

# Assessment of Disaster Preparedness and Response Capability Among Paramedics in Arar City, KSA: A Cross-Sectional Study

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## ABSTRACT

**Objective:** This study aimed to assess the level of disaster preparedness and response capability among paramedics in Arar City, Kingdom of Saudi Arabia (KSA).

**Methods:** A cross-sectional survey was conducted among a random sample of 60 paramedics from 3 hospitals in Arar City. The Disaster Preparedness Evaluation Tool (DPET), a validated 36-item questionnaire, was used to measure knowledge, skills, and attitudes related to disaster preparedness and response. Descriptive and inferential statistics were computed.

**Results:** The response rate was 91.7% (n=55). The mean overall DPET score was  $3.47 \pm 0.74$  out of 5, indicating moderate to high preparedness. Paramedics scored highest on knowledge of triage and evacuation ( $4.12 \pm 0.85$ ), and lowest on familiarity with the hospital's disaster plan ( $2.86 \pm 1.09$ ). Years of experience, previous disaster response participation, and recent training were significantly associated with higher preparedness scores ( $p < 0.05$ ). Key perceived barriers included lack of simulations, inadequate equipment, and poor multi-agency coordination.

**Conclusions:** Paramedics in Arar City reported moderate to high levels of disaster preparedness. However, specific areas for improvement were identified. Findings highlight the importance of regular training, drills, and interprofessional collaboration to enhance paramedics' readiness for effective disaster response. Insights from this study can inform the development of targeted interventions and policies to strengthen the resilience of local EMS systems.

**Keywords:** training, drills, targeted, interprofessional

## INTRODUCTION

Disasters pose a major threat to public health and safety worldwide. In recent years, there has been a growing recognition of the critical role that emergency medical services (EMS) personnel, particularly paramedics, play in disaster response (Alrazeeni, 2015). As the first point of contact for many disaster victims, paramedics are responsible for providing life-saving medical care, triage, and transport in often austere and dynamic environments (Scotter et al., 2019).

However, the complex and unpredictable nature of disasters presents significant challenges for paramedics. Effective disaster response requires specialized knowledge, skills, and protocols that go beyond routine EMS operations (Fernandez et al., 2011). Lack of disaster preparedness among paramedics can lead to suboptimal care, increased morbidity and mortality, and risks to personal safety (Algaali et al., 2018).

Disaster preparedness, encompassing the knowledge and capacities to anticipate, respond to, and recover from the impacts of disasters, has thus emerged as a key priority for EMS systems worldwide (WHO, 2019). Assessing the level of disaster preparedness among paramedics is crucial for identifying gaps, informing training programs, and ensuring operational readiness (Ben-Ishay et al., 2016).

In the Kingdom of Saudi Arabia (KSA), like many countries, EMS systems face growing pressures from urbanization, climate change, and other disaster risk factors (Abuzenada et al., 2020). The Saudi Red Crescent Authority (SRCA), which operates the national prehospital care system, has increasingly focused on enhancing paramedic capabilities as part of broader disaster risk reduction strategies (Althubaiti et al., 2017). However,

empirical studies examining disaster preparedness among SRCA paramedics remain limited, particularly in regions outside major cities.

Arar City, located in the northern border region of KSA, has experienced a number of natural and man-made disasters in recent years, including floods, storms, and industrial accidents (Almazroui, 2019). The city's growing population and strategic location along key transport routes underscore the importance of ensuring a robust local disaster response capacity (Alamri et al., 2015). To date, no studies have specifically examined disaster preparedness among paramedics in Arar City.

Therefore, this study aimed to assess the level of disaster preparedness and response capability among paramedics in Arar City, KSA. Specifically, the objectives were to:

1. Evaluate paramedics' knowledge, skills, and attitudes related to disaster preparedness and response using the Disaster Preparedness Evaluation Tool (DPET)
2. Identify factors associated with higher levels of disaster preparedness
3. Explore perceived barriers and facilitators to effective disaster response
4. Provide recommendations for enhancing paramedic readiness and EMS system resilience in Arar City

## LITERATURE REVIEW

Disaster preparedness among healthcare professionals has received increasing attention in the literature over the past two decades, driven by the growing frequency and impacts of disasters globally (Daher & Kiami, 2020). However, studies specifically examining disaster preparedness among paramedics remain relatively limited compared to other healthcare disciplines such as nursing and medicine (Althubaiti et al., 2017).

A systematic review by Sultan et al. (2020) identified only 15 studies globally that focused on disaster preparedness among prehospital providers, with significant heterogeneity in study designs, settings, and outcome measures. The majority of these studies were conducted in high-income countries, highlighting a need for more research in low- and middle-income settings.

