunities may be related to the relationship between advancing age and perceived skill level. This is supported by other literature that shows EMS workers had additional opportunities to practice exercises and engage in training over time.^{29,30} Consequently, this

enhanced their disaster skills and provided them with more access to knowledge, information, and drills.³⁰⁻³⁴

Participants also expressed that their level of preparedness was affected by their location. Participants described their experience that Saudi Arabia's training curriculum and policies are not standardized. They reported that hospitals have developed unique, hospital-specific disaster policies and training curricula for EMS workers in response to gaps in policy and training. These unique hospital policies and training curricula are a barrier to EMS workers' disaster preparedness. This was likely due to the lack of a comprehensive national policy on EMS workers' disaster preparedness. For example, participants working in military hospitals reported higher knowledge, skills, and preparedness for disaster. The findings aligned with international studies that reported working in military hospitals possessed workers with more skills and knowledge for disaster preparedness than those who worked in civilian hospitals.^{5,35} The authors describe that this imbalance in the preparedness of EMS workers was because military workers had higher exposure to clinical cases and disaster duties in their workplace. Military workers in these studies also contributed to drafting disaster plans in their workplaces, which increased their understanding of disasters.^{5,35,36}

A lack of understanding and access to workplace policies and procedures also hinders the EMS workers preparedness for disasters. This was reported by some participants who stated they did not know the procedures and policies of their hospitals. This is because the existing practice requires them to approach their supervisors for procedural instruction and reassurance during disasters. The current policies of the EMS workers' hospitals influenced their skills and knowledge acquired. The participants believed that the presence of frameworks and policy guidelines are crucial in promoting their disaster knowledge and skills. According to Al-Hunaishi, et al,³⁷ knowledge was determined by the extent to which EMS workers are aware of existing policies, guidelines, and regulations. Other studies concurred on this point and described that EMS workers who had better knowledge and understanding of their workplace disaster guidelines and policies reported better preparedness.^{38,39} They presented better understanding of what was expected of them during disaster response. Unclear procedures and policies restrict the opportunities and the ability of EMS workers to develop better skills and knowledge for disasters.^{40,41} Another study reported that the useful method to increase EMS workers' understanding of their roles in disaster is through conducting lectures followed by mock drills.⁴² The authors described that this combination offered the EMS workers not only the chance to understand their workplace's procedures for disasters, but also the chance to exercise essential skills during the sessions.⁴² However, Hammad, et al⁴³ revealed that there is no consensus on the best mode, content, or delivery method, and disaster education is limited in relevance, frequency, and availability.

Some approaches to improving the educational levels among EMS workers include standardized curriculum development, regular training and drills, and continuous assessment and feedback. First, the development of a standardized curriculum is crucial. This would involve collaborating with local and international experts to create a comprehensive curriculum that includes theoretical knowledge and practical skills. This curriculum should be regularly updated to incorporate global health and emergency organizations' latest guidelines and best practices.⁴² Secondly, implementing regular training and drills that are

available to all workers will significantly enhance the practical skills of EMS workers. These sessions should be scheduled at least bi-annually to keep EMS workers up-to-date with the latest protocols. Realistic disaster drills that simulate various emergency scenarios, supported by advanced simulation technology, will provide EMS workers with hands-on experience and improve their readiness for real-life emergencies.⁴³ Utilizing diverse delivery methods, such as a blended learning approach combining online modules, in-person training, and interactive simulations, will cater to different learning preferences and ensure comprehensive coverage.⁴⁴

Finally, continuous assessment and feedback mechanisms are essential to ensure the effectiveness of the training programs. Implementing pre-training and post-training assessments will measure knowledge gain and skills improvement, while collecting feedback from EMS workers on the training content and delivery methods will help refine and enhance the programs. Regular reviews and updates of the training programs based on assessment results and feedback will ensure they remain relevant and effective. This approach will foster a culture of continuous improvement and ensure that EMS workers in Saudi Arabia are consistently well-prepared to respond to disasters and emergencies.^{42,43}

