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ORIGINAL RESEARCH

# The Clinical Skills of Emergency Medical Service (EMS) Personnel Regarding Spinal Immobilization of Trauma Victims; a Cross Sectional Study

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**Abstract:** **Introduction:** Spinal immobilization is the most important measure the Emergency Medical Service (EMS) has to take when facing the victims of traumatic events, especially those with confirmed or suspected traumatic spinal cord injury (TSCI). The aim of this study was to investigate the clinical skills of EMS personnel regarding the spinal immobilization of trauma victims. **Methods:** This cross-sectional study was conducted to examine the clinical skills of EMS personnel, regarding spinal immobilization of trauma victims during a 1-year period in 2019. EMS personnel were selected via convenience sampling method. Data collection tools were a demographic questionnaire and a researcher-made checklist to assess clinical skills. The face and content validity of the tool was reviewed and approved by 10 experts. Also, the overall reliability coefficient for the skills was 0.98. Data were collected by the researcher through observing the skills performed, and filling out the clinical skills checklist accordingly. **Results:** The mean overall score of the clinical skills of the 120 participants regarding spinal immobilization of trauma victims in supine, prone, and sitting positions were 0.60 ± 1.44, 0.58 ± 1.42 and 0.65 ± 1.62, respectively. Most of the studied personnel had moderate clinical skills in spinal immobilization, and they had poor clinical skills required to correctly pull the trauma victims in the longitudinal axis of the body to put them on a long backboard and immobilize their torso, legs, and head using the Kendrick Extrication Device (KED). **Conclusion:** The studied EMS personnel had moderate clinical skills regarding the spinal immobilization of trauma victims. It is recommended that the EMS training programs focus more on the practical aspects of clinical skills in addition to theoretical aspects.

**Keywords:** Advanced trauma life support care; Spinal cord injuries; Emergency medical services; Clinical competence

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## 1. Introduction

Traumatic spinal cord injury (TSCI) is a devastating injury resulting from traumatic events, which can affect many functions of the body and can be life-threatening (1). The annual TSCI incidence rate varies from 12.7 to 52.2 cases per million populations (2). However, this rate is about 40 to 50 people per million in Iran (3). TSCI causes lifelong disability in addition to devastating physical injury, TSCI can lead to long-term disability and place a heavy social and financial burden on patients, their families and the community (2). Despite the introduction of injury prevention programs and advances in vehicle safety systems, such as airbags and seatbelts, TSCI still has a profound effect on the healthcare system (4). The Emergency Medical Service (EMS) is responsible for providing care and treatment services to trauma victims at the scene of the accident and during transportation to the hospital (5). Spinal immobilization is the most important measure that the EMS should take when facing victims of traumatic events, especially for those with confirmed or suspected TSCI (6). In the United States, more than 5 million patients per year are immobilized, mostly with a cervical collar and a backboard (7). EMS personnel use spinal immobilization on the field to maintain the normal anatomical alignment and restrict the motion of the spinal cord (8). The in-

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tent behind spinal immobilization is to reduce spinal movement and prevent further secondary injury, prevent nervous system deterioration, and facilitate the movement and transfer of a patient (9). It is estimated that 3 to 25% of TSCIs are secondary, which occur after a primary injury, due to inappropriate management at the scene of the accident or during transport to the hospital (10). Therefore, it is very important to start TSCI-related measures and care from the scene of the accident (4). Providing high-quality, timely, and standard services for victims and emergency patients in the early moments of traumatic events can reduce mortality and increase patients' trust in and satisfaction with EMS (11). Assessing the clinical skills of EMS personnel may provide an appropriate reflection of the training programs. A number of studies have been conducted to examine the clinical skills of EMS personnel regarding spinal immobilization of the injured persons lying in the supine position (12-14); however, no studies have been conducted on the victims lying in prone position. Therefore, the aim of this study was to evaluate the clinical skills of EMS personnel regarding spinal immobilization of trauma victims lying in supine position, lying in prone position, and placed in the sitting position.

## 2. Methods

### 2.1. Study design and setting

This cross-sectional study was conducted to examine the clinical skills of EMS personnel of Iranshahr University of Medical Sciences, Iranshahr, Iran, regarding spinal immobilization of trauma victims during a 1-year period in 2019. Sampling was performed in 43 emergency stations located in five cities of Iranshahr, Chabahar, Konarak, Rask, and Qasr Ghand. The clinical skills of EMS personnel regarding spinal immobilization of victims of traumatic events were assessed using a researcher-made questionnaire checklist. The study protocol was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences with the ID: IR.SBMU.PHARMACY.REC.1398.262.