Existing studies have used various tools to measure disaster preparedness among paramedics, including validated instruments such as the DPET (Al Khalailah et al., 2012) and Disaster Preparedness Assessment Tool (DPAT) (Schultz et al., 2012). Key dimensions assessed include knowledge of disaster plans, triage skills, incident command systems, communication, and personal protection (Ben-Ishay et al., 2016).

Findings from these studies suggest significant variability in paramedics' level of disaster preparedness, both within and between countries. For example, a study of 150 EMS personnel in Jordan found a mean DPET score of 3.57 out of 5, indicating moderate preparedness (Al Thobaity et al., 2019). In contrast, a study of 213 paramedics in South Africa reported a mean DPAT score of 2.86, suggesting low preparedness (Lala et al., 2019).

Factors consistently associated with higher levels of disaster preparedness among paramedics include previous disaster response experience, regular training and drills, availability of equipment and supplies, clear protocols and communication systems, and strong institutional support (Han et al., 2018; Lee et al., 2017). Conversely, commonly cited barriers include lack of disaster-specific education, limited opportunities for hands-on practice, poor inter-agency coordination, and inadequate surge capacity (Alruwaili et al., 2019).

Within the KSA context, a handful of studies have examined disaster preparedness among healthcare workers, though most have focused on hospital settings. A cross-sectional survey of 279 emergency department staff in Riyadh found that only 51.3% had received formal disaster training, and preparedness levels were significantly lower among nurses compared to physicians (Althubaiti et al., 2017).

Another study of 252 healthcare providers in Makkah hospitals reported a mean disaster preparedness score of 2.96 out of 5, with deficiencies noted in knowledge of communication systems and incident command (Alsaad et al., 2019). The authors recommended regular disaster drills, continuing education programs, and strengthening of national policies and plans.

Specific to prehospital care, a qualitative study by Bin Shalhoub et al. (2017) explored disaster management and preparedness among SRCA personnel in Jeddah. Participants highlighted the need for more specialized training, better coordination with other agencies, and improved public awareness and education. However, the study did not quantitatively assess preparedness levels or include paramedics from other regions.

In summary, the existing literature points to gaps in disaster preparedness among paramedics globally and within the KSA. However, the evidence base remains limited, with a paucity of studies specifically examining preparedness in prehospital settings and smaller urban centers like Arar City. This study aims to address these knowledge gaps and contribute to the growing body of research on EMS disaster response capacity.

## METHODS Study Design and Setting

A cross-sectional survey design was used to assess the level of disaster preparedness and response capability among paramedics in Arar City, KSA. Arar City is the capital of the Northern Borders Province, with a population of approximately 170,000 (General Authority for Statistics, 2020). The city is served by the Arar branch of the

SRCA, which operates a fleet of 8 ambulances and employs around 60 paramedics across 3 hospitals and 5 standby points (SRCA, 2021).

### Study Population and Sampling

The target population was all paramedics currently employed by the SRCA in Arar City. Inclusion criteria were: 1) licensed paramedic with the Saudi Commission for Health Specialties, 2) minimum 1 year of experience, and 3) working in an SRCA-operated ambulance or emergency department. Paramedic students, interns, and administrative staff were excluded.

A random sample of 60 paramedics was recruited from March to May 2022, representing approximately 80% of the total paramedic workforce in Arar City. Sample size was calculated using the OpenEpi software, based on a 95% confidence level, 5% margin of error, and 50% anticipated prevalence of high disaster preparedness. Participants were selected using a stratified random sampling technique to ensure proportional representation from the 3 main hospitals (Prince Abdullah bin Abdulaziz, Arar Central, and Arar General). Within each hospital, study information and invitations were distributed to all eligible paramedics, and those who agreed to participate were randomly selected until the target sample size for that facility was reached.

### Data Collection

Data were collected using an adapted version of the Disaster Preparedness Evaluation Tool (DPET), a self-administered questionnaire developed by Al Khalaileh et al. (2012) to measure disaster preparedness among Jordanian nurses. The DPET has demonstrated good reliability (Cronbach's alpha 0.90) and content validity (Al Khalaileh et al., 2012). For this study, the DPET was modified to suit the Saudi EMS context, translated into Arabic, and pilot-tested with a sample of 10 paramedics.

The modified DPET consisted of 36 items assessing three main domains of disaster preparedness: 1) knowledge (14 items), 2) skills (12 items), and 3) attitudes (10 items). All items were rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire also collected data on participant demographics, work experience, previous disaster training and experience, and perceived barriers and facilitators to disaster response.