Moreover, to enhance disaster preparedness among EMS workers in Saudi Arabia, this study recommends to develop a disaster education framework based on international standards and local context. This framework should aim to increase disaster preparedness by standardizing hospital training curricula and policies. For example, hospitals could implement action cards for EMS workers that are easily accessible during disasters. These action cards allow EMS workers to know their tasks according to incident command system structures and organizational structures, thereby improving efficiency and clarity during disaster response.^{29,34}

Strengths and Limitations

This paper recruited EMS workers from a demographically and geographically representative sample of the EMS workforce in Saudi Arabia to obtain the EMS workers' disaster preparedness. Additionally, the semi-structured interview built from the survey results allowed for identifying the EMS workers' facilitators, barriers, and cultural impacts related to disaster preparedness in Saudi Arabia. This paper also has limitation; the authors conducted this paper at a time of great change for the EMS profession, as it is a developing field in Saudi Arabia. This development period combined with global events such as the COVID-19 pandemic that has affected the field and shifted the disaster management focus from incident response to prolonged response.

Conclusion

This study revealed a better understanding of the EMS workers' experience regarding disaster preparedness in Saudi Arabia. Many challenges were highlighted, thus reflecting a barrier for EMS workers to increase their knowledge, skills, and preparedness for disasters, including limited experience and exposure for disasters, unstandardized training and educational curriculum, and inaccessible workplace policy and procedures for disasters response. Adopting three effective strategies for Saudi EMS workers to develop better knowledge, skills, and preparedness for disasters will increase their disaster preparedness: (1) equitable and standardized training and educational opportunities for EMS workers in Saudi Arabia; (2) develop a secondment program to provide exchange experiences for military and government EMS workers; and (3) consider mentorship programs as a key component of EMS workers in Saudi Arabia. These recommendations may help Saudi EMS workers to increase their preparedness for disasters. Future research could assess the effectiveness of the Saudi Arabian workplaces' equitable and standardized education and training opportunities for EMS workers.

Overall, this study suggests to develop a disaster education framework based on international standards and the local context to enhance disaster preparedness among EMS workers in Saudi Arabia. Such a framework should integrate comprehensive training programs covering theoretical knowledge and practical skills which are essential for effective disaster response. Collaborating with international experts and adapting global best practices will ensure that EMS workers are well-equipped to handle diverse disasters. Additionally, establishing standardized policies and procedures across all health care facilities, supported by regular drills and assessments, will further enhance the readiness and capabilities of EMS workers in responding to disasters effectively. This approach addresses the current gaps in disaster preparedness and establishes a sustainable framework for continuous improvement in emergency response capabilities across the health care sector in Saudi Arabia.

Author Contributions

Study Design: YA, GC, AH.

Data Collection: YA.

Data Analysis: YA, GC, AH.

Study Supervision: YA, GC, AH.

Manuscript Writing: YA, GC, AH.

Critical Review for Important Intellectual Content: YA, GC, AH.

