



Enhancing Nurses' Disaster Preparedness and Response Via Simulation-Based Training

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ABSTRACT

Introduction: Disaster preparedness is a critical component of nursing practice. Emergency nurses who often deal with high-stress, time-sensitive situations are in need to have updated skills, knowledge and confidence in dealing with disaster. Simulation-based training is valuable tool to enhance the overall preparedness of healthcare professionals.

Objectives: The study determined to evaluate the impact of Simulation-Based training on disaster preparedness and response among frontline nurses at Ministry of Health Hospitals in Najran, Saudi Arabia.”

Methods: A quasi-experimental research study with a one-group pretest-posttest design was conducted among 34 nurses working in the emergency department, disaster teams/units, and intensive care units (ICUs) of various MOH Hospitals in Najran, Saudi Arabia. The participants completed the emergency preparedness information questionnaire (EPIQ). Simulation based training and debriefing were provided to the participants. Data were analyzed by using descriptive and inferential statistics.

Results: In our study nurses had higher familiarity scores in triage, basic first aid, and biological agent detection with the mean score of 8.99 (SD=4.232) but lower scores in accessing critical resources and reporting, isolation, quarantine, decontamination, the Incident Command System (ICS), psychological issues, epidemiology communication, connectivity, and clinical decision-making 1.71 with (SD=0.944). However, simulation training was found to be an effective method of increasing practical skills among emergency nurses. The post-intervention mean score showed increased scores in all areas, with an overall mean score increase from 34.83% of pre-intervention to 80.27% of post-intervention.

Conclusion: Nurses' disaster preparedness is greatly improved by simulation-based training, which also enhances their knowledge, abilities, and clinical decision-making capabilities. Simulation exercises offer a realistic and effective learning experience that could prepare emergency nurses to handle high-stress situations since they are hands-on and immersive.

KEYWORDS: disaster preparedness, response, simulation based training, nurses

INTRODUCTION

“A disaster is characterized by a profound disturbance in the functioning of a community or society, leading to extensive human, material, economic, or environmental losses that surpass the affected community's or society's capacity to manage using available resources (1,2). Globally, natural disasters claim an average of 45,000 lives annually, representing 0.1% of all deaths over the past decade (3). In

2022, there were 387 reported natural hazards according to the disasters in Numbers-World report (4). Saudi Arabia, faces frequent natural disasters, accounting for 40.7% of all such events and contributing to 90% of total global disaster victims. The country is vulnerable to multiple natural hazards, including floods, sand and dust storms, and drought (5). Notable among these disasters are the floods triggered by intense storms that brought heavy rainfall to the desert



kingdom during the final days of the annual Hajj pilgrimage, a time when millions of people were gathered (6). Particularly, floods have emerged as the most prevalent natural hazard in recent years (7). Additionally, the southern region has been grappling with numerous man-made disasters and crises since 2015.

“Emergency preparedness stands as a crucial mandate for frontline healthcare workers, especially doctors and nurses, who often serve as the primary responders in disaster scenarios (8). Their duty extends beyond providing immediate care, they bear the responsibility of delivering effective interventions to mitigate the physical, psychological, and social distress experienced by survivors (9). Emergency nurses, in particular, face unique demands in disaster situations. Firstly, they require specialized skills in event management, triage, and safe evacuation procedures (10). Secondly, adept communication, care coordination, and meticulous record-keeping within the bounds of privacy laws are paramount during such crises (11). Despite years of experience and training, multiple studies have highlighted substantial self-reported gaps in emergency competencies and disaster readiness among nurses (12,13). Hence, an imperative exists for nurses to receive comprehensive education and training in disaster response. This training equips them with a profound understanding of disaster plans and incident dynamics, enabling them to offer optimal care, even in scenarios of prolonged power outages (14,10). Consequently, integrating disaster training into nursing education emerges as vital. Active involvement of nurses across all stages of disaster planning is crucial to augment the comprehension of their roles and expected contributions in any disaster response” (15,16).

