

# Time Indices of Emergency Medical Services

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## Abstract

**Background:** Almost 25% of the world population suffer from early death due to preventable events. Trauma and sudden cardiac death are known as common causes of death. The arrival time to help the patient is known as a very important factor in enhancing survival and reducing side effects.

**Objectives:** The aim of the present study was to identify the factors relating to the efficacy of prehospital emergency service (time-related performance). In addition, it was intended to describe time indices of prehospital services among patients who had internal medical and trauma related problems.

**Methods:** In the present cross-sectional study, all the calls to the emergency medical service (EMS) were monitored. The reasons of these calls were internal medical problems and trauma (March 2009 to March 2013). The frequency of calls were derived from the information bank of EMS in Isfahan, Iran. Demographic features, type of events, time indices of EMS and the outcomes of registered patients were collected and the data were analyzed using descriptive and analytical statistics. Descriptive statistics included frequency, percentage, mean, median, and standard deviation and inferential statistics included t-test, ANOVA, multiple regression and chi-square test.

**Results:** From a total of 299956 cases who had sought help, 61.9% were men. Also, 48.5% of the cases had internal medical and 51.5% had traumatic injuries. In 61.5% of the cases, the injured persons were transferred to the hospital and 3.2% of the cases resulted in death. The men had a mortality rate of 1.6 more than women ( $P < 0.001$ ). Response times were significantly higher than the standard of 8 minutes ( $P < 0.001$ ). In 50.6% of the cases, the mean response time was less than 8 minutes.

**Conclusions:** Considering the increasing trend of traumatic events, especially in active groups of society (age groups of less than 45), equipping and updating ambulances and providing the EMS personnel with better training can help the injured people in reducing aftermath consequences. On the other hand, increasing neurologic problems in these age groups is an alarm for health managers and health workers, so that they can improve public health through revising health guidelines. Increase in the response time in prehospital emergency missions is also an alarm for the managers who must revise the methods of conducting emergency missions.

**Keywords:** Internal Medical, Trauma Events, Time Indices, Help-Asking, Emergency Medical Services

## 1. Background

Prehospital measures are among major health care activities of each society, and lack of these activities may lead to irrecoverable consequences for society (1, 2). What is of great importance these days is that quality and quantity of services in medical emergency plays a central role in health care around the world (3, 4). Primary identification of the injuries, primary recovery and desirable measures of EMS have a crucial role in treating the injured people (5, 6).

Unintentional events are the second cause of mortality in Iran. In addition, Iran is one of the countries with the highest mortality rate in the world. The frequency of road accidents in Iran is 20 times more than the average of the world. EMS sector in Iran needs special attention, permanent training, and updating (7, 8). In a study in Canada in

2006, the most common reasons for calling ambulance included trauma, epilepsy and respiratory problems (9). The response time is a very important factor in enhancing the injured persons' survival chance and reducing side effects (10). Mortality is one of the most important issues in emergencies, and due to the high number of accidents this issue warrants more attention (11). Trauma is one of the main causes of mortality in the world. It is the second reason of mortality in Iran (12-14). In car accidents, 50% of deaths occur in the first hour, 25% while transferring to the hospital, and 25% of deaths are due to infections (15). An emergency medical technician (EMT) is known as a key element in the survival chain (16). The prehospital system should be simple, efficient and permanent (17). The EMT personnel are divided into Franko and Anglo. In Franko the equipment and facilities are provided at the injury site and physicians

are employed in the ambulance. In Anglo, the technicians who have passed the primary courses of first aid attend the injury site, take the primary measures then transfer the injured to the hospital (18).

Time indices are of great importance in EMS (19). One of the factors of efficiency in delivering emergency services is their occurrence within a suitable distance (20). In general, the efficiency of ambulance services is determined through measuring two factors, namely, response time and service time. The less the time, the higher the efficiency (21). In 2004, in England the average response time was reported to be 6 minutes (22). Newgard et al. in 2010 in their prospective cohort study investigated traumatic events of individuals older than 15 years during 16 months (3656 cases). In that study no significant relationship was found between death, and delay times, response time, scene time, transfer and total time (23). Similarly, another study was also conducted by Bidari et al. in 2007, in which 500 injured persons who had been transferred to the hospital were investigated. The average (SD) response time was 12 minutes and 54 seconds (1 minute and 24 seconds) and transfer time of 34 min and 37 s (2 minutes and 40 seconds) (24).

