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Evaluating the effect of a scenario-based pre-hospital trauma management training course on the knowledge and clinical skills of emergency medical service students

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Abstract

Introduction Implementing innovative educational methods is crucial for enhancing emergency technicians' knowledge and skills in providing fundamental care for trauma patients. This study aims to assess the impact of a scenario-based pre-hospital trauma management (PHTM) course on the knowledge and skill level of emergency medical system (EMS) students in Iran.

Methods This semi-experimental, single-group pre-test-post-test study involved 25 emergency medical students participated in the PHTM training course. The students underwent two days of training (6 h per day) in a simulated, scenario-based environment across 5 stations, using realistic patients. The PHTM course knowledge assessment tool and a standard clinical skills checklist were used to collect data before and after the intervention.

Results The results revealed that EMS students had an average level of trauma knowledge and clinical skills before the PHTM course, which significant improved to a desirable level after the intervention($P=0.0001$). The average skill level increased from 57.44 before the intervention to 122.24 afterward. The results also demonstrated that the interventions significantly improved students' skill levels in various PHTM domains, including trauma patient assessment, spinal motion restriction for sitting and lying positions, immobilization of injured long bones and joints, application of a traction splint, bleeding control and shock treatment, airway management, and ventilation/endotracheal intubation skills($P=0.0001$).

Conclusion The findings of this study indicate that scenario-based and simulated training methods, as applied in the PHTM workshop, are effective in improving emergency medical students' knowledge and clinical skills for managing trauma patients.

Keywords Trauma management, EMS student, Scenario-based learning

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Introduction

Trauma are among the leading global health issues, resulting in numerous casualties worldwide [1]. It is estimated that trauma-related emergencies are responsible for a significant portion of youth and child mortality [2]. An immediate and effective response to incidents can significantly reduce trauma-related mortality rates [2]. The emergency medical service (EMS) systems, as the frontline in managing traumatic emergencies, play a critical role in the treatment and care of trauma victims. It is consistently focused on delivering high-quality care for trauma patients [3]. The success of EMS depends on several key factors: the presence of trained emergency medical technicians (EMTs) at the scene, rapid response times, the skill level of EMTs, swift interventions at the scene, and timely transfer to the most appropriate hospital [4, 5]. More accurate and scientifically informed interventions by EMTs will lead to greater reductions in trauma-related mortality and disability [6]. Some studies have indicated that deficiencies in the knowledge and skills of EMTs are key factors contributing to their poor performance in effectively caring for and treating trauma victims [7, 8]. Therefore, enhancing the knowledge and skills of EMS technicians through new and effective training methods can significantly improve their ability to save the lives of critically injured trauma patients [9, 10].

Given the importance of enhancing the knowledge and skills of EMTs in trauma management, the National Medical Emergency Organization in Iran has developed and executed PHTM training course in recent years. The PHTM course aims to enhance the quality of care for trauma patients during the early stages of the trauma continuum (prehospital phase) [11, 12]. During these course, theoretical concepts and principles of trauma patient care are applied through scenarios involving patient cases and simulated scenes. The effectiveness of this course in in-service training has been demonstrated by numerous studies within the Iran [13–15]. However, the benefits of this course for emergency medical students are still unknown. The theoretical training provided in classrooms, primarily through lectures, question and answer sessions, and the use of visual aids such as video projectors and PowerPoint presentations, is insufficient to fully prepare EMS students for dealing with traumatic emergencies. Therefore, the researchers of this study aimed to investigate the effect of a scenario-based PHTM training course on the knowledge and clinical skills of EMS students.

Methods

Study design and setting

The study design is a semi-experimental, one-group pretest-posttest design. Following this design, a group of 25 EMS students was selected using the census method from Qazvin University of Medical Sciences in 2023 to participate in the PHTM training course.The students was pre-tested using the research tools and then participated in a two-day training course. Upon completing the course, they were tested again using the same tools. Figure 1 illustrates the experimental process. Criteria for inclusion in the study were a willingness to participate and no prior experience with PHTM training courses. It is important to note that, as part of their two-year academic program, these students complete a two-unit course titled "Advanced Trauma," alongside other course units (totaling 65 units), including subjects like internal emergencies. Exclusion criteria included absence during training days or withdrawal from the study.