“Simulation-based training stands as a pivotal instrument in enhancing the preparedness and response capabilities of nurses amidst disasters (17). Replicating real-life scenarios, this method offers an invaluable platform for skill development, decision-making, and teamwork within a controlled yet realistic environment (18,19). A thorough review of existing literature consistently highlights the efficacy of simulation-based training in equipping nurses with the essential competencies required for effective disaster response. (20,21). Across various studies, its positive impact on improving clinical skills, critical thinking, and communication, and fostering collaborative efforts among nursing teams remains evident. Furthermore, simulation exercises provide a secure arena for nurses to engage with diverse disaster scenarios, encompassing mass casualty incidents, infectious disease outbreaks, and resource-constrained environments (18,22). This exposure significantly contributes to boosting their confidence and adaptability, crucial attributes in high-stress situations (23). Therefore, this study determined to evaluate the impact of Simulation-Based Training on disaster preparedness and response among frontline nurses at Ministry of Health hospitals in Najran, Saudi Arabia.”

METHODOLOGY

Study design

A quasi-experimental study with a one-group pretest-posttest design was conducted to enhance the nurses' disaster response preparedness via Simulation-Based Training in Najran Saudi Arabia.

Setting

The study was conducted at Najran Training Center, Simulation lab, Najran KSA. The training center has contained various moderate-fidelity medical, newborn, and critical simulators. Najran is located in the southern part of the KSA, where the border is exposed to potential risk of disasters.

Sample/Sampling technique/ Sample size

The study participants were nurses working at various MOH hospitals in the Najran region of KSA. Particularly, nurses employed in emergency departments (EDs), disaster teams/units, and intensive care units (ICUs). The study's subjects were gathered using the purposive sampling approach. The G* power 3.1.9.7 program was used to calculate the sample size. The computed result is 34 for a significance level (α) of 0.05, a power of 0.80, and an effect size of 0.5. (23)

Inclusion / Exclusion Criteria

The nurses who enrolled in the advanced trauma care course agreed to participate in the study. Nursing practitioners including nursing specialists, charge nurses, and head nurses were included in the study. In contrast, nurses who did not receive any training in simulations were excluded.

Instruments for data collection

Part 1: Part 1: Socio-demographic data: This tool was developed by the investigator; it includes age, gender, years of experience, educational status, hours of work, any participation in a real disaster, and previous experience with simulation-related course programs.

Part 2: Enhancing Nurses' Disaster Response Preparedness through EPIQ

The tool was adopted from the Emergency Preparedness Information Questionnaire (EPIQ). It is a standardized tool used to measure emergency preparedness (25). The questionnaire consists of multiple items designed to measure self-reported familiarity with different aspects of emergency preparedness. The questionnaire consists of 18 items under 8 major divisions. There are three items in the first domain, triage and first aid, and five items in the second domain, which is biological agent and detection, the evaluation of vital resources and reporting with a single item are covered in the third section. The incident command system, which consists of 4 elements, is the fourth important piece. Isolation, quarantine, and decontamination with a single item make up the fifth item. Sixth domain consist of psychological issues with two items. The seventh domain include epidemiology and clinical decision-making with

one item and the eighth domain: is communication and connectivity with one subtheme. Each question was followed by a 5-point Likert scale with scores ranging from 1 to 5 (I am quite knowledgeable about this topic and an expert in competency on this topic). The highest possible score was 90, while the lowest was 18. The tool took 15 to 20 minutes on average to finish. The data from the pre-and post-test were solely obtained using the same instrument (26).

Data Collection Procedure

The data collection procedure for enhancing nurses' disaster response preparedness via simulation-based training was conducted through several phases. The data was gathered in the following steps. In the first phase, the baseline assessments were conducted using the Emergency Preparedness Information Questionnaire (EPIQ) to understand the current level of disaster response preparedness, communication skills, decision-making, and teamwork among the nurses. During the second phase, the simulation session the nurses were given a scenario, focusing on triage, trauma, basic first aid, assessing the critical cases and hypovolemic shock assessment and management, and a comprehensive review of the nurses' performance and interactions during the disaster scenarios was carried out through video sessions. Following the simulation, a debriefing session was held to discuss the experience and gather feedback from the participants. In the final phase, a post-test was conducted using the same

questionnaire to assess the nurses' performance across various aspects, including technical skills, psychological issues, epidemiological and clinical decision-making, communication and connectivity patient interaction, and the overall clinical environment. The data collected was then analyzed using descriptive and inferential statistics to evaluate the effectiveness of the simulation-based training in enhancing nurses' disaster response preparedness.

