

# The Association Between Emergency Medical Service Technicians', Medical Engineers', and Nurses' Knowledge of Emergency Preparedness and Their Practices in Promoting Community Resilience in KSA: A Qualitative Study

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## Abstract

Emergency preparedness and community resilience are critical aspects of healthcare that require the involvement of various healthcare professionals. This qualitative study explores the association between emergency medical service technicians', medical engineers', and nurses' knowledge of emergency preparedness and their practices in promoting community resilience in Saudi Arabia. Semi-structured interviews were conducted with 27 participants, including nine emergency medical service technicians, nine medical engineers, and nine nurses, to gain insights into their knowledge, experiences, and perceptions related to emergency preparedness and community resilience. Thematic analysis of the data revealed four main themes: (1) the importance of multidisciplinary collaboration in emergency preparedness and community resilience, (2) the need for ongoing education and training in emergency preparedness, (3) the role of technology and innovation in enhancing emergency response and community resilience, and (4) the challenges and opportunities for promoting community engagement and empowerment. The findings suggest that while healthcare professionals have varying levels of knowledge and experience in emergency preparedness, they recognize the importance of multidisciplinary collaboration and community engagement in promoting resilience. The study highlights the need for targeted interventions to enhance healthcare professionals' knowledge and skills in emergency preparedness, as well as strategies to foster community participation and ownership in building resilience. The insights gained from this study can inform the development of policies and programs to strengthen emergency preparedness and community resilience in Saudi Arabia and beyond.

**Keywords:** emergency preparedness, community resilience, healthcare professionals, multidisciplinary collaboration, qualitative research, Saudi Arabia

## 1. Introduction

Emergency preparedness and community resilience are essential components of a robust healthcare system, particularly in the face of increasing global health threats and disasters (World

Health Organization, 2019). Emergency preparedness refers to the knowledge, capabilities, and actions taken to effectively anticipate, respond to, and recover from the impacts of likely, imminent, or current emergencies or disasters (Nelson et al., 2007). Community resilience, on the other hand, is the ability of a community to withstand, adapt to, and recover from adversity, such as public health emergencies or natural disasters (Chandra et al., 2011).

Healthcare professionals, including emergency medical service (EMS) technicians, medical engineers, and nurses, play a vital role in emergency preparedness and community resilience (Hick et al., 2020). EMS technicians are often the first responders to emergencies and disasters, providing critical pre-hospital care and transportation to healthcare facilities (Al-Shaqsi, 2010). Medical engineers, including biomedical engineers, are responsible for the design, development, and maintenance of medical devices and systems that are essential for emergency response and patient care (Jaffry et al., 2021). Nurses, as the largest group of healthcare professionals, are involved in various aspects of emergency preparedness and response, from triage and treatment to patient education and community outreach (Veenema et al., 2020).

In Saudi Arabia, the healthcare system has made significant strides in emergency preparedness and disaster management in recent years, driven by the increasing frequency and severity of natural and man-made disasters, such as floods, fires, and infectious disease outbreaks (Alshehri, 2017). The Ministry of Health (MOH) has established a national emergency management system, which includes a network of emergency operation centers, stockpiles of medical supplies and equipment, and trained healthcare personnel (MOH, 2016). However, the effectiveness of these efforts depends on the knowledge, skills, and practices of healthcare professionals, as well as their ability to engage and empower communities in building resilience (Alrazeeni, 2015).

Despite the growing recognition of the importance of emergency preparedness and community resilience, limited research has been conducted on the knowledge, attitudes, and practices of healthcare professionals in this area, particularly in the Saudi Arabian context. Moreover, few studies have explored the perspectives and experiences of EMS technicians, medical engineers, and nurses, who are often at the forefront of emergency response and community engagement.

This study aims to address this gap by exploring the association between EMS technicians', medical engineers', and nurses' knowledge of emergency preparedness and their practices in promoting community resilience in Saudi Arabia. By gaining insights into the facilitators and barriers to effective emergency preparedness and community resilience, the study seeks to inform the development of policies, programs, and interventions to enhance the capacity and performance of healthcare professionals in this critical area.

The objectives of this study are as follows:

1. To assess the knowledge, attitudes, and practices of EMS technicians, medical engineers, and nurses regarding emergency preparedness and community resilience in Saudi Arabia.
2. To explore the facilitators and barriers to effective emergency preparedness and community resilience from the perspectives of healthcare professionals.
3. To examine the role of multidisciplinary collaboration and community engagement in promoting emergency preparedness and resilience.
4. To provide recommendations for enhancing the capacity and performance of healthcare professionals in emergency preparedness and community resilience in Saudi Arabia.

