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Effect of Game-Based and Simulation-Based Training on Triage Knowledge in Mass Casualty Incidents: A Quasi-Experimental Study among Nurses in Semnan, Iran

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Abstract

Background: *Mass casualty incidents involve sending a large number of injured people to hospitals. Mass casualty incidents require efficient triage to prioritize care, and nurses, as the largest healthcare workforce, play a key role in crisis response. This study aimed to evaluate the effect of combined game-based and simulation-based training on improving nurses' triage knowledge in mass casualty incidents in hospitals affiliated with Semnan University of Medical Sciences, Iran.*

Methods: *This quasi-experimental study with a pretest-posttest design involved 55 crisis team nurses from eight hospitals affiliated with Semnan University of Medical Sciences, selected via convenience sampling. Participants completed a pretest, followed by a lecture, game-based training, and simulation with 10 simulated patients. Data were analyzed using the Wilcoxon test in SPSS version 26.*

Results: *The increase from the pre-test mean of 11.87±2.31 to the post-test mean of 15.75±1.65 (P-value<0.001) indicated a significant improvement in nurses' knowledge of triage principles.*

Conclusions: *Game-based and simulation-based training significantly improved nurses' triage knowledge and enhanced their preparedness for mass casualty incidents. It is recommended that these methods be integrated into nursing education and that follow-up assessments be conducted.*

Keywords: Triage, Simulation training, Learning, Mass casualty incidents, Nurses.

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Introduction

Mass casualty incidents are among the events that result in many people being injured, and these accidents require the preparation of personnel in hospital emergency departments.[1] Such incidents send many patients to health care centers. Therefore, preparedness to accommodate this volume of casualties and having a plan to respond to the influx of patients are essential roles of the emergency department.[2] In these situations, hospitals need trained and experienced staff to effectively manage under critical conditions.[1, 3] As the main pillars of the health care system, nurses play an important role in responding to them, and the importance of preparing to deal with accidents among nurses is always one of the most important principles.[4] To decide to treat a disease and examine the severity of the injury, a process called triage, which is one of the most important management concepts in the emergency department, is used. Various triage systems are used worldwide, all of which aim to reduce the mortality rate and reduce the waiting time for patients who need urgent and special measures.[5] In critical situations, the decisions made by the triage nurse can have significant effects on the patient's condition.[6] The role of the nurse in triage becomes more important because if there is a mistake in the triage process, it can cause more injuries and adverse effects to the patient.[7] Therefore, to play this role, it is necessary for triage nurses to acquire the excellent skills and key competencies needed to perform tasks in the emergency department .[8] If accurate triage is performed, even with limited medical resources, the highest possible effectiveness is achieved for the greatest number of people.[9]

Recent studies, have shown that game-based training can significantly improve nurses' skills and behavioral fluency in crisis and disaster management compared to case-based training, highlighting the need for innovative educational approaches.[10] Teaching through traditional lecture methods is not effective for conveying complex topics that require analysis and synthesis. Without practical experience, applying theoretical knowledge becomes very difficult. In nursing education, experiential learning emphasizes active teaching strategies such as simulations, role-playing, and problem- or inquiry-based learning. This learning method allows nurses to enhance their clinical skills in a safe environment and develop the theoretical knowledge learned in a controlled setting.[11, 12] Participants understand innovative teaching strategies better than traditional teaching methods because their motivation increases with collaboration and all-round participation.[13] Exercises for the preparation of health care systems by organizations are very important because of the many challenges associated with mass casualty incidents. Exercises are part of the cycle of training, planning and evaluation.[14]