The results of another study conducted by Bahadori et al. (2009) showed that the response time of the EMS in urban areas of Iran, with the exception of Tehran, was 7 min, and in suburban areas was 14 min (25). Khanke (2011) investigated the main reasons for calling to EMS between 2010 and 2011. Most of the injured were men with 81.7% and women with 18.3%. Traumas with a frequency of 726 cases were the most frequent.

In another study by Delshad et al. (2013) the reasons for calling to the EMT of Tehran were investigated. Car accidents (77.9%), stab wound (11.1%), falling down (4.6%), burning (2.1%) and CO poisoning (1.5%) were the main causes, respectively. CO poisoning was higher among women compared with men and the frequency rates of car accidents and stab wounds were higher among men compared to women (26). Panahi et al. (2007) reported that the average response time for children was 10 minutes and 15 seconds (27).

## 2. Objectives

The aim of this study was to determine the frequency distribution of problems which lead to prehospital service delivery, describe time indices of EMT service delivery and investigate the outcomes of preservice EMT missions.

## 3. Methods

In this cross-sectional study, all the calls to EMS in Isfahan, Iran, were recorded and investigated from March 2009 to March 2013. The prehospital variables including demographic information (age and gender), cardiopulmonary arrest, cardiovascular, neurologic, respiratory, abdominal pain and poisoning, and trauma (multiple trauma, head and neck trauma, trunk trauma, limb trauma, spine trauma, burn, gynecology and CO poisoning) and outcomes were assessed and registered. Moreover, the time differences including response time, scene time and transfer time were calculated in order to assess the time indices. Each mission was started by calling the monitoring room and sending the nearest ambulance to the site. The needed information of EMS was given to dispatch by the EMT. At the end of each mission, the information of each patient was recorded.

Data were analyzed using the SPSS software version 18.0 (SPSS, Inc, Chicago, Illinois, USA). Descriptive statistics (frequency, percentage, mean, median, and standard deviation) and inferential statistics (t-test, ANOVA, multiple logistic regression and chi-square test) were used to examine the relationship between different variables like age, gender, time indicators, traumatic problems, internal medical problems, and the year of occurrence.  $P < 0.05$  was considered as the level of significance.

## 4. Results

In the time period 299956 cases were investigated. From these cases, 11.7% were recorded in 2009, 21.8% in 2010, 23.9% in 2011, 20.0% in 2012 and 22.5% in 2013. Also, 236713 cases (79%) resulted in providing service from which 61.9% were men and 38.1% women. Other cases were not patients or were false alarms.

The sudden increase in the number of cases after 2009 was due to more than 20% increase in the number of ambulances in Isfahan city and thus, it can cause increase in the number of EMS missions.

The highest rate of requests for help was 26.6% which belonged to the age group of 16-30 year old people; 48.5% (114806) belonged to internal medical and 51.5% (121907) were trauma. From among the internal medical problems, neurological problems (45.6%) and from among traumatic problems multiple traumas (45.1%) were the most common traumas. The other internal medical problems included cardiovascular (35.7%), and respiratory problems (7.3%), poisonings (5.5%), cardiopulmonary arrest (3.7%), and abdominal pain (2.2%). The frequency distribution rates of other traumatic problems were limb traumas (21.9%), head and neck traumas (21.8%), trunk trauma (6.4%), spine

trauma (3.5%), CO poisoning (0.6%), gynecology (0.4%) and burns (0.3%). The frequency rates of transferring to hospital, mission cancelling, not allowing to transfer, death, helping the caller and unknown consequences were 61.5%, 17.6%, 8.9%, 3.2%, 1.9% and 6.8%, respectively. The most common internal medical problem in cases who had asked for help was neurological problems for men (44.6%) and women (47.1%). The most common internal medical problem among men of 0 - 45 years old in 2009 and between 2011 and 2013 was neurological problems. Fifty-nine percent of the referrals in the age range of 0 - 15, 57.2% in the age range of 16 - 30, 49.5% in the age range of 31 - 45 years old were found to have neurological problems. Also, 45.5% of the referrals in the age range of 46 - 60 years and 41.2% of the referrals in the age of more than 60 years old had cardiovascular problems. Cardiovascular problems were the most common problems among the referrals of older than 45 years during 2009 - 2010. In this age range in 2010 and 2012 neurological problems were the most prevalent problems. Cardiopulmonary arrest, respiratory problems, abdominal pain and poisoning were more common among men compared to women in all age ranges. In 2009, cardiovascular problems were the most common problems (45.7%). However, in 2009 and between 2011 and 2013 the most common problems were neurological problems.

