Original Article

# The Effects of Multidisciplinary Education for Nurses and Physicians on the Management of Patients with Multiple Trauma

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**Abstract**

**Background:** Trauma is a leading cause of death and disability in developing countries. In-service training is a strategy for improving health-care providers' trauma-related knowledge and skills. **Objectives:** The purpose of this study was to evaluate the effects of multidisciplinary education for nurses and physicians on the management of patients with multiple trauma. **Methods:** This quasi-experimental study was conducted in 2017–2018 in Al Zahra hospital, Isfahan, Iran. Initially, the triage-related characteristics of 200 patients with multiple trauma were documented using specific checklist. Then, a multidisciplinary education program on the Emergency Service Index (ESI) triage and advanced trauma life support (ATLS)-based trauma management was implemented for emergency department (ED) staff, including 80 emergency nurses and 82 medical residents. After the intervention, the triage-related characteristics of another sample of 200 patients with multiple trauma were documented similarly. Data analyses were conducted using the Chi-square, Mann–Whitney and Wilcoxon tests. **Results:** The mean of waiting time for the first visit by emergency medicine specialists, the relative frequency of endotracheal intubation, and the length of stay in the ED significantly decreased from 19.45 ± 13.41 min, 12%, and 7.55 ± 1.59 h at pretest to, respectively, 14.01 ± 1.81 min, 3%, and 3.91 ± 0.71 h at posttest. Moreover, the relative frequency of patients who were transferred directly from the ED to the operating room significantly increased from 13% at pretest to 27% at posttest. **Conclusion:** Multidisciplinary education based on the ESI triage and ATLS can reduce the waiting time for specialized care services, facilitate patient transfer from the ED to the operating room, and shorten patient stay in the ED. It is also partially effective in alleviating overcrowding in the ED.

**Keywords:** *Emergency department, Hospital, Injuries, Medical staff, Multiple trauma, Triage*

## Introduction

Road accident injuries are the third leading cause of death in the world after myocardial infarction and cerebrovascular disease.[1] According to the World Health Organization, these injuries caused 1.25 million deaths in 2014.[2] Around 90% of all trauma-induced deaths happen in lower-middle-income countries, where there are limited resources for trauma management.[2] A recent estimate indicates that around two million lives could be saved each year if the countries had advanced trauma care systems.[3] Iran is among the countries with the highest rate of death due to road accidents. Annually, 27,000 deaths and around 24,0000 cases of injuries happen due to road accidents.[4,5] A study in Ardebil, Iran, revealed that the incidence of accidents which lead to hospitalization in the emergency department (ED) was 692 cases per 100,000 people.[6]

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However, the number of ED beds is not proportionate to the number of patients.[7]

ED is responsible for providing emergency medical care, and patients with multiple trauma are the most in need of emergency care.[8-10] Timely and effective management of these patients helps protect their lives and prevent trauma-associated complications.[11] However, disproportionate patient-bed ratio in these wards causes the patient to wait long time for an empty bed. Such long waiting time together with patient long stay in the ED negatively affect care quality, patient satisfaction,[7] treatment outcomes,[7,8] and public attitude toward health-care delivery systems.[8] Long waiting hours not only result in overcrowding in the ED but also increase the rates of morbidity, mortality,[8,10] and medical errors.[9,10] A study reported a 1.5% - increase in mortality for each 1 h a critically-ill patient stays in ED.[10] Thus, waiting time and the length of stay are key criteria for the assessment of care quality in the ED.[6,7]

The primary goals of trauma management are to rapidly assess injuries, determine management priorities, and provide quality care services. A strategy to reduce waiting and stay times in the ED is the use of early triage to provide patients with early, safe, and quality specialized services.[12] However, a study reported that nurses do not have adequate triage knowledge and skills. Thus, specialized educations are needed to improve their triage-related knowledge and skills and thereby, improve care quality and patient outcomes.[13] Such educations can be provided using systematic and logical approaches based on the principles of advanced trauma life support (ATLS).[14-17] ATLS-based training is a well-accepted approach for training health-care providers respecting the principles of trauma management. Such training approaches can improve the quality and effectiveness of patient care.[16-18] A recent study reported that an interprofessional training have led to safe sedation procedures in the ED.[19] In another study in Sweden, interprofessional teamwork shortened the patients' length of stay but increased the proportion of patients who left the hospital without being seen by a physician.[20] Although studies of teamwork and inter-professional training have reported improvements in the quality of care, patient satisfaction, and work environment, no published data are available on the effect of multidisciplinary education on the management of patients with multiple trauma.

