

Original Article

Promotion of Knowledge, Skill, and Performance of Emergency Medical Technicians in Prehospital Care of Traumatic Patients: An Action-research Study

Javad Dehghannezhad, Farzad Rahmani¹, Rouzbeh Rajaei Ghafouri², Hadi Hassankhani³, Abbas Dadashzadeh, Zhilla Heydarpoor Damanabad⁴

Road Traffic Injury Research Center, School of Nursing and Midwifery, Tabriz University of Medical Sciences, Tabriz, Iran, ¹Department of Emergency Medicine, Sina Medical Research and Training Hospital, Tabriz University of Medical Sciences, Tabriz, Iran, ²Department of Emergency Medicine, Tabriz University of Medical Sciences, Tabriz, Iran, ³Center of Qualitative Studies, School of Nursing and Midwifery, Tabriz University of Medical Sciences, Tabriz, Iran, ⁴Department of Pediatric Nursing, School of Nursing and Midwifery, Tabriz University of Medical Sciences, East Azerbaijan Province, Tabriz, Iran

ORCID:

Javad Dehghannezhad: <https://orcid.org/0000-0003-1304-4726>

Farzad Rahmani: <https://orcid.org/0000-0001-5582-9156>

Rouzbeh Rajaei Ghafouri: <https://orcid.org/0000-0002-3760-572X>

Hadi Hassankhani: <https://orcid.org/0000-0002-6710-5582>

Abbas Dadashzadeh: <https://orcid.org/0000-0002-2432-1904>

Zhilla Heydarpoor Damanabad: <https://orcid.org/0000-0001-6969-4109>

Abstract

Background: Annually, there is a high rate of mortality due to trauma. Prehospital emergency personnel are the first caregivers present beside trauma patients, and their dexterity to take care of trauma patients is of great significance in the vast majority of patients' survival. **Materials and Methods:** This study was action research with the participation of 125 prehospital emergency personnel from May 2016 to December 2018 in five stages (observation, reflection, planning, action, and evaluation) in Iran. Knowledge, skills, and performance of personnel were assessed before and after the action. Data collection tools included knowledge questionnaire and PERFECT skill assessment checklist by Objective Structured Clinical Examination method and researcher-made checklist for performance. Data were analyzed using SPSS-21 software. **Results:** The findings indicated that 67.82% and 84.4% of prehospital emergency staff have median to low knowledge and expertise in respect to trauma care, respectively. Their performance of necessary measurements for trauma patients was poor prior to training. There was a significant difference between the mean knowledge, skills, and performance of medical emergency technicians before and after the training course ($P = 0.00$). **Conclusions:** Participation of beneficiaries in planning for trauma patient's care is helpful. Establishment of prehospital trauma life support training in the medical emergency, training curriculum, and its instruction to prehospital emergency personnel while serving in trauma care will be of great benefit.

Keywords: Action research, emergency, pre-hospital, trauma

INTRODUCTION

Trauma is among the major threats to society's health and trauma resulting from road accidents leads to high levels of casualties annually,^[1] as road accidents are dubbed as road wars.^[2] According to the World Health Organization statistics, road accident deaths are the ninth leading cause of death worldwide and are expected to rise to rank third by 2020.^[3] Trauma has also imposed considerable direct and indirect economic and social costs on society and annually results in

Address for correspondence: Ms. Zhilla Heydarpoor Damanabad, Department of Medical-Surgical, Faculty of Nursing and Midwifery, South Shariati Street, Tabriz, East Azerbaijan Province, Iran. E-mail: haydarpoor22@yahoo.com

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about one billion dollars of economic damage to society, all of which leading health-care policy-makers and planners to take fundamental measurements in this regard.^[4]

Car accidents are the third leading cause of death in Iran; more than 21,000 accidents take place annually, killing about 14,000 and leaving 7000 individuals injured.^[5] The increasing incidence of road traffic accidents and traumatic injuries in Iran doubles the significance considering trauma patients care as an important issue, although new methods of caring for traumatic patients are not applied and necessary training is not provided either.^[6]

