Improving the Emergency Medical System´s Response to Emergencies in a Middle-Income Country

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Cover illustration: Pre-hospital Emergencies' Four Ts (Time, Triage, Treatment and Transport) by Parisa Dehbozorgi

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Dedicated to my beloved parents,

Whose strong faith and their ocean of passion have been the greatest motive and inspiration throughout my life.

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ABSTRACT

Introduction:

The main task for all Emergency Medical Services (EMS) is to save lives and be available to those with severe medical conditions. In both of the situations, a timely arrival by the ambulance is mandatory. Irrespective of the origin and geographical belonging, all EMS are faced with two critical problems: 1) long response times and 2) availability. One way to achieve a shorter response time is to bring ambulances closer to the patients. The lower availability of ambulances is often due to the unnecessary transportation of patients with benign conditions, who can be assessed and discharged at the scene or at their homes by the ambulance crew, using qualified follow-up procedures and standardized protocols. The aim of this study was to analyze and evaluate the response times and ambulance availability in a middle-income country (Shiraz, Iran) and to test the above-mentioned measures as part of system improvement.

Method and Material:

Study I: Descriptive study aimed to study the Shiraz EMS in Iran (around 1.7 million inhabitants). Information about the EMS organization, resources, response times, and discharged patients and their follow-up was obtained, registered, and analyzed.

Study II: Interventional and prospective study aimed to statistically evaluate the ambulance response time in two groups of ambulances: 1) permanently stationed ambulances (PS) and 2) temporarily stationed ambulances, "fluid deployment" (TS). The latter were localized based on the registered data pointing out areas with a high number of incidents during a defined period.

Study III: Prospective follow-up of retrospective data about patients discharged at the scene or at their homes by the EMS, 4–12 months after an incident. A questionnaire, consisting of nine questions, was used as part of a quality control measure for the EMS, following the patient's approval.

Study IV: Interventional study aimed to evaluate a new protocol for discharging patients with non-traumatic abdominal pain. NOTRAPS was developed based on three validated protocols: RETTS-A triage, Behavioral Pain Scale, and VAS scale, which were approved by five specialists.

Results:

Study I: A long ambulance response time and an unclear follow-up of patients discharged at the scene.

Study II: Implementing "fluid deployment" of ambulances resulted in a statistically significant reduction in the response time (2 min) for ambulances that were temporarily stationed. A tendency toward a lower mortality rate in this group of ambulances was also obtained (not statistically significant).

Study III: Two groups of patients were identified: those who were discharged by the EMS crew (A) and those who were discharged based on their own decision (B). In this low-quality follow-up, the mortality rate was 4.8% in Group A and 6.1% in Group B.

Study IV: Using NOTRAPS in patients with "non-traumatic abdominal pain" vs. consulting a physician at a dispatch center, there was a slight but statistically significant difference in the safety and accuracy of EMS

paramedic´s decision on transport to the hospital in NOTRAPS group (*p* 0.02).

Conclusions:

EMS face the same challenges worldwide (longer ambulance response times and unnecessary ambulance use). A shorter ambulance response time could be achieved by fluid deployment. Patients with benign conditions may be discharged at the scene by the ambulance crew, with better follow-up and standardization. One way to achieve standardization is by using relevant protocols such as NOTRAPS, which was used in this study for assessment of non-traumatic abdominal pain. These results may have a better implication in middle- and low-income countries.

Keywords: EMS, Emergencies, Response time, Ambulances, Protocols, Abdominal pain

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SAMMANFATTNING PÅ SVENSKA

Bättre tillgänglighet och kortare svarstider är två viktiga utmaningar för ambulansverksamheten. Tillgängligheten för de mest allvarliga fallen kan ökas genom att skilja mellan allvarliga och godartade medicinska tillstånd med hjälp av standardiserade och evidens-baserade protokoll och rutiner. En kortare svarstid kan uppnås genom att lokalisera ambulanserna närmare patienterna. Syftet med denna studie var att analysera och utvärdera svarstider och ambulanstillgänglighet i ett medelinkomstland samt att försöka förbättra dessa parametrar genom att införa nya metoder och rutiner.

Fyra olika studier genomfördes. Den första studien syftade till att beskriva ambulanssjukvården i Shiraz, Iran avseende dess organisation, resurser, svarstider och patienthantering samt uppföljning. I den andra studien jämfördes svarstider statistiskt mellan två grupper av ambulanser: 1) permanent stationerade (PS) respektive 2) tillfälligt stationerade ambulanser (TS). Studie 3 följde upp de patienter som skrivits hem eller lämnats på plats av ambulans- personalen, 4-12 månader efter insats genom användning av en enkät bestående av nio frågor. Den sista studien syftade till att utvärdera ett nytt protokoll för bedömning av patienter med icke-traumatisk buksmärta. Protokollet NOTRAPS, utvecklades baserat på tre andra validerade protokoll och godkändes före testet av fem experter.

Resultatet av första studien visade på en förhållandevis lång svarstid för ambulanserna samt en bristande uppföljning av patienter som lämnats på plats av ambulans personalen. I studie 2, resulterade temporär placering av ambulanser under vissa tidsperioder i en statistiskt signifikant minskning av svarstiden (2 min). Studien antydde också en tendens till lägre dödlighet i

denna grupp, vilken dock ej var statistiskt signifikant. I studie 3 följdes två grupper av patienter upp: de som ambulanspersonalen lämnat på plats (A) och de som valt att själva avstå från transport till sjukhus (B). Uppföljningen visade på en hög dödligheten i båda grupperna (4,8% i grupp A och 6,1% i grupp B). I studie 4 användes ett nytt protokoll hos en grupp av patienter med "icke-traumatisk buksmärta" (A) och resultatet jämfördes med grupp B som hanterades enl. befintlig rutin. Resultatet visade en bättre träffsäkerhet i protokollgruppen gällande transport av sjuka patienter till sjukhus.

Ökad tillgänglighet och kortare svarstider ar två svåra utmaningar för ambulanssjukvården världen över. En kortare svarstid kan uppnås genom tillfällig placering av ambulanser utanför ambulansstationerna. Tillgängligheten bör kunna ökas genom hårdare selektion av vilka patienter som kräver ambulanstransport till sjukhus alternativt kan hänvisas till annan vårdinrättning. Standardiserade vårdprotokoll kan vara ett sätt att uppnå detta, men kräver goda uppföljningsrutiner för att kunna monitorera medicinsk säkerhet.

LIST OF PAPERS

This thesis is based on the following studies, referred to in the text by their Roman numerals.

I. Peyravi M, Ortenwal P, Djalali A, Khorram-Manesh A. An overview of Shiraz emergency medical services, dispatch to treatment. Iran Red Crescent Medical Journal. 2013 Sep; 15(9):823-8.

II. Peyravi M, Khodakarim S, Örtenwall P, Khorram-Manesh A. Does temporary location of ambulances ("fluid deployment") affect response times and patient outcome? International Journal of Emergency Medicine. 2015 Dec; 8 (1):37.

III. Peyravi M, Örtenwall P, Khorram-Manesh A. Can Medical Decision-making at the Scene by EMS Staff Reduce the Number of Unnecessary Ambulance Transportations, but Still Be Safe? PLoS Current. 2015 Jun 30

IV. Peyravi M, Örtenwall P, Karimi A, Khorram-Manesh A. Pre-hospital evaluation of abdominal pain using a new protocol- NOTRAPS. Submitted.