### Objectives

The purpose of this study was to evaluate the effects of multidisciplinary education for nurses and physicians on the management of patients with multiple trauma.

## Methods

This before-after quasi-experimental study was conducted in 2017–2018 in Al Zahra Hospital, Isfahan, Iran. The hospital is a first-class university hospital with a trauma care center and an annual ED admission rate of more than 70,000 patients. It is affiliated to Isfahan University of Medical Sciences, Isfahan, Iran.

The statistical population of the study consisted of patients with multiple trauma who referred to the ED of Al Zahra Hospital. The inclusion criteria were acute multiple trauma and admission to the ED. Patients were excluded if they requested hospital discharge against medical advice and rejected at least one of the prescribed treatments. Patients were recruited consecutively.

The sample size was calculated using an online sample size calculator based on the number of patients with multiple trauma who had referred to the study setting in 2016, which was equal to 10,800. With a confidence level of 0.95%, the calculator output showed that 186 patients were needed for each of the two phases of the study – 372 in total. In Phase I or the control phase, a consecutive sample of 200 patients with multiple trauma were recruited from October 1 to December 21, 2017, and data on their demographic and clinical characteristics were collected. In Phase II or the intervention phase, the study intervention was implemented, and then, another sample of 200 patients with multiple trauma were selected from January 31, 2018 to April 3, 2018, and their characteristics were evaluated.

The study intervention was a 4-h Emergency Service Index (ESI) triage workshop and an 8-h ATLS-based trauma management workshop which were held over 1 week for all 162 medical and nursing staff in the ED. The staff were 80 ED nurses, 56 emergency medicine medical residents, twelve 1st- and 2nd-year general surgery residents, six 2nd-year orthopedic residents, four 2nd-year neurosurgery residents, and four 2nd-year urology residents. The syllabus of the training program contained triage based on the fourth version of ESI (Level 1 - resuscitation, Level 2 - emergent, Level 3 - urgent, Level 4 - less urgent, and Level 5 - nonurgent), primary and secondary trauma assessment and management, airway management, shock, head injuries, chest and abdominal injuries, vertebral and spinal cord injuries, and musculoskeletal injuries. Workshop sessions included both theoretical (lecture-based) and practical trainings. It is noteworthy that triage accuracy was verified by an attending emergency medicine specialist or a senior emergency medicine medical resident.

Initially, data on patients' age, gender, and mechanism of trauma were collected. Moreover, a researcher-made

checklist was used to collect data on triage level, time of medical visits, duration of clinical and paraclinical procedures, patient transfer to hospital ward or intensive care unit, mechanical ventilation in the ED, length of hospital stay, ultimate patient outcome, and hospitalization costs. The checklist was designed based on the timetable forms of the Bureau of Emergency Services at the Ministry of Health and Medical Education of Iran and exiting literature.[18] The validity of the checklist was confirmed by five faculty members from Isfahan University of Medical Sciences, Isfahan, Iran. Reliability of the checklist was also confirmed through inter-rater agreement method and by calculating Cohen's $\kappa = 0.88$.

### Ethical considerations

This study was approved by the Ethics Committee of Isfahan University of Medical Sciences, Isfahan, Iran (with the code of IR.MUI.REC.1396.2.120). Permissions for the study were also obtained from the authorities of the study setting. The purpose of the present study was explained to all participants, and they all provided written informed consent before recruitment to the study. They were also assured of questionnaire anonymity and data confidentiality. Nursing managers in the study setting were also informed about the purpose of the study.

### Data analysis

To analyze the data, SPSS software (v11.5; SPSS Inc., Chicago, IL, USA) was used. In the Kolmogorov–Smirnov test, the quantitative variables showed nonnormal distribution. Then, Mann–Whitney U-test was used for between groups comparison of the quantitative variables, Wilcoxon test was used for within-group comparison of the quantitative variables. Chi-square test was also used for between-group comparisons respecting categorical and nominal variables. $P < 0.05$ was considered statistically significant.