Supplementary Materials

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References

- EM-DAT: The Emergency Events Database. Université Catholique de Louvain (UCL) – Brussels, Belgium. 2020. www.emdat.be. Accessed February 20, 2021.
- Centre for Research on the Epidemiology of Disasters (CRED), United Nations Office for Disaster Risk Reduction (UNDRR). The Human Cost of Disasters - An overview of the last 20 years 2000-2019. 2020. <https://reliefweb.int/report/world/human-cost-disasters-overview-last-20-years-2000-2019>. Accessed February 20, 2021.
- Abosuliman SS, Kumar A, Alam F, Rashid A. Disaster preparedness and management in Saudi Arabia: an empirical investigation. *International Journal of Safety and Security Engineering*. 2013;3(3):196–208.
- Alrehailli NR. A systematic review of the emergency planning for flash floods response in the Kingdom of Saudi Arabia. *Australian Journal of Emergency Management*. 2021;36(4):82–88.
- Al Thobaity A, Plummer V, Innes K, Copnell B. Perceptions of knowledge of disaster management among military and civilian nurses in Saudi Arabia. *Australas Emerg Nurs J*. 2015;18(3):156–164.
- Inter-Agency Standing Committee, World Health Organization. Health Cluster Guide: A Practical Guide for Country-Level Implementation of the Health Cluster. 2011. https://iris.who.int/bitstream/handle/10665/70128/WHO_HAC_MAN_2009.7_eng.pdf. Accessed February 20, 2021.
- Ministry of Health. *Emergency Preparedness and Response Plan Guidelines*. Saudi Arabia: Ministry of Health. 2021.
- Alazmy W, Samarkandi O, Williams B. The history of emergency medical services response to mass casualty incidents in disasters, Saudi Arabia. *Journal of Emergency Medicine, Trauma, & Acute Care*. 2020;20(2020):1:3.

