**Original Research**

# Investigating The Relationship Between The Time Interval Of Transferring Patients With Multiple Traumas By The Pre-Hospital Emergency Room And Mortality In Patients Referred To The Emergency Room

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## Abstract

**Background:** An essential component of the health care delivery system, pre-hospital emergency services (also known as emergency medical services, or EMS) are responsible for transporting patients to medical facilities and offering pre-hospital care.

**Method:** This descriptive-analytical study examined 800 patients with multiple traumas who were referred by the pre-hospital emergency from 21 January 2020 to 21 January 2022 to Khatam Al-Anbia Hospital in Zahedan. Based on the data recorded in the emergency system and the time information kept by Zahedan Medical Emergency Center, the following time intervals are totaled: transport time, scene time and response time. The time intervals are measured starting from the moment a technician receives the call at 115 and ending when the technician arrives at the emergency site, moving to Khatam Al-Anbia Hospital, and arriving at the hospital triage. Additionally, other pertinent data such as (age, sex, underlying disease, time of accident based on work shift, type of trauma, mechanism of trauma, level of consciousness upon entering the emergency room, severity of trauma and outcome in the first 24 hours). Additionally, the patient's transfer time to the hospital was verified, as was their mortality within the first 24 hours.

**Results:** Patients transported with higher Response Time, Transport Time and Total Run Time had significantly higher mortality ($P<0.001$, $P=0.004$ and $P=0.005$, respectively). However, Scene Time was not associated with mortality ($P=0.808$). In addition, older age, underlying disease, response time, scene time, transport time, work shift and level of consciousness have a significant relationship with mortality.

**Conclusion:** Patient mortality during the first 24 hours is influenced by the length of time the patient is transferred from the accident scene to the hospital. The study's conclusions can be used as a guide to adjust the patient-affecting time intervals.

**Keywords:** Medical Emergency, Pre-Hospital Emergency, Trauma

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## Introduction

Today, the occurrence of trauma is one of the main problems that threaten the health of the society. Trauma is any type of penetrating or non-penetrating injury that occurred due to external factors and includes traffic accidents, falls, drowning, etc. (1,2). Multiple trauma and multiple impacts are medical terms that describe the condition of an individual who has suffered a traumatic injury such as a serious head injury, defined by an Injury Severity Score (ISS) of 16 or greater (3). In most parts of the world, trauma victims form the young and efficient segment of the society. Trauma is the most common cause of death in the ages of 15-44 years and is the third most common cause of death in all ages (4). Unfortunately, the significance of this issue has received less attention in developing nations where trauma is the leading cause of death as well as one of the primary causes of disability and disability among the working population. As things continue to deteriorate, the World Health Organization projects that by 2020, accidents will rank as the second leading cause of death globally. According to an analysis of the death rate from trauma per 100,000 people, Iran had a rate of 39 and the rest of the world had 88 (5,6,7). The initial level of care given to patients with life-threatening conditions by emergency medical technicians (EMTs) and paramedics before they are transported to a hospital is known as prehospital emergency medical services (EMS). Response times are to be shortened by EMS. This is the amount of time that passes between making an emergency call to an ambulance station and the emergency ambulance showing up to assist. The higher the survival rate, the shorter the response time (8). Research has shown that time is an important factor in the survival of multiple trauma patients, and the shorter the time between the accident and the start of surgery, the more likely the patient will survive. Therefore, much emphasis has been placed on the emergency response time due to its great importance (9,10). In Iran, the annual toll from traffic-related fatalities is equal to the population of one or more small cities. Many other detrimental economic, social, and psychological repercussions are also caused by these incidents, in addition to the fact that many people are killed and injured, leaving many more with physical disabilities (11). The ultimate prognosis of the patient is significantly influenced by the accurate and consistent pre-hospital emergency care provided in accident situations. Due to the lack of information in the provinces of Sistan and Baluchistan regarding trauma patients, this study aims to investigate the relationship between the time intervals of sending trauma patients from the scene to the hospital by the pre-hospital emergency room of Zahedan city with mortality was performed in the first 24 hours. This is because, in various studies, the relationship between the time intervals of transporting patients with multiple traumas by the pre-hospital emergency room and mortality has been stated in different ways.

