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ORIGINAL RESEARCH

The Effectiveness and Benefits of Disaster Simulation Training for Undergraduate Medical Students in Saudi Arabia

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Background: There is a growing recognition of the need for disaster management training for medical students in Saudi Arabia, but there is limited research on its effectiveness. Thus, this study evaluated the effectiveness of a disaster simulation training program for undergraduate medical students in Saudi Arabia.

Methods: A disaster management simulation activity was conducted for 32 medical students. The students attended a 30-minute lecture about mass casualty incidents (MCIs) and completed a pre-simulation survey. They were then randomly assigned to one of three groups (performer, actor, observer) and asked to apply their skills to triage patients after a Level C MCI. A debriefing session was conducted using the plus/delta debriefing method. Then, the students completed a post-simulation survey.

Results: The results showed that after the simulation training the students' self-confidence in their ability to respond to a disaster increased from 40.7% to 59.4% (p value < 0.01), to utilize incident command structure increased from 37.9% to 62.5% (p value < 0.01), to demonstrate START triage for victims of a disaster increased from 28.2% to 65.7% (p value < 0.01), and to apply safe search and rescue techniques increased from 40.7% to 59.4% (p value < 0.01). The students' self-confidence in their ability to perform basic first aid skills also increased after the simulation.

Conclusion: The study findings suggest that disaster management simulation training can be an effective way to increase medical students' self-confidence and preparedness for disaster response.

Keywords: disaster, simulation, undergraduate training

Introduction

A disaster is known as a sudden incident that causes damage, human suffering, or death and that necessitates governmental emergency responses.¹ According to the Emergency Event Database (EM-DAT), 185 million people were affected by 387 natural disasters and hazards that occurred in 387 different countries in 2022, and approximately 224 billion US dollars were spent on disasters globally.² Due to the increased prevalence of natural and human-made disasters, disaster training and preparedness have become essential requirements at all community levels, including the health care system, to reduce the likelihood and severity of morbidity, mortality, and disability risks.³

Saudi Arabia has unique cultural, religious, social, and environmental dynamics. The country hosts the largest Islamic gathering, which takes place annually during the pilgrimage season, and hosts approximately three million religious pilgrims each year. This high population density could have the potential to turn into a disaster situation such as the stampede disaster that took place in Mina in 2015, which resulted in the death of approximately 700 people.⁴ Another important recurring natural disaster is extreme rainfall events with resulting strong winds, droughts, and flashes that have

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socioeconomic consequences.⁵ Such events have revealed and prompted the need for improvement and development of disaster management strategies and plans.

In 2003, the Association of American Medical Colleges emphasized the importance of incorporating disaster management training into the medical curriculum.⁶ The effectiveness of a training program was examined and proven to be essential for different levels and societies worldwide.⁷ An American study tested the implementation of a 24-hour disaster training for medical students in a medical center and found that students showed a significant improvement in disaster preparedness and management, with retention rates reaching up to 80% over the 2-year program.⁸

Although the benefits of disaster management implementation training in Saudi medical universities is less commonly discussed, Saudi research has suggested the use of a short or intermediate training curriculum training model as the foundation for disaster preparedness with clear educational standards and guidelines. This training can be applied in future clinical scenarios.⁹ Medical students should be properly trained for the disaster challenges they could face in their future careers, and more evaluation is needed for this vital step.¹⁰

This study evaluated the effectiveness and benefits of an implemented disaster simulation program for undergraduate medical students. The study can pave the way for a nationwide establishment of disaster management training for all medical and university students around the kingdom.