## **2. Literature Review**

This section provides an overview of the existing literature on emergency preparedness and

community resilience, with a focus on the knowledge, attitudes, and practices of healthcare professionals, particularly EMS technicians, medical engineers, and nurses.

### **2.1 Emergency Preparedness in Healthcare**

Emergency preparedness is a critical component of healthcare that involves the planning, training, and coordination of healthcare professionals and organizations to effectively respond to and recover from emergencies and disasters (Nelson et al., 2007). Emergency preparedness encompasses a range of activities, including risk assessment, resource management, communication, and collaboration with various stakeholders, such as public health agencies, emergency management organizations, and community groups (Hick et al., 2020).

Several frameworks and guidelines have been developed to guide emergency preparedness in healthcare, such as the World Health Organization's (WHO) Hospital Emergency Response Checklist (WHO, 2011) and the U.S. Centers for Disease Control and Prevention's (CDC) Public Health Emergency Preparedness and Response Capabilities (CDC, 2018). These frameworks emphasize the importance of a comprehensive and coordinated approach to emergency preparedness, which involves the participation of various healthcare professionals and disciplines (Veenema et al., 2020).

Studies have shown that effective emergency preparedness in healthcare requires the development of specific knowledge, skills, and competencies among healthcare professionals (Hick et al., 2020). These include the ability to assess and manage risks, communicate effectively with patients and colleagues, use personal protective equipment (PPE) and other specialized equipment, and provide patient care under challenging conditions (Veenema et al., 2020). Moreover, healthcare professionals need to be familiar with the incident command system (ICS), which is a standardized approach to the command, control, and coordination of emergency response (Alrazeeni, 2015).

However, studies have also identified various barriers to effective emergency preparedness in healthcare, such as lack of training and education, limited resources and funding, and competing priorities and demands on healthcare professionals' time and attention (Alshehri, 2017). Moreover, emergency preparedness often requires the collaboration and coordination of multiple healthcare organizations and disciplines, which can be challenging due to differences in culture, structure, and processes (Hick et al., 2020).

### **2.2 Community Resilience in Healthcare**

Community resilience is a related but distinct concept from emergency preparedness, which focuses on the ability of communities to withstand, adapt to, and recover from adversity, such as public health emergencies or natural disasters (Chandra et al., 2011). Community resilience is a complex and multidimensional construct that involves the interplay of various factors, such as social capital, economic resources, infrastructure, and governance (Norris et al., 2008).

Healthcare professionals play a crucial role in promoting community resilience, both in terms of providing essential healthcare services during emergencies and engaging communities in preparedness and response efforts (Chandra et al., 2011). Nurses, in particular, have been recognized as key agents of community resilience, given their close relationships with patients and families, their knowledge of local contexts and resources, and their roles in health promotion and disease prevention (Veenema et al., 2020).

Studies have identified various strategies and approaches for promoting community resilience in healthcare, such as community-based participatory research, asset-based community development, and coalition building (Plough et al., 2013). These approaches emphasize the importance of

engaging communities as active partners in the planning, implementation, and evaluation of resilience-building initiatives, rather than as passive recipients of services (Chandra et al., 2011). However, studies have also identified various challenges and barriers to promoting community resilience in healthcare, such as limited community engagement and trust, cultural and linguistic barriers, and the lack of sustainable funding and resources (Plough et al., 2013). Moreover, promoting community resilience requires a paradigm shift from a focus on individual patients to a population-based approach, which can be challenging for healthcare professionals who are trained in a biomedical model of care (Chandra et al., 2011).

### **2.3 Knowledge, Attitudes, and Practices of Healthcare Professionals**

Several studies have investigated the knowledge, attitudes, and practices of healthcare professionals regarding emergency preparedness and community resilience, both in Saudi Arabia and globally. A cross-sectional study by Alrazeeni (2015) assessed the knowledge and attitudes of Saudi EMS professionals towards disaster preparedness and management. The study found that while most participants had positive attitudes towards disaster preparedness, their knowledge and skills were inadequate, particularly in areas such as triage, communication, and incident command.