Ethical Consideration

Informed consent was obtained from all study participants, ensuring that they were informed about their voluntary participation and the option to withdraw from the study without consequences. Administrative permission was secured to conduct the study, and the study was approved by the Institutional Review Board. The obtained data was stored in a password-protected folder and handled confidentially, and the researchers were committed to not disclosing the respondents' identities under any circumstances.

Statistical Analysis

Data entry and statistical analysis were done using the SPSS21 statistical software package. Descriptive statistics were used to measure the study variables, such as frequency and percentage distribution. A Paired Student test was utilized to determine statistical significance between pre- and post-test familiarity scores after the simulation.

RESULT

Table 1. Describes the demographic characteristics of the participants.

Demographic Profile	Variable	Number (34)	Frequency %
Age in years	30-40	14	41.5
	41-50	12	35
	51-60	08	23.5
Female	Male	12	35.5
	Female	22	64.5
Educational Status	Diploma	06	18
	Bachelors	26	76.5
	Masters	02	5.5
Hours of Work / Week	>48 hours /per week	18	53
	< 48 hours /per week	16	47
Any participation in real disaster	yes	18	53
	No	16	47
Simulation related course attended	Yes	06	17.5
	No	28	82.5

Table 1 shows the demographic variables of the participants. The majority of the participants were aged from 30 to 40 years (n=14; 41.5%); were female (n=22, 64.5%); had a bachelor's degree (n=26; 76.5%); had worked for an average of ≥ 48 hours per week (n=18; 53. %); participated in real disaster (n=18; 53%); and attended a course related to simulation majority of the participants reported no (n=28;82.5%).



Table 2. Pre-test description of nurse's response regarding familiarity with emergency preparedness information questionnaire

Items of Familiarity	Very familiar	Somewhat familiar	Familiar to neutral	Somewhat familiar	Not familiar	Mean	Standard deviation
I. Triage and basic first aid	7 (20.5%)	6(17.6%)	8(23.5%)	7(20.5%)	6(18%)	5.71	2.678
II. Biological agent detection	8(23.5%)	9(26.6%)	6(17.6%)	5(14.7%)	6(17.6%)	8.99	4.232
III. Accessing critical resources and reporting	5(15.1%)	8(23.3%)	7(20.5%)	8(23.5%)	6(17.6%)	1.88	0.986
IV. The Incident Command System (ICS)	6(17.6%)	7(20.6%)	8(23.6%)	7(20.1%)	6(17.6%)	6.49	2.222
V Isolation, quarantine and decontamination	5(15.1%)	6(17.5%)	10(29.4%)	6(17.5%)	7(20.5%)	1.71	0.766
VI. Psychological issues	6(17.6%)	7(20.6%)	9(26.4%)	6(17.6%)	6(17.5%)	3.18	1.220
VII. Epidemiology and clinical decision making	6(17.6%)	7(20.6%)	6(17.6%)	7(20.6%)	8(23.6%)	1.69	922
VIII.Communication and connectivity	7 (20.5%)	8(23.6%)	8(23.6%)	6(17.6%)	5(14.7%)	1.71	0.944
Total Score	7(20.5%)	6(17.6%)	8(23.6%)	7(20.6%)	6(17.7%)	31.35	11.677

The results showed that nurses were generally more familiar with triage and basic first aid, with a mean score of 5.71 (SD=2.678). They were also familiar with biological agent detection, with a mean score of 8.99(SD=4.232). However, accessing critical resources and reporting, isolation, quarantine, and decontamination had lower familiarity scores, with mean scores of 1.88 (SD=1.71) respectively.The Incident Command System (ICS) had a moderate familiarity score, with a mean score of 6.49 (SD=2.222). Psychological issues had a mean score of 3.18 (SD=1.220). While epidemiology and clinical decision-making had a lower mean score of 1.69 (SD=922) Communication and connectivity had a mean score of 1.71 (SD=0.944). The total score of the EPIQ was 31.35, with (SD=11.677) indicating varying levels of familiarity with different aspects of emergency preparedness among nurses.