Methods and Materials

This study was designed to evaluate the effectiveness of a disaster simulation training program for undergraduate medical students in Saudi Arabia. The study methodology was reviewed and approved by PNU IRB committee (log number: 23–0467). Seventy-two female students aged between 21–24 years at the Third Year College of Medicine in Princess Nourah bint Abdulrahman University were invited to participate in a disaster management simulation activity. In total, 44.4% of them were willing and participated in the training. Participation in the simulation activity was voluntary, and the activity performed in the week before final exams, which explains the lower attendance rate. Thirty-two students presented at the simulation center at Princess Nourah bint Abdulrahman University and attended the randomization process; eight students were then assigned to be performer group), three students were assigned to be simulated patients (actress group), and twenty-one students were assigned to be observers (observer group).

After the learners attended a thirty-minute lecture about mass casualty incidents (MCIs) in the auditorium and completed a pre-simulation survey, they were escorted to a very large simulation lab. The lab was constructed as a hospital emergency room, and patients pushed into the room as the scenario progressed (Figures 1 and 2). The students were randomly assigned to one of three groups to represent their role in the activity (performer, actress, or observer) and were asked to apply the skills to triage patients after a Level C MCI and perform START triage (Figure 3). A debriefing session was carried out with all participants using the plus/delta debriefing method. All thirty-two students attended the pre-simulation lecture, completed the pre-simulation survey form, presented at the activity site, attended the simulation training, participated in the post-training discussion (debriefing), and completed the post- survey form (Supplementary Table 1). The pre-post survey forms were adapted from the Bentley et al's pre and post simulation exercise evaluation and focus on evaluation of the simulation training aspects such as exercise conduct and related participants' benefits.¹¹

Statistical Analysis

Data were analyzed using the statistical package SPSS version 24. Qualitative variables were presented in number and percentage while Quantitative variables were presented in mean and standard deviation. *T*-test was used to compare between related samples, while comparisons between groups were done using analysis of variance (ANOVA). P-values less than 0.05 were considered significant.

Results

Thirty-two medical students participated and submitted their responses using an online questionnaire. Nineteen percent of them had participated in a related disaster management activity prior to attending this simulation activity.

(Table 1) showed the number (percentage) of the participants' responses to the self-confidence survey during the disaster management simulation. Regarding the participants' self-confidence before the simulation session, less than half



Figure I Simulation lab was constructed as a hospital emergency room.





of the participants were confident that they could assist and be part of the hospital disaster management team: 40.7% of the students felt confident in their ability (agreed or strongly agreed) to respond to a disaster; 37.6% were confident in their ability to utilize the incident command structure; 28.2% were confident in their ability to demonstrate START triage for victims of a disaster; and 40.7% were confident in their ability to apply safe search and rescue techniques. Conversely, 68.7% of the students felt confident in their ability to perform basic first aid skills. After the simulation session, the participants' self-confidence increased such that more than half of the participants were confident that they could assist



Figure 3 Triaging patients using START triage.

and could be part of the hospital disaster management team in each of the abovementioned ways (59.4%, 62.5%, 65.7%, 59.4%, and 78.1%, respectively).

The participants' total mean (standard deviation) scores on the five items of the self-confidence survey are presented in Table 2. *T*-test was used to compare between related samples. In general, there was an increase in the mean total scores of the participants' self-confidence in their ability to perform the skill components gained during the training. A statistically significant difference was found in the item regarding the participant's confidence in her ability to demonstrate START triage for victims of a disaster (t=-2.7, p value=0.01).

