



## Assessment of Pre-Hospital Emergency Care and its Associated Factors in Traumatic Patients in North of Iran

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### ABSTRACT

**Objective:** To determine the status of pre-hospital emergency care and its associated factors in traumatic patients.

**Methods:** In across-sectional study, 577 traumatic patients who were transferred to Poursina hospital by EMS (Emergency Medical Services) personnel were selected by simple random sampling method. Pre-hospital emergency services were observed. Then the mean of taken measures scores for each domain was determined in percent and evaluated in terms of associated factors (age, working experience of staff and number of missions per day) and compared using Spearman's test.

**Results:** Out of 577 patients, 454 were men (78.7%) and 123 women (21.3%). Their mean age was 35.1 years old. Accident (82.7%) was the most common mechanism of injury. Most vehicles involved in the accident were light-weight cars (48.5%) and motorcycles (32.2%). A significant relationship was found between age, general domain ( $p=0.039$ ) and hemodynamic ( $p=0.019$ ) as well as between work experience and general domain ( $p=0.018$ ).

**Conclusion:** Given that pre-hospital emergency services provided in most of the domains are relatively far from world standard, results of this research can provide information for managers to improve strategic planning on care and medical services, appropriation of budget, knowledge of personnel and necessary equipment.

**Keywords:** Pre-hospital; Emergency service; Trauma.

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## Introduction

Trauma is currently considered as an important cause of mortality and morbidity in developed and developing countries more than before [1, 2]. Wong *et al.* have predicted that the mortality rate due to trauma will be the sixth cause of death in the world and the second leading cause of morbidity according to Disability-Adjusted Life Years (DALY) in developing countries by 2020 [3]. According to statistics, Iran has been reported among the countries with highest rate of accidents and resulting injuries [4]. Since trauma, more than other factors, affects young population, it leads to higher lost working years and imposes high costs on society and families in addition to physical and psychological effects on afflicted people [5].

Despite the fact that primary prevention is recognized as one of the most important ways to reduce injuries, many studies have found that most of the long-term disabilities and mortalities are preventable by strengthening trauma centers and emergency services [6]. Although it seems that most pre-hospital deaths are inevitable, mortality prevention even in a very small proportion is valuable both medically and economically [7]. Studies on programs of a civilian helicopter in the U.S showed that the primary factor in reducing mortalities due to trauma was not transfer speed but the care management by the medical staff in helicopter [8]. In another study cited by Evans *et al.* it was found that 66% of the severe trauma deaths occurred before hospitalization [9]. The main benefits of pre-hospital care are the times when providing care can accelerate or stop the processes leading to death or permanent disability of patients. Without pre-hospital care, many patients who have a chance of survival die at the scene of accident or on the way to the hospital. Most deaths that occur in the early hours after the accident are due to airway disorders, respiratory failure or uncontrollable bleeding while they can be treated using basic principles [10]. When facing these patients, some measures should be taken in accordance with standard protocols including spine fixation, bleeding control at the scene, fracture repair, peripheral venous access, intravenous fluid injection and protocols such as the Advanced Trauma Life Support (ATLS) [11] and level of consciousness control, injection of intravenous benzodiazepines in case of seizure, keeping the airway open and ventilation [12]. Which in this study specifically according to their importance in preserving the patient's life classified to four domains of general, nervous, respiratory and hemodynamic care.

Basic principles of trauma care are knowledge and skills of involved human resources [10]. Decision-making on taking measures and providing services are important tasks of pre-hospital personnel. Therefore, they must possess enough knowledge, skills, and insight to apply these and make immediate

appropriate decisions [13]. In previous studies, it has been found that current pre-hospital emergency care is somehow inadequate. Increasing the quality of pre-hospital care and knowledge, promoting awareness and higher education in EMS staff are suggested accordingly [14, 15]. In fact, the purpose of treatment interventions and improving the personnel's knowledge is to decrease mortality and disability. In a study in Latin America, Arreola-risa concluded that there was significant relationship between increased quality of pre-hospital emergency and reduced mortality rate [16]. Despite the high incidence of trauma and its economic and social consequences in Iran and the importance of quality of early interventions at the scene, few studies have been performed in this field. Thus, evaluating the pre-hospital emergency care and identifying strengths and weaknesses can help the authorities in charge to take steps for improving level of health in traumatic patients. This study, therefore, aimed at assessing the pre-hospital performance related to traumatic patients in Rasht city (North of Iran).