CONTENT

ABBREVIATIONS

ABCD	Airway, Breathing, Circulation and disability
CPR	Cardiopulmonary Resuscitation
ED	Emergency Department
EMS	Emergency Medical Services
GP	General Practitioner
ICU	Intensive Care Unit
K-S	Kolmogorov-Smirnov
NOTRAPS	Non-Traumatic Abdominal Pain Scale
ORs	Odds Ratios
PBS	Patient Behavioral Scale
PS	Permanently Stationed
RETTS-A	Rapid Emergency Triage and Treatment System-Ambulance
RTA	Road Traffic Accidents
SAR	Search and Rescue
SD	Standard Deviation
TS	Temporarily Stationed
VAS	Visual Analog Scale

1 INTRODUCTION

1.1 History

The concept of ambulances as a specialized vehicle to manage those who are injured was probably produced first by Napoleon Bonaparte´s chief surgeon "Dominique Jean Larrey" in 1794. However, it was not put into practice until 1796, when his horse-drawn ambulances were used for the first time at Udine, Padua, and Milan. He adapted his ambulances to various conditions [1]. The system was developed later on in different areas of the world, and it was used to move cholera patients to the hospitals, in London in 1832. The first known hospital-based ambulance service is reported from Ohio, U.S.A., back in 1865 [2]. In June 1887, the first ambulance service at the scene of an event was presented in London [3]. In 1881, ambulances were used for the first time in a disastrous fire in Vienna [4].

During the late 19th century, automobiles were added to the system, which also reduced the response time compared to that of the earlier horse-drawn ambulances [3]. There is some dispute about where the first civilian pre-hospital care started. Some historians claim that the world´s first component of civilian pre-hospital care at the scene started in 1928 in Virginia, U.S.A., while others mention Toronto, Canada as the first place with formal training for ambulance attendants, as early as 1892.

During World War I and II, new advances were made: specifically, traction splints were introduced, reducing the mortality and morbidity rate of injured soldiers with leg fractures; two-way radio communication for efficient dispatching became available; ambulances were staffed with physicians, and hospital based ambulances became more customary [5]. The development of CPR (Cardiopulmonary Resuscitation) and defibrillation as the standard form

of care for out-of-hospital cardiac arrest, together with the production of new pharmaceuticals during the 60s, created new and exciting possibilities within the Emergency Medical Services (system). This progress also necessitated a continuous discussion and implementation of new standards for ambulances and new routines for the care of patients as well as the development of other means of transportation such as helicopters and airplanes [6].

1.2 General

Emergency Medical System or Services, hereinafter called EMS, are the entities designed and staffed to provide out of hospital healthcare in emergencies [7, 8]. Such emergencies might range from cardiac arrest, allergic reactions, injuries caused by road traffic accidents, mass casualty incidents, and other disasters or major incidents.

From being only a transport unit, EMS today are the frontline of the healthcare system and the link between the patients' home/the scene of the incident and hospitals. The main goal of EMS is to save lives by providing treatment and care to those in need, either by treating and managing their condition on the scene and during transportation or arranging a timely transfer of patients to the hospitals or other healthcare facilities for definitive care [9].

The term EMS, emphasizing the need for emergency care, was not used initially and evolved during the course of its development to reflect a change from a simple system of ambulance transportation (ambulance services) to a system in which more advanced treatment could be given primarily and before arrival to an emergency department (ED) [10].

Although all countries have an EMS, the quality and availability of these EMS are different. In most countries, the EMS is staffed by members of the public and is connected via an emergency number to a control unit ("Dispatch

Center"), which initiates a mission by sending out a suitable resource, based on the country´s resources and the level of professionalism of the EMS staff [11].

There are many factors, which may affect the choice of a suitable resource for a specific mission. Some of these factors include the knowledge and education of the staff, the availability of resources in terms of the number of ambulances and the level of equipment in each ambulance, the geography, and demography of each region, as well as the specific patient´s medical condition. Consequently, in some countries, EMS may "stay and play" and perform advanced medical interventions, while in other countries "scope and run" is practiced [12]. In some jurisdictions, EMS may also handle technical rescue tasks such as extrication, water rescue, and search and rescue (SAR) [13, 14].

1.3 Different models and philosophies

In general, EMS follows two varying philosophies: either Anglo-American or Franco-German. The former is not staffed with physicians and basically uses emergency medical technicians or paramedics. A mixed alternative has also emerged, using a combination of these two philosophies (e.g., Swedish EMS). Each type has its own limitations and capabilities, that is, pros and cons. A Franco-German model brings the ED closer to the patients, while the Anglo-American model offers various types of care depending on the staff's knowledge and skills. In this system, a physician is most likely involved at the dispatch center for provision of medical oversight to guide the work of the ambulance crews. This may also be accomplished by creating offline control points such as routines and guidelines/protocols to standardize the whole system [15].

1.4 EMS tasks and difficulties

High-quality pre-hospital care is characterized by ***Early detection, Early reporting, Early response, Good on scene/field care, Care in transit, and Transfer to definitive care*** [16]. Whatever the philosophy, tasks, and qualifications, all EMS work is to save lives. The most important prerequisite for saving lives is to have skilled staff. The response time is also an important factor, and studies have shown that shorter response times result in higher rates of survival [17, 18]. The response time, however, may be influenced by traffic congestion and limited availability of ambulances. Since the economic situation relating to healthcare in most countries does not allow for a substantial increase in the number of ambulances, there is a need to find new ways of reducing the response times [19, 20].

The recent economic austerity within the healthcare systems worldwide has also resulted in a reduction of emergency departments and healthcare centers, resulting in the overcrowding of emergency departments. Long queues and dissatisfaction have forced patients to seek a new pattern of the search for qualified care [21]. From this perspective, the number of unnecessary ambulance transportations has increased, forcing EMS to find new ways of managing patients. Suggested solutions include triaging of patients, transferring of patients directly to a ward, bypassing EDs, and discharging patients with benign conditions already at the scene of the incident or at their home. With regard to triage, different studies have shown that there are many triage methods, which cause different problems at different levels of healthcare. One such problem is the discrepancy between the triage conducted by the dispatch center and that done by the ambulance crew at the scene. There is also a discrepancy between the ambulance crew´s triage and the one conducted at the ED [22]. New studies are in the process to integrate the triage methods between the different levels of healthcare. Transporting certain

patient categories directly to the receiving units at the hospitals rather than the emergency departments has already been done for some diagnoses such as myocardial infarction, hip fractures, stroke as well as patients with palliative needs. This is only possible through standardization of the care process through protocols and education of the pre-hospital staff, giving them the possibility and responsibility of making the ultimate decisions [22, 23].

With regard to discharging the patients directly at the scene, the legislation in some countries is very restrictive. However, new attempts have been made to facilitate adequate decision-making in patients that do not have an urgent need for healthcare. Such measures will reduce the number of unnecessary ambulance transportations, thus, making more ambulances available for those in real need of such an asset and possibly also reduce the overcrowding of EDs [24]. To achieve this, standardized protocols and proper follow-up are mandatory.