Simulation is an effective training model to increase preparedness for such situations.[3, 15] One of the goals of simulation-based training is to improve clinical decision-making, increase accuracy in patient triage, reduce patient triage time, and increase accuracy in treatment functions.[3] Simulation is one of the main and integral elements of nurses' education, during which nurses learn to improve their clinical skills without fear of harming patients and strengthening their critical thinking. In recent years, much attention has been given

to simulation-based education in the learning of nurses, and simulation-based education is among the important curricula of nurses.[16] Simulation-based training gives Participants the opportunity to be in a real environment and respond appropriately to existing situations via predesigned protocols. Simulations have been widely reported to be effective.[17] A similar study in 2018 by Rezaei et al. compared the triage training method based on simulation versus lecture and reported that the triage simulation training method can significantly increase the ability of nurses to triage and reduce repeated triages caused by carelessness in the initial triage.[18]. In another study in 2024 by Elaine with the aim of investigating the effect of training based on triage simulation in mass casualty incidents, it was found that triage training via the simulation method can improve the self-confidence of medical trainees.[19]

Game-based training generally uses game-participant elements to increase people's motivation and improve learning. On the basis of the available evidence, games improve learning outcomes.[20, 21] Game-based learning gives Participants the opportunity to start solving complex problems by interacting with others. The benefits of game-based learning include increased engagement, self-efficacy, deep knowledge retention, and the enjoyment of learning. Additionally, displaying a scoreboard during the game increases the sense of competition among participants.[22] One of the important features of games is that they provide instant feedback to the participants and allow nurses to evaluate themselves in the moment. It is believed that game-based training increases the motivation of Participants and thus leads to the acquisition of knowledge and skills. In recent years, a growing body of research has been published on the potential of games as tools to enhance nursing education. Currently, games have become complementary and alternative methods for educational programs on the basis of knowledge and performance.[10, 23] The ultimate goal of training is for Participants to be able to apply the acquired skills in specific situations. Repeated training can lead to the consolidation of the learned skills. To prevent the forgetting of these skills, it is recommended that assessments be continuous and conducted at different time intervals.[24] Despite the critical role of nurses in such events, traditional lecture-based training often fails to equip them with practical triage skills. Innovative methods such as game-based and simulation-based training are needed to address this gap, particularly in regions like Semnan, where limited studies on triage preparedness have been conducted. This study aimed to evaluate the effect of combined game-based and simulation-based training on improving nurses' triage knowledge in mass casualty incidents in hospitals affiliated with Semnan University of Medical Sciences, Iran.

Materials and Methods

This quasi-experimental study with a pretest-posttest design was conducted between December 2023 and July 2024**.** In this study, after interhospital coordination, 55 crisis team nurses from 8 hospitals (Kosar, Amir al-Momenin, Taamin Ejtemaei, Motamedi, Imam Hussein, Sina, 15 Khordad, Velayat) affiliated with Semnan University of Medical Sciences who were selected non randomly participated. Sampling was conducted using a convenience method, with crisis team nurses selected based on voluntary participation. The sample size of 55 nurses was determined based on feasibility and prior studies on triage training, ensuring sufficient power.[25] Written informed consent was obtained from all participants after explaining the study objectives and ensuring the confidentiality of their information. The inclusion criterion for this study was that crisis nurses identified in each hospital have a bachelor's degree or higher. The exclusion criteria included unwillingness to continue participation, failure to complete the questionnaires, or being scheduled for the hospital's morning shift. This study has been approved by the Ethics Committee of Semnan University of Medical Sciences and has an ethical code.

Data were collected using pretest and posttest questionnaires consisting of 20 questions from the ESI5, START, and JUMP START triage systems. Forty questions with 4 options were selected after the investigations were carried out by Panel of Experts actually accident and disaster experts. There were 20 pretest questions and 20 posttest questions. The contents of the posttest and pretest questions were the same, but they were not repeated.

The questionnaires included Six questions from the ESI5 triage, 7 questions from the START triage, and 7 questions from the JUMP START triage were equally and fairly placed in the pretest and posttest, and the questions were at the same level in terms of difficulty in answering. Before the lecture, the pretest questions were distributed to the participants, and 20 minutes were given to answer the questions. A 90-minute lecture was subsequently given by an expert in this field. The contents of this speech included the following:

Training on how to manage patients during mass casual incidents, comparing ESI5 and ESI4 triage and checking the changes made in the new model, how to use proper triage in dealing with incidents that have led to mass casualties, explaining about START and JUMP START triage and using these patterns in times of mass casualty incidents and increasing nurses' insight in dealing with patients who have urgent needs in providing services.