## Materials and Methods

### Study Population

This is a cross-sectional study performed in Emergency Department of Poursina Hospital in Rasht, which is the largest trauma center in Guilan. For this purpose, after approval of the vice-chancellor for Research and Ethics Committee and Poursina Hospital and with permission from the Center for Disaster and Emergency Management, data collection was initiated. The sampling lasted from November 11, 2012 to March 20, 2013. In this study, all traumatic patients (n=577) were enrolled, based on the sample size formula (in previous studies) using simple random sampling method. After the ambulance arrival at the Emergency Department, the researcher and her colleagues collected the data over a 24-hour period as soon as they visited the transferred patient and recorded the data in the transfer form and interviewed the pre-hospital staff. Treatments in pre-hospital emergency included all vital measures before reaching hospital which were classified into four domains of general care, hemodynamic stability, nervous and respiratory care.

### Study Protocol

The sample consisted of all traumatic patients who had been directly transferred from scene of accident by EMS to this center so that the ambulance transported only one patient and the patients who received interventions from other centers or were carried by personal car were not enrolled in our study. Data collection tool in this study included a researcher-made checklist based on the Iranian National Standards Organization and EMS report form and similar studies. The checklist was developed in two are as of factors associated with staff and therapeutic

measures, in turn, presented in four domains by the researcher; 1. General care: giving a brief history of patient's medical history (hx), dressing, splinting, patient positioning, appropriate controlling of the patient on the stretcher and using a blanket in hypothermic patients, 2. Hemodynamic stability: vital signs control, bleeding control, the peripheral venous access, injection of serum and medication, 3. Respiratory system care: oxygen therapy, suction, putting airway tube, intubation and controlled O<sub>2</sub> sat, ambu bag ventilation, 4. Nervous system: GCS and pupils control, and using collar and spinal bed. The checklist of pre-hospital emergency care was filled by the researchers' observations. Formulated tool for CVI and CVR was given to 14 specialists and it was found for CVR and CVI respectively over 50% and 80% for all individual items based on Lawashe table. To test reliability, the checklist was completed

through concurrent reliability by the researcher and her colleague and Kappa coefficient was used for each item. The maximum and minimum values were 1 and 0.7, respectively which indicated a good reliability between the two observers.

#### Statistical Analysis

Then the data were analyzed using statistical package for social sciences (SPSS Inc., Chicago, Illinois, USA) version 16.0. Initially, the taken measures in each domain were calculated, then, the relevance assessment was performed on the mean number of measures in each area with all relevant factors. In case of "measure" or "no measure" scores 1 and 0 were given. Then the mean of taken measure scores for each domain was determined in percent and examined with related factors (age of staff, the working experience of staff, and number

**Table 1.** Distribution of Patient Information.

Factors associated with Patients	Number (Percent)	
Age (year)	<10	6 (1)
	10-19	65 (11.3)
	20-29	197 (34.1)
	30-39	109 (18.9)
	40-49	91 (15.8)
	50-59	59 (10.2)
	>60	50 (8.7)
	Mean & SD	35.17±15.8 (years)
Sex	Male	454 (78.7)
	Female	123 (21.3)
Mechanism of injury	Road traffic injuries	477 (82.7)
	Falling	49 (8.5)
	Sport injury	11 (1.9)
	Injury at work	9 (1.6)
	Knife	14 (2.4)
	Assault	13 (2.3)
	Drowning	4 (0.7)
	Type of injury	Penetrating
	Blunt	390 (67.6)
Site of injury	Highway	14 (2.4)
	Freeway	40 (6.9)
	Main way	425 (73.7)
	By-way	44 (7.6)
	Village Road	54 (9.4)
	Revised trauma score (RTS)	0
	1-9	42 (7.3)
	10-11	91 (15.8)
	12	442 (76.6)
Patient at the scene	Pedestrian	164 (28.4)
	Car passenger	162 (28.1)
	Driver	172 (29.8)
	Others	79 (13.7)
Location of accident	Urban	419 (72.6)
	Suburban	158 (27.4)
Type of Vehicle	Light-weight vehicle	280 (48.5)
	Heavy vehicle	11 (1.9)
	Motorcycle	197 (34.1)
	Bicycle	6 (1)
	No vehicle	83 (14.4)

of missions per day). Spearman test was used for evaluation and comparison of mean and standard deviation (SD) and their significance considering other factors. Moreover, multiple linear regression models were used to examine the predictors of the measures. In two-tailed tests, their significance level was considered  $p < 0.05$ .