## Results

In total, 400 patients were included – 200 in the control and 200 in the intervention phase. The means of patients' age in the control and the intervention phases were, respectively, 44.14 ± 17.48 (in the range of 22–82) and 44.71 ± 23.89 (in the range of 17–85). Most patients in the control and the intervention phases were male (74% vs. 70%). Patients in these two phases or groups did not significantly differ from each other respecting their age and gender [Table 1].

Figure 1 shows the triage level and its accuracy before and after the intervention. There were no statistically significant differences between the control and the intervention groups respecting triage level ($P = 0.48$) and its accuracy ($P = 0.19$).

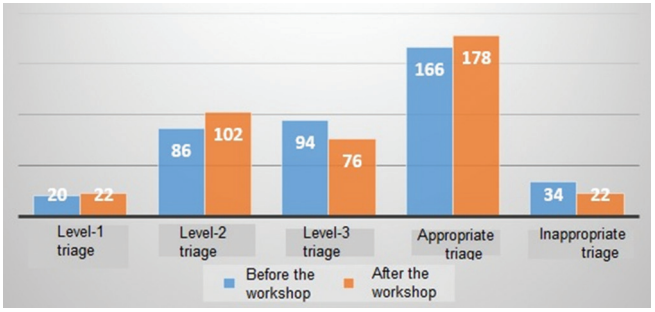


**Figure 1:** Levels and accuracy of triage before and after the study intervention

**Table 1: Patients' characteristics[a]**

| Characteristics | Time | | *P* |
|---|---|---|---|
| | Before | After | |
| Age | 44.14 ± 17.48 | 44.71 ± 23.89 | 0.56[b] |
| Gender | | | |
| Male | 148 (74) | 140 (70) | 0.43[c] |
| Female | 52 (26) | 60 (30) | |
| Mechanism of trauma | | | |
| Traffic accidents | 119 (59.5) | 96 (48) | 0.009[c] |
| Fall | 31 (15.5) | 59 (29.5) | |
| Stroke | 40 (20) | 36 (18) | |
| Other | 10 (5) | 9 (4.5) | |
| Endotracheal intubation | 24 (12) | 6 (3) | 0.01[c] |
| Intensive care unit admission | 22 (11) | 26 (13) | 0.64[c] |
| Transfer to the operating room | 26 (13) | 54 (27) | 0.00[c] |
| Death | 10 (5) | 8 (4) | 0.81[c] |

[a]Data are presented as Mean ± SD or *n* (%), [b]Mann–Whitney U-test, [c]Chi-square test. SD: Standard deviation

Table 2 shows the mean values of waiting time in different areas of the ED and hospital as well as the mean values of patient stay in the ED and hospital. The means of the waiting time for the first visit by emergency medicine specialist and other physicians as well as the means of patient stay in the ED in the intervention group were significantly less than the control group [$P < 0.05$, Table 2]. The means of waiting time for the first visit by emergency medicine specialists at all triage levels in the intervention group were also significantly less than the control group [$P < 0.05$, Table 3]. However, there were no statistically significant differences between the groups respecting other waiting times, hospital stay, and hospitalization costs [$P > 0.05$, Table 2]. The study intervention significantly reduced the waiting time for paraclinical measures such as chest radiography and computed tomography scanning [$P < 0.05$, Table 2].

The number of endotracheal intubations in the ED significantly decreased after the intervention ($P = 0.01$)