Questions	Time	Strongly Disagree n(%)	Disagree n(%)	Neutral n(%)	Agree n(%)	Strongly Agree n(%)
I feel confident in my ability to respond to	Pre-simulation	2(6.3)	6(18.8)	(34.4)	10(31.3)	3(9.4)
a disaster	Post-simulation	1(3.1)	3(9.4)	9(28.1)	14(43.8)	5(15.6)
I feel confident in my ability to utilize the incident command structure	Pre-simulation	-	7(21.9)	13(40.6)	10(31.3)	2(6.3)
	Post-simulation	2(6.3)	4(12.5)	6(18.8)	16(50)	4(12.5)
I feel confident in my ability to demonstrate START triage for victims of a disaster	Pre-simulation	2(6.3)	7(21.9)	14(43.8)	7(21.9)	2(6.3)
	Post-simulation	3(9.4)	2(6.3)	6(18.8)	15(46.9)	6(18.8)
I feel confident in my ability to apply safe search	Pre-simulation	-	8(25)	(34.4)	10(31.3)	3(9.4)
and rescue techniques	Post-simulation	1(3.1)	2(6.3)	10(31.3)	16(50)	3(9.4)
I feel confident in my ability to perform basic first	Pre-simulation	-	2(6.3)	8(25)	17(53.1)	5(15.6)
aid skills	Post-simulation	1(3.1)	1(3.1)	5(15.6)	17(53.1)	8(25)

 Table I Number (Percentage) of the Participants' Responses to the Self-Confidence Survey During the Disaster Management

 Simulation

Abbreviations: n; number, %; percentage.

Questions		Pre-Simulation Mean (SD)				Post-Simulation Mean (SD)		
	Total	Actress	Observer	Performer	Total	Actress	Observer	Performer
I feel confident in my ability to respond to a disaster	3.2(1)	4(1)	3(1)	3.3(0.9)	3.6(1)	4.3(0.6)	3.3(1)	4(0.5)
I feel confident in my ability to utilize the incident command structure	3.2(0.9)	4.3(0.6)	3(0.9)	3.1(0.9)	3.5(1)	4.7(0.9)	3.2(1)	3.8(0.7)
I feel confident in my ability to demonstrate START triage for victims of a disaster	3(1)	3.3(0.6)	2.9(1)	3(0.8)	3.7(1)#	4.3(0.6)	3.4(1)	4.3(0.7)
I feel confident in my ability to apply safe search and rescue techniques	3.3(1)	4(1)	3(0.9)	3.4(0.9)	3.6(0.9)	4(1)	3.5(1)	3.6(0.9)
I feel confident in my ability to perform basic first aid skills	3.8(0.8)	4(1)	3.8(0.6)	3.8(1)	3.9(0.9)	4(1)	3.8(0.9)	4.4(0.7)
Total	16.4(4)	19.7(4)	16(3.8)	16.5(3.7)	18.3(4)#	21.3(3.5)	17.3(4.5)	19.9(2.4)

Table 2 Part	ticipants' Mean	Scores on the C	Confidence Survey	Items During the	Disaster Manageme	ent Simulation
				0	0	

Note: "Statistically significant results compared to the total mean in the pre-simulation survey.

The effect of the participant's role on participants' confidence during the disaster management simulation activity at different survey times was detected using two-way analysis of variance test with repeated measures. The participant's role did not show any significant effect on the participants' confidence.

(Table 3) presented the number (percentage) of participants' assessment of the disaster management simulation. Regarding the medical students' thoughts about the disaster management simulation activity, the following trends were identified: 84.4% of the students found that the simulation was relevant to their work (agreed or strongly agreed); 81.3% found that the simulation clarified or provided more information; 87.5% found that the simulation was realistic; and 81.2% intended to use the learned skills. Moreover, 78.1% of the students agreed that the facilitators were knowledgeable.

To detect the usefulness and quality of simulation activity components, analysis of variance (ANOVA) test was used to compare between different groups. The highest level of agreement about the usefulness and quality of simulation activity components was detected among the performer group, while the lowest level of agreement was detected among the actress group. However, this difference did not have any statistical significance (Table 4).