## Method

This study was a descriptive-analytical study. The files of patients with multiple traumas who were referred to Khatam Al-Anbia Hospital in Zahedan from February 2020 to February 2022 by the pre-hospital emergency department were examined. The sample size considering (99% confidence interval, 95% chance ratio based on and adding 15 base sample size of each of the independent changes studied) was 800 cases. The method of sampling was such that the researcher obtained the total number of eligible cases separately for each year and each month based on the year of the incident. Based on the total sample size of 800, the sample size was 400 cases per year. With this explanation, the researcher selected 20 cases using a random number table from among all the cases in each month and was investigated. Exclusion criteria include; The age was less than 16 years and more than 65 years, the accident happened outside the urban area of Zahedan, the patient died at the scene of the accident or before reaching the hospital, and there was a lack of information in the files. After approving the project in the Research

Council of the Faculty of Medicine and obtaining approval from the Ethics Committee of Zahedan University of Medical Sciences, the researcher collected the required information based on the information collection forms. Based on the time information recorded in the Zahedan Medical Emergency Center, based on the contents recorded in the emergency system, the time spent from the moment of calling 115 to the moment the technician arrives at the emergency location, the time spent from the moment of arrival at the emergency location Until the moment of departure to Khatam Anbia Hospital, the time spent from the moment of departure to the hospital until the moment of reaching the hospital triage and the total of three time intervals: Transport time, Scene time, Response time and recorded using the patient file in Khatam Al Anbia Hospital. Other necessary information including: (age, sex, underlying disease, time of accident based on work shift, type of trauma, mechanism of trauma, level of consciousness upon entering the emergency room, severity of trauma and outcome in the first 24 hours) were extracted. In this way, in this research, the important time indicators of providing pre-hospital emergency services (based on national standards) were extracted. These indicators were analyzed based on the information recorded in the Zahedan Medical Emergency Center and the patient's file in Khatam Al Anbia Hospital as the main trauma center in Zahedan. Considering the effect of confounding variables such as the time of the accident (based on the work shift) and the underlying disease and the type and mechanism of the trauma, the frequency of deaths in the first 24 hours after the accident was assessed and the relationship of the desired outcome with independent variables was investigated. Using SPSS 22 software, the results were described using descriptive tests, including frequency, percentage, mean, standard deviation, and tables and graphs. Independent t-tests and one-way ANOVA are used to examine the relationship between time variables and independent variables. Finally, regression analysis was done to determine the effect of variables predicting death in the first 24 hours. The significance level of the tests was considered less than 5%.

**Results**

The frequency distribution of age in the studied subjects is respectively 20-29 years old (270 people, 33.75 %), 40-49 years old (153 people, 19.1 %), 30-39 years old (138 people, 17.25 %), 19-16 years (126 people, 15.75%), 50-59 years (74 people, 9.25%) and more than 60 years (39 people, 4.8%). Also, the mean and standard deviation of the age of the investigated subjects were equal to 33.04 and 13.11 years (Table 1).

662 of the studied subjects (82.8%) were male and 138 (17.3%) were female. 114 of the studied people (14.2%) had an underlying disease and the rest (686 people, 85.8%) had no underlying disease. The mean and standard deviation of the level of consciousness based on the Glasgow criteria were 12.16 and 3.78, respectively. Also, the lowest and highest GCS levels in the studied subjects were 3 and 15, respectively. The frequency distribution of injury mechanism was 634 people (79.3 %) vehicle accidents, 99 people (12.3 %) fights, and 67 people (8.4 %) falling from level or uneven surfaces (Table 2).

The frequency distribution of the triage level was 343 people (42.9 %) in level 1 and 457 people (57.1 %) in level 2. The frequency of deaths in the first 24 hours was equal to 74 people (9.3 %) (Table 3).

The frequency distribution of the type of trauma was blunt in 733 people (91.6%) and penetrating in 67 people (8.4%). The findings of the duration recorded by Zahedan Medical Emergency Center were shown in Table 4 (Table 4).

Based on the results of the Mann-Whitney statistical test, patients transported with higher Response Time, Transport Time and Total Run Time had significantly higher mortality ($P < 0.001$, $P = 0.004$ and $P = 0.005$ respectively). However, Scene Time was not associated with mortality ($P=0.808$) (Table 5).

Based on the findings of the multivariate regression test, older age, underlying disease,

response time, scene time, transport time, work shift and level of consciousness have a significant relationship with mortality (Table 6).