From a worldwide perspective, countries may also be categorized based on their national income as high-income, middle-income, and low-income countries [25]. Irrespective of how the countries are presented, all facts mentioned above are valid. Moreover, the difficulties are even more critical in countries with less financial and educational support, having larger areas and less staff.

1.5 New era and new challenges

The recent increase in terrorist attacks in the Western world (Boston, Paris, and Brussels) has clearly demonstrated that the outcome of victims from a terror attack is strongly related to the medical management on the scene, at hospitals and during transport between these two sites. The injuries sustained have been similar to the injuries seen during recent armed conflicts (i.e. Iraq and

Afghanistan), necessitating a new prehospital strategy using tourniquets, clotting agents/devices and rapid transfer of victims to the appropriate hospitals. A continuous training in a multidisciplinary setting with a focus on safety for staff and victims including the creation of common protocols and guidelines are important points mentioned in the literature [26, 27].

1.6 EMS in high-, middle-, and low-income countries

1.6.1 High-income country, Swedish EMS

As one of the high-income countries, the Swedish EMS has a variety of alternatives for providing out of hospital care. The standard ambulances are staffed with a nurse and a driver with basic medical training. The system in place in many counties can also provide ambulances staffed with specialist nurses in anesthesiology as well as ambulances/fast response cars staffed with physicians (usually anesthesiologists) for more critical cases or secondary transfers of patients requiring intensive care [28]. The public has access to EMS by calling 112. The dispatcher at the dispatch center uses the Swedish Medical Index to determine the priority of the mission and has software support to dispatch the correct resource to the patient. The missions are prioritized as priority one to four, with different response times [29, 30].

Priority 1: Patients in need of immediate emergency medical care that should be reached by the EMS units within 10 minutes (life-threatening conditions).

Priority 2: Patients in need of emergency care within 30 minutes.

Priority 3: No emergency. The patient can safely wait for an ambulance without any risk of deterioration.

Priority 4: Patients without any need of pre-hospital care. These patients could be advised to use other means of transportation (taxi, personal vehicle, public transport).

Although a high-income country with an advanced healthcare system, the main challenges for the Swedish EMS are to meet the response times as well as cope with the demand of ambulance transports for patients who do not require such service.

1.6.2 Middle-income country, Iranian EMS

As a middle-income country, the Iranian EMS was introduced in 1975 influenced by the Anglo-American model, staffing the ambulances with paramedics. However, there are other middle-income countries with totally different approaches, where ambulances are still used as transport vehicles only [31]. The center of the Iranian system has a dispatcher, which can be reached by dialing 115. The dispatcher uses an index to triage the patient and decides the priority of the condition. Each ambulance is staffed with one nurse with training in anesthesiology and one paramedic trained in Basic Life Support (six months training; the length and level of training for paramedics varies widely between different countries and as a consequence also their scope of practice). Moreover, in the Fars region (see below), one ambulance is designed to work as a mobile ICU (Intensive Care Unit), staffed with one general practitioner (GP), one nurse, and one paramedic. Another GP works as a consultant for the technicians at the dispatch center to make medical decisions in dubious cases [31].

The Iranian EMS has improved during the last few decades and has expanded and become a nationwide organization with a responsibility to also act during major incidents and disasters. However, similar to other developing countries, it is faced with infrastructural problems such as traffic congestion, narrow

roads, and some organizational issues, namely, lack of human resources and shortcomings in the command and control systems [32]. Besides the national EMS, some private ambulance companies transfer non-urgent patients. Looking at improvement as measurable parameters, the response time, for a normal call, was set to less than eight minutes in cities and less than 15 minutes in suburban areas. This setting has been met in some cities, while it has not been achieved in the larger urban areas yet [31].

As a middle-income country, with a relatively advanced healthcare system, the main issues within the EMS field are the same as for the Swedish EMS (response times and management of the patients with no need for ambulance transportation).

1.6.3 Low-income country, EMS in Ghana

Low-income countries, such as Ghana, do not have appropriate financial resources for healthcare, and EMS is a low priority [33]. Existing emergency care systems are rudimentary in comparison to those in developed countries and therefore many medical conditions often present as emergencies due to the lack of timely access to care. Communicable infectious diseases are among the top 10 causes of morbidity and mortality. However, road traffic accidents (RTA) are most common due to poor conditions of transport and road infrastructure (average of 1900 fatalities/year. Injury-related deaths, particularly deaths due to motor vehicle crashes, are expected to rise dramatically by 2020. Eighty-one percent (81%) of RTA deaths occur in the field or in the pre-hospital setting and a further 5% of trauma deaths occur in the emergency room or within 4 h of arrival in hospital. Other causes of emergencies besides RTA are domestic accidents, natural disasters, medical emergencies, surgical emergencies, and obstetric emergencies [33].

EMS provide a chain of survival linking pre-hospital care to definitive in-hospital care. The need to improve emergency services in Ghana has long been recognized. However, no action has been taken to improve EMS. Prior to 2001, the only means of transport to a health care facility consisted of taxis, other commercial vehicles, and private vehicles. Late arrival in hospital, mishandling of severely injured patients by untrained persons, inadequately trained staff and inadequate equipment were all known as the main contributing factors to the high mortality rates [34].

1.7 Shiraz EMS in the heart of the Fars province

Shiraz is the capital of the Fars province, located in the southern part of Iran with approximately 1.7 million inhabitants, living in an area of 225 km^2 [31]. Currently, the EMS in Shiraz conducts more than 118,000 missions, of which around 45,000 are missions that result in transferring patients to the hospital every year. The EMS response time is set to less than 8 minutes in the city and up to 15 minutes outside of the city border. However, the average response time today is around 11 min [31]. The system has the same structure and follows the same principles as the rest of the country, explained above [31].

All data are registered in a registry at the EMS center, which provides all the information about gender, age, and diagnosis of the patient, time of the calls, decisions made at the dispatch center, time of events, and area in which the event occurs. This registry is used for the improvement of the system on a yearly basis. A lack of financial resources and modern equipment, as well as an inadequate urban infrastructure, are among some of the difficulties facing the Shiraz EMS. This actualizes the need for finding measures, which can maintain the ambulance response times and reduce unnecessary ambulance missions in order to make resources available to those in real need.

2 AIM

2.1 Overall aims

The aim of this study was to analyze and evaluate the current situation of the Shiraz EMS in order to identify difficulties in providing high-quality EMS and suggesting and testing ways of improving the system.

2.2 Specific aims

I- To evaluate the current situation of Shiraz's EMS by comparing the data obtained during two different time periods.

II- To compare the response times and its effect on patients' outcome using an interventional approach between two groups of patients attended to by permanently (PS) and temporarily stationed ambulances (TS) (fluid deployment).

III- To assess the procedures adopted by the staff of the Shiraz EMS and the outcome of the patients discharged from the scene over a one-year period.

IV- To evaluate the 30 days outcome of the patients discharged at the scene by the Shiraz EMS, using a standardized protocol (2014–5).

3 PATIENTS AND METHODS

Data for all the studies in this project were collected by the administrative staff of Shiraz's EMS and were managed based on the Shiraz University regulation concerning the collection and management of patient data. If possible, the personal data were used anonymously; otherwise, the patients were contacted by the EMS staff and were informed orally or by letter as necessary. Each study was conducted using appropriate statistical methodology (see below).