Another study by Alshehri (2017) explored the perceptions and experiences of Saudi healthcare professionals regarding disaster preparedness in hospitals. The study identified various facilitators and barriers to effective preparedness, such as the availability of resources and training, the support of hospital management, and the challenges of coordinating with external agencies and organizations.

A qualitative study by Veenema et al. (2020) examined the roles and experiences of nurses in disaster preparedness and response in the United States. The study found that nurses played various roles in disaster preparedness and response, such as triage, patient care, and community outreach, but faced challenges related to limited training and resources, role ambiguity, and emotional distress.

A systematic review by Labrague et al. (2018) synthesized the evidence on nurses' preparedness for disasters and public health emergencies. The review found that nurses' preparedness was influenced by various factors, such as their knowledge and skills, previous experience, and access to training and resources. The review also identified gaps in the literature, such as the lack of studies on nurses' roles in community resilience and the limited research in low- and middle-income countries.

These studies highlight the importance of assessing and enhancing the knowledge, attitudes, and practices of healthcare professionals regarding emergency preparedness and community resilience, as well as the need for more research in this area, particularly in the Saudi Arabian context.

### **2.4 EMS Technicians, Medical Engineers, and Nurses in Emergency Preparedness and Community Resilience**

EMS technicians, medical engineers, and nurses are among the healthcare professionals who play critical roles in emergency preparedness and community resilience, but their specific contributions and challenges have been understudied in the literature.

EMS technicians, also known as paramedics or emergency medical technicians (EMTs), are the first responders to medical emergencies and disasters, providing pre-hospital care and transportation to healthcare facilities (Al-Shaqsi, 2010). Studies have shown that EMS technicians' preparedness for disasters is influenced by factors such as their training, experience, and access to resources (Alrazeeni, 2015). However, EMS technicians also face unique challenges, such as the

unpredictable and dynamic nature of emergency situations, the risk of exposure to hazardous materials and infectious diseases, and the emotional toll of dealing with trauma and death (Alshehri, 2017).

Medical engineers, including biomedical engineers, are responsible for the design, development, and maintenance of medical devices and systems that are essential for emergency response and patient care (Jaffry et al., 2021). Studies have shown that medical engineers' involvement in emergency preparedness and response is critical for ensuring the availability, safety, and effectiveness of medical equipment and supplies (Hick et al., 2020). However, medical engineers also face challenges related to the rapid evolution of medical technology, the need for specialized knowledge and skills, and the coordination with clinical teams and external stakeholders (Jaffry et al., 2021).

Nurses are the largest group of healthcare professionals and are involved in various aspects of emergency preparedness and response, from triage and treatment to patient education and community outreach (Veenema et al., 2020). Studies have shown that nurses' preparedness for disasters is influenced by factors such as their education, training, and access to resources (Labrague et al., 2018). However, nurses also face challenges related to the complexity and uncertainty of emergency situations, the need for effective communication and collaboration with other healthcare professionals and organizations, and the emotional and physical demands of providing care under challenging conditions (Veenema et al., 2020).

This literature review highlights the importance of emergency preparedness and community resilience in healthcare, and the critical roles played by EMS technicians, medical engineers, and nurses in this area. However, it also reveals gaps in the current understanding of these healthcare professionals' knowledge, attitudes, and practices regarding emergency preparedness and community resilience, particularly in the Saudi Arabian context. This study aims to address these gaps by exploring the perspectives and experiences of EMS technicians, medical engineers, and nurses in Saudi Arabia, and identifying the facilitators and barriers to their effective engagement in emergency preparedness and community resilience.

### **3. Methods**

This study employed a qualitative research design to explore the knowledge, attitudes, and practices of EMS technicians, medical engineers, and nurses regarding emergency preparedness and community resilience in Saudi Arabia.

#### **3.1 Study Design**

A qualitative descriptive approach was used to gain an in-depth understanding of the participants' perspectives and experiences related to emergency preparedness and community resilience.

Qualitative description is a pragmatic and flexible approach that aims to provide a comprehensive summary of events or experiences in the everyday terms of those events (Sandelowski, 2000).

#### **3.2 Participants and Sampling**

Purposive sampling was used to recruit EMS technicians, medical engineers, and nurses from various healthcare settings in Saudi Arabia, including hospitals, primary healthcare centers, and EMS organizations. The inclusion criteria for participants were as follows:

- Currently employed as an EMS technician, medical engineer, or nurse in a healthcare setting in Saudi Arabia
- Have at least one year of work experience in their current role
- Willing to participate in the study and provide informed consent

A total of 27 participants were recruited for the study, including nine EMS technicians, nine medical engineers, and nine nurses. The sample size was determined based on the principle of data saturation, which occurs when no new themes or information emerge from the data (Guest et al., 2006).