Items	Strongly Disagree n(%)	Disagree n(%)	Neutral n(%)	Agree n(%)	Strongly Agree n(%)		
The simulation content was relevant to my work	1(3.1)	I (3.I)	3(9.4)	18(56.3)	9(28.1)		
The simulation provided me with new information (or clarified existing information)	1(3.1)	1(3.1)	4(12.5)	(34.4)	15(46.9)		
The simulation was realistic	-	I(3.I)	3(9.4)	13(40.6)	15(46.9)		
I intend to use what I learned from this simulation	2(6.3)	1(3.1)	3(9.4)	17(53.1)	9(28.1)		
The facilitator(s) was knowledgeable	-	I(3.I)	6(18.8)	13(40.6)	12(37.5)		

Table 3 Number (Percentage) of Participants' Assessment of the Disaster Management Simulation

Abbreviations: n; number, %; percentage.

Participant Role Items	Total	Actress	Observer	Performer	F	P value
The simulation content was relevant to my work	4(0.9)	4.7(0.6)	3.9(1)	4.1(0.6)	I	0.4
The simulation provided me with new information (or clarified existing information)	4.2(1)	4.3(0.6)	3.9(1)	4.8(0.5)	2	0.15
I intend to use what I learned from this simulation	3.9(1)	3.7(0.6)	3.8(1.2)	4.5(0.5)	1.6	0.2
The simulation was realistic	4.3(0.8)	4.3(0.6)	4.3(0.8)	4.5(0.8)	0.3	0.7
The facilitator(s) was knowledgeable	4.1(0.8)	3.7(1)	4.1(0.9)	4.1(0.8)	0.5	0.6

Table 4 Comparison of Participants' Mean Scores on the Assessment of the Disaster Management Simulation Using Analysis ofVariance Test

Discussion

We aimed to assess a disaster management simulation training exercise among medical students after assigning them to different roles: performer, observer, and actress. The simulation session effectively increased the participants' self-confidence in assisting and being part of a hospital disaster management team, especially in performing START triage.

In this study, the medical students considered disaster management as part of their duty, as they could be called to offer prehospital triage and emergency care during disaster events.⁹ They also felt that disaster management simulation clarified the essentials of hospital disaster response by involving them in a realistic, stressful, high-risk event. Live simulation is a valuable teaching methodology in medical specialties. It can affect participants' knowledge, skills and behaviors by allowing them to apply the gained theoretical knowledge in a proper safe learning environment.^{12,13} In addition, it allows them to recognize their lack of disaster-related knowledge and enhances their disaster management skills, especially in patient triage. Regardless of the chosen specialty, medical personnel are asked to provide on-site leadership during disasters. Having disaster management training could help medical personnel, including medical students, to be valuable assets during actual disasters.^{3,7,8}

During disasters, medical students with effective skilled participation can help the societal recovery process by providing familiar basic life aid and by executing START triage skills.¹⁴ In agreement with Patel et al, all students, including non-health major students, should have practical first aid skills-related training to provide useful assistance for themselves and others.¹⁴ Despite a lack of sufficient prior disaster management training exposure, more than half of the third-year college of medicine students were not interested in participating in disaster management simulation training, which could be related to the time of the activity near the end of the academic year, challenging academic schedules, and/or a lack of motivation to participate.¹⁵ We had similar results as Patel et al, who stated that 59% of undergraduate engineering students at the University of Texas, Arlington, were not willing to participate in disaster management and improve disaster preparedness.

Based on the students' thoughts and comments, we can assume that the disaster management simulation exercise was useful in improving theoretical knowledge and practical skills, especially in triaging a high number of patients in a short time and adhering to the assigned role in a disaster situation. Most students acknowledged the facilitator's knowledge-ability. Disaster management simulation is considered an efficient educational method to implement disaster management essentials to respond safely to a natural disaster. Simulation training offers opportunities to practice learned skills and should serve as an initial step in the field of disaster preparedness.^{10,13} Moreover, successful disaster education could be applied through the continuous involvement of facilitators in disaster risk reduction courses to enhance their disaster preparedness and relevant experience.^{14,16}