Table 3. Impact of simulation-based training on familiarity with emergency Preparedness and response among nurses

Items of Familiarity	Pre-intervention	Pre-intervention	95% Confidence Interval of the Difference		t value	df	p-value
	Mean (SD)	Mean (SD)	Lower	Upper			
I. Triage and basic first aid	5.71 (2.678)	12.06 (0.431)	-6.908	-5.792	-22.662	79	0.001
II. Biological agent detection	8.99 (4.232)	20.19 (0.843)	-12.044	-10.356	-26.408		0.001
III. Accessing critical resources and reporting	1.88(0.986)	4.04 (0.249)	-2.348	-1.977	-23.205		0.001
IV. The Incident Command System (ICS)	6.49 (2.222)	15.94 (0.603)	-9.967	-8.933	-36.407		0.001
V.Isolation, quarantine, and decontamination	1.71(0.766)	4.01 (0.194)	-2.482	-2.118	-25.163		0.001
VI. Psychological issues	3.18 (1.220)	8.04 (0.295)	-5.145	-4.58	-34.236		0.001
VII. Epidemiology and clinical decision making	1.69 (922)	4.00 (0.159)	-2.508	-2.117	-23.502		0.001
VIII. Communication and connectivity	1.71 (0.944)	3.98 (0.224)	-2.462	-2.063	-22.574		0.001
Total Score	31.35 (11.677)	72.25 (1.595)	-43.326	-38.474	-33.552	0.001	

The results of this study demonstrated a significant improvement in the emergency nurses' responses who underwent simulation. The post-intervention mean score showed increased scores in triage and basic first aid 80.4% (p <0.001), biological agent detection 80.76% (p <0.001), accessing critical resources and reporting 80.8 % (p <0.001),the IncidentCommand System (ICS) 79.7 % (p <0.001),Isolation, quarantine, and decontamination 80.2 % (p <0.001), psychological issues 80.4 % (p <0.001), epidemiology and clinical decision making 80% (p <0.001) ,Communication and connectivity 79.6 % (p <0.001). The study exhibited an overall mean score increase from 34.83% of pre-intervention to 80.27% of post-intervention (p < 0.001) which showed that simulation was an effective method of training for increasing the practical skills among the emergency nurses. These results suggest that the simulation program effectively improved nurses' familiarity with the EPIQ categories, leading to a significant increase in their preparedness levels.

DISCUSSION

The present study aimed to evaluate the impact of simulation-based training on emergency preparedness for disaster among the trauma nurses. The study demonstrates that simulation-based training significantly can enhance the nurse's preparedness and response. The interactive and hands-on nature of simulation exercises with different scenarios provided a realistic and immersive learning experience, which was more effective in improving knowledge, skills, and critical decision-making compared to traditional didactic training.

We examined the response regarding familiarity with the Emergency Preparedness Information Questionnaire. Most of the nurses were familiar with triage basic first aid, and biological agent detection with a mean and standard deviation 5.71 (SD= 2. 678). However, accessing critical resources and reporting, isolation, quarantine, and decontamination had lower familiarity scores, with mean scores of 1.88 and 1.71, respectively. Similar findings have been reported in other studies. The present study results were in line with a study conducted by Gojjam et al in Ethiopia, which found that the mean score of familiarity with emergency and disaster preparedness was 106.1 ± 31.8 , with approximately 52.3% of participants scoring higher than the mean score (27). Therefore, to improve the nurses' familiarity with emergency preparedness, it is recommended to provide appropriate disaster preparedness information training to emergency nurses and other healthcare professionals (28).

The results of the current study showed that a major proportion of the nurses reported that they are moderately familiar with the Incident Command System (ICS) with a mean score of 3.18 (SD= 1.220). These findings were congruent with the study conducted by Worrall (2012) reported the lowest ratings in Incident Command Systems, and connectivity among nurses during the disaster response (29).

The present also overlooked clinical decision-making, epidemiology and psychological concern, communication, and connectivity and the results reported that the majority of the participants were familiar with these concerns. Susan et al (2008) evaluated nurses' familiarity with emergency preparedness using the EPIQ and reported that the instrument assessed nurses' self-reported familiarity with various aspects of emergency preparedness, including clinical decision-making, communication, and connectivity (30). McKibbin et al. (2011), reported that nurses' acquaintance with disaster preparedness was inadequate, and their knowledge of biological and epidemiological agents were limited (31). The vast majority of participants had a high degree of knowledge of communication and connectivity, suggesting that nurses had differing degrees of experience with various parts of emergency preparedness. Therefore, further studies are recommended to explore these contradictory study findings.