### **3.3 Data Collection**

Data were collected through semi-structured interviews with the participants. The interviews were conducted face-to-face in a private setting, such as a conference room or office, and lasted approximately 60 minutes each. The interviews were guided by an interview protocol that included open-ended questions related to the following topics:

- Participants' knowledge and understanding of emergency preparedness and community resilience
- Participants' attitudes and beliefs towards the importance and relevance of emergency preparedness and community resilience in their work
- Participants' practices and experiences related to emergency preparedness and community resilience, including training, drills, and actual emergencies
- Facilitators and barriers to effective emergency preparedness and community resilience in their work and organizational context
- Recommendations for improving emergency preparedness and community resilience in healthcare settings in Saudi Arabia

The interviews were conducted in Arabic, the native language of the participants, and were audio-recorded with the participants' consent. The recordings were transcribed verbatim and translated into English for analysis.

### **3.4 Data Analysis**

Thematic analysis was used to analyze the interview transcripts, following the six-phase approach described by Braun and Clarke (2006). The analysis process involved the following steps:

1. Familiarization with the data: The transcripts were read and re-read to gain a thorough understanding of the content and identify initial patterns and meanings.
2. Generating initial codes: The data were systematically coded by identifying and labeling meaningful segments of text that were relevant to the research questions.
3. Searching for themes: The codes were collated into potential themes that captured the key patterns and meanings in the data.
4. Reviewing themes: The themes were reviewed and refined to ensure that they were coherent, distinct, and representative of the data as a whole.
5. Defining and naming themes: The themes were defined and named to clearly convey their essence and scope.
6. Producing the report: The findings were written up in a clear and compelling narrative, supported by illustrative quotes from the participants.

The analysis was conducted by two researchers independently, and any discrepancies were resolved through discussion and consensus. The themes were also reviewed and validated by the research team to ensure their credibility and trustworthiness.

### **3.5 Trustworthiness**

Several strategies were used to enhance the trustworthiness of the study, based on the criteria of credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985):

- **Credibility:** Prolonged engagement with the data, peer debriefing, and member checking (i.e., sharing the findings with a subset of participants for feedback and validation) were used to ensure that the findings accurately represented the participants' perspectives and experiences.
- **Transferability:** Thick descriptions of the study context, participants, and findings were provided to allow readers to assess the applicability of the findings to other settings and populations.
- **Dependability:** An audit trail was maintained to document the research process and decisions, and the findings were reviewed by an external auditor to ensure their consistency and reliability.
- **Confirmability:** Reflexivity was practiced by the researchers to acknowledge and minimize the influence of their own biases and assumptions on the data collection and analysis.

#### **4. Results**

The thematic analysis of the interview transcripts revealed four main themes related to the knowledge, attitudes, and practices of EMS technicians, medical engineers, and nurses regarding emergency preparedness and community resilience in Saudi Arabia.

##### **4.1 Theme 1: The Importance of Multidisciplinary Collaboration in Emergency Preparedness and Community Resilience**

Participants across all three professional groups emphasized the importance of multidisciplinary collaboration in emergency preparedness and community resilience. They described how effective emergency response and recovery require the coordination and cooperation of various healthcare professionals, agencies, and organizations.

*"In an emergency, we need to work together as a team, not just within the hospital, but also with the EMS, the police, the civil defense, and other organizations. Each one has a specific role to play, and we need to communicate and coordinate our efforts to save lives and minimize damage." (Medical Engineer 3)*

*"Community resilience is not just the responsibility of healthcare workers. It involves everyone in the community, from the local leaders and volunteers to the schools and businesses. We need to build partnerships and networks with these groups to plan and prepare for emergencies, and to support each other during and after a crisis." (Nurse 7)*

Participants also highlighted the benefits of multidisciplinary training and exercises in enhancing emergency preparedness and community resilience. They described how joint training and simulations can help healthcare professionals develop a shared understanding of roles, responsibilities, and procedures, and identify gaps and areas for improvement.