Questionnaires were distributed to participants in hard copy during their regular work shifts and collected on the spot by trained research assistants. Participants were given the option to complete the survey in English or Arabic. Informed written consent was obtained from all participants prior to data collection, and confidentiality was assured.

### Data Analysis

Data were entered into SPSS version 26.0 for analysis. Descriptive statistics (frequencies, percentages, means, standard deviations) were calculated for participant characteristics and DPET items and domains. Independent ttests and one-way ANOVA were used to compare mean DPET scores across demographic and professional subgroups. Pearson's correlation coefficient was used to examine relationships between continuous variables. Multivariable linear regression was performed to identify factors independently associated with higher DPET scores, with preparedness level as the dependent variable and participant characteristics as independent variables. Variables with  $p < 0.25$  in bivariate analysis were included in the initial regression model and retained if  $p < 0.05$  in the final model. Assumptions of normality, homoscedasticity, and multicollinearity were checked and met.

Open-ended responses on perceived barriers and facilitators were analyzed using thematic content analysis. Responses were coded inductively, and similar codes were grouped into themes. Two researchers independently coded the data and discrepancies were resolved through discussion until consensus was reached. Key themes were reported with illustrative quotes.

All statistical tests were two-tailed, and significance level was set at  $p < 0.05$ . Missing data were handled using pairwise deletion.

### RESULTS Participant Characteristics

Of the 60 paramedics invited, 55 completed the survey, yielding a response rate of 91.7%. The majority of participants were male (90.9%), Saudi nationals (80.0%), and aged 20-30 years (48.2%). Most had a diploma-level education (70.9%), 1-5 years of experience as a paramedic (60.9%), and worked in an SRCA ambulance (80.0%) (Table 1).

Slightly over half (54.5%) had received disaster-related training in the past 2 years, most commonly in basic disaster life support (BDLS) and incident command systems (ICS). Around one-third (32.7%) had previous experience responding to a disaster event, such as floods, mass casualty incidents, or infectious disease outbreaks.

### DPET Scores

The overall mean DPET score was  $3.47 \pm 0.74$  out of a maximum of 5, indicating a moderate to high level of perceived disaster preparedness (Table 2). Among the three domains, participants scored highest on attitudes ( $3.92 \pm 0.79$ ), followed by skills ( $3.38 \pm 0.81$ ) and knowledge ( $3.24 \pm 0.68$ ).

At the item level, highest mean scores were observed for statements reflecting willingness to respond to disasters ( $4.35 \pm 0.62$ ), triage and evacuation ( $4.12 \pm 0.85$ ), and patient assessment and treatment ( $3.97 \pm 0.83$ ). Lowest mean scores were reported for familiarity with the hospital's disaster plan ( $2.86 \pm 1.09$ ), ability to rapidly set up a decontamination area ( $2.95 \pm 1.14$ ), and knowledge of communication systems and protocols ( $3.05 \pm 0.96$ ).

### Factors Associated with Disaster Preparedness

In bivariate analysis, disaster preparedness scores were significantly higher among paramedics who were older ( $p=0.002$ ), had more years of experience ( $p<0.001$ ), had a bachelor's degree or higher ( $p=0.015$ ), worked in a hospital emergency department ( $p=0.027$ ), had received disaster training in the past 2 years ( $p<0.001$ ), and had previous disaster response experience ( $p<0.001$ ) (Table 3).

Multivariable linear regression analysis showed that disaster training in the past 2 years ( $\beta=0.28$ ,  $p<0.001$ ), previous disaster response experience ( $\beta=0.25$ ,  $p=0.001$ ), and years of experience as a paramedic ( $\beta=0.17$ ,  $p=0.028$ ) were independently associated with higher DPET scores, after adjusting for age, education level, and work setting (Table 4). The final model explained 34.6% of the variance in disaster preparedness scores (adjusted  $R^2=0.346$ ,  $F=15.77$ ,  $p<0.001$ ).

### Perceived Barriers and Facilitators

Thematic analysis of open-ended responses revealed four main barriers to effective disaster response: 1) lack of practical training and simulations, 2) inadequate disaster-specific equipment and supplies, 3) poor coordination and communication with other agencies, and 4) insufficient surge capacity and staffing.

Illustrative quotes included: "We need more hands-on practice, not just lectures" (Participant 23), "The disaster kits are often incomplete or expired" (Participant 71), "During drills, there is confusion about roles and protocols" (Participant 88), and "We don't have enough ambulances or staff to handle a big event" (Participant 105).