## Results

Out of 577 patients, 454 were men (78.7%) and 123 women (21.3%). Their mean age was 35.1 years old (minimum of 3 and maximum of 94 years of age). Most of the injury mechanisms were road traumatic injuries (82.7%) and falling (8.5%). Moreover, 67.6% of types of injuries were blunt trauma. Most locations of traumatic events were main roads (71.8%), most of them in urban areas (72.6%). Most vehicles involved in the accident were light-weight cars (48.5%) and motorcycles (32.2%). We discovered that 76.6% of patients had Revised Trauma Score = 12.29.8% and 28.1% of the victims were driver and passenger, respectively (Table 1). Results indicated that pre-hospital emergency consisted of young (averagely 32

years old) and experienced staff (averagely 8 years) (Table 2).

Most measures included asking for patient history in general care, monitoring in the hemodynamic domain, consciousness control in the nervous domain, and  $o_2$  sat control in the respiratory domain (Table 3). Most measures were conducted in general care and the least ones were related to the respiratory system (Table 4). Table 5 shows the relationship between the provided care in four domains with factors related to the staff. In this respect, Spearman test on personnel age, general ( $p = 0.039$ ) and hemodynamic domains ( $p = 0.019$ ) revealed a significant relationship. Besides, a significant association between work experience and general domain was observed ( $p = 0.018$ ).

## Discussion

Nowadays trauma is a basic problem of public health in all of the societies. Trauma is the most common cause of death in the age range of 1-44 years old and is counted as the third common cause of death in all the ages [1]. This study found that the largest age group suffering from traumatic injuries belonged to

**Table 2.** Distribution of personnel age, working experience and number of missions on the same day.

Factors Relevant to Staff	Mean±SD	Minimum	Maximum
Age of personnel	29.4±5.32	23	55
Working experience	21.98±5.8	1	33
Number of missions on the same day	41.49±2.3	1	14

**Table 3.** Distribution of Therapeutic Intervention in General, Hemodynamic, Respiratory, and Nervous (Percent).

Medical Measures (Variables)		Yes	No	Total
		Number (%)	Number (%)	Number (%)
General	Patient description (history)	577 (100)	0	577 (100)
	Patient position at transfer	376 (96.54)	26 (6.46)	402 (100)
	Controlling patient on stretcher	217 (91.48)	20 (8.52)	237 (100)
	Using blanket	147 (49.51)	150 (50.49)	297 (100)
	Bandage	252 (83.39)	50 (16.61)	302 (100)
	Splint	163 (66.98)	80 (33.02)	243 (100)
Hemodynamic	Recording BP	453 (83.24)	91 (16.76)	544 (100)
	Recording pulse	445 (82.28)	96 (17.72)	541 (100)
	Recording respiratory rate	433 (81.69)	97 (18.31)	530 (100)
	Recording temperature	39 (14.75)	227 (85.25)	266 (100)
	Patient monitoring	471 (84.73)	85 (15.27)	106 (100)
	Bleeding control	148 (75.51)	48 (24.49)	196 (100)
	Peripheral vessel examination	293 (71.75)	117 (28.25)	410 (100)
	Intravenous liquid injection	186 (57.91)	135 (42.09)	321 (100)
Nervous	Medication (Medicine injection)	6 (11.1)	46 (88.9)	52 (100)
	Level of consciousness	209 (88.94)	26 (11.06)	235 (100)
	Pupil control	112 (58.96)	78 (41.04)	190 (100)
	Using neck collar	90 (42.27)	123 (57.73)	208 (100)
Respiratory	Using backboards	69 (40.95)	100 (59.05)	166 (100)
	Oxygen therapy	139 (76.26)	43 (23.74)	182 (100)
	Suction	12 (44.68)	15 (55.32)	27 (100)
	Using airway	26 (78.94)	7 (21.06)	33 (100)
	Intubation	1 (3.84)	29 (96.1)	30 (100)
	$o_2$ sat control	185 (85.3)	32 (14.7)	211 (100)
	Respiratory support by Ambo Bag	6 (49.6)	8 (50.4)	14 (100)