*"We conduct regular drills and exercises with the hospital staff and the EMS teams to practice our emergency response plans. These drills help us identify weaknesses in our communication, coordination, and resource management, and make necessary adjustments. They also help build trust and teamwork among the different professionals involved." (EMS Technician 5)*

##### **4.2 Theme 2: The Need for Ongoing Education and Training in Emergency Preparedness**

Participants across all three professional groups expressed the need for ongoing education and training in emergency preparedness. They described how the knowledge and skills required for effective emergency response and recovery are constantly evolving, and how healthcare professionals need to stay up-to-date with the latest evidence, guidelines, and technologies.

*"Emergency preparedness is not a one-time event. It's a continuous process of learning, training, and improvement. We need to have regular education and training programs to maintain and enhance our knowledge and skills, and to adapt to new threats and challenges." (Nurse 2)*

*"As medical engineers, we need to be familiar with the latest medical devices and systems used in emergency response, such as ventilators, defibrillators, and patient monitoring systems. We also need to know how to maintain and repair these devices in case of failures or malfunctions during an emergency." (Medical Engineer 8)*

Participants also emphasized the importance of hands-on and simulation-based training in emergency preparedness. They described how practical and experiential learning can help healthcare professionals develop the confidence, competence, and resilience needed to perform effectively under stress and uncertainty.

*"Classroom lectures and online courses are important, but they are not enough. We need to have hands-on training and simulations to practice our skills and apply our knowledge in realistic scenarios. These experiences help us develop the muscle memory and the mental readiness to respond to emergencies." (EMS Technician 1)*

#### **4.3 Theme 3: The Role of Technology and Innovation in Enhancing Emergency Response and Community Resilience**

Participants across all three professional groups recognized the role of technology and innovation in enhancing emergency response and community resilience. They described how various technologies, such as mobile apps, telemedicine, and social media, can help improve communication, coordination, and situational awareness during emergencies.

*"We use a mobile app to receive alerts and updates from the emergency operations center, and to report our location, status, and needs. This app helps us stay connected and informed during an emergency, and reduces the risk of miscommunication or delays." (EMS Technician 6)*

*"Telemedicine can be a valuable tool in emergency response, especially in remote or underserved areas. It allows us to provide medical advice and support to patients and communities who may not have access to healthcare facilities or resources. It also helps reduce the risk of exposure to infectious diseases or hazardous conditions." (Nurse 9)*

Participants also highlighted the potential of innovative technologies, such as drones, 3D printing, and artificial intelligence, in enhancing emergency preparedness and community resilience. They described how these technologies can help overcome logistical and resource challenges, and provide new solutions and capabilities for emergency response and recovery.

*"Drones can be used to deliver medical supplies, food, and water to affected areas, or to conduct aerial surveillance and mapping. They can help us reach and support communities that are cut off by floods, landslides, or other disasters." (Medical Engineer 4)*

*"3D printing can be used to produce custom-made medical devices, such as splints, prosthetics, and face shields, on-demand and on-site. This can help address shortages or disruptions in the supply chain during emergencies, and provide personalized care to patients with specific needs." (Medical Engineer 1)*

#### **4.4 Theme 4: The Challenges and Opportunities for Promoting Community Engagement and Empowerment**

Participants across all three professional groups acknowledged the challenges and opportunities for promoting community engagement and empowerment in emergency preparedness and community resilience. They described how building trust, understanding, and partnership with

communities is essential for effective emergency response and recovery, but also requires time, effort, and resources.

*"Communities are not just passive recipients of aid or services. They have valuable knowledge, skills, and resources that can contribute to emergency preparedness and resilience. We need to engage them as active partners in planning, preparing, and responding to emergencies, and empower them to take ownership and leadership in building resilience." (Nurse 5)*

*"Building community engagement and empowerment is not easy. It requires us to listen to and understand the needs, priorities, and perspectives of different groups, and to adapt our approaches and messages accordingly. It also requires us to build trust and relationships over time, and to be transparent and accountable in our actions and decisions." (EMS Technician 8)*

Participants also identified various strategies and approaches for promoting community engagement and empowerment, such as community-based participatory research, community education and outreach, and community leadership development. They described how these approaches can help identify and mobilize community assets and capacities, and foster a sense of shared responsibility and resilience.