The next step was to play a preplanned game such that 3 nurses from each hospital were voluntarily selected as a combination of experienced and less experienced nurses, and in the form of 2 groups, they started responding to scenarios related to triage in mass casualty incidents. An evaluator displayed the scores of each group on the board, and another evaluator controlled the time allotted to answer the questions, which was 10 seconds for each question.

The scoring system was developed by disaster experts. The rules of the game were displayed on the screen before the start of the game via PowerPoint (the correct answer to each question had 20 positive points, and the wrong answer to each question had 10 negative points; if both groups did not answer within the specified time, no points were awarded to the two groups). The designed scenarios were similar to past incidents in Semnan Province. These scenarios in the list of risks faced by Kosar Hospital in Semnan, which the hospital faced many times in the past. During the exercise in the game method, the participants were given the opportunity to display their knowledge in a competitive and exciting atmosphere at the designated time. Immediately after each question was answered, the correct answer was displayed so that the Participants could evaluate themselves in the moment. To

create an opportunity to increase the competence of nurses in making decisions as quickly and accurately as possible in mass casual incidents and to gain scientific experience, a simulated exercise in the form of a competition in a controllable environment similar to real conditions at the time of mass incidents was designed and implemented. To maintain this simulated model, the questions were designed on the basis of the START and JUMP START triages, and after several round table discussions with experts in this field were held, after the revisions, a total of 20 questions were designed. Each question included the history and vital signs of the patient, and the triage team fully read each question to determine the level and color of the triage and the appropriate actions for each patient. To maintain moderation, each group from the triage team was given 10 questions with the same number of questions related to each color (4 questions from the triage level with red color, 4 questions from the triage level with yellow color and one question from the triage level with green and black color). For each group, a red-level question with active bleeding conditions was designed to evaluate the performance of the triage team in dealing with these conditions and performing the correct actions. Ten simulated patients were placed in the scene, and for each of them, a question card was attached to their clothes with a pin. Because 10 simulated patients were helped, a maximum of 1 minute was considered for the triage of each patient, for a total of 10 minutes. The items to be evaluated include choosing the right equipment and refraining from removing unrelated equipment according to the patient's triage level at the time of triage; separating people with the green triage level to separate emergency and nonemergency cases as the first step; choosing the correct color of the appropriate triage according to the history mentioned in the question card; and performing actions in the field of work of the triage nurse, such as preventing active bleeding by using gas and bandages and opening the injured airway or performing 5 artificial respirations in children under 8 years old; and choosing the correct installation site triage cards.

The Wilcoxon signed-rank test was used to compare the pretest and posttest scores of the participants, as the data were not normally distributed based on preliminary normality tests (Shapiro-Wilk test, P-value<0.05). This non-parametric test was chosen to assess the significance of differences in triage knowledge scores before and after the intervention, with a significance level set at 0.05. The analysis was performed using SPSS version 26.

Results

The study included 55 crisis team nurses, with a majority being female (67.27%) and holding a bachelor's degree (90.9%). The mean age was 30.02±7.59 years, with work experience ranging from 1 to 28 years. (Table 1)

Table 1. Demographic information of the study participants

Demographic characteristics		Number (Percentage) / Standard Deviation±Mean / Age range
Gender	Male	18 (32.73)
	Female	37 (67.27)
Degree	Bachelor of nursing	50 (90.9)
	Master's degree in nursing	5 (9.1)
Age	years	(18 to 55) 30.02±7.59
Work history	years	(14.5±8.2)