Data collection tools

Research tools consisted of a demographic information questionnaire, a standard knowledge assessment questionnaire for the PHTM course, and a standard clinical skills checklist. The PHTM course knowledge assessment questionnaire is a standardized tool used globally in PHTM courses [16]. It includes 50 multiple-choice questions with four options each, covering areas such as initial patient assessment, airway management, breathing examination, blood circulation examination, disability

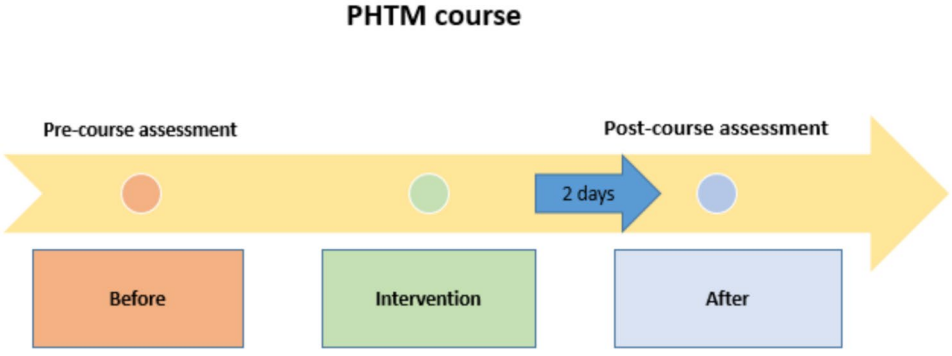

Fig. 1 Quasi-experimental one-group pretest-posttest design

assessment, detection, and secondary assessment. Each question has a single correct answer worth 2 points, with total scores ranging from 0 to 100. Scores are categorized as follows: 0–49 (poor knowledge and skill), 50–59 (average knowledge and skill), 60–79 (good knowledge and skill), and 80–100 (very good knowledge and skill). The tool's validity was confirmed by ten trauma experts in Heydarpour et al.'s study, with reliability confirmed via Cronbach's alpha for knowledge (0.85) and skill (0.79) [13, 16].

The standardized clinical skill checklist includes nine essential skills in pre-hospital trauma care: (1) trauma patient examination (40 points), (2) spinal motion restriction for a sitting patient (11 points), (3) spinal motion restriction for a supine patient (13 points), (4) immobilization of an injured long bone (11 points), (5) immobilization of an injured joint (9 points), (6) application of a traction splint (13 points), (7) bleeding control and shock management (11 points), (8) insertion of an oropharyngeal or nasopharyngeal airway and suctioning (12 points), and (9) oral-tracheal ventilation and intubation (19 points). This checklist was adapted from the translated "National Registry of Emergency Medical Technicians Skills Sheets" [17]. In this checklist, each skill is scored with 1 point for correct performance and 0 points for non-performance. Clinical skill levels are categorized as follows: a score of 0–36 indicates poor skill, 36–92 represents average skill, and 93–139 reflects good skill. The checklist is completed through an objective structured clinical skill (OSCE) evaluation, with OSCE stations designated for the nine skills. Prior to the course commencement, the evaluators underwent a two-hour training session to familiarize themselves with the checklist's structure and items, as well as the proper procedures for assessing participants. Each research participant completes all skills uniformly following a fixed, standard protocol aligned with their training. This checklist was developed by Norouzinia and colleagues in 2016, based on a translation of the National Registry of Clinical Skills Sheets for Emergency Medical Technicians [18]. The content validity of this tool was confirmed by ten experts from the University of Social Welfare and Rehabilitation Sciences, the National Medical Emergency Organization, and EMS of Tehran city. Its reliability was calculated using Cronbach's alpha, yielding an 80% reliability score for the skill set [18].

Table 1 Content of the PHTM training program

Day 1	- Scene management, and initial Trauma patient assessment - Mecanisms of injeres in diffrent incidents - Bleeding and shock management in trauma patients - Airway management, breathing, ventilation and oxygenation in trauma patients
Day 2	- Evaluation and management of burned trauma patients - Evaluation, immobilization and transfer of trauma patients, specially the patints with spinal trauma Management, limitation and stabilization in fractures and sprains