The most common traumatic problems among men and women were multiple trauma with 48.9% and 41.4%, respectively. Multiple trauma was the most common traumatic problem in all age ranges in the time period between 2009 and 2011. In 2012, head and neck trauma was the most common in all age ranges. In 2013, limb trauma was the most common traumatic problem. In general, during five years 54% of the referrals in the age range of less than 15 years, 55% of the referrals in the age range of 16 - 30 years, 48% of the referrals in the age range of 31 - 45 years, 24.4% of the referrals in the age range of 46 - 60 years and 36.9% of the referrals in the age of older than 60 years had multiple trauma. Multiple trauma, head and neck and spine traumas were more common in men compared to women in all age ranges. In men and women head and neck trauma in 2010 with 28.7%, limb trauma in 2012 with 37.8% and 37.4% in 2013 were found to have the highest percentages. Moreover, 46.2% of the callers with internal medical and 58.1% with traumatic problems were men. Furthermore, 29.3% of the callers were older than 60 years old with internal medical problems and 38% of the callers with traumatic problems were in the age range of 16 - 30 years.

In the time period between 2009 and 2013, the most frequent requests for help with internal medical problems belonged to the year 2011 (24.2%) and traumatic problems (23.1%) belonged to 2010. The average response times divided years of study (2009 - 2013, 8.4, 8.6, 8.9, 9.1, and 9.4

minutes, respectively) were significantly higher than the world standard which, is 8 minutes ( $P < 0.001$ ). In 50.6% of the cases, the average response time was less than 8 minutes. In addition, the average scene time was significantly less than its standard in the world, which is 15 minutes ( $P < 0.001$ ). The response time in cardiopulmonary arrest was lower compared to other problems in men and women. The death rates were significantly reduced in 2012 and 2013 compared to 2008, ( $P < 0.001$ ).

## 5. Discussion

The present study aimed to determine the frequency distribution of the reasons for calling, time indices, and follow-up of EMS. The quality and quantity of services in EMS play a crucial role in health care throughout the world. Therefore, prehospital measures, which are major actions in providing healthcare, can be considered as one of the necessities of healthcare organizations (2, 28). Primary identification of the injuries in events, triage of injured people for more desirable services, and also primary resuscitation of the injured plays a crucial role in pre-informing people with different types of needs (5, 29). In spite of the high number of events and accidents, the important point is that with on time services, recovery and saving the injured persons' lives can be attained (16).

The response time is a very important factor in saving the injured people and reducing the side effect (10). In a study conducted in Shiraz, 49.9% of the emergency missions were carried out during 8 to 10 minutes, which is higher than the standard time of 8 minutes (30). In a study in Yazd, it was revealed that the response time in 81.1% of the EMS missions was less than 8 minutes (31). In a study by Kleindorfer, in Ohio, it was found that 93% to 97% of the EMS missions have been conducted in 10 minutes (32). In another study, which was conducted in 2008, the researchers found that from among 1945 investigated missions, the average response time was been 8.2 minutes (33). In the EMS system, one of the main strategies is sending the nearest ambulance (34). Results of some studies showed that lack of enough ambulances, traffic, improper distribution of ambulances and weak management have been among the main reasons for increased response time (35-38). According to the regulations of comprehensive EMS services and considering the population of Isfahan in 2013, this city needs 70 ambulances. This city has 45 ambulances and 35 motorcycle ambulances.

In 2000, more than 9 million accidents resulted in injury in Iran. As a result, four million injured people were treated immediately and one million people were hospitalized (39). In a study in Markazi province, Iran, the frequency of events, which resulted in treatment in hospi-

tals, was reported to be 692 cases per 100,000 people (40). Prehospital service delivery is affected by various factors like man power and its distribution, training, equipment, management and organizing. The length of response time, scene time and transport time may be due to inefficiency in one of the chains of service delivery like proper information delivery system, equipped ambulances and readiness of technicians (40).

Considering the fact that the EMS department is considered as the first line of health care, this dissatisfaction can result in negative consequences on health care system. Equipping and updating ambulances and providing the EMS personnel with better training can help the injured people in reducing aftermath consequences.

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