The results of the above box plot show the difference in pretest and posttest scores after the intervention. The first quartile in the pretest shows much lower scores compared to the first quartile in the posttest. The mean and standard deviation of the participants' pretest scores in the study were 11.87±2.31. The minimum score in the second quartile of the pretest was 10, and the minimum score in the second quartile of the posttest was 15. The mean and standard deviation of the participants' posttest scores in the study were 15.75±1.65. The highest score in the posttest was 19, and the highest score in the pretest was 18. The upward trend in scores after the intervention is clearly observed in this chart. A statistically significant difference was observed between pretest and posttest scores (P-value<0.001). (Figure 1)

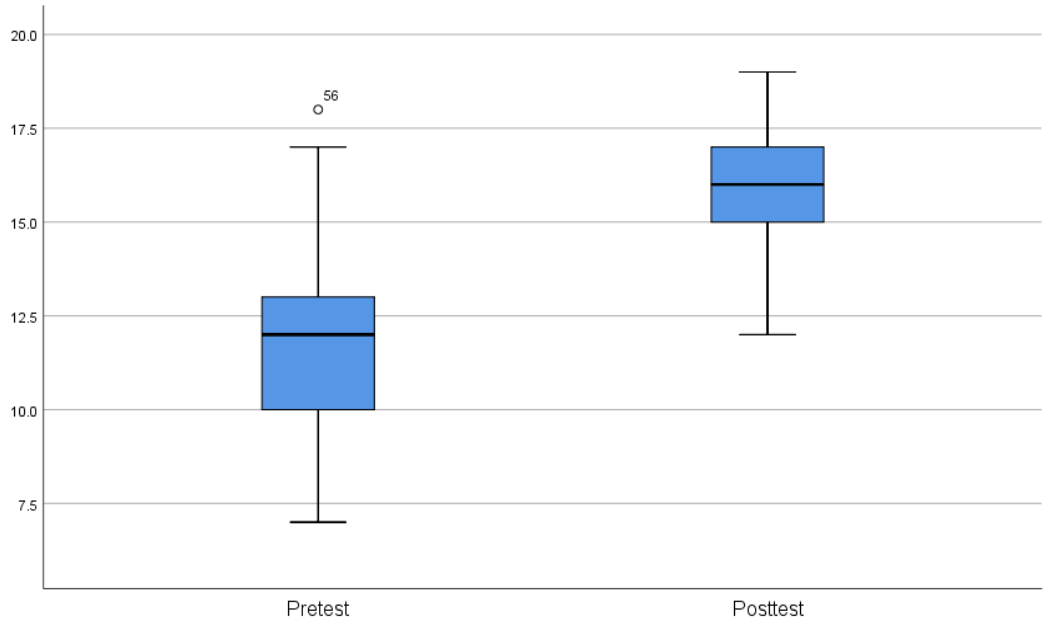

Figure 1. Box plot of pretest and posttest scores

Discussion

This study aimed to evaluate the effect of combined game-based and simulation-based training on improving nurses' triage knowledge in mass casualty incidents. In recent years, many lecture-based trainings have been conducted in the field of triage, but methods based on games and simulated exercises have been reported to be highly effective in addition to conventional and traditional training.[10] The results of this study are in line with the results of Kim et al.'s study, which was conducted with the aim of determining the effectiveness of responding to mass casualty incidents via a simulation method in nursing students. Education via a simulation method can increase the knowledge level of students, improve their response to mass casualty incidents and is highly effective.[4] Additionally, in another study conducted by Faraji et al. with the aim of investigating the effectiveness of triage training in prehospital emergency nurses, the effect of this training method was observed to be very impressive.[25]

One of the greatest problems faced by the nurses in this study was the response of the nurses in the practice section, who used the game method to solve the scenarios that were in the list of past risks so that they could not respond to the scenarios in the set time and lost time. The lack of ability of nurses to control time for immediate response was also shown in the study of Al Marzouq et al. so that emergency nurses did not have proper timing for triaging patients, and the level of education of the nurses in this study, similar to the previous study, did not show any significant relationship with the pre- or posttest results.[5] The findings of game-based training in the present study showed that the nurses who participated from the trauma center hospital were more prepared to solve the scenarios than other nurses were. The trauma center nurses were more skilled in both answering questions and timing to solve the scenarios. The ability of trauma center nurses to respond to and solve scenarios was observed in line with another study that was conducted with the aim of determining the effectiveness of triage training in trauma patients.[26] When faced with the simulated patients, according to the need for speed and precision, the nurses all used START triage as effective triage.