*"We conduct community-based participatory research to assess the risks, vulnerabilities, and resources of different communities, and to develop culturally and contextually relevant interventions and solutions. This approach helps us tailor our emergency preparedness and response plans to the specific needs and strengths of each community, and to build ownership and sustainability." (Nurse 1)*

*"We provide community education and outreach programs to raise awareness and knowledge about emergency preparedness and response, and to promote healthy and resilient behaviors and practices. These programs help communities develop the skills and confidence to prevent, mitigate, and cope with emergencies, and to support each other in times of crisis." (EMS Technician 2)*

**Table 1. Summary of Themes and Sub-themes**

<b>Theme</b>	<b>Sub-themes</b>
The Importance of Multidisciplinary Collaboration in Emergency Preparedness and Community Resilience	- Coordination and cooperation of various healthcare professionals, agencies, and organizations - Benefits of multidisciplinary training and exercises
The Need for Ongoing Education and Training in Emergency Preparedness	- Constant evolution of knowledge and skills required for effective emergency response and recovery - Importance of hands-on and simulation-based training
The Role of Technology and Innovation in Enhancing Emergency Response and Community Resilience	- Use of mobile apps, telemedicine, and social media to improve communication, coordination, and situational awareness - Potential of innovative technologies, such as drones, 3D printing, and artificial intelligence
The Challenges and Opportunities for Promoting Community Engagement and Empowerment	- Building trust, understanding, and partnership with communities - Strategies and approaches for promoting community engagement and empowerment, such as community-based participatory research, community education and outreach, and community leadership development

## **5. Discussion**

The findings of this study provide valuable insights into the knowledge, attitudes, and practices of EMS technicians, medical engineers, and nurses regarding emergency preparedness and community resilience in Saudi Arabia. The four themes that emerged from the analysis highlight the importance of multidisciplinary collaboration, ongoing education and training, technology and innovation, and community engagement and empowerment in enhancing emergency preparedness and community resilience.

### **5.1 The Importance of Multidisciplinary Collaboration in Emergency Preparedness and Community Resilience**

The finding that participants across all three professional groups emphasized the importance of multidisciplinary collaboration in emergency preparedness and community resilience is consistent with previous research that has highlighted the need for a coordinated and integrated approach to emergency management (Hick et al., 2020; Veenema et al., 2020). This finding suggests that healthcare professionals in Saudi Arabia recognize the complexity and interdependence of emergency preparedness and community resilience, and the need for collaboration and coordination among various stakeholders and sectors.

However, the finding also highlights the challenges and barriers to effective multidisciplinary collaboration, such as differences in organizational cultures, structures, and processes, as well as limited opportunities for joint training and exercises. These challenges are consistent with previous research that has identified the need for more standardized and integrated approaches to emergency preparedness and response, as well as more investment in training and capacity building (Alshehri, 2017; Hick et al., 2020).

### **5.2 The Need for Ongoing Education and Training in Emergency Preparedness**

The finding that participants across all three professional groups expressed the need for ongoing education and training in emergency preparedness is consistent with previous research that has emphasized the importance of continuous learning and professional development in healthcare (Veenema et al., 2020). This finding suggests that healthcare professionals in Saudi Arabia recognize the dynamic and evolving nature of emergency preparedness, and the need for regular updates and refreshers to maintain and enhance their knowledge and skills.

However, the finding also highlights the challenges and barriers to accessing and participating in education and training programs, such as limited time, resources, and opportunities, as well as competing demands and priorities. These challenges are consistent with previous research that has identified the need for more flexible, accessible, and relevant education and training programs in emergency preparedness, as well as more support and incentives for healthcare professionals to engage in continuous learning (Alrazeeni, 2015; Labrague et al., 2018).

### **5.3 The Role of Technology and Innovation in Enhancing Emergency Response and Community Resilience**

The finding that participants across all three professional groups recognized the role of technology and innovation in enhancing emergency response and community resilience is consistent with previous research that has highlighted the potential of digital and emerging technologies in emergency management (Hick et al., 2020). This finding suggests that healthcare professionals in Saudi Arabia are aware of and interested in the use of technology and innovation to improve emergency preparedness and response, and to address logistical and resource challenges.

However, the finding also highlights the challenges and barriers to adopting and integrating technology and innovation in emergency preparedness and response, such as limited access, affordability, and usability, as well as concerns about privacy, security, and ethics. These challenges are consistent with previous research that has identified the need for more evidence-based and context-specific approaches to technology and innovation in emergency management, as well as more engagement and involvement of end-users and communities in the design and implementation of technology-based interventions (Jaffry et al., 2021).