**Table 2: Pre- and post-test waiting times for receiving health-care services**

| Waiting times | Time | | *Z* (*P*)[a] |
|---|---|---|---|
| | Before | After | |
| Waiting time for the first visit by emergency medicine specialists (min) | 19.45 ± 13.41 | 14.01 ± 9.81 | −4.20 (0.00) |
| Waiting time for the first visit by a surgeon (min) | 25.94 ± 24.53 | 18.31 ± 7.82 | −0.96 (0.33) |
| Waiting time for the first visit by other health-care professionals (min) | 55.84 ± 5.65 | 39.12 ± 5.13 | 03.71 (0.001) |
| Waiting time for the FAST (min) | 9.64 ± 7.81 | 8.35 ± 5.73 | 1.72 (0.56) |
| Waiting time for computed tomography scanning (min) | 46.91 ± 4.20 | 31.82 ± 6.11 | −2.10 (0.001) |
| Waiting time for chest radiography (min) | 49.52 ± 3.84 | 40.70 ± 3.86 | −2.01 (0.04) |
| Waiting time for patient transfer to the operating room (min) | 130.02 ± 82.71 | 94.51 ± 63.82 | −3.24 (0.002) |
| Length of stay in the ED (h) | 7.55 ± 1.59 | 3.91 ± 0.71 | −6.02 (0.00) |
| Total length of hospital stay (h) | 5.11 ± 1.13 | 4.12 ± 0.53 | −3.196 (0.71) |
| Hospitalization costs (Million Riyals) | 4.91 ± 3.51 | 4.32 ± 3.18 | 1.72 (0.18) |

[a]The results of the Mann–Whitney; FAST: Focused assessment with sonography in trauma, ED: Emergency department

**Table 3: Waiting time for medical visit by emergency medicine specialists at the three levels of triage before and after the intervention**

| Triage level | Waiting time for the visit (min) | | *Z* (*P*[a]) |
|---|---|---|---|
| | Before | After | |
| 1 | 4.33 ± 1.50 | 1.11 ± 1.10 | −3.52 (0.000) |
| 2 | 16.24 ± 1.54 | 7.81 ± 5.41 | −2.14 (0.03) |
| 3 | 30.13 ± 14.89 | 17.71 ± 12.32 | −2.97 (0.003) |

[a]The results of the Mann–Whitney test

While the number of direct patient transfers from the ED to the operating room significantly increased after the intervention ($P$ = 0.001). The number of deaths before and after the intervention was, respectively, ten and eight, with no statistically significant difference [$P$ = 0.40, Figure 2].

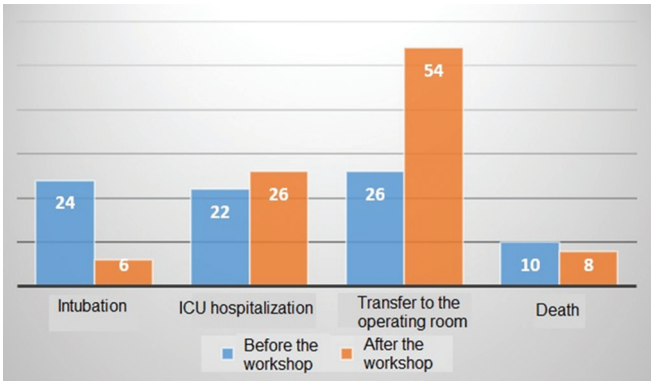


**Figure 2:** The rates of endotracheal intubation, transfer from the emergency department to the operating room and intensive care unit, and death before and after the study intervention

## Discussion

The results of this study showed that after the intervention, the meantime of the first visit by emergency medicine specialists significantly decreased at all triage levels. The waiting time for the first visit at the first and the second ESI triage levels after intervention was, respectively, 1.11 ± 1.10 and 7.81 ± 5.41 min, on an average. A meta-analysis study on patient waiting time in the ED in Iran also reported that the mean of waiting time for the first visit in the ED was 5.9 ± 0.6 (95% confidence interval [CI]: 4.7–7.2) min.[21] Another study also showed that the duration between triage and the first medical visit was 13.5 ± 7.6 min for the first and the second triage levels and 16.4 ± 10.1 min for the third and the fourth triage levels.[22] The shorter waiting time in the present study might be attributable to the effect of the multidisciplinary education in increasing the coordination between the caring team and rapid assessment of the triage team, including nurses and physicians after the intervention.

Our intervention significantly reduced the waiting time for the first visit by emergency medicine specialists and also for the other nonsurgical therapeutic interventions. These findings are attributable to the measures taken for early visits by ED staff and other specialists. Currently, overcrowding is one of the greatest problems in the ED, resulting in limited empty beds for newly-admitted patients and long waiting time at the third level of ESI triage. A study reported a negative correlation between the number of patients and the waiting time for the first medical visits at the third and the fourth levels of triage.[22] Therefore, one of the most necessary strategies in the ED is the correct and quick triage of incoming patients to reduce waiting time for medical visits and emergency care services.