In Sarkisian's study, with the aim of determining the type of effective triage for recent mass casualty incidents, triage via the START method was reported to be 85% effective and accurate.[27] After implementing the exercise in a game and simulation method such that the nurses were not afraid of harming the patients, their self-confidence and motivation to learn strengthened, and they became willing to solve more scenarios so that all the participating nurses they wanted to continue solving the scenarios.

The type of training for nurses should be such that they can actively participate in the training process. New educational methods have been reported to be very important and effective in the field of nurses' learning. The response attitudes of crisis team nurses to mass casualty incidents were reported to be positive after they practiced the game method and field simulation. The use of modern educational methods in different populations and larger sample sizes for nurses is recommended. Additionally, to prevent the forgetting of acquired skills, it is recommended to conduct follow-up assessments at different time intervals. Limitations of this study included the lack of a control group and a relatively small sample size. It is recommended that future studies be conducted with a control group and larger sample size.

Ethical Considerations

The present study was approved by the ethics committee of Semnan University of Medical Sciences with the ethics code IR.SEMUMS.REC.1403.055. In this educational process, a clear explanation of the objectives of the study to the experts, the confidentiality of the personal information of the nurses participating in the research process, and the noninterference of the personal opinions of the researchers in the stages of data collection, analysis and reporting of the different parts of the study are presented.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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References

1. Apiratwarakul K, Cheung LW, Tiamkao S, et al. Smart glasses: a new tool for assessing the number of patients in mass-casualty incidents. Prehospital and disaster medicine 2022;37(4):480-484. doi: 10.1017/S1049023X22000929

2. Armstrong JBP. Preparing your emergency department for disaster: Optimizing surge capacity during mass casualty events. SAGE Publications Sage CA: Los Angeles, CA; 2024:86-89. doi: 10.1177/08404704231199403

3. Moran ME, Zimmerman JR, Chapman AD, et al. Staff perspectives of mass casualty incident preparedness. Cureus 2021;13(6). doi: 10.7759/cureus.15858

4. Kim J, Lee O. Effects of a simulation-based education program for nursing students responding to mass casualty incidents: A pre-post intervention study. Nurse education today 2020;85:104297. doi: 10.1016/j.nedt.2019.104297

5. Almarzooq AM. Emergency department nurses' knowledge regarding triage. International Journal of Nursing 2020;7(2):29-44. doi: 10.15640/ijn.v7n2a5

6. Gorick H, McGee M, Wilson G, et al. Understanding triage assessment of acuity by emergency nurses at initial adult patient presentation: a qualitative systematic review. International emergency nursing 2023;71:101334. doi: 10.1016/j.ienj.2023.101334

7. Dumrique J, Enriquez A, Liyanage N. Challenges Nurses Face when Performing Triage in Accident and Emergency Departments. 2024.

8. Domagala SE, Vets J. Emergency nursing triage: keeping it safe. Journal of Emergency Nursing 2015;41(4):313-316. doi: 10.1016/j.jen.2015.01.022

9. Sigle M, Berliner L, Richter E, et al. Development of an anticipatory triage-ranking algorithm using dynamic simulation of the expected time course of patients with trauma: modeling and simulation study. Journal of Medical Internet Research 2023;25(1):e44042. doi: 10.2196/44042

10. Hosseini MM, Hosseini TM, Qayumi K, Baeradeh N. Game-based vs. case-based training for increasing knowledge and behavioral fluency of nurse students regarding crisis and disaster management; a quasi-experimental study. Archives of Academic Emergency Medicine 2022;10(1):e77.