3.1 Statistics

3.1.1 Studies I and III

Data analysis was conducted using the SPSS version 15 and 20 (SPSS Inc., Chicago, Illinois, U.S.A.) for study one and three, respectively. The data analysis is expressed using descriptive statistics including range and mean ± Standard Deviation (SD). Frequency and percentage of categorical data are presented.

3.1.2 Study II

Different methods were used for the data analysis in study two:

1. One-sample proportional test to examine whether a sample value differs from a population value.
2. The One-Sample Kolmogorov-Smirnov (K-S) test to examine whether the data are normally distributed comes from a uniform, Poisson, or exponential distribution.
3. One-sample Wilcoxon test to examine the mean or median of a single population.
4. Two-sample test for equality of proportions.
5. Mann-Whitney-Wilcoxon Test to examine the abnormal

distributions.

6. Bootstrapping is a nonparametric method, which allows for the comparison of estimated standard errors, confidence intervals, and hypothesis testing.

A more detailed description of the Bootstrapping method is presented in Appendix 1. Statistical analysis was performed using the R, version 3.0.1. [35]. P values less than 0.05 were considered as significant. Quantitative variables were reported as mean ± SD; median and qualitative data were reported in terms of proportions. For analytical purposes, the Mann-Whitney U-test was used to compare the response times between the temporarily stationed and permanently stationed ambulances. Moreover, a 2-sample test for equality of proportions was utilized to compare the mortality rate between the two groups of patients. Finally, logistic regression was used to report the odds ratios (ORs). In this regression, the response was a binary variable (response time ≤ 8 min vs. > 8 min; dead vs. alive), and the reference category was temporarily stationed ambulances.

3.1.3 Studies IV

Data analysis was carried out using SPSS 19 (SPSS Inc., Chicago, Illinois, USA). Range, mean and standard deviation (SD) were used for descriptive statistical analysis. Sensitivity and specificity and predictive values were also calculated and confidence interval was measured by Stata software ver12 with wald method. The sample size of this study was calculated [22]. Significance level (α) = 5%, Power = 90%, Standard deviation of outcome = 10, Non-inferiority limit, d= 5. The result indicated a required sample size of 69 patients per group and a total sample size of 138. Due to possible exclusions, we aimed to collect 100 patients in each group and thus a total sample size of 200 patients.

3.2 Ethical permission

The ethical committee of Shiraz Medical University approved all studies conducted in this thesis (2011-100/7 Feb.2011). Complementary approval was issued on 2016-02-27 and 2016-03-02.

3.3 Study design

3.3.1 Study one, Descriptive study

Shiraz is the capital of the Fars province with around 1.7 million inhabitants. In this study, the Shiraz EMS was evaluated in two steps. Information about the EMS, including its strengths and weaknesses, were identified and resulted in three further studies (see below).

First step: This retrospective analytical study covered the time period from March 21, 2011, to March 20, 2012. All ambulance missions performed by the Shiraz EMS have been recorded in a digital database since 2008 (Shiraz EMS registry). All data are recorded by the officer in charge at the dispatch center after termination of each mission. Before 2008, data were collected manually. Both registries comprised information about age, sex, chief complaint, and clinical finding for each patient. In addition, other information about the mission such as various time intervals (response, scene, evacuation, and total time) was also collected for all the ambulance missions.

Second step: In this part of the study, the data obtained from the Shiraz EMS during two one-year periods (March 21, 2011, to March 20, 2012, and September 22, 1999, to September 21, 2000) were compared, in order to identify the difference between these two time periods.

3.3.2 Study two, First interventional study

This prospective study aimed to reduce the response times by changing the ambulance positioning from their ordinary locations (Permanently Stationed = PS) to a new place, calculated based on the accumulated data at the dispatch center (Temporarily Stationed = TS). Based on the registered peak number of missions related to a limited time frame, new locations were identified, and two separate studies were conducted during two different time periods, in order to confirm the obtained results.

The first study was undertaken between March 21, 2012, and March 20, 2013. Two groups of patients were studied: those attended to by crews dispatched from the PS ambulances vs. the TS ambulances. Normally, all 24 available ambulances were running as PS. However, during the selected time period, eight out of the 24 ambulances were located at temporary stations (TS). The temporary locations were chosen based on the accumulated EMS data (EMS center's registry), in which the most geographically affected areas, with regard to the number of incidents and traffic congestion together with the distance to the nearest hospital were used to identify the most appropriate locations for TS. The time, in which the ambulances were temporarily deployed, was between 1–2 h every day (average 1.5 h), all weekdays, and at eight stations, simultaneously. During this time, the 16 remaining ambulances were running based on their daily schedule with all the ambulances based at the permanent ambulance stations scattered around the city; however, it was possible to dispatch them by radio to any given location. The critical key factors were to compare the response times and the outcome in patients. Response times were calculated based on the time elapsed from receiving the alarm call until the ambulance's arrival at the scene. Scene time was calculated as the time spent by the ambulance crew on the scene, and evacuation time was the time registered for the transportation of a patient to a hospital. The outcome is

defined as survival to the hospital's emergency department (ED). The following parameters were studied: age, gender, and the reason for the mission, response time, scene time, evacuation time, and total time for each mission. Survival upon reaching the hospital to hospital was used to evaluate the outcome between TS and PS.

A new prospective study was conducted between January 17, 2015, and February 10, 2015 (24 days). Twenty-four available ambulances were divided into three groups: A, B, and C. One group of ambulances (n=8) was stationed as TS during an 8-day period, while the remaining two groups acted as PS ambulances (Figure 3). Thus, all of the ambulances acted once as TS and twice as PS. All ambulances were equipped and staffed similarly. The missions were performed at a designated peak time, between 10:00–12:00 a.m. each day.

3.3.3 Study Three, Retro-prospective study

In this study, patients who had been discharged at the scene or after the EMS visited them at their home were retrospectively identified and were prospectively followed-up by telephone calls 4–12 months after the EMS mission. A questionnaire, consisting of nine questions, was used as part of the quality control for the EMS, following the patient's approval. All the questionnaires were marked by a number, and the patients' data were not available to the main author at the time of the review.

Retrospective data on all of the missions conducted by the Shiraz EMS between 2012 and 2013 (n=81,999) were reviewed, and data (age, gender, main complaint, primary diagnosis on the scene, etc.) regarding all of the patients discharged at the scene/home by the EMS staff on the 5th, 15th, and 25th of each month were collected. These patients were later followed-up by using a questionnaire. The questions were designed by a panel of researchers and members of the pre-hospital team at the Pre-hospital and Disaster

Medicine Center (PKMC) in Gothenburg. Patients were contacted by telephone for an interview, and if not available their relatives were interviewed. The following questions were asked (Appendix 2):

1- What were the main reasons to request an ambulance, your chief complaint?
2- What were your symptoms?
3- Was the decision not to be transported to the hospital your own, or did the ambulance crew make it?
4- If it was the staff's decision, were you satisfied with it?
5- Did your symptoms continue after being discharged? If your answer is yes, what were those?
6- Did you visit a clinic or hospital/physician after being discharged by the EMS?
7- What was their diagnosis/opinion when visiting the clinic or hospital?
8- What was the treatment?
9- Have you recovered?