One of the criteria for social development is the provision of prompt and appropriate health services to the public.^[7] In the health-care system, in cases of emergency, the first contact is made with the prehospital emergency department, and this system addresses the specific health needs of individuals outside the hospital complex.^[8] Accurate and proper conduction of prehospital care has a significant impact on reducing the mortality and morbidity of traumatic injuries, and saving a person's life in the event of an accident depends on the expertise and knowledge of people on the injured bed.^[9] Given the importance of prehospital care for traumatic injuries, of total 264 guidelines, the German Trauma Association has assigned 66 to prehospital trauma patient's management.^[10]

One of the main reasons underlying the improper function of prehospital emergency staff in providing care to injured patients is the lack of required knowledge and skills.^[11] Training individuals with scientific and practical abilities and skills to provide services to the injured in the most critical times of crisis is of great importance.^[12] Thus, the promotion of knowledge and skills of this segment of the health-care system facilitates the provision of emergency care with optimal quality of care and reduction in mortality and morbidity.^[13]

Training emergency medical system staff with the principles of prehospital basic care for trauma patients is unique and is conducted for the provision of high-quality and accurate service to trauma patients so that an effective step is taken toward a reduction in the mortality and morbidity of trauma patients.^[14,15] In their study, Patel *et al.* asserted that one of the reasons underlying the delay of prehospital emergency staff in the transfer of trauma patients is inadequate training.^[16]

In Iran's education system, the training for nursing staff and those with other fields (operating room and anesthesia) who are authorized to work in a prehospital emergency does not have the necessary competence for traumatic patient's care.^[17] A research has revealed that one of the top priorities for emergency centers is instructing special courses for trauma patients' care.^[6] In addition, a study showed that training practical skills when confronting crisis and assessment skills is one of the priorities in education needed for prehospital emergency staff in Iran.^[18]

One of the ways to improve the quality of service provision is to exert useful changes in practice in organizations in the real scenarios, in which personnel themselves engage and strive to

improve service quality.^[19] Action research is a strategy rooted in philosophical foundations such as pragmatism as well as praxis, which has been known as a special research approach in health-care environments, which not only leads to enhancement in service provision but also fortifies all staff engaged in health care including caregivers and care receiver.^[20]

On the one hand, there are insufficient measures in Iran to empower prehospital emergency personnel to provide basic prehospital care for trauma patients, and on the other hand, the number of traumatic injuries is increasing every day; hence, the aim of this study was to improve knowledge, skills, and performance of medical emergency staff in providing care for trauma patients so that with such approach, the upcoming issues would be addressed and resolved and the quality of service provided to trauma patients would improve.

MATERIALS AND METHODS

This project was derived from the Road Traffic Injury Research Center (RTIR.5/4/7748) Tabriz University of Medical Sciences, Tabriz, Iran. This study was conducted to strengthen emergency medical staff for traumatic injuries care with a participatory action-research approach among the staff of Tabriz Prehospital Emergency Center from May 2016 to December 2018. This project was an audit for emergency medical staff. Action research is a dynamic process, which develops through cyclical steps and results in alterations in the system and leads to promotion in services provision and fortifying of all individuals engaged in health care.^[21] In this study, the O'Leary's Cyclic Method was used which consisted of five cyclic steps including observe, reflect, plan, act, and evaluation.^[21]

Participants

Tabriz Prehospital Emergency Center had 20 ambulance stations and 100 emergency medical technicians (EMTs) and 15 operators. All technicians and operators involved in this project. Participants in this study consisted of 125 of prehospital emergency staff in Tabriz including 1 head of center, 5 medical emergency faculty members, 100 medical emergency technicians, 15 operators, 5 emergency medicine specialists, 3 managers, 2 training persons, 4 dispatch physicians, and 1 person in charge of quality control. To select the participants for this action research, purposeful sampling was used, and for the part of quantitative research, all technicians and operators were selected. In contrast to some qualitative studies, participants in the action-research study were not separated from the research process.^[2] Inclusion criteria were as follows: working in prehospital emergency services, having at least 1 year of clinical work experience, and willingness to participate in the research. Exclusion criteria included people with physical and psychological problems.

First stage (observe/data collection)

The first step aimed to collect data to assess the knowledge, skills, and performance of medical emergency staff in Tabriz regarding trauma patient's care. Questionnaires were

employed to evaluate their knowledge, objective structured clinical examination (OSCE) test to assess skills, and a researcher-made checklist to inspect performance, which tested the attitude toward the injured.