11. Murray R. An overview of experiential learning in nursing education. Advances in Social Sciences Research Journal 2018;5(1). doi: 10.14738/assrj.51.4102

12. Afrasiabifar A, Najafi Doulatabad S, Mosavi A. Comparing the effect of feedback lecture and conventional lecture on the students' learning and satisfaction to teach intensive nursing cares. Journal of Nursing Education 2014;3(3):69-78.

13. Gandhi S. Nursing Students Perceptions about Traditional and Innovative Teaching Strategies-A Pilot Study. Journal of Krishna Institute of Medical Sciences (JKIMSU) 2015;4(1).

14. Moss R, Gaarder C. Exercising for mass casualty preparedness. Elsevier; 2022. p. e67-e70. doi: 10.1016/j.bja.2021.10.016

15. Becker R, Majers JS, Moody J. Disaster preparedness for charge nurses: A program evaluation. Journal of Emergency Management (Weston, Mass) 2021;19(1):39-45. doi: 10.5055/jem.0551

16. Morgan S, Jones B. Developing pre-registration nurses' resilience to mass casualty situations through the pedagogy of simulation. British Journal of Healthcare Assistants 2022;16(4):196-202. doi: 10.12968/bjha.2022.16.4.196

17. Pek JH, Quah LJJ, Valente M, Ragazzoni L, Della Corte F. Use of simulation in full-scale exercises for response to disasters and mass-casualty incidents: a scoping review. Prehospital and disaster medicine 2023;38(6):792-806. doi: 10.1017/S1049023X2300660X

18. Riza'i A, Ade WA, Albar I, Sulitio S, Muharris R. Teaching start triage: a comparison of lecture and simulation methods. Advanced Science Letters 2018;24(9):6890-6892. doi: 10.1166/asl.2018.12874

19. Yu E, Coffey C. Prehospital mass casualty incident triage simulation builds knowledge and confidence in medical trainees. AEM Education and Training 2024;8(2):e10962. doi: 10.1002/aet2.10962

20. Chugh R, Turnbull D. Gamification in education: A citation network analysis using CitNetExplorer. Contemporary Educational Technology 2023;15(2). doi: 10.30935/cedtech/12863

21. Ma D, Shi Y, Zhang G, Zhang J. Does theme game-based teaching promote better learning about disaster nursing than scenario simulation: A randomized controlled trial. Nurse education today 2021;103:104923. doi: 10.1016/j.nedt.2021.104923

22. May A. Gamification, game-based learning, and student engagement in education. 2021.

23. Schwengel DA, Divito A, Burgess N, et al. Influx! A game-based learning tool for in-hospital interprofessional disaster preparedness and response. British journal of anaesthesia 2022;128(2):e213-e215. doi: 10.1016/j.bja.2021.11.028

24. Meservy D, Monson MA. Impact of continuing education on nursing practice and quality of patient care. SLACK Incorporated Thorofare, NJ; 1987. p. 214-220. doi: 10.3928/0022-0124-19871101-10

25. Faraji A, Khankeh H, Hosseini M, Abdi K, Rezasoltani P. Effect of simulated training course on preparedness of nurses to do pre-hospital triage. Journal of health promotion management 2013;2(4):24-29.

26. Ghazali SA, Abdullah KL, Moy FM, Ahmad R, Hussin EOD. The impact of adult trauma triage training on decision-making skills and accuracy of triage decision at emergency departments in Malaysia: A randomized control trial. International Emergency Nursing 2020;51:100889. doi: 10.1016/j.ienj.2020.100889

27. Sarkisian S. Current Disaster Triage Methods in Mass Casualty Incidents. Prehospital and Disaster Medicine 2023;38(S1):s182-s182. doi: 10.1017/S1049023X23004703