Educational intervention

The educational intervention followed the content and structure of the PHTM training course provided by the National Medical Emergency Organization. This course was conducted as a two-day, 12-hour workshop (6 h per day) covering trauma patient management (as outlined in Table 1). Prior to the course, participants were thoroughly briefed on the location, schedule, content, and process of the training. Next, all practical skill evaluation stations (5 stations) set up in the clinical skills center of Qazvin University of Medical Sciences, where the course was held, were shown to the study participants for initial familiarization. To simulate a realistic bedside environment, these stations were designed in line with the course content and structured around various scenarios in a simulated setting. At each station, a simulated casualty (volunteer), tailored to the scenario's requirements, was prepared by a professional makeup artist and thoroughly trained to perform their role before the course commenced. The scenarios used for skill assessment included: a car swerving and colliding with a guardrail on the side of the highway, resulting in injuries to the driver, a young man (station1). A motorcycle overturns, resulting in a spinal injury to a middle-aged man (station2). A child boy falls from a height, resulting in a fracture of the left femur and injury with swelling to the right wrist(station3). A young man sustained a gunshot injury, resulting in a punctured right chest with a sucking wound(station4) and a middle-aged man jumped from a second-floor window to escape a fire and lost consciousness upon landing(station5). At each station, the necessary medical equipment, appropriate to the respective scenario, was prepared in advance and made available to the participants. Before starting the training course, the PHTM course knowledge evaluation tool and the standard clinical skill checklist were completed after the participants were exposed to the practical skill stations. Following this, the training content was delivered over two days (6 h per day) as outlined in Table 1. After completing the educational intervention, the participants' knowledge and clinical skills were re-evaluated and recorded using the same research tools in the same day after the course. The clinical skills assessment involved presenting participants with a scenario at each station (describing a traumatic incident with details of the injured person). They were asked to perform clinical actions and interventions based on the scenario's information within a 10-minute timeframe, treating the hypothetical injured person. Finally, the data collected before and after the intervention were analyzed using

Table 2 Demographic information of participants

Variables	Categories	Frequency	Percentage
Gender	Female	0	0
	Male	25	100
Work history as an EMS technician	1 < yrs	4	16
	2–5 yrs	19	76
	5 > yrs	2	8
Age	20–25	3	12
	26–30	17	68
	31–35	5	20

Table 3 Comparison of knowledge and skill score related to PHTM before and after intervention

Variable	Time	Befor intervention	After intervention	t	*p*-value
		M ± SD	M ± SD		
PHTM Knowledge		58.16 ± 3.71	74.26 ± 3.30	-6.8	0.001
PHTM Skill		57.44 ± 9.31	122.24 ± 6.9	-11.8	0.001

SPSS version 20 software, employing descriptive (mean, standard deviation, frequency, percentage) and analytical (paired t-tests) statistical tests.

Results

In this study, 25 EMS students, with an average age of 29 years, were selected and evaluated according to the study objectives. All participants were male, and the majority (95%) were employed as operational technicians in EMS centers while completing their studies (Table 2). The results indicated that, on average, students' PHTM knowledge and skills scores were at an intermediate level prior to the training course. After completing the course, these scores improved to a good level (Table 3). The paired t-test statistical analysis showed a statistically significant difference in students' average PHTM knowledge before and after the intervention ($P < 0.001$) (Table 3). Similarly, the analysis of students' skill levels in PHTM revealed a statistically significant improvement from before to after the intervention ($P < 0.001$). The average skill level increased from 57.44 ± 9.31 before the intervention to 122.24 ± 6.9 afterward (Table 3). The results also demonstrated that the PHTM training course significantly improved students' skill levels in various PHTM domains, including trauma patient assessment, spinal motion restriction for sitting and lying positions, immobilization of injured long bones and joints, application of a traction splint, bleeding control and shock treatment, airway management, and ventilation/endotracheal intubation skills. All improvements were statistically significant ($P < 0.001$) (Table 4).

Discussion

This study aimed to assess the impact of a scenario-based PHTM training course on the knowledge and skills of undergraduate EMS students in managing and caring for trauma patients. The findings indicate that teaching trauma care principles through scenario-based learning—using simulated scenes and patient scenarios—significantly enhances students' knowledge and skills in this area. Numerous studies have examined the impact of scenario-based learning on participants' knowledge, attitudes, and skills, consistently showing positive outcomes [13, 19–21]. In Pongtriang et al.'s (2016) study, the effects of scenario-based versus lecture-based learning on the knowledge and attitudes of emergency medical technicians regarding chest trauma patients were compared. The findings highlighted the effectiveness and acceptability of the scenario-based learning method [20]. In a other study by Hani et al. (2023), the effectiveness of head trauma management training was evaluated using scenario-based and lecture-based methods to improve clinical decision-making among EMS staff. The results preferred the scenario-based learning method over the traditional lecture-based approach [19].