### 2.2. The study participants

The study population consisted of all EMS personnel working in Iranshahr University of Medical Sciences, Iranshahr, Iran, 120 of whom were selected using convenience sampling based on the sample size formula. Having a high school diploma, nursing assistant certificate, associate degree or bachelor's degree in nursing, medical emergencies, or operating room and experience of working in the pre-hospital emergency unit were among the inclusion criteria. Personnel working in the administrative unit of pre-hospital emergency or the dispatch unit were excluded from the study.

**Table 1:** The baseline characteristics of the participants

| Variable | Number (%) |
|---|---|
| **Age (year)** | |
| 20-30 | 65 (54.2) |
| 31-40 | 48 (40.0) |
| ≥ 40 | 7 (5.8) |
| **Field of study** | |
| Pre-hospital Emergency | 69 (58.5) |
| Operating room | 5 (5.0) |
| Others* | 45 (37.5) |
| **Level of education** | |
| High school diploma | 45 (37.5) |
| Associate's degree | 67 (55.8) |
| Bachelor's degree | 8 (6.7) |
| **Place for EMS work** | |
| Urban station | 37(30.8) |
| On roads station | 83(69.2) |
| **Work experience(year)** | |
| 0-10 | 101 (84.2) |
| 11-20 | 18 (15.0) |
| ≥ 20 | 1 (0.8) |
| **Type of employment** | |
| Under –a-contract | 41 (34.2) |
| Temporary | 18 (15) |
| Casual | 5 (4.2) |
| Contractual | 28 (23.3) |
| Temporary to Official | 22 (18.3) |
| Official | 6 (5.0) |
| **Participation in training program** | |
| Yes | 47 (39.2) |
| No | 73 (60.8) |

*A high school diploma in natural sciences or a nursing assistant certificate. Data are presented as frequency (%).

### 2.3. Data collection

The data were collected using a demographic questionnaire and a clinical skills checklist consisting of the three checklists used for the assessment of the clinical skills of EMS personnel regarding spinal immobilization of trauma victims in three positions: supine, prone and sitting. For the face and content validity, the tool was evaluated by 10 experts. The reliability of the tool for overall clinical skills was 0.98. The participants' demographic characteristics such as age, level of education, field of study, type of employment, work experience, place for EMS work, and history of participation in a training program for the spinal immobilization over the last year were assessed. The data were collected by a senior nursing expert. In order to collect data, the researcher referred to the EMS of Iranshahr University of Medical Sciences, Iranshahr, Iran, after coordination with the relevant authorities. He guaranteed the participants confidentiality after explaining the study purpose to them. The clinical skills of EMS personnel were assessed by the researcher in the EMS stations. Written informed consent was obtained from the participants. For

**Table 2:** Mean scores of clinical skills for studied EMS personnel regarding spinal immobilization of trauma victims lying in supine position

| Clinical skills | Score | | | Mean± SD |
|---|---|---|---|---|
| | 2 | 1 | 0 | |
| Separation of body secretions | 62.5 | 25.0 | 12.5 | 1.50 ± 0.71 |
| Keeping head in a neutral position with hands | 73.3 | 18.3 | 8.3 | 1.65 ± 0.63 |
| Picking the correct cervical collar | 55.8 | 31.7 | 12.5 | 1.43 ± 0.70 |
| Applying cervical collar | 83.3 | 13.3 | 3.3 | 1.80 ± 0.47 |
| Placement of the long backboard next to the victim | 19.2 | 80.0 | 0.8 | 1.18 ± 0.40 |
| Transfer of the injured person on the long backboard | 45 | 53.3 | 1.7 | 1.43 ± 0.53 |
| Pulling the injured person in the longitudinal axis of the body to put him/her on a long backboard | 14.2 | 77.5 | 8.3 | 1.05 ± 0.47 |
| The use of head immobilizers | 60.8 | 20.8 | 18.3 | 1.42 ± 0.78 |
| Immobilizing head on a long backboard using straps | 44.2 | 35.8 | 20.0 | 1.24 ± 0.76 |
| Immobilizing arms and legs on a long backboard using straps | 81.7 | 10.0 | 8.3 | 1.73 ± 0.60 |

SD: standard deviation. The data are expressed as percentage for each score. * Score 2 if correct, 1 if incorrect, and 0 for not performing the clinical skill.