**Discussion**

Pre-hospital emergency service (Emergency Medical Services, EMS) is an important part of the health service delivery system and they play a key role in providing pre-hospital services and transferring patients to medical centers. The purpose of such medical services is to provide appropriate treatment, at the correct place and time and using available resources (12-13). If pre-hospital measures are not provided at the right time, many patients die at the scene of the accident and during transportation or may suffer complications and disabilities (14). For each of the time indicators, especially prominent indicators such as Response Time, standards have been set to measure the medical service system with these values. Response time in urban areas should not exceed 10 minutes (15). In our country, the average of this index (Response Time) is 8 minutes (in other words, less than 4 minutes is considered as a short duration, between 4 and 8 minutes as an average duration and above 8 minutes as a long duration) (16). In the present study, this time was equal to 13.94 minutes, which is much higher than the national index. Feizollahzadeh and his colleagues (2022) conducted a study with the aim of investigating response time in Tabriz city. In this study, the response time was 11.58 minutes (in the long range) and this time was related to factors such as technical preparation, traffic conditions, accident time, and the level of education of ambulance personnel (17). In Sistan and Baluchistan province, this time may be affected by things such as long distances between cities and the small number of pre-hospital emergency centers in Sistan and Baluchistan province compared to other provinces of Iran. The emergency center of Khatam Al-Anbia Hospital, Zahedan, as a trauma center of Zahedan city, covers accidents and injuries in long distances. The time spent from the moment of arriving at the emergency site to the moment of moving to the hospital should be less than 15 minutes (16). In this connection, the average Scene Time was equal to 1/8; This time was much less than the standard time. The time to stay at the scene of the accident includes accessing the patient, performing therapeutic interventions, stabilizing the patient's condition and preparing the patient for transfer from the scene. Also, the number and skill of the ambulance personnel is also effective during the scene (18-19). The average stage time in Tehran was 17.31, Urmia 7.4, Kermanshah 16.73, Ankara 8.65, Riyadh 13.47 and America 13.40 minutes (18-19, 20-22, 13). Based on clinical practice, in some situations, it is beneficial to stabilize patients at the scene, while in some critical situations and time constraints, the speed of transferring patients to the desired hospital is the most important priority. In this context, the role of pre-hospital emergency personnel with experience in the scene, despite being different in different regions and countries, is an integral part of the care process (23); Therefore, by considering the conditions of the environment, the patient and the experiences of the emergency personnel, the difference in time intervals at the scene of the accident can be understood to some extent. Furthermore, the duration of patient transfers from the scene to the hospital was 25.8 minutes. These findings indicate that the patient transfers were completed within a reasonable timeframe and are somewhat in line with previous research. The time it takes to transfer trauma patients in urban areas is currently short, and it appears that transferring patients quickly and easily is more beneficial than attempting to conduct additional interventions on the scene. Because there is a greater need to apply advanced techniques in rural and non-urban environments, it may take longer to complete interventions (23). The average duration of the entire dispatch in the present study was 48.8 minutes. In line with our findings, the total dispatch time of similar studies conducted in Tehran (50 minutes), Urmia (37 minutes), Ankara (46 minutes), Riyadh (35 minutes) and America

was 31 minutes (18, 15, 13, 20-22); Therefore, it can be inferred that Zahedan pre-hospital emergency personnel had brought the patients to Khatam hospital emergency in the same period of time as in other big cities. Based on the results of the Mann-Whitney statistical test, patients transferred with higher Response Time, Transport Time and Total Run Time had significantly higher mortality. However, Scene Time was not associated with mortality. In this regard, Mahama and his colleagues in 2018 investigated the anxiety response time of pre-hospital emergency and the survival rate of trauma patients in Ghana. In this cross-sectional study, 652 cases of patients referred to the pre-hospital emergency room were examined. The findings of this study showed that the survival rate of patients was 87% and the average time of transferring patients was 82 minutes. In addition, they stated that the survival rate of trauma patients was related to the average response time (24). In order to better understand the relationship between pre-hospital emergency time intervals and mortality in the initial twenty-four hours after medical emergencies, Ranjbar and colleagues conducted research on this topic in 2016. In summary, although this time is effective in reducing the mortality of emergency patients, interventions in the area of patient transfer time should be done cautiously as this time can result in a reduction in pre-hospital care (25). This cross-sectional study, which examined 2884 multiple trauma patients, demonstrated that Response Time, Scene Time, Transport Time, and overall time to reach the emergency room had a significant relationship with mortality. Our study's findings are in line with those of these two investigations. In addition, our study showed that older age, underlying disease, shift work and level of consciousness are also significantly related to mortality. In this regard, Ito and his colleagues in 2022 investigated 19,141 cases of multiple trauma patients caused by road accidents and the relationship of variables related to patients and emergency with mortality. The findings of this study showed that the duration of transfer to the emergency room, holidays, night shift, the number of calls to the emergency medical center and age over 65 years were related to the mortality of patients (26). Bech and colleagues (2018) also looked at risk factors related to short-term mortality in Denmark over time after arriving at the emergency department. Over the course of two years, 43178 cases involving patients older than 18 were examined in this study. According to the study's findings, the overall 30-day mortality rate was 4%, and mortality was related to male sex, older age, and underlying diseases (27). For these reasons, it can be generally concluded that patients who are older, have lower consciousness, or work night shifts should receive more attention because they are more likely to suffer permanent harm or even pass away.