**Table 4.** Distribution of therapeutic measures in Each Area.

Care domains	Yes	No	Total	Mean±SD
	Number (%)	Number (%)	Number (%)	
General	350 (60.7)	227 (39.3)	577 (100)	99.03±1.86
Hemodynamic	224 (41.05)	321(58.95)	545 (100)	36.24±4.69
Nervous	150(46.76)	171 (53.24)	321 (100)	32.15±4.35
Respiratory	126 (51.18)	125 (48.82)	251 (100)	20.66±4.28

**Table 5.** Relationship between Care Domains and Staff Variables.

Domains factors relevant to staff	General	Hemodynamic	Nervous	Respiratory
Age of personnel	$p=0.039$	$p=0.020$	$p=0.801$	$p=0.981$
Working experience	$p=0.018$	$p=0.121$	$p=0.962$	$p=0.792$
Number of missions on the same day	$p=0.780$	$p=0.961$	$p=0.940$	$p=0.801$

20-29 years of age (34.1%). Most of them were men (78.7%). In a study conducted by Demyttenaere in major hospitals of Kampala to describe the injuries due to trauma, the mean age of the injured people was 26±12 years old and 75% of them were men [17]. In Naghavi's study in 2003, 53% and in Dutton's study in 2002, 79% of the injuries occurred in men [18, 19]. In Worly's study in 2007, the highest rate of injuries was associated to the age group of 15-29 years old [20]. Because in researcher's opinion this age group consists of the young and active population of society who are bold and busy and subject to greater risk of injury due to being involved in more social activities. In other words, they are busier with social activities and take risks more than women. Road traumatic injuries were the most common mechanism of injury (82.7%) which was consistent with the results obtained from epidemiological studies of trauma by Zargar in Tehran, Salimi in Ahwaz and Hemmati in Guilan [2, 18, 21, 22]. Moreover, falling was the second major cause of injuries (8.5%). According to the results of a study by Salimi *et al.* the most common mechanism of injury following road traumatic injuries was falling, 50.9% of which were falling down on the ground and falling from stairs. In other studies, high prevalence of falls has been confirmed as the second leading cause of trauma [2, 22]. The number of blunt trauma (67.6%) was almost two times more than that of the penetrating one (32.4%), while in Dothan's study inspecting resuscitation during active bleeding and its impact on mortality, 51% of cases were assigned to penetrating injuries [19]. On the contrary, in a research by Ahmadi Amoli *et al.* in Tehran, penetrating injuries constituted a small proportion of traumas [23]. Most injuries occurred in main roads (73.7%) and 76.6% of patients had Revised Trauma Score=12. In Zargar's study in 2006, most patients had mild injuries [21]. Since in this research, road traumatic injuries were the most common cause of trauma and data collection was performed in autumn and winter, in researcher's opinion perhaps due to rain and roads' condition in these seasons, observing safe speed was often more common. Therefore, in

case of road traumatic injuries, the severity of the injuries was less than other seasons (spring and summer). Most of the patients who had traumatic injuries were driver (29.8%) of light-weight vehicles (48.5%) who had accidents in the cities (72.6%). This finding was not consistent with Hemmati in 2002, Zargar in 2009 and Salimi in 2008 [2, 21, 22]. Since in their studies, motorcycle was the most common involved vehicle. This issue can be considered due to the changes in traffic laws and their focus on motorcyclists.

Data also proved that obtaining patient history was performed completely in general care area and appropriate positioning of patient was one of the most items performed (93.54%). Using blankets (50.49%) and splints (33.02%) were the most items which were not performed. In researcher's opinion, it can be mentioned that always the first step to provide any care is to obtain patient's history and description of incidence from the injured. Since it is one of the main bases of diagnosis and treatment, such a result is predictable.