9. Almukhlifi Y. *Disaster Preparedness Among Emergency Medical Services Worker in Saudi Arabia*. Thesis. University of Newcastle, Australia. 2022.
10. Alharthy A, Almutairi M, Alshehri M, Eshaq A. Disaster preparedness in Saudi hospitals: awareness and attitudes of staff. *J Emerg Manag*. 2017;15(4):307–317.
11. Alanazy A, Fraser J, Wark S. Provision of Emergency Medical Services in rural and urban Saudi Arabia: an overview of personnel experiences. *Asia Pacific Journal of Health Management*. 2021;16(2):i559.
12. Alshammari T, Jennings PA, Williams B. Evolution of emergency medical services in Saudi Arabia. *Journal of Emergency Medicine, Trauma, & Acute Care*. 2017;2017(1):4.
13. Alharthy N, Mutairi MA, Alsahlh A, et al. Workplace violence among emergency medical services workers in Riyadh, Saudi Arabia. *Journal of Hospital Administration*. 2017;6(3):26–32.
14. AlObaid AM, Gosling C, McKenna L, Williams B. Perceptions of EMS leaders and supervisors on the challenges faced by female paramedics in Riyadh Saudi Arabia: a qualitative study. *Int J Emerg Services*. 2021;10(2):235–246.
15. Saudi Commission for Health Specialties. EMS Programs and Certifications. 2020. <https://www.scfhs.org.sa/>. Accessed February 20, 2021.
16. Hammad KS, Arbon P, Gebbie K, Hutton A. Nursing in the emergency department (ED) during a disaster: a review of the current literature. *Australas Emerg Nurs J*. 2012;15(4):235–244.
17. Öztekin SD, Larson EE, Akahoshi M, Öztekin D. Critical care nurses' disaster preparedness and organizational support. *Journal of Nursing Scholarship*. 2016;48(1):65–73.
18. AlShammari T, Jennings P, Williams B. National study of Saudi Arabian emergency medical services professional profiles: an inferential analysis. *Australasian Journal of Paramedicine*. 2019;16:1–9.
19. DeJonckheere M, Vaughn LM. Semi-structured interviewing in primary care research; a balance of relationship and rigor. *Fam Med Community Health*. 2019;7(57):e000057.
20. Horton J, Macve R, Struyven G. Qualitative research: experiences in using semi-structured interviews. *The Real Life Guide to Accounting Research*. 2004;339–357.
21. Tong A, Sainsbury P, Craig J. Consolidated Criteria for Reporting Qualitative Research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care*. 2007;19(6):349–357.
22. Creswell JW. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Thousand Oaks, California USA: Sage Publications. 2014.
23. Francis JJ, Johnston M, Robertson C, et al. What is an adequate sample size? Operationalizing data saturation for theory-based interview studies. *Psychology and Health*. 2010;25(10):1229–1245.
24. Walker JL. The use of saturation in qualitative research. *Can J Cardiovasc Nurs*. 2012;22(2):37–46.
25. Polit, D.F. and Beck, C.T. (2012) *Nursing Research: Generating and Assessing Evidence for Nursing Practice*. Wolters Kluwer Health, Philadelphia.
26. Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology*. 2006 Jan;3(2):77–101. doi: [10.1191/1478088706qp0630a](https://doi.org/10.1191/1478088706qp0630a)
27. Schwandt TA, Lincoln YS, Guba EG. Judging interpretations: but is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. *New Directions for Evaluation*. 2007;114:11–25.
28. National Health and Medical Research Council (NHMRC). *Australian Code for the Responsible Conduct of Research*. Commonwealth of Australia, Canberra: NHMRC, Australian Research Council and Universities Australia. 2018.
29. Albanese J, Paturas J. Disaster and emergency management: a case study of the role of education and training in preparedness and response. *J Emerg Manag*. 2018; 16(3):187.
30. Al Khalailah MA, Bond E, Alasad JA. Jordanian nurses' perceptions of their preparedness for disaster management. *Int Emerg Nurs*. 2012;20(1):14–23.
31. Almukhlifi Y, Crowfoot G, Wilson A, Hutton A. Emergency healthcare workers' preparedness for disaster management: an integrative review. *J Clin Nurs*. 2021.
32. Albanese J, Paturas J. The importance of critical thinking skills in disaster management. *J Bus Contin Emer Plan*. 2018;11(4):326–334.
33. Paton D, Jackson D. Developing disaster management capability: an assessment center approach. *Disaster Prevention and Management*. 2002;1(2):115–122.
34. Paton D, Jackson D. Disaster and emergency management: strategies for enhancing preparedness. *Disaster Prevention and Management*. 2002;11(3):210–216.
35. Tzeng WC, Feng HP, Cheng WT, et al. Readiness of hospital nurses for disaster responses in Taiwan: a cross-sectional study. *Nurse Education Today*. 2016;47:37–42.
36. King HC, Spritzer N, Al-Azzeh N. Perceived knowledge, skills, and preparedness for disaster management among military health care personnel. *Mil Med*. 2019;184(9–10): e548–e554.
37. Al-Hunaishi W, Hoe VC, Chinna K. Factors associated with healthcare workers willingness to participate in disasters: a cross-sectional study in Sana'a, Yemen. *BMJ Open*. 2019;9(10):e030547.
38. Setyawati AD, Lu YY, Liu CY, Liang SY. Disaster knowledge, skills, and preparedness among nurses in Bengkulu, Indonesia: a descriptive correlational survey study. *J Emerg Nurs*. 2020;46(5):633–641.
39. Taskiran G, Baykal U. Nurses' disaster preparedness and core competencies in Turkey: a descriptive correlational design. *International Nursing Review*. 2019; 66(2):165–175.
40. Catlett CL, Jenkins JL, Millin MG. Role of emergency medical services in disaster response: resource document for the National Association of EMS Physicians position statement. *Prehosp Emerg Care*. 2011;15(3):420–425.
41. Henderson AC, Pandey SK. Leadership in street-level bureaucracy: an exploratory study of supervisor-worker interactions in emergency medical services. *International Review of Public Administration*. 2013;18(1):7–23.
42. Öztekin SD, Larson EE, Akahoshi M, Öztekin İ. Japanese nurses' perception of their preparedness for disasters: quantitative survey research on one prefecture in Japan. *Japan Journal of Nursing Science*. 2016;13(3):391–401.
43. Hammad KS, Arbon P, Gebbie KM, Hutton A. Nursing in the emergency department: the impact of the professional practice environment on nurses' responses to practice dilemmas. *International Journal of Nursing Practice*. 2012; 18(5):448–456.
44. Bumblauskas D, Vyas N. The convergence of online teaching and problem-based learning modules amid the covid-19 pandemic. *Electronic Journal of e-Learning*. 2021;19(3):147–158.