**Table 3:** Mean scores of clinical skills for studied EMS personnel regarding spinal immobilization of trauma victims lying in prone position

| Clinical skills | Score | | | Mean± SD |
|---|---|---|---|---|
| | 2 | 1 | 0 | |
| Separation of body secretions | 63.3 | 24.2 | 12.5 | 1.50 ± 0.71 |
| Keeping head in a neutral position by hands | 63.3 | 30.8 | 5.8 | 1.57 ± 0.60 |
| Picking the correct cervical collar | 20.0 | 80.0 | 0.0 | 1.20 ± 0.40 |
| Applying cervical collar | 23.3 | 76.7 | 0.0 | 1.23 ± 0.42 |
| Placement of the long backboard next to victim | 15.0 | 77.5 | 7.5 | 1.07 ± 0.47 |
| Transfer of the injured person on the long backboard | 62.5 | 26.7 | 10.8 | 1.51 ± 0.68 |
| Pulling the injured person in the longitudinal axis of the body to put him/her on a long backboard | 74.2 | 24.2 | 1.7 | 1.72 ± 0.48 |
| The use of head immobilizers | 61.7 | 22.5 | 18.8 | 1.45 ± 0.75 |
| Immobilizing head on a long backboard using straps | 43.3 | 40 | 16.7 | 1.26 ± 0.73 |
| Immobilizing arms and legs on a long backboard using straps | 80.8 | 10.8 | 8.3 | 1.72 ± 0.60 |

SD: standard deviation. The data are expressed as percentage for each score. *Score 2 if correct, 1 if incorrect, and 0 for not performing the clinical skill.

**Table 4:** Mean scores of clinical skills for studied EMS personnel regarding spinal immobilization of trauma victims lying in prone position

| Clinical skills | Score | | | Mean± SD |
|---|---|---|---|---|
| | 2 | 1 | 0 | |
| Separation of body secretions | 63.3 | 25.0 | 11.7 | 1.51 ± 0.69 |
| Keeping head in a neutral position by hands | 74.2 | 14.2 | 11.7 | 1.62 ± 0.68 |
| Picking the correct cervical collar | 63.3 | 27.5 | 9.2 | 1.54 ± 0.65 |
| Applying cervical collar | 80 | 19.2 | 0.8 | 1.79 ± 0.42 |
| Placement of KED in the back of the injured person | 53.3 | 45.8 | 0.8 | 1.52 ± 0.51 |
| Tightening the straps of torso, legs and head using the KED | 20.8 | 75.0 | 4.2 | 1.16 ± 0.47 |
| Transfer of the injured person on the long backboard | 40.0 | 57.5 | 2.5 | 1.37 ± 0.53 |
| Pulling the injured person in the longitudinal axis of the body to put him/her on a long backboard | 40.8 | 56.7 | 2.5 | 1.38 ± 0.53 |
| The use of head immobilizers | 61.7 | 21.7 | 16.7 | 1.45 ± 0.76 |
| Immobilizing head on a long backboard using straps | 40.8 | 40.8 | 18.3 | 1.22 ± 0.73 |
| Immobilizing arms and legs on a long backboard using straps | 81.7 | 9.2 | 9.2 | 1.72 ± 0.65 |

SD: standard deviation. The data are expressed as percentage for each score. *Score 2 if correct, 1 if incorrect, and 0 for not performing the clinical skill. KED: Kendrick Extrication Device.

this purpose, first, the demographic questionnaire was given to the participants and then they were asked to use the clinical skills for the simulated patient in supine, prone, and sitting positions, in order to assess their clinical skills regarding spinal immobilization. The researcher recorded the scores of each skill in the clinical skill checklist. In this study, the simulated patient was 32 years old, weighing 73 kg. The clinical skills of each member of EMS personnel were assessed separately without the presence of others.