The result of the current study indicated that statistically significant improvement in the familiarity with emergency preparedness and responses among nurses who underwent the simulation-based training. The post-simulation mean score showed increased scores in various areas, such as triage and basic first aid: 80.4% ($p < 0.001$), biological agent detection: 80.76% ($p < 0.001$), and accessing critical resources and reporting: 80.8% ($p < 0.001$). These improvements indicate that the simulation-based training was effective in enhancing the nurses' competencies in emergency preparedness and response. (1,2,3). Similar to our study results, Temesgen Ayenew et al (2022) also reported that simulation-based training had improved healthcare practitioners' emergency response learning and increased their familiarity with emergency preparedness (27). Hence, simulation-based training plays a crucial role in enhancing nurses' disaster response preparedness, focusing on various aspects such as communication, triage, critical thinking, and teamwork.

The study also highlighted a significant improvement in the pre and post-familiarity scores among the nurses in various areas after the simulation-based training. The improvements in familiarity scores were observed in the following areas such as the Incident Command System (ICS) 79.7 % ($p < 0.001$), isolation, quarantine, and decontamination 80.2 % ($p < 0.001$), psychological issues 80.4 % ($p < 0.001$), epidemiology and clinical decision making 80% ($p < 0.001$) and Communication and connectivity 79.6 % ($p < 0.001$). These results were consistent with a study conducted by Matlock, T. A. (2017) and Madeline et al (2015) emphasized that the simulation-based training was effective in enhancing the nurses' familiarity with various aspects of emergency preparedness and response, including the Incident Command System, which is crucial for effective coordination during emergencies (31,32). Similar studies have also reported the effectiveness of education and training in improving nurses' familiarity with emergency preparedness and disaster response core competencies by Temesgen Ayenew et al (2022) (27). The present study demonstrated that simulation-based training was an effective method for increasing practical skills among emergency nurses. In our study the overall mean score increased significantly from 34.83% pre-intervention to 80.27% post-intervention ($p < 0.001$), indicating that the simulation program effectively improved nurses' familiarity with the EPIQ categories, leading to a significant increase in their preparedness levels (1,3). Similar to our study results Jenifer, (2023) emphasized that simulation-based learning allows trainees to apply newly learned skills in a supportive environment, leading to improved disaster competencies and preparedness levels. Shandiz Moslehi, et al (2023) also highlighted that simulation-based training particularly relevant in the context of emergency preparedness, enhances familiarity with various core competencies, including the Incident Command System, isolation, quarantine,

decontamination, and other essential areas (33). Rivera et al. (2019) evaluated and compared the effectiveness of two training interventions for emergency preparedness, using traditional training methods and simulation-based training. They found that integrating simulation-based training into emergency preparedness curricula could improve nurses' preparedness and self-confidence in emergencies (34). Similarly, Duong et al. (2019) surveyed Australian emergency department nurses and found that simulation-based training could raise the level of awareness and education in emergencies. The present study adds to the growing body of evidence supporting the effectiveness of simulation-based training in nursing education, particularly in the context of emergency preparedness (35). Hence, simulation-based training can improve nurses' practical skills, competencies, and preparedness levels, leading to better patient outcomes during emergencies.

STRENGTH AND LIMITATION OF THE STUDY

This study outlined the enhancement of nurses' disaster preparedness and response via Simulation-Based Training among nurses in Najran region. Simulation-based training may not completely replicate the complexity and unpredictability of real-life disaster situations. However, the study also identified several limitations that warrant consideration. Firstly, the study used a limited sample size to evaluate the effectiveness of simulation-based training. This could impact the generalizability of the findings and the ability to draw robust conclusions about the effectiveness of the simulation-based training. Secondly, the research was performed with voluntary participation, which might have led to selection bias. The participants who volunteered for the study may have different characteristics or motivations compared to those who did not participate, potentially affecting the study's results. Finally, the study was conducted only among nurses in the emergency and intensive care unit in Najran, Saudi Arabia, which limits the generalizability of the findings to a broader population of nurses. However, the identified limitations suggest the need for further research with larger and more diverse samples to conclusively determine the effectiveness of simulation-based training as an educational program for disaster preparedness and response among nurses.

CONCLUSION

Simulation-based training significantly ameliorates the emergency preparedness of emergency nurses, leading to improvements in knowledge, skills, and clinical decision-making skills. The hands-on and immersive nature of simulation exercises provides a realistic and effective learning experience that could equip trauma nurses to respond to high-stress emergencies. Healthcare institutions should consider the integration of simulation-based training into their educational programs to ensure that the healthcare workers are adequately prepared to provide life-saving care.

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