The findings of the present study also showed that the intervention had no significant effects on triage accuracy. This finding may be due to periodic in-service triage training programs for the nurses in the study setting and their familiarity with ESI triage. On the other hand, the study intervention significantly reduced the waiting time for specialized medical visits, and it significantly changed the waiting time for paraclinical measures such as chest radiography and computed tomography scanning. An earlier study into the effects of

changes in the health-care delivery system on different waiting times in the ED reported that the intervention significantly reduced only the time interval from ED admission to ultrasound studies.[21] Another study indicated that staff training significantly reduced the time intervals from ED admission to computed tomography scanning, endotracheal intubation, and surgical operation, while it had no significant effects on intensive care unit stay, hospital stay, complication rate, mortality rate, and the time interval between ED admission to ultrasound assessment of trauma.[20] Similarly, a study reported that ATLS training significantly improved the effectiveness of emergency care services for patients with severe trauma.[17] Hospital-level trauma care quality improvement programs were also reported to significantly reduce mortality and complication rates in developing countries.[18] Perhaps, one of the reasons for the significance of our research findings is the involvement of nurses in the training process in the ED as the largest provider of care in the hospital. Tins finding also signifies the importance of coordination between nurses and doctors and its beneficial effects on patient and the health-care system's outcome.

Our findings also showed that the waiting time for computed tomography scanning and chest radiography after intervention was 31.82 ± 6.11 and 40.7 ± 3.86 min, respectively. An earlier study reported that the time interval between arrival at the radiology department and receiving radiology results in Iran was 23.2 ± 3.0 (95% CI: 17.2–29.1) min.[21] The waiting time for computed tomography scanning is different in different countries.[21,23] The difference among the studies in waiting time for computed tomography depends on the number of patients referred to this unit and to the guidelines and hospitals rules. Although the waiting time for such procedures depends on the number of patients needing such services, the decrease in the waiting time after the intervention might again be attributed to the improvement of the nurses' performance in coordinating the procedures such as computed tomography and radiography.

Moreover, after the intervention, the length of patient stay in the ED in our study was 3.91 ± 0.71 h which shows a decrease of more than 3.5 h. In a previous study, the entry-to-exit time in the ED was 276.7 ± 45.2 min,[19] but in another study, this time was 187.4 ± 15.3 min.[18] Our findings revealed that the intervention of the study significantly reduced patient stay in the ED probably due to the reduction in the waiting time for medical visits and other health-care services. Relative reductions in the waiting time for radiologic studies and computed tomography scanning might also have contributed to the reduction in total ED stay in the present study. All these findings were in line with the findings of several earlier studies.[14-16]

Education of nurses or physicians along with other professions and using more active education methods can lead to the improvement in teamwork. This kind of education can improve the relationship between professions and train a compatible group of responsible professionals which can bring about a high-quality health care service to the patients and will lead to decreasing the side effects of diseases. Interprofessional education with focus on multidisciplinary interactions and promotion in professional socialization process of health sciences students provides necessary competency and ability for developing interprofessional collaborations and comprehensive patient-centered team care among graduates for addressing challenges in health systems.

This study was conducted in a teaching hospital and its results might not be generalizable to other hospitals and EDs. Therefore, further multicenter studies with larger samples are needed to obtain more generalizable results. The length of the intervention was also short. Therefore, similar educational programs with longer periods and regular repetition of the intervention might also lead to better results. Moreover, some nurses in the study setting worked rotation shifts. Therefore, some nurses and residents might have managed patients in the ED not based on the study intervention. Therefore, ESI triage and ATLS training programs are recommended for all ED nurses and residents at the time of their recruitment for working in the ED.

## Conclusion

Multidisciplinary education based on the ESI triage and ATLS for nurses and physicians significantly reduces the waiting time for medical visits and other specialized care services in the ED, facilitates patient transfer from the ED to the operating room in case of the need for surgery, and shortens patient stay in the ED. Therefore, such programs are recommended to be regularly implemented for ED staff. Of course, further studies should be conducted to provide adequate evidence concerning the effects of multidisciplinary education on patient outcomes in the ED. The frequency of cases with different problems were different before and after the intervention and this might have affected the outcome.

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## Conflicts of interest

There are no conflicts of interest.

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