3.3.4 Study Four, Third interventional study

In this study, and based on the results from the third study, a new protocol was used for discharging the patients with non-traumatic abdominal pain.

Study Population:

Inclusion criteria: 1) All patients with non-traumatic abdominal pain, who were registered at the dispatch center´s registry and for whom an ambulance was sent, 2) RETTS-A inclusion criteria i.e. patients between 16 – 65 years old, with no significant past medical history (e.g. cardiovascular diseases, neurologic and psychiatric disorders, history of surgery, pregnancy, and liver diseases).

Exclusions criteria: Patients under 16 and over 65 years of age, or with significant past medical history.

This prospective study was carried out from May 2015 to May 2016 in Shiraz, Iran. Shiraz is located in the south of Iran and is the capital of Fars province with a land area of 225-km^2 and 1.7 million inhabitants [36]. The patients were alternated and randomly divided by dispatchers, using the basic method of simple randomization [37], into two groups of A) with NOTRAPS and B) without NOTRAPS. The study duration was set to a year or as soon as enough patients were collected (see power calculation and statistic). All included patients consented to follow-up. A 30-day follow-up questionnaire was sent out to evaluate patients' condition and possible re-admission if dismissed as well as their clinical diagnosis, treatment, and response to treatment if transported to the hospital (Appendix 2) [24]. Those who were transported to the hospital were also followed by studying their medical records for that specific stay and final diagnosis when discharged. Patients referred to a GP were followed up by phone. Those admitted and treated with medication more than 3 days, having surgery performed or subjected to any other intervention only available at the hospital were classified as in need of ambulances. Others were classified as not needing ambulances.

Protocol

A new protocol called Non-Traumatic Abdominal Pain Scale (NOTRAPS) was created. This was based on three validated scales;

a. **Rapid Emergency Triage and Treatment System-A**mbulance (**RETTS-A):** This triage algorithm is used on a daily basis in the pre-hospital setting in Sweden. It has been validated and is regularly revised [38]. It consists of different parts in which demographic data is collected

(e.g. sex, age, and past medical history). Vital signs are evaluated step by step to further categorize the patients into four triage groups (red, orange, yellow and green) [39,40] (See NOTRAPS protocol page 19).

b. Patient behavioral scale (PBS) depicts the severity of pain in a patient by specifically looking at the patient's facial and body expression. It has 5 grades; however, since the last grades are only applicable in unconscious patients they were not used at all in this study [41].

c. Visual Analog Scale (VAS) is a scale by which patients can express their pain on a scale of one to ten. VAS was used by the patients to express the severity of abdominal pain [42].

Finally, another scale (not validated) was used to indicate the duration of pain. Longer periods of pain indicated less severity, while the acute onset of pain would indicate an emergency [43].

The proposed protocol was discussed among 5 senior professionals consisting of one surgeon, one anesthesiologist, one emergency medicine physician, one ambulance nurse and one dispatch nurse. A protocol was thus created by combining three different validated scales (a-c) in two stages. The three scales were; a) RETTS –A, b) PBS and c) VAS.

The protocol is used starting with RETTS-A. Any patient falling into categories red or orange (vital signs) are immediately transported to the hospital. Thus, only patients categorized into yellow or green will continue having their pain assessed by PBS and VAS. To the sum of the points from these two scales, the points obtained from the last protocol (d = pain duration) was added. Patients triaged as red or orange in this stage were also transported to the hospital, while the remaining patients were advised or booked for a visit at their healthcare center (See NOTRAPS protocol page 19). The cut-off points for different priorities were chosen based on the consensus in the group of evaluators.

NOTRAPS Protocol

Prehospital support for decision-making in non-traumatic abdominal pain (modified RETTS ™) **PKMC**

Ambulance No.: **Cause of contact:** **Time of arrival:** **Date:** **Patient No.:**

Current problem: .....

	YES	NO		YES	NO		YES	NO		YES	NO
Healthy			Cardiac insufficiency			Bleeding tendency			Immunosuppression		
Cardiovascular disease			cerebrovascular disease			Respiratory disease			Hypertension		
Kidney disease			Liver disease			Malignancy			Diabetes, tablets		
Diabetes, Insulin			Allergic			operated < 3 months					

Part 1: a) PHYSIOLOGIC EVALUATION/TRIAGE

TRIAGE	RED	ORANGE	YELLOW	GREEN
AIRWAY	Blocked Stridor	OK	OK	Ok
BREATHING	spo2 <90% with O2 Respiratory Rate (RR) > 30 or <8	spo2 >90% without O2 RR > 25	spo2 90-95% without O2 RR > 25	spo2 >95% without O2 RR 8-25 (normal)
CIRCULATION	Pulse steady 130 or irregular 150 Systolic Blood Pressure < 90 mmHg	>120 or <40	>110 or <50	50-110
DISABILITY	Unconscious Seizure	Somnolent	Acute disoriented	Alert
EXPOSURE	Temperature	>41 °, < 35 °	> 38.5 °	35-38.5 °

Part 2: OBJECTIVE EVALUATION OF ABDOMINAL PAIN

b) Behavioral Pain Scale CREW

Item	Description	Score
Facial expression	Relaxed	1
	Partially tightened (e.g. Brow lowering)	2
	Fully tightened (e.g. eyelid closing)	3
	Grimacing	4
Upper limb movements	No movement	1
	Partially bent	2
	Fully bent with finger flexion	3
	Permanently retracted	4
Total		8

c) VAS scale: Pain Severity Scale PATIENT

1 2 3 4 5 6 7 8 9 10

d) Pain duration

Hour	Point
> 1 day	0
< 24 h	1
< 18 h	2
< 16 h	3
< 14 h	4
< 12 h	5
< 10 h	6
6-9 h	7
3-5 h	8
1-2 h	9
< 1 h	10

AVERAGE POINT "VAS" PATIENTS AND CREW + POINT OBTAINED PAIN DURATION

b + c + d → 23-28 Points RED | 16-22 Points ORANGE | 11-15 Points YELLOW | < 10 Points GREEN