Simulation intensifies the learning environment through experience and observation in performer, observer, and actress roles. Although the gained knowledge and self-confidence were independent of the assigned role, there were negative attitudes toward the role applied in the simulation activity. Active engagement of participants in post-simulation debriefing using structured guided feedback can minimize this gap.¹² Students realized that the training was a chance to reflect on their own knowledge and practice and understood the importance of the theoretical and practical aspects of the disaster management

training that could be repeated with different intended outcomes. Accordingly, the simulation session could be conducted at the beginning of the academic year instead of at the end to enhance students' participation. In addition, most of the students who were allocated to observer roles preferred to be assigned to active roles to meet their learning outcomes. Observers support performers by providing them with structured formulated peer feedback after careful, less stressful observation.^{12,17} Our results showed that all participants' self-confidence was increased after the training independent of their role. We had similar results as Thidemann and Soderhamn, who found that observers in the simulation session attained higher scores in self-confidence on the posttest by benefitting from various learning methods.¹³ O'Regan et al suggested that focusing and clarifying the observer role using an observer tool could increase observers' satisfaction and learning outcomes.¹²

Regarding START triage, which is the main duty during training, a significant difference in self-confidence before and after the simulation session was found, demonstrating that the performer, observer, and actress groups felt confident in this learning outcome. Experienced student actors play intense stressful supporting roles to help the active participant concentrate on their learning intentions during the simulation training. Their psychological insights, in addition to the physical aspect, could be imparted by the performer's actions during different scenarios by perceiving several emotions. Debriefing and reflection could transform their experiences into learning.¹⁸ The learning ability of student actors is variable, but their learning perspectives could be enhanced by promoting their association with performers' learning experience.¹⁷

Our study found a link, though not statistically significant, between the student role and simulation activity satisfaction, with the active performer group who had hands-on experience showing higher satisfaction than the passive secondary groups, namely, observers and actresses. In contrast, Rantatalo et al and Thidemann and Soderhamn concluded that live simulation was an educational activity that promoted learning outcomes for all students independent of their role.^{13,17} Therefore, planning, designing, and conducting live simulations with constructed debriefing concerned with passive secondary group engagement is necessary to overcome the limitations for their learning affordance.¹⁷ Emotional involvement in simulation scenarios with clarified role objectives can increase role satisfaction and learning outcomes.¹² Moreover, students' communication during elaborate scenario encounters, application of knowledge, and learning of skills are considered beneficial tools to improve learning outcomes during simulation activity.¹³

Despite this study including a disaster management simulation, it had some limitations, including the small sample size, limited generalizability and the usage of a self-report survey with the possibility of recall bias. Therefore, more comprehensive research with larger student samples is needed to evaluate disaster management training and understand the factors affecting it.

Conclusions

This study evaluated the effectiveness and benefits of a disaster management simulation training for undergraduate medical students. The realistic disaster management simulation reduced the gap between theoretical concepts and handson application by positively affecting the students' self-confidence in being part of a hospital disaster management team, especially in performing START triage.

The results also indicated that the participants' role not only affected the training satisfaction level but also modulated their self-confidence level. Our findings can direct the staff in medical faculties to implement disaster management simulation training in their curricula using well-designed simulation scenarios with a structured debriefing concerned with passive group engagement.

Abbreviations

MCIs, Mass Casualty Incidents; START, Simple Triage And Rapid Treatment; EM-DAT, Emergency Event Database.

Ethical Approval

The study methodology was reviewed and approved by Princess Nourah bint Abdulrahman University IRB committee (log number: 23-0467). All participants provided written informed consents to participate in this study.

Disclosure

The authors report no conflicts of interest in this work.