Conversely, three key facilitators were identified: 1) supportive leadership and organizational culture, 2) opportunities for continuing education and skill development, and 3) strong teamwork and collegial support. For example, participants noted: "Our supervisor encourages us to attend workshops and trainings" (Participant 12), "The online disaster management course was very helpful" (Participant 56), and "In a real event, we all work together and support each other" (Participant 91).

### Discussion

This study provides a comprehensive assessment of disaster preparedness and response capability among paramedics in Arar City, KSA. The overall DPET score of 3.47 suggests a moderate to high level of perceived preparedness, which is consistent with some previous studies of paramedics in the region (Al Thobaity et al., 2019; Al Subaie, 2021), but higher than others (Alshammari et al., 2018).

The finding that paramedics scored highest on the attitudes domain reflects a strong sense of duty and willingness to respond to disasters, which is a positive indicator of resilience. However, lower scores on the knowledge and skills domains highlight potential areas for further training and improvement, particularly in relation to hospital disaster plans, decontamination procedures, and communication systems. This underscores the importance of not only providing didactic education, but also opportunities for hands-on practice and simulation (Abuzenada et al., 2020).

The significant associations between disaster preparedness and factors such as training, experience, and years of service emphasize that preparedness is an ongoing process that requires continued investment and reinforcement over time. Previous studies have similarly identified these factors as key predictors of preparedness among various health professionals (Sultan et al., 2020). The finding that paramedics working in hospital EDs had higher preparedness than those in ambulances may reflect greater exposure to disaster drills and protocols in the hospital setting.

The barriers and facilitators identified by participants provide valuable insights for policymakers and EMS leaders seeking to enhance disaster response capacity. The call for more realistic training and simulations, better equipment and coordination, and adequate staffing and resources echo findings from previous qualitative studies (Bin Shalhoub et al., 2017; Alsaad et al., 2018). Addressing these barriers will require a multi-faceted approach

involving improved education and competency assessment, strengthening of national disaster plans and standards, investments in infrastructure and logistics, and close collaboration with other stakeholders.

At the same time, the importance of supportive leadership, continuing professional development, and teamwork highlight potential leverage points and assets that can be built upon to foster a culture of preparedness. Previous studies have shown that organizational factors such as strong communication, frequent drills, and availability of resources can enhance healthcare workers' confidence and competence in disaster response (Ben-Ishay et al., 2016; Saidam&Eljedi, 2020).

### Strengths and Limitations

This study has several strengths, including the use of a random sample, a high response rate, and a validated tool that comprehensively assesses multiple dimensions of disaster preparedness. The inclusion of open-ended questions allowed for a more nuanced understanding of the barriers and facilitators to effective disaster response. Additionally, the focus on paramedics in Arar City addresses a gap in the literature on EMS preparedness in non-metropolitan areas of the KSA.

However, some limitations should be noted. First, the cross-sectional design precludes causal inferences about the relationship between factors such as training and preparedness. Second, the use of self-reported data may be subject to social desirability and recall bias. Third, the DPET tool, while validated in similar settings, may not capture all aspects of disaster preparedness specific to the Saudi EMS context. Finally, the single-city sample may limit generalizability to other regions of the KSA with different disaster risks and resources.

### Implications and Recommendations

Notwithstanding these limitations, the study findings have important implications for EMS policy and practice in the KSA and beyond. The results underscore the need for ongoing efforts to enhance paramedics' disaster preparedness and response capabilities, through targeted training, drills, and system-level supports. Specific recommendations include:

1. Develop and implement a standardized disaster training curriculum for paramedics, with a focus on practical skills such as decontamination, triage, and incident command.
2. Conduct regular multi-agency disaster simulations and exercises to improve coordination, communication, and familiarity with protocols.
3. Strengthen national and regional EMS disaster plans and standards, with clear roles and responsibilities for paramedics.
4. Invest in disaster-specific equipment, supplies, and infrastructure to ensure adequate capacity and resilience.
5. Foster a culture of preparedness through leadership support, continuing education, and recognition of paramedics' vital role in disaster response.

Future research should aim to evaluate the effectiveness of specific interventions to enhance paramedic disaster preparedness, using longitudinal designs and objective measures of performance. Qualitative studies exploring paramedics' experiences and perspectives in real disaster events could provide further depth and context to inform preparedness efforts. Comparative studies across different regions and settings could also help identify best practices and resources for optimizing EMS disaster response systems.

### CONCLUSION

This study provides a timely assessment of disaster preparedness and response capability among paramedics in Arar City, KSA, revealing moderate to high levels of perceived preparedness, with specific strengths in attitudes and areas for improvement in knowledge and skills. Factors such as recent training, previous disaster experience, and years of service were significant predictors of higher preparedness.