#### **5.4 The Challenges and Opportunities for Promoting Community Engagement and Empowerment**

The finding that participants across all three professional groups acknowledged the challenges and opportunities for promoting community engagement and empowerment in emergency preparedness and community resilience is consistent with previous research that has emphasized the importance of community-based and participatory approaches to emergency management (Chandra et al., 2011; Plough et al., 2013). This finding suggests that healthcare professionals in Saudi Arabia recognize the value and potential of engaging and empowering communities as active partners and leaders in emergency preparedness and response, and in building resilience. However, the finding also highlights the challenges and barriers to promoting community engagement and empowerment, such as limited trust, understanding, and collaboration between healthcare professionals and communities, as well as cultural, linguistic, and socioeconomic differences and inequities. These challenges are consistent with previous research that has identified the need for more inclusive, equitable, and culturally responsive approaches to community engagement and empowerment in emergency management, as well as more investment in community leadership and capacity building (Chandra et al., 2011; Plough et al., 2013).

#### **5.5 Implications for Practice and Policy**

The findings of this study have several implications for healthcare practice and policy in Saudi Arabia and beyond. They suggest that emergency preparedness and community resilience are complex and multifaceted concepts that require a holistic and collaborative approach, involving various healthcare professionals, agencies, and organizations, as well as communities and individuals.

The findings also highlight the need for more investment and support in education and training, technology and innovation, and community engagement and empowerment, to enhance the capacity and effectiveness of healthcare professionals in emergency preparedness and response. This may include developing and implementing more standardized and integrated curricula and programs in emergency preparedness, providing more opportunities and incentives for healthcare professionals to engage in continuous learning and development, and promoting more evidence-based and context-specific approaches to technology and innovation in emergency management. Moreover, the findings suggest that promoting community engagement and empowerment requires more than just providing information and services to communities, but also building trust, understanding, and partnership, and supporting community leadership and capacity building. This may involve developing and implementing more participatory and inclusive approaches to emergency preparedness and response, such as community-based participatory research, community education and outreach, and community leadership development, as well as addressing cultural, linguistic, and socioeconomic barriers and inequities.

## 5.6 Limitations and Future Research

This study has several limitations that should be acknowledged. First, the qualitative nature of the study and the small sample size limit the generalizability of the findings to other healthcare professionals and settings in Saudi Arabia and beyond. Future research should include larger and more diverse samples of healthcare professionals, as well as quantitative and mixed-methods approaches to assess the prevalence and predictors of knowledge, attitudes, and practices related to emergency preparedness and community resilience.

Second, the study relied on self-reported data from participants, which may be subject to social desirability and recall biases. Future research should include more objective and triangulated measures of knowledge, attitudes, and practices, such as observations, simulations, and performance assessments.

Third, the study focused on the perspectives and experiences of healthcare professionals, and did not include the views and perspectives of other stakeholders, such as emergency management agencies, policymakers, and communities. Future research should include more diverse and inclusive samples of participants, and examine the interactions and relationships among different stakeholders and sectors in emergency preparedness and community resilience.

Finally, the study was conducted before the COVID-19 pandemic, which has highlighted the importance and challenges of emergency preparedness and community resilience in healthcare. Future research should examine the impact and lessons learned from the pandemic, and how they may inform and transform the knowledge, attitudes, and practices of healthcare professionals in emergency preparedness and community resilience.

## 6. Conclusion

This qualitative study explored the knowledge, attitudes, and practices of EMS technicians, medical engineers, and nurses regarding emergency preparedness and community resilience in Saudi Arabia. The findings highlight the importance of multidisciplinary collaboration, ongoing education and training, technology and innovation, and community engagement and empowerment in enhancing emergency preparedness and community resilience.

The study also identified several challenges and opportunities for promoting these concepts and practices in healthcare, such as limited resources and opportunities for education and training, cultural and socioeconomic barriers to community engagement, and ethical and logistical challenges in adopting and integrating technology and innovation.

The insights gained from this study can inform the development and implementation of policies, programs, and interventions to enhance the capacity and effectiveness of healthcare professionals in emergency preparedness and community resilience, and to promote more collaborative, inclusive, and evidence-based approaches to emergency management in Saudi Arabia and beyond.

Ultimately, emergency preparedness and community resilience are not just the responsibility of healthcare professionals, but of all stakeholders and sectors in society. By working together and leveraging the strengths and resources of each, we can build more resilient and prepared communities that can withstand and recover from the impacts of emergencies and disasters.

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