4 RESULTS

4.1 Study One

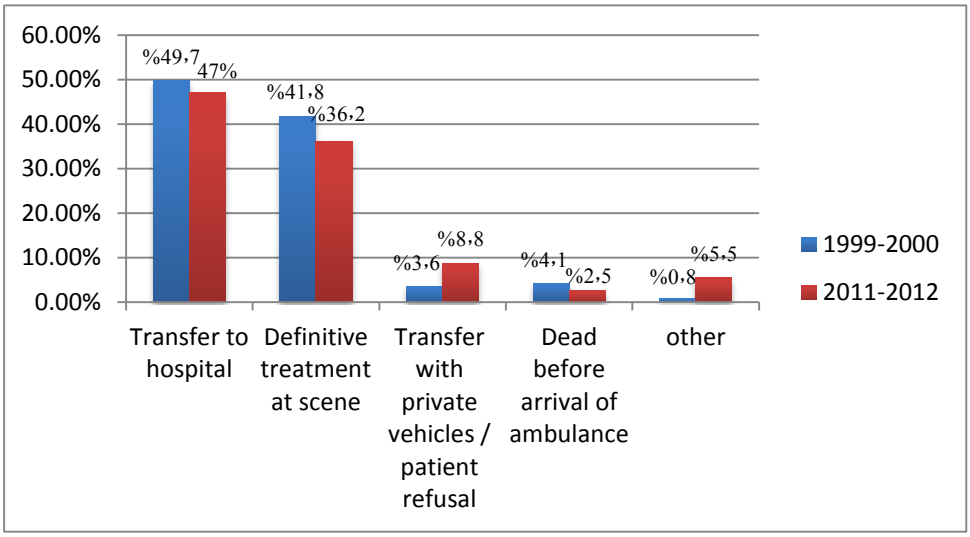
During the study period (2011–2012), Shiraz's EMS performed 84,084 missions divided into the following categories: trauma 39,282 (46.7%); neurology 21,936 (26%); cardiovascular 10,889 (13%); airway problems 4,782 (5.7%); psychiatry 1,710 (2%); intoxications 1,342 (1.6%); surgery 1,272 (1.5%); internal medicine 304 (0.4%); infections 40 (0.01%); and others 378 (0.5%). In 2,149 cases, the diagnosis was not available (2.6%). The gender of the patients could be determined in 65,062 cases [male 40,487 (62.3%) and female 24,575 (37.7%)].

The most common cause of trauma was Road Traffic Accidents [RTA] (27,257; 76.5%) in both the urban and suburban areas, followed by falls, and assaults. The rate of accidents increased 4.5% from spring to summer and decreased by 5.5% from autumn to winter, but only for traffic accidents in the urban areas. The main reasons for transportation were registered for 46,091 patients (54.8%). In the remaining cases, transportation was performed privately, and no information was thus available. Decreased level of consciousness was the most common reason (13.8%) for an ambulance request, followed by chest pain in 10.5% of the cases, dyspnea in 5.7%, and convulsion (epilepsy) in 4.7% of the cases.

Of 84,084 (100%) patients, around 56% were transported to the hospitals. Some 47% were transferred by ambulances and 8.8% by private cars. Definitive medical treatment at the scene was given to 36.2% of the patients (minor injuries, non-emergency cases including those refusing to be transported to the hospitals), who were discharged at the scene directly. In 4.6% of the accidents, there were no casualties. The number of deaths at the

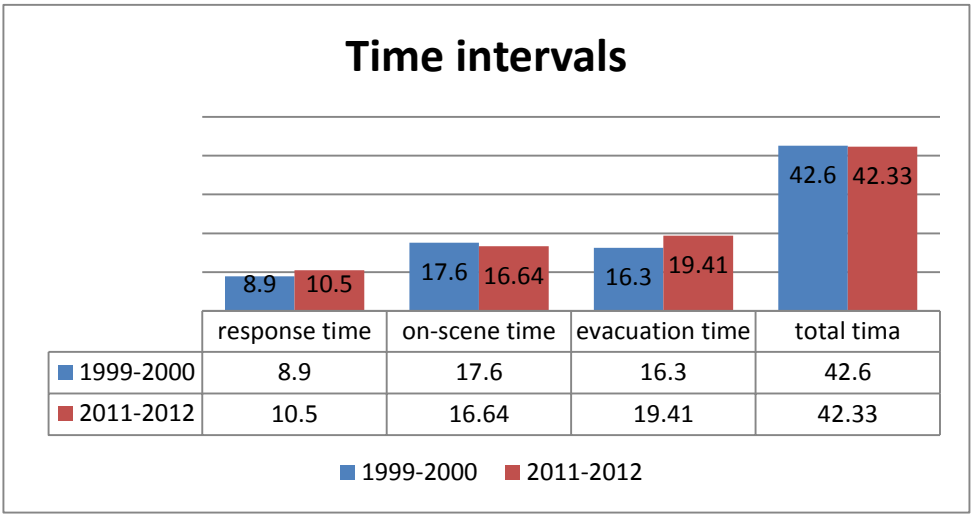
scene, before ambulance arrival, was 2.5%, of whom 0.3% (198) was due to RTA. Twenty-two persons died after the arrival of the ambulance crew, 15 died at the scene, and seven persons died during transport to the hospital (Figure 1).

Figure 1: Comparisons between two different time periods with regard to mean of transport to the hospital and mortality



The comparison between the two time periods showed a six-fold increase in the daily missions during 2011–2012 compared to the data from 1999–2000. There was a more frequent use of ambulances among those aged 21–40-years-old, highly dominated by men. There was an increasing number of trauma cases. The response, scene and evacuation times remained largely the same, although the response time was longer than it had been 10 years earlier (Figure 2). Fewer people were managed at the scene, while more people were using private cars to transport patients to the hospitals. The number of deaths before the arrival of an ambulance had decreased (Figure 1).

Figure 2: Comparisons between different time intervals for two different time period



4.2 Study Two

Study period 1

During the study period (2012–2013), Shiraz's EMS performed 83,673 missions. A total of 2,132 missions were excluded due to insufficient data (addresses and localization). Of the remaining missions (81,541), 1,571 (2%) and 79,970 (98%) were performed by TS and PS, respectively. Both groups were matched regarding the distribution of gender (sig = 0.189) by a 2-sample test for equality of proportions and age by Mann-Whitney-Wilcoxon Test (sig = 0.621).

Around 61% of patients were male, and 39% were female. The most common age group (39.5%) was between 21 and 40 years of age. Approximately 95% of the missions were performed in the urban areas and the other 5% were in the rural areas. The reasons for the missions were grouped into different

categories of diagnosis and were similar in both groups. Trauma was the most common reason for dispatching an ambulance, followed by decreased level of consciousness, cardiovascular diseases, and neurological causes (including cerebrovascular diseases), respectively.

In order to evaluate the impact of choosing different deployment of ambulances (TS vs. PS), the outcomes were calculated statistically by looking at the response times and mortality rates. To avoid bias due to an unequal sizes of our samples, three different evaluation approaches were used (see Appendix 1). A 2-min reduction in the response time in favor of the TS ambulances was recorded ($p < 0.001$–[95% CI, 1.975, 2.025]). Differences between the response times in the two groups, comparing the missions in the urban vs. the rural areas based on the pre-calculated 8 and 15 min response thresholds were measured. For urban missions, the results of logistic regression showed that the odds of the response time less than 8 min for PS vs. TS decreased by 14% (OR = 0.86, $P < 0.02$). The rural missions were excluded from the analysis because of the low number of missions in this category.

The outcome for patients transported by PS and TS ambulances was compared. In general, only around 45% of the patients were transferred to the hospitals (44.6% in PS compared to 44.8% in TS). The remaining number of patients received definitive treatment at the scene, i.e., were treated and left at the site or sent home (36.2% in PS vs. 35.1% in TS) or were transported by other means, alternatively refused to be transported to the hospital (10.3% in PS vs. 11.2% in TS). Non-survivors were divided into two groups:

a. “Dead upon EMS arrival”: Response times related to patients who were dead upon EMS arrival, assuming that shorter response times could have increased their chances of survival. The mortality in TS and PS groups were 25 out of 1,571 (1.5%) vs. 1,884 out of 79,970

(2.3%). The difference is statistically significant (p = 0.04–[95% CI, 0.006, 0.012]).

b. "Died during EMS treatment," i.e., those who died at the scene or during transport after the initiation of treatment. None of the patients treated in the TS group died after the arrival of the ambulance, while 27 patients died in the PS group.