Instruments

Knowledge

Measuring knowledge questions with respect to basic prehospital care in trauma patients consisted of 50 four-choice questions and range of 0 to 100, with scores in 0–49 range indicating poor knowledge, 50–79 medium knowledge, and 80–100 good knowledge. In this study, to determine the validity of the questionnaire, three trauma experts were approved and the reliability was calculated with Cronbach's alpha (0.85).

Skills

To assess skill, the PERFECT checklist was employed using OSCE methodology under Prehospital Trauma Life Support (PHTLS) scenarios. It included five stations named ABCDE, with each having a simulated patient and primary evaluation items and critical measures; secondary evaluation based on the checklist was assessed. To evaluate validity, the checklist was handed to five specialists of emergency medicine and its reliability was calculated with Cronbach's alpha (0.82). It was scored in the form of instructor potential, successful, repeat course, and fail. Range of 0 to 100 with scores in 0–49 range indicated fail, 50–59 – repeat course, 60–69 – successful, and 80–100 – instructor potential.

Performance

To evaluate the performance of the emergency technician, emergency mission cards to trauma patients were exploited and all the missions 6 months before and after the PHTLS course were analyzed based on the checklist. This checklist included interventions for traumatic patients (vital signs control and pulse oximetry measured, use of airway, oxygen therapy, bleeding control and bandage, IV lines, use of a cervical collar, employment of splint, fasten spider belt, spine board, and consultation with a dispatch physician). The checklist was handed to five specialists of emergency medicine and its reliability was calculated with Cronbach's alpha (0.77). Scores were recorded as the number and percentage of interventions before and after training.

Second stage (reflect)

Following data collection, data were inspected with the cooperation of all participants and problems were identified according to their views. In this step, two focus group sessions were held with all participants. Only 15 informed technicians were invited to comment on how to enhance care for traumatic injuries, and it was finally agreed that PHTLS courses should be held with the standard methods.

Third stage (plan)

Initially, a meeting was held with the participants to coordinate the program, and then, five of the emergency medicine professors who had a PHTLS certificate were invited to teach. Five individuals were selected among village staff as simulated

trauma patients and were trained necessary materials, and one makeup artist was invited to put makeup of simulated patients. The training sessions were held in 8 groups, each consisting of 12 6-h sessions, each month by the emergency medicine physicians in the Tabriz Emergency Medical Center. Pretest and posttest on staff knowledge were conducted before and after the course.

Fourth stage(act)

At this step, courses were taught by instructors to 100 technicians and 15 operators in 12 6-h sessions in eight-person groups. Of 12 sessions, six were dedicated to theoretical concepts including primary and secondary assessment, breathing, circulation, disability, and expose and six were practical training sessions in 6 rooms with 6 simulated patients according to the standard PHTLS scenarios. First, each eight-person group attended theory classes, and then, the stage was practical. Each technician was present in six rooms that simulated patients were based on a scenario. Scenarios in rooms were based on trauma included airway obstruction, respiratory problems, circulatory system disorder, central nervous system injury, rescue the patient from the car, and immobilization of the patient. Each room had an instructor, usually, an emergency medicine specialist, and the evaluation was done based on the checklist.

Five stage (evaluation)

Assessment of the knowledge of prehospital basic care in traumatic injuries in prehospital emergency staff of each group after completion of each course was conducted with standard 8th edition PHTLS questions, and skill evaluation was conducted using the OSCE test before and after the course. The performance of the staff was inspected for 6 months after completion of the course through the checklist and was compared to that of 6 months before the course.

Data were analyzed using computer SPSS software (SPSS 22.0, IBM Corp, Chicago, USA) was used for data analysis. Descriptive analysis of quantitative variables was performed using the mean and standard deviation of the variables. Descriptive analysis of ordinal variables was performed using absolute and relative frequency determination. Paired *t*-test was used to compare the relationship between before and after education.

RESULTS

The median age of participants in the present study was 35 years with an average 10 years of work experience; 59% of them have educated in emergency medicine and 63% of them possessed bachelor degree [Table 1].