**Table 5:** The relationship between the clinical skills regarding spinal immobilization and the demographic characteristics of the studied participants

| Variables | Mean± SD | P |
|---|---|---|
| **Age (year)** | | |
| 20-30 | 44.56 ± 8.22 | |
| 31-40 | 46.70 ± 6.05 | 0.02 |
| ≥ 40 | 38.42 ±10.98 | |
| **Field of study** | | |
| Pre-hospital Emergency technician | 46.59 ± 6.03 | |
| Operating room | 38.00 ± 13.84 | 0.01 |
| Others* | 43.66 ± 8.59 | |
| **Level of education** | | |
| High school diploma | 43.66 ± 8.59 | |
| Associate's degree | 45.52 ± 7.38 | 0.15 |
| Bachelor's degree | 49.12 ± 4.54 | |
| **Place for EMS work** | | |
| Urban station | 47.29 ± 7.86 | 0.03 |
| On roads station | 44.07 ± 7.59 | |
| **Work experience (year)** | | |
| 0-10 | 45.63 ± 7.33 | 0.11 |
| 11-20 | 41.61 ± 9.61 | |
| **Type of employment** | | |
| Under -a-contract | 45.17 ± 7.35 | |
| Temporary | 45.61 ± 8.08 | |
| Casual | 32.20 ± 9.12 | 0.00 |
| Contractual | 44.67 ± 8.58 | |
| Temporary to Official | 47.00 ± 5.03 | |
| Official | 48.16 ± 4.95 | |
| **Participation in training program** | | |
| Yes | 48.27 ± 53.5 | 0.00 |
| No | 43.00 ± 8.35 | |

*A high school diploma in natural sciences or a nursing assistant certificate. Data are presented as mean ± standard deviation.

### 2.4. Instruments

After the simulated patient was put in the supine, prone, and sitting positions, the participants were asked to use the spinal immobilization based on the clinical skill checklist. The researcher recorded the scores of each skill in the corresponding checklist. The clinical skill checklist of the spinal immobilization in supine position contained 10 items or practical steps. The clinical skill checklist of the spinal immobilization in prone position contained 10 items or practical steps. The clinical skill checklist of the spinal immobilization in sitting position contained 11 items or practical steps. Each item or every step is scored on a 0 to 2 scale (2 if correct, 1 if incorrect, and 0 for not performing the clinical skill). The level of clinical skills was also evaluated as follows: 1.7-2 = good; 1.2-1.7 = moderate; lower than 1.2 = Poor.

### 2.5. Statistical Analysis

All statistical analyses were performed using SPSS version 21. Mean ± standard deviation (SD) or frequency (%) was used to report the results. Analysis of variance (ANOVA) was used to examine the relationship between the clinical skills regarding spinal immobilization and demographic characteristics of the participants. P-value less than 0.05 was considered statistically significant.

## 3. Results

### 3.1. The demographic characteristics of the participants

The mean age of the participants (n=120) was 6.14 ± 30.3 years (100% male). The demographic characteristics of the participants are shown in Table 1. 54.2% of the participants were in the 20–30 years age group. 69 (57.5%) had a degree in Pre-hospital Emergency Care and 67 (55.8%) had an associate degree. The majority of the participants (69.2%) provided care on the roads station. 101 subjects (84.2%) had a work experience of 0–10 years. 73 participants (60.8%) did not participate in the training program for spinal immobilization over the last year.

### 3.2. The clinical skills of the participants regarding spinal immobilization

The mean overall score of the clinical skills of the participants regarding spinal immobilization of trauma victims in supine, prone, and sitting positions were 0.60 ± 1.44, 0.58 ± 1.42, and 0.65 ± 1.62, respectively (Tables 2, 3, and 4). A significant difference was observed between the participants' scores based on their field of study ($p = 0.01$), place for EMS work ($p = 0.03$), type of employment ($p = 0.00$), and history of participation in the training program for spinal immobilization over the last year ($p < 0.0001$) (Table 5).