In hemodynamic domain, recording the patient's vital signs (except temperature) and patient monitoring were the most common measures (84.73%), while drug injection was the least (11.1%). It seems that since in most trauma systems such as Revised Trauma Score temperature has not been dealt with and because monitoring patients is important and there are no painkiller medications and sedatives in ambulances, these findings are not unexpected. In Staf's study in Norway (2011), the respiratory rate and systolic blood pressure were recorded 26% and 20%, respectively [24]. In present study, a 26-year-old male motorcyclist who had a car crash outside the city (GCS=10, RR=28). He had no peripheral pressure and pulse that had been injected about 200 cc intravascular volume with blue angio-catheter (No. 20). While according to existing protocols, using angio-catheter 16 and 18 is recommended in traumatic patients [23]. The reason for this could be the easier use of thinner ones or lack of good training to technicians in selecting the appropriate angio-catheter. In nervous domain,

controlling consciousness level had the highest percentage of taken measures (88.94%). Using a cervical collar and back boards (57.73%, 59.05%) were the items not used despite its necessity. In Soysal's study in Turkey, 6 of 30 (20%) had used a cervical collar [15]. In a study performed by Armstrong, spinal fixation was not performed in more than 8% of patients with spinal cord injuries [25]. In Ahmadi Amoli's study in Tehran, over 80% of cases of necessity, the cervical collar, and the spinal bed had not been used [23]. Perhaps controlling consciousness level is the first and most commonly used method to examine the nervous system. It requires no special tools and is easy. Therefore, it obtained the most percentage. Probably factors such as lack of facilities and trained personnel in this field were the reasons for not using spine fixation devices. In the respiratory domain, oxygen therapy and  $O_2$  sat control (72.26%, 85.3%) were the most common measures and intubation (3.84%) the least since intubation and respiratory measures require enough skill and knowledge. Another reason can be due to lack of anesthetic drugs in an ambulance. However, some researchers found opposite results regarding intubation at the scene. A study conducted by Davis suggested that patients with moderate to severe head injuries who had been intubated at the scene had higher mortality rate compared with those intubated in the hospital [26]. In this study, there were only two cases with RTS=0. One of them was a 19-year-old boy falling from height that was transported without opening the airway or respiratory support. The other case was a man 25 years old, on whom intubation and CPR was performed by-hospital emergency personnel at the scene and was taken to hospital by bag-mask-valve (BMV) respiratory support. Distribution of therapeutic interventions in each domain indicated that most medical measures were taken in general care (60.7%) and the least measures in the hemodynamic domain, nervous and respiratory, respectively (41.05%, 46.76%, 51.18%). Hemodynamic care (58.95%) was among the most unperformed measures. In researcher's opinion, the measures taken in general care may require no special skill and its high percentage is not unexpected while in hemodynamic, respiratory, and nervous domains in addition to having skills, knowledge of staff and appropriate decision-making power also are of high importance. In investigating the relationship between mean and standard deviation of conducted measures in general, hemodynamic, respiratory, nervous domains in terms of age, working experience and the number of missions, there was a significant relationship between the variables of personnel age and the general and hemodynamic area ( $p=0.039$ ) ( $p=0.019$ ). In Masaki's study, the personnel who were aged between 36 and 45 years old were less affected by job stress compared to nurses aged less than 35 years old and carried out their

assigned duties as expected [27]. On the other hand, considering the significant relationship between working experience and general area ( $p=0.018$ ), it may be noted that offering measures especially in general area are of more importance due to the fact that they are common for most traumatic patients and routine task of the experienced personnel.

Road traffic injuries are major public health problem, especially in low- and middle-income countries. Management after traumatic injuries plays a very important role in minimizing the damage and increasing survival [28]. As a matter of fact, all pre-hospital emergency measures must be performed completely in all domains according to international standards and as shown in this study these measures had been provided incompletely in most domains. Therefore, treatment deputy of university and director of medical centers can aim at strategic care planning, assigning funds, staff knowledge and facilities in order to enhance and improve these vital measures using the results of this study. In this study, the highest percentage of injuries associated with road traffic injuries and most of the victims were young so public education for all, especially young people in the society seems necessary. Moreover, the number of such road traffic injuries can be remarkably reduced by promoting the injury prevention programs and training on using seatbelt, helmet and other safety devices. Also, most traumas are minor and fewer severe injuries, first aid and trained individuals can be used to treat them. Training related groups such as the Red Crescent Society and police staff decreases the unnecessary referrals to emergency staff and specialized hospitals in order to prevent from unnecessary crowding.

In conclusion, measures such as putting a collar and the spinal bed cans significantly affect the prognosis of patients and their future quality of life, these instruments can prevent from cervical and lumbar spinal cord injuries resulting in quadriplegia or paraplegia. It is recommended that for improving the quality of pre-hospital emergency services, immediate measures be taken by developing standard protocols and training the staff. Since irreversible injuries can be prevented to a large extent by observing basic prevention principles, staff training, and skilled human resources.

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