Approximately 67.82% (78 individuals) of the participants were in low level of knowledge before taking an educational course and following taking educational course, 91.3% (105 persons) were in medium to a high level of knowledge. In respect to skill, before the educational course, about 84.4% (94 individuals) belonged to medium to low level and neither could be placed in

Table 1: Demographic characteristics of the emergency medical technician and operators (n=115)

Characteristics	n (%)
Sex, n (%)	
Male	100 (86.9)
Female	15 (13.1)
Fields of study, n (%)	
Medical emergency	68 (59.6)
Nursing	25 (21.9)
Anesthesia	12 (10.5)
Operating room	3 (2.6)
Other	7 (5.4)
Level of education, n (%)	
Diploma	2 (1.8)
Associate diploma	40 (35.1)
Bachelor	73 (63.1)
Age (years), mean differences (SD)	35.60 (7.88)
Experience of work (years), mean differences (SD)	9.95 (6.84)

SD: Standard deviation

the excellent level. Whereas after this course, about 93% (107 individuals) reached medium to a high level and 6 achieved an excellent score. In addition, a comparison of the mean difference of knowledge and skills of medical emergency technicians before and after the course displayed a statistically significant difference ($P = 0.00$) [Table 2].

In this study, the performance of medical emergency staff in the use of the backboard, cervical collar, spider belt, airway and splint for trauma patients was lower, and all of which increased significantly following this training course.

Moreover, the results of this study indicated that following this training course, prehospital interventions for trauma patients including vital signs control and pulse oximetry measurement, use of airway, employment of splint, oxygen therapy, bleeding control and bandage, venipuncture, use of cervical collar, backpack, spider belt, and medication use in consultation with a dispatch physician in the management of trauma patients by EMTs have enhanced dramatically compared to those of pretraining, and comparison of mean difference in necessary measurements for trauma patients by medical emergency staff displayed significant statistical difference before and after this course ($P = 0.00$) [Table 3].

DISCUSSION

The present study was conducted to promote knowledge, skill, and performance of medical emergency personnel in trauma care through the action-research method. The results of the present study indicated that the participation of personnel in the research through action research method resulted in brainstorming for appropriate solutions and involvement of the majority of authorities in research assisted greatly in the implementation of interventions, and the implemented interventions, particularly PHTLS training courses, led to promotion in knowledge, skill, and performance of medical emergency personnel in trauma patients care.

The results of a study conducted by Häske *et al.* demonstrated that basic prehospital care training courses enhance the skills of medical emergency technicians in safe trauma patient's care.^[22] Moreover, the results of Teuben *et al.* study which assessed the final status of patients transported by EMTs over a 7-year period proved that the time taken to transfer patients to an equipped clinic by PHTLS-trained technicians was dramatically reduced, and these technicians have been quick in performing in incident scene and possess incident scene management and minimized human casualties.^[11] These courses have given prehospital emergency personnel sufficient confidence in dealing with trauma patients.^[23] Silanuwat and Krairojananan study revealed that PHTLS courses led to scene management conduction for traumatic patients in <10 min and improved outcomes for traumatic patients, including reduced mortality and morbidity among these patients,^[24] which demonstrates the importance of PHTLS training in improving and enhancing the efficiency of prehospital emergency system staff.

One of the findings of this study is the promotion of prehospital personnel knowledge with respect to trauma patient care through the conduction of trauma patient care course, pertinent to which the study by Nandasena and Abeysena revealed that EMT-basic staff knowledge is medium level and intermediate and paramedic personnel knowledge is medium to low.^[25] In addition, a study in Indonesia reported prehospital care nurses' knowledge of traumatic patients to be insufficient.^[26] In this regard, Frank *et al.* study in Germany indicated that PHTLS course resulted in an increase in medical emergency staff knowledge and individuals were satisfied with these courses and proposed these courses be added to the university curriculum.^[27] Thus, these courses can be incorporated into the medical emergency curriculum and taught as a workshop for this group.

Another finding of this study was the increase of personnel's ability to perform practical tasks for traumatic patients which is the consequence of practical actions on simulated patients with makeup, and Esmailzadeh *et al.* in their study aiming to determine the effect of training programs about trauma patient management on clinical decision making of medical emergency staff reported that following conduction of this program, decision-making and management abilities of prehospital emergency technicians have improved.^[28] In addition, Kreinest *et al.* demonstrated that individuals who had taken a PHTLS course had higher levels of skills and self-confidence in decision-making and curing trauma patients.^[23] Hence, it is better to combine such programs with technicians training programs during their service and education.