In the current study, results indicated that most students were at an average level of PHTM knowledge prior to the intervention. Similarly, Norouzinia et al. (2016) found that, in their evaluation of EMS students' knowledge and clinical skills in trauma management, most students demonstrated an average level of knowledge in this area [18]. Similarly, in Shakri et al.'s (2018)

Table 4 Comparison of skill component scores before and after intervention

Variable	Time	Befor intervention	After intervention	t	*p*-value
		M ± SD	M ± SD		
Trauma patient assessment skill		19.64 ± 8.04	39.92 ± 2.30	-11.8	0.001
The ability to limit movement of the sitting position		4.92 ± 1.75	9.28 ± 5.44	-4.3	0.001
The ability to limit movement of the lying down position		5.04 ± 1.77	10.52 ± 1.61	-14	0.001
The ability to limit movement of the injured long bones		4.52 ± 2.00	10.00 ± 0.76	-11.67	0.001
The ability to limit movement of the injured joint		4.00 ± 1.50	7.36 ± 1.49	-8.78	0.001
The skill of using traction splint		5.04 ± 8.04	10.60 ± 2.17	-9.77	0.001
Bleeding control skill/shock treatment		4.48 ± 1.38	9.56 ± 1.12	-17.28	0.001
Airway management Skills		4.56 ± 1.60	10.84 ± 1.43	-17.52	0.001
Skill of ventilation / endotracheal intubation		5.24 ± 2.38	17.16 ± 1.67	-22	0.001

study, it was found that approximately 80% of EMTs in the EMS of Tehran had an average level of knowledge in trauma patient care [22]. In the present study, the results indicated that the PHTM training course significantly improved students' knowledge regarding trauma patient care. These findings align with those of Heydarpoor et al. (2021), who also demonstrated that the basic trauma care course positively impacted the knowledge and skills of pre-hospital emergency workers [13].

The results of the present study indicated that, prior to the intervention, most participants were at an average level in terms of trauma patient management and care skills across all dimensions. Similarly, in the studies by Norouzinia et al. (2016) and Shakeri et al. (2018), the results showed that most participants demonstrated a good skill level in this area [18, 22]. In the present study, the results showed that the PHTM training course significantly improved the skill level of EMS students across all dimensions of trauma patient care. This indicates that the PHTM educational program was effective in enhancing students' skills in managing and caring for trauma patients. In line with the results of this study, Esmailzadeh et al. (2019) conducted a study to investigate the effect of a trauma patient management training program on the clinical decision-making abilities of emergency medical technicians. The results showed that the trauma management training program, which included both lecture-based and simulation-based training, led to a significant improvement in the decision-making abilities of the participants [15, 22]. Similarly, in the study by Heydarpoor et al. (2021), which aimed to investigate the effect of a basic trauma care course on the knowledge and skills of emergency medical personnel, the results demonstrated a statistically significant difference in the participants' knowledge and skills before and after the training course [13].

Study limitations

One of the limitations of this study was the small sample size (The total number of students was 25), which made it challenging to assess the effect of the intervention in two separate groups and compare it with other educational methods. Future studies are suggested to explore the impact of the scenario-based PHTM educational course in comparison with other educational approaches including traditional (lecture-based) and modern techniques like virtual reality and metaverse-based education. Another limitation of the study was the participants' proximity to graduation, which made it impractical to evaluate the intervention's effects over an extended period, such as a month or more. Furthermore, the university's Clinical Skills Center was accessible to the research team for only two days. Therfor, Future studies are encouraged to investigate the intervention's effects over one-month and three-month intervals.

Conclusion

Proper and principled care of trauma patients, especially at the accident scene (pre-hospital), plays a critical role in determining patient outcomes. Therefore, it is vital to utilize effective educational methods that closely simulate real-life scenarios to improve the knowledge and skills of EMS students in trauma care. The results of this study indicate that while the scenario-based PHTM training course significantly enhances the knowledge and skills of EMS students, larger controlled studies with both experimental and control groups would offer more reliable outcomes. The educational officials and managers can incorporate this method into the training programs for EMS students, focusing on the care and treatment of trauma patients with proper planning and implementation.

Abbreviations

EMS	Emergency medical services
EMT	Emergency medical technician
PHTM	Pre-hospital trauma management
OSCE	Objective Structured Clinical Examination

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Author contributions

All authors have read and approved the manuscript. Study design: MB-J, RA, and YA-SH. Data collection and analysis: MB-J, RA, YA-SH and ZA. Manuscript preparation: MB-J, RA.

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Data availability

The datasets that were used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Clinical trial number

Not applicable.

Ethics approval and consent to participate

This paper was derived from the Qazvin University of Medical Sciences (QUMS) research project with No.402000070. The institutional review board of QUMS approved all the methods and steps of this study, and the requirement for informed consent was waived by the QUMS Research Ethics Committees (no.IR.QUMS.REC.1402.182). The study procedures were in accordance with the Declaration of Helsinki ethical guidelines, and all research units (EMS students) voluntarily participated in this investigation.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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