Study period 2

The low number of missions performed by the TS ambulances in study period 1 was due to the chosen methodology and the time selection. In order to eliminate a possible statistical bias made by the number of missions in the first study, a follow-up study was conducted. Of the 474 missions that were conducted in the second time period, 329 were conducted by the PS and 145 by the TS ambulances. There was no statistically significant difference between the cohorts in this study compared to the first study; the mean (± SD) age was 45.08 (±22.85), and 58.2% of the cases were male vs. 41.8 female. The mean (± SD) response time for the PS ambulances in this study was 12.39 (±5.48) min vs. 10.36 (±5.65) min for the TS ambulances. The 2-min difference in the response time in favor of the TS ambulances was statistically significant using the One-Sample Kolmogorov-Smirnov and Mann-Whitney Tests ($p < 0.001$). This result is in accordance with the results found in the first study.

There was no significant difference in mortality before the arrival of the ambulances between PS and TS in the second study (PS = 17 vs. TS = 5). Moreover, no deaths were registered during treatment at the scene or during transfer to the hospital in any of the groups (PS nor TS), respectively.

4.3 Study Three

In the third study, patients were followed after being discharged at the scene. Two groups of patients were identified: those who were discharged by the EMS crew and those who decided not to follow the EMS decision due to private reasons. The study was hampered by a low response rate and missing data. However, both groups had a high mortality rate with 4.7% in those discharged by the EMS and 6.2% in those who decided not to follow the EMS decision due to private reasons.

In total, 3,019 patients who were directly discharged at the scene were identified. Of these, 994 (33%) patients could be followed up. No information could be obtained for the remaining 2,025 patients due to 1) 1,469 patients (49%) did not reply to our calls, 2) 90 patients (3%) were unwilling to cooperate, 3) 91 patients (13%) could not recall their interaction with the EMS, and 4) 85 missions were cancelled because the patients changed their minds or were not present at the scene upon ambulance arrival.

Information about major complaints leading to an ambulance call was available for 935 out of the 994 patients. Table 1 reflects these complaints divided into eight categories, including whether the complaint existed after the EMS management at the scene. As shown in Table 1, there was a reduction in the number and rate of complaints after the EMS engagement (26% to 93%).

Table 1. Major reasons for(complaints about) calling an ambulance

Before ambulance arrival			**After discharge from the scene**		
Categories	**Number**	**%**	**Number**	**Difference in number**	**% reduction**
Trauma	67	7.2	24	43	64
Toxic	31	3.3	20	11	35
Neurology	212	22.7	14	198	93
Circulation	138	14.8	50	88	36
Medical	337	36	247	90	26
Respiratory	131	14	56	75	57
Surgery	13	1.4	6	7	54
Psychiatry	6	0.6	1	5	83

The most impressive reduction concerned neurological and psychiatric cases and the least reduction was seen among the patients with medical, toxic, and circulatory disorders, followed by surgical and respiratory cases.

Information about decision-making at the scene and follow-up were available for 879 out of the 994 patients. In 71.2% (626 cases), the recipients made the decision not to be transferred to the hospital after the EMS staff's arrival. In most cases, the symptoms had subsided or the patient did not want any help from the staff due to other reasons. In 28.8% (253 cases), the EMS staff discharged the patients at the scene of the incident or left him or her at their home after definitive treatment or advice. A primary diagnosis was made, and recommendations such as self-care guidance or later and planned visits to a health care center were given. In seven cases, the patients were recommended to be transported to the hospital, but they rejected, not favoring the hospital suggested by the EMS. Table 2 depicts the distribution of the patients after examination at the scene by the EMS staff.

Table 2. Patients' status at the time of investigation

Decision maker	Current situation	Number	Percent
Patient (n=626)	With Problem	229	36.6
	Without problem	358	57.2
	Dead	39	6.2
EMS (n=253)	With Problem	75	29.7
	Without problem	166	65.6
	Dead	12	4.7
Total (n=994)	With Problem	304	30.6
	Without problem	524	52.7
	Dead	51	5.1
	Unknown	115	11.6

The patients who rejected transportation (626 out of 994, [63%]) filled in a release sheet before being discharged at the scene. Of the remaining 368 patients, 253 (25.5%) were discharged at the scene by the EMS, and in 27 (2.7%) patients no information was available. Among the patients discharged by the EMS, 34 (13.5%) were recommended to seek healthcare privately due to the non-urgent nature of their complaints. Another 18 (7.1%) patients were transported to a clinic or hospital due to the insufficient treatment at the scene. Around 43.9% of the patients (n=436 out of 994) were male and 386 (38.8%) female. In the remaining 172 (17.3%) patients, no information could be found about the gender.

For 442 (44.5%) patients, the symptoms remained unchanged after they were discharged at the scene, while the symptoms subsided in 489 (49.2%). Of the remaining 6.3%, 4.3% (n=43) did not reply to this question and 2% (20) were deceased. As shown in Table 2, a sum of 229 patients still had complaints after deciding to go home themselves compared to 75 out of the 253 patients discharged by the EMS (36.6% vs. 29.7%). On the other hand, 358 of those who decided to go home had no complaint in their follow-up versus 166 who

were discharged by the EMS staff (57.2% vs. 65.6%). There was a statistically significant difference in favor of the decisions made by the EMS staff according to the chi-square test ($p < 0.001$).

In this study, 51 patients died after being discharged at the scene. Of these, 39 belonged to those who left the scene on their own volition compared to 12 out of the 253 patients (5%) who were discharged by the EMS staff at the scene. Although the number of deaths was lower in the latter group (discharged by the EMS), there was no statistically significant difference in mortality between these two groups ($p < 0.5$). The causes of deaths were not available since autopsies are not performed in Iran due to current practices unless a crime is suspected.