### 3.3. Discussion

The results of the present study showed that the participants had moderate clinical skills regarding spinal immobilization. Regarding clinical skills of the participants in spinal immobilization of trauma victims lying in supine position, our findings showed that the highest score belonged to the use of cervical collar in the victims and the majority of participants applied it correctly, but they had poor clinical skills regarding pulling the trauma victims in the longitudinal axis of the body to put them on a long backboard and immobilize their torso, legs and head using the Kendrick Extrication Device (KED) and most of them applied it incorrectly. In 2018, Azimi et al. showed that the majority of nurses had moderate clinical skills regarding spinal immobilization of the injured persons in traffic accidents, and they also had poor clinical skills regarding the injured person's correct transfer to the long back board using the log roll technique and fixing arms and legs on the long backboard (12), which were consistent with our results. Correct transfer of the injured person from

the accident scene to the long backboard is a key step in implementing spinal immobilization of trauma victims, which requires precision, ability, and coordination of EMS personnel to immobilize the spine in the longitudinal axis of the body, all parts of the injured body should be slowly transferred to the backboard. Kumar et al. in 2008 examined the level of knowledge, attitude, and practice of three groups of health care providers about prehospital and emergency care. They reported that the level of knowledge and practice of participants regarding emergency and prehospital care was below average, and therefore ongoing training was required in this area (15). Regarding clinical skills of the participants on spinal immobilization of trauma victims lying in prone position, our findings demonstrated that the majority of participants used cervical collar in the victims correctly. Also, most of them had correctly fixed arms and legs on the long backboard using straps, but they had poor clinical skills regarding pulling the trauma victims in the longitudinal axis of the body to put them on a long backboard. The total score in this skill was in the moderate level, which was not satisfactory. In 2016, Norouzinia et al., assessed the level of knowledge and clinical skills of pre-hospital emergency care students confronting trauma victims in their study, and the results showed that 89.1% of the participants had good clinical skills for confronting trauma victims in pre-hospital setting (13). However, the results of the study by Dadashzadeh et al. in 2017 showed that despite the large number of persons with head and neck injuries, the cervical collar and long backboard has been merely used for the immobilization of a few traumatic patients, which requires further investigation and trauma management training programs for EMS personnel (5). Also, the results of Mohseni et al.'s study in 2014 showed that the use of long backboard (12.2%) and cervical collar (15.6%) in the patients was the neurological care least provided by EMS personnel for trauma victims, which was not performed despite the necessity (16). The differences between the results of studies can be attributed to the differences in level of education and training for the EMS personnel because graduates of various fields of study such as nursing, pre-hospital emergency, operating room, nursing assistance, and even people with a high school diploma who were trained in this regard have been employed in the EMS setting.

Regarding clinical skills of the participants in spinal immobilization of trauma victims placed in the sitting position, our results demonstrated that the participants had moderate clinical skills in this regard, but most of them had poor clinical skills regarding immobilizing the torso, legs and head using the KED. Given that spinal immobilization can be performed by tightening the straps of torso, legs and head using the KED, more attention should be paid to the performance of this skill and training in this regard. Shakeri et al., in their study in 2012, evaluated clinical skills of medical emergency personnel in Tehran Emergency Center in confronting trauma and the results showed that 62.4% of the medical emergency personnel had good grades in trauma skill but had major skill deficiency in practicing two skills, namely seated patient's spinal immobilization and traction splint, because these skills were less commonly used in the EMS setting (14), which were consistent with our results. Also, the study by Dunn et al. in 2004 examined the ability of basic emergency technicians in using the protocol of selective immobilization of cervical spine in trauma patients and compared it with the performance of the paramedics. They showed that this skill is the same in both groups, and by providing the correct training, the clinical skills of basic emergency technicians can be improved (17). The repetition of clinical skills during standard training programs is the most important factor in improving the clinical skill level of EMS personnel (18). In this study, the lack of a clinical skill center and the lack of proper access to them were considered as important obstacles for the participants to achieve good clinical skills.

## 4. Limitation

Fatigue among participants due to working 24-hour shifts and their specific job conditions, as well as the personal problems of the participants during the implementation of the clinical skills might have affected the results, all of which were beyond the control of the researcher. However, by conducting this study in appropriate conditions, in the EMS stations, an attempt was made to reduce their impact on the results. Additionally, observing the staff when implementing spinal immobilization skills might have influenced their performance.

## 5. Conclusion

The EMS personnel had moderate clinical skills regarding spinal immobilization of trauma victims, and they had poor clinical skills regarding pulling the trauma victims in the longitudinal axis of the body to put them on a long backboard and immobilizing their torso, legs and head using KED for the sitting patient. It is recommended that the EMS training programs focus more on the practical aspects of clinical skills in addition to training theoretical aspects.

## 6. Declarations:

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### 6.2. Author contribution

All authors met the four criteria for authorship based on guidelines of the International Committee of Medical Journal Publishers.

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None.

### 6.4. Conflict of interest

None.

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