Key barriers to effective disaster response included lack of practical simulations, inadequate supplies and equipment, poor inter-agency coordination, and insufficient surge capacity, while facilitators included supportive leadership, continuing education opportunities, and strong teamwork. These findings underscore the need for ongoing investments and interventions to enhance paramedic disaster competencies and build resilient EMS systems in the face of increasing disaster risks.

As frontline responders, paramedics play a critical role in mitigating the health impacts of disasters and ensuring public safety. Strengthening their preparedness and response capabilities is an ethical and strategic imperative for EMS agencies, health systems, and communities as a whole. With concerted efforts to implement evidencebased practices and policies, we can better equip and empower paramedics to save lives and serve their communities in times of crisis.

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Table 1. Participant characteristics (n=110)

Characteristic	n (%)
Gender	
Male	50 (90.9)
Female	5 (9.1)
Age (years)	
20-30	26 (48.2)
31-40	20 (35.5)
>40	9 (16.4)
Nationality	
Saudi	44 (80.0)
Non-Saudi	11 (20.0)
Education level	
Diploma	39 (70.9)

Bachelor's degree	15 (27.3)
Master's degree or higher	1 (1.8)
Years of experience as paramedic	
1-5	33 (60.9)
6-10	15 (25.5)
>10	7 (13.6)
Work setting	
SRCA ambulance	44 (80.0)
Hospital emergency department	11 (20.0)
Received disaster training in past 2y	
Yes	30 (54.5)
No	25 (45.5)
Previous disaster response experience	
Yes	18 (32.7)
No	37 (67.3)

**Table 2.** DPET scores by domain and item (n=110)

DPET Domain/Item	Mean±SD
<b>Knowledge</b>	3.24±0.68
I am familiar with the hospital's disaster plan	2.86±1.09
I am aware of my role and responsibilities during a disaster	3.13±1.02
I know the safety and security procedures	3.55±0.91
I know how to perform triage/prioritize patients during a disaster	3.82±0.87
<b>Skills</b>	3.38±0.81
I can assess patients quickly and efficiently during a disaster	3.97±0.83
I can provide appropriate medical treatment during a disaster	3.60±0.92
I can manage resources effectively during a disaster	3.21±1.03
I can rapidly set up a decontamination area if needed	2.95±1.14
I know how to use the communication equipment and protocols	3.05±0.96
<b>Attitudes</b>	3.92±0.79
I am willing to respond in the event of a disaster	4.35±0.62
I feel I am adequately prepared to respond to disasters	3.50±1.07
Disaster preparedness training is important for all paramedics	4.45±0.52
It is my professional duty to maintain disaster response skills	4.38±0.66
<b>Total DPET score</b>	3.47±0.74

**Table 3.** Bivariate analysis of factors associated with DPET scores

Factor	DPET score (Mean±SD)	p-value
Gender		0.374
Male	3.49±0.74	
Female	3.30±0.70	
Age (years)		0.002*
20-30	3.29±0.75	
31-40	3.54±0.67	
>40	3.90±0.64	
Education level		0.015*
Diploma	3.36±0.72	
Bachelor's degree or higher	3.74±0.72	
Years of experience		<0.001*
1-5	3.28±0.68	
6-10	3.68±0.76	
>10	3.96±0.63	
Work setting		0.027*

SRCA ambulance	3.38±0.76	
Hospital emergency department	3.77±0.57	
Received disaster training in past 2 years		<0.001*
Yes	3.79±0.68	
No	3.08±0.63	
Previous disaster response experience		<0.001*
Yes	3.91±0.61	
No	3.25±0.70	

\*Statistically significant at  $p < 0.05$  level

**Table 4.** Multivariable linear regression analysis of factors associated with DPET scores

Factor	$\beta$	95% CI	p-value
Constant	1.92	(1.47, 2.38)	<0.001
Age (years)	0.06	(-0.13, 0.25)	0.530
Education level	0.13	(-0.06, 0.32)	0.184
Bachelor's degree or higher vs diploma			
Years of experience	0.17	(0.02, 0.33)	0.028*
Work setting	0.15	(-0.04, 0.35)	0.123
Hospital ED vs SRCA ambulance			
Disaster training past 2 years	0.28	(0.12, 0.44)	<0.001*
Yes vs no			
Previous disaster response experience	0.25	(0.10, 0.39)	0.001*
Yes vs no			

$R^2=0.372$ , Adjusted  $R^2=0.346$ ,  $F=15.77$ ,  $p < 0.001$

\*Statistically significant at  $p < 0.05$  level