**Conclusion:**

Patient mortality during the first 24 hours is influenced by the length of time the patient is transferred from the accident scene to the hospital. The findings of this study can serve as a guide for adjusting the patient-affecting time intervals. Additionally, by taking into account educational initiatives and the rectification of intra- and interdepartmental management structures, pre-hospital emergency time intervals can be directed in the proper direction.

**Limitations of the study:**

In this study, the time indicators of pre-hospital emergency services were recorded from dispatch cards in the pre-hospital emergency message center, and there is a possibility that the times announced by 115 operational technicians are not as accurate as they should be.The second limitation of the study was related to the lack of analysis of days of the week, education level of emergency medical technicians and their experience, pre-hospital emergency facilities, etc.; Therefore, it is recommended to carry out more comprehensive studies in order to investigate the pre-hospital emergency situation and remove their limitations.

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**Table & Figure:**

**Table 1: Frequency distribution of the age range in the studied subjects**

| Variable (age range) | Number | Percentage |
|---|---|---|
| 16-19 years | 126 | 15.75 |
| 20-29 years | 210 | 33.75 |
| 30-39 years | 138 | 17.25 |
| 40-49 years | 153 | 19.1 |
| 50-59 years | 74 | 9.25 |
| More than 60 years | 39 | 4.8 |
| All subjects studied | 800 | 100 |

**Table 2: Frequency distribution of the injury mechanism in the studied subjects**

| Variable | CA and MA | | Falling | | Fight | |
|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent |
| Mechanism of injury | 634 | 79.3 | 67 | 8.4 | 99 | 12.3 |

**Table 3: Frequency distribution of deaths in the first 24 hours in the study subjects**

| Variable | Yes | | No | | All subjects studied | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Death in the first 24 hours | 74 | 9.3 | 726 | 90.8 | 800 | 100 |

**Table 4: The duration recorded by the Zahedan Medical Emergency Center in the study subjects**

| **Variable** | **N** | **Mean** | **SD** | **Min** | **Max** |
|---|---|---|---|---|---|
| Response Time (the time spent from the moment of calling 115 to the moment the technician arrives at the emergency location) | 800 | 13.94 | 9.63 | 2 | 60 |
| Scene Time (the time spent from the moment of arriving at the emergency room to the moment of moving to the hospital) | 800 | 8.09 | 4.54 | 2 | 20 |
| Transport Time (the time spent from the moment of departure to the hospital until the moment of arrival at the hospital triage) | 800 | 25.83 | 23.55 | 2 | 90 |

| | | | | | |
|---|---|---|---|---|---|
| Total Run Time<br>(sum of the above three time intervals) | 800 | 47.87 | 30.55 | 10 | 138 |

**Table 5: Correlation of duration recorded by Zahedan Medical Emergency Center and mortality in the first 24 hours**

| | Yes | | No | | P-Value |
|---|---|---|---|---|---|
| | Median | Interquartile range | Median | Interquartile range | |
| Response Time | 15 | 10 | 10 | 10 | <0.0001 |
| Scene Time | 5 | 5 | 5 | 5 | 0.808 |
| Transport Time | 20 | 5/32 | 15 | 33 | 0.004 |
| Total Run Time | 60 | 46 | 36 | 47 | 0.005 |

**Table 6: The results of the regression model of significant variables related to the mortality rate**

| **Predictor variable** | **Non-standard coefficient** | | **Standard coefficient** | **P-Value** |
|---|---|---|---|---|
| | B | Std. Error | | |
| Constant | 0.0855 | 0.106 | - | <0.001 |
| Age | 0.002 | 0.001 | 0.081 | 0.019 |
| Sex | -0.038 | 0.022 | -0.05 | 0.093 |
| underlying disease | 0.107 | 0.027 | 0.129 | <0.001 |
| Response Time | 0.004 | 0.001 | 0.147 | <0.001 |
| Scene Time | 0.008 | 0.002 | 0.123 | <0.001 |
| Transport Time | 0.001 | 0.001 | 0.066 | <0.001 |
| work shift | 0.029 | 0.011 | 0.086 | 0.006 |
| Mechanism of injury | -0.016 | 0.013 | -0.037 | 0.244 |
| level of consciousness | 0.054 | 0.003 | 0.709 | <0.001 |
| Intensity of triage | 0.001 | 0.023 | 0.001 | 0.995 |