References

- 1. Below R, Wirtz A, Guha-Sapir D. Disaster category classification and peril terminology for operational purposes; 2009.
- 2. Disasters in numbers- world 2022. Available from: https://reliefweb.int/report/world/2022-disasters-numbers#:~:text=In%202022%2C%20the% 20Emergency%20Event,totaled%20around%20US%24%20223.8%20billion. Accessed July 10, 2024.
- 3. Kaji AH, Coates W, Fung -C-C. A disaster medicine curriculum for medical students. Teach Learn Med. 2010;22(2):116-122. doi:10.1080/10401331003656561
- 4. Ministery of Health. MOH's Obituary of Mina Crush Victims 2015. Available from: https://www.moh.gov.sa/en/Ministry/MediaCenter/News/ Pages/News-2015-09-24-009.aspx. Accessed July 10, 2024.
- 5. Almazroui M. Rainfall Trends and Extremes in Saudi Arabia in Recent Decades. Atmosphere. 2020;11(9):964. doi:10.3390/atmos11090964
- Association of American Medical Colleges. Training future physicians about weapons of mass destruction: report of the expert panel on bioterrorism education for medical students. 2003. Available from: https://members.aamc.org/eweb/upload/Training%20Future%20Physicians% 20About%20Weapons.pdf. Accessed July 10, 2024.
- 7. Hermann S, Gerstner J, Weiss F, et al. Presentation and evaluation of a modern course in disaster medicine and humanitarian assistance for medical students. *BMC Med Educ.* 2021;21(1):610. doi:10.1186/s12909-021-03043-6
- Wiesner L, Kappler S, Shuster A, DeLuca M, Ott J, Glasser E. Disaster training in 24 hours: evaluation of a novel medical student curriculum in disaster medicine. J Emergency Med. 2018;54(3):348–353. doi:10.1016/j.jemermed.2017.12.008
- 9. Bajow NA, Maghraby NH, Alatef Sultan SA, Mani ZA, Aloraifi S. Disaster health education framework for short and intermediate training in Saudi Arabia: a scoping review. *Front Public Health.* 2022;2022:2440.
- Gable BD, Misra A, Doos DM, Hughes PG, Clayton LM, Ahmed RA. Disaster day: a simulation-based disaster medicine curriculum for novice learners. J Med Educ Curric Develop. 2021;8:23821205211020751. doi:10.1177/23821205211020751
- Bentley S, Iavicoli L, Boehm L, et al. A simulated mass casualty incident triage exercise: simWars. *MedEdPORTAL*. 2019;15:10823. doi:10.15766/ mep 2374-8265.10823
- 12. O'Regan S, Molloy E, Watterson L, Nestel D. Observer roles that optimise learning in healthcare simulation education: a systematic review. *Advan Simulat.* 2016;1:1–10. doi:10.1186/s41077-015-0004-8
- 13. Thidemann I-J, Söderhamn O. High-fidelity simulation among bachelor students in simulation groups and use of different roles. *Nurse Education Today*. 2013;33(12):1599–1604. doi:10.1016/j.nedt.2012.12.004
- 14. Patel RK, Pamidimukkala A, Kermanshachi S, Etminani-Ghasrodashti R. Disaster preparedness and awareness among university students: a structural equation analysis. *Int J Environ Res Public Health*. 2023;20(5):4447. doi:10.3390/ijerph20054447
- 15. Booker QS, Austin JD, Balasubramanian BA. Survey strategies to increase participant response rates in primary care research studies. *Family Pract.* 2021;38(5):699–702. doi:10.1093/fampra/cmab070
- Amri A, Bird DK, Ronan K, Haynes K, Towers B. Disaster risk reduction education in Indonesia: challenges and recommendations for scaling up. Nat Hazards Earth Sys Sci. 2017;17(4):595–612. doi:10.5194/nhess-17-595-2017
- 17. Rantatalo O, Sjöberg D, Karp S. Supporting roles in live simulations: how observers and confederates can facilitate learning. *J Vocat Educ Train*. 2019;71(3):482–499. doi:10.1080/13636820.2018.1522364
- 18. Billett S. Integrating learning experiences across tertiary education and practice settings: a socio-personal account. *Educ Res Rev.* 2014;12:1–13. doi:10.1016/j.edurev.2014.01.002

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