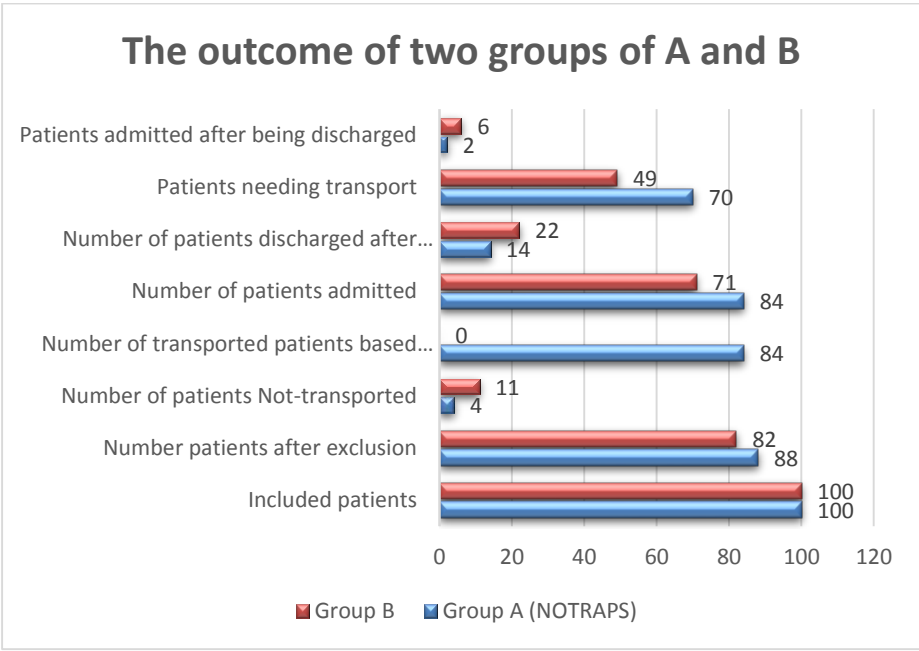
4.4 Study Four

A total of 200 patients were included in this study, divided into two groups: Group A using NOTRAPS protocol and Group B without protocol and evaluated in a routine manner. Twelve patients from Group A and 18 patients from Group B were excluded from the study based on the RETTS-A exclusion criteria. The final number of patients in each group was then 88 in Group A and 82 in Group B. Group A consisted of 46 (52.3%) males and 42 (47.7%) female patients with a mean age of 40.25 ± 14.05. There were 43 (52.4%) males and 39 (47.6%) female patients in Group B with a mean age of 37.87 ± 13.94 years.

Based on the NOTRAPS protocol, 84 (95.5%) patients in group A were transported to the hospital by ambulances and four patients were recommended to visit their GPs. All 84 patients passed the RETTS-A evaluation scale. The decision made to transport these patients was then based on the sum of other scales in the protocol.

In group B, EMS staff, after consultation with a physician, transported 71 (86.5%) of the patients to the hospital by ambulance and the remaining 11 patients were recommended to visit a general practitioner. Figure 3 shows the whole process of inclusion and exclusion and outcome in both groups of transported and not transported patients (Figure 3).

Figure 3: The inclusion, exclusion, admission and outcome in two groups of patient managed according to NOTRAPS (A), or existing routines (B)



All patients transported to the hospital in both groups were examined and if needed admitted. In NOTRAPS group 70 out of 84 patients (83.3%) were admitted and thus classified as needing an ambulance based on the criteria mentioned under method section (admitted for treatment, surgery, or delivery, or died due to worsening of their conditions). Surgical diseases were the most common diagnosis in both groups: 39 (44.3%) patients in NOTRAPS group compared to 24 (29.3) patients in Group B. Other clinical diagnoses were

internal medicine conditions, gynecological diseases, infectious diseases, poisoning, etc. Three deaths in this group occurred in patients with liver cirrhosis (n=2) and one patient with abdominal cancer – all of them previously unknown. The rest of patients in this group (n= 14) were discharged from the ER. In the other group (B), the number of patients in need of ambulance transportation was 49 (69.0%) out of 71 patients. The remaining 22 patients were discharged. The number of patients with abdominal pain leading to an intervention or treatment was higher in group A compared to group B (70 vs. 49). Table 3 shows the follow-up results in both transported and not transported patients.

Table 3: the follow-up results in both transported and not transported patients.

Group A	Needing an ambulance	not-needing an ambulance	
transported	70	14	
not transported	2	2	
Group B	Needing an ambulance	not-needing an ambulance	(*p* 0.02)
transported	49	22	
not transported	6	5	

Of those not transported to the hospital in group A (n=4), two patients were admitted to the hospital within the follow-up time (50%), while in group B six out of 11 patients were admitted to the hospital (54%). The difference between

two groups of A and B with regard to the accuracy of the transporting true cases with abdominal pain was statistically significant. Based on the test of equal proportions, there is a significant difference between the prevalence of needing an ambulance in two groups ($P_A = 0.82, P_B = 0.67, Sig = 0.02$) (Table 3). The predictive validity of NOTRAPS was measured by sensitivity and specificity of the diagnosis using NOTRAPS protocol (Group A), compared to that of group B (Table 3, 4). The decision made by EMS staff to transport the patient was defined as a positive result. If the patient transported by the ambulance was proven to be significantly sick in the follow-up, then the case is truly positive, otherwise, it is a false positive case. True negative cases are defined as those who were not transported and were also proven not being sick, while otherwise, they would be false negative cases. NOTRAPS shows a higher sensitivity and a lower specificity. In conclusion, there was a slight but statistically significant difference in the safety and accuracy of EMS paramedic´s decision on transport to the hospital in NOTRAPS group, compared to that of the other group (p 0.02). The protocol also showed a higher sensitivity in favor of group A.

Table 4: Sensitivity and specificity of the diagnosis using NOTRAPS protocol or without the protocol.

Zone	**Group A**	**Group B**	**Ratio A/B**
Sensitivity	0.97 (0.93- 1)	0.89 (0.80-0.97)	1.08
Specificity	0.12 (0-0.28)	0.18 (0.03-0.33)	0.69
Positive predictive value	0.83 (0.71-0.83)	0.69 (0.58- 0.79)	1.2
Negative predictive value	0.25 (0.01- 0.98)	0.45 (016-0.74)	0.55

5 DISCUSSION

Different factors influence the outcome of pre-hospital management of patients with critical conditions such as management structures (command and control, communication, common standards), available resources (staff, vehicles, technical devices, and financial means), infrastructure (roads and hospitals) and finally, staff education and training.

5.1 Management structures

A pre-hospital mission is the result of various actions managed by different actors. Since no chain is stronger than the weakest link, the actors involved must cooperate closely. To do so, there is a need for common structures. This means that a successful pre-hospital service not only depends on a true collaboration, cooperation, and communication between all involved partners externally (hospitals, county council, etc.), but also internally (dispatch center, ambulance staff, etc.). This process should then be coordinated at a higher level (regionally, nationally, or internationally) [44]. Such coordination can be achieved through standardization. However, since many actors may have their own rules, routines, and traditions, standardization may be difficult to achieve. The most common denominators are common protocols, education, and training. In addition, standardization makes it easier to evaluate and compare the results and outcomes of an organization.

Therefore, EMS in all countries follow some major philosophies (Anglo-American, Franco-German, and Mixed). In Iran, the EMS was established in 1975 in association with the American EMS and based on the Anglo-American system. This means that the system has a dispatch center with an educated staff to take emergency calls and prioritize the severity of the injuries or medical conditions. Based on that decision-making, they dispatch an ambulance to the

patient. This vehicle is staffed with emergency technicians or paramedics, who based on their knowledge make a decision and consult a physician at the dispatch center, whenever the patient situation is critical or there is a need for transport to the hospital.

Evaluation of the Iranian EMS as the foundation of this thesis showed that although new guidelines and strategies have been introduced and implemented in this system, the increasing population, as well as the number of motor vehicles, have been challenging factors for the EMS in the biggest cities in Iran such as Shiraz [30]. A comparison between the two time periods (12 years apart) indicated a 2.4-fold increase in the number of trauma cases attended to by the EMS. Almost all traumas were related to RTA.

Since the number of emergencies, trauma cases, and deaths in RTA has been increasing during the last few decades, the question was raised as to whether there are ways to hamper this development. One point to address this was if the available resources could be more efficiently used. The economic decline worldwide has also hit a country with good natural resources such as Iran; thus, there was no financial possibility to increase the number of ambulances.

In cases of life-threatening conditions, shorter EMS response times seem beneficial. In order to increase the availability of ambulances for such cases, triage