In this study, scenario-based education improved technicians skills in caring for trauma patients. Van Dillen *et al.* study demonstrated that the introduction of simulation into training can improve prehospital care providers' confidence in performing tourniquet placement and needle decompression

Table 2: Assessment of knowledge and skills of medical emergency technicians and operators (n=115)

Variable	Before education, n (%)	After education, n (%)	Mean differences (SD) (after-before)	95% CI for difference		P
				Lower bound	Upper bound	
Knowledge						
Very good	17 (14.8)	56 (48.7)	14.73 (15.89)	11.79	17.66	0.00
Good	20 (17.38)	49 (42.6)				
Medium	42 (36.52)	8 (7)				
Poor	36 (31.30)	2 (1.7)				
Skill						
Instructor potential	0	6 (5.2)	0.52 (0.75)	0.38	0.66	0.00
Successful	18 (15.7)	101 (87.8)				
Repeat course	73 (63.5)	4 (3.5)				
Fail	24 (20.9)	4 (3.5)				

SD: Standard deviation, CI: Confidence interval

Table 3: Assessment of performance of medical emergency technicians and operators (n=115)

Variable	Before education, n (%)	After education, n (%)	Mean differences (SD) (after-before)	95% CI for difference		P
				Lower bound	Upper bound	
Vital signs control and pulse oximetry measured	110 (95.7)	115 (100)	0.043 (0.20)	0.05	0.081	0.025
Use of airway	55 (47.8)	109 (94.7)	0.46 (0.50)	0.37	0.56	0.00
Oxygen therapy	99 (86.1)	110 (95.7)	0.95 (0.29)	0.041	0.15	0.001
Bleeding control and bandage	101 (87.8)	106 (92.2)	0.43 (0.20)	0.005	0.081	0.025
IV lines	106 (92.2)	112 (97.4)	0.052 (0.22)	0.01	0.093	0.014
Use of cervical collar	21 (18.3)	94 (81.7)	0.63 (0.53)	0.53	0.73	0.00
Employment of splint	48 (41.7)	97 (84.3)	0.42 (0.49)	0.33	0.51	0.00
Fasten spider belt	24 (20.9)	98 (85.2)	0.64 (0.49)	0.55	0.73	0.00
Spine board	19 (16.5)	99 (86.1)	0.69 (0.48)	0.60	0.78	0.00
Consultation with a dispatch physician	67 (58.3)	105 (91.3)	0.33 (0.47)	0.24	0.41	0.00

SD: Standard deviation, CI: Confidence interval, IV: Intravenous

in critically injured patients.^[29] In addition, the aim of Abelsson and Lundberg study was to examine how nurses in the ambulance service experienced participation in trauma simulation. The findings showed that there are statistically significant increases between the pre- and posttests.^[30] Therefore, a simulation is an option for teaching staff to handle complex health-care situations and it is suggested to improve the care of traumatic patients and use simulation training.

Another important finding was enhanced personnel performance after the completion of training courses in the current study. A study by Scott *et al.* indicated that prehospital emergency technician's performance has improved in oxygen therapy, liquid therapy, cervical and splint use, and the administration of analgesic drugs, through the implementation of training programs, which is consistent with the findings of this study.^[31] In addition, the results of a study conducted by Fredø showed that nearly 80% of trauma patients who were transferred by prehospital emergency agents with fixed and immobilized cervical collarbone, backbone, and spider belt had normal neurologic status at diagnosis which is totally in agreement with the results of this study.^[32] Hence, training trauma patients care courses results in effective interventions exclusive for

trauma patients, and this can lead to enhancement in the quality of trauma patient's care.

Limitations

The training was continued for technicians in 20 other provinces in groups of 8; because we did not have access to their data, we conducted this study in a province. Furthermore, to do action research at the national level, there is a need to engage the health system, and a nationwide study in this area is proposed.

CONCLUSIONS

Participation of majority of beneficiaries in planning for trauma patients planning as a foundation for professional clinical services within the existing educational program can be effective in reducing deficits in education and care for trauma patients. Through a rethinking action-research approach, participants have established PHTLS courses to change trauma patient's care. In addition, these courses promoted knowledge, skills, and performance of prehospital emergency staff in trauma patient's care. Therefore, incorporating these courses into the medical emergency curriculum and training

this course to prehospital emergency personnel while serving trauma patients will be beneficial.

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Conflicts of interest

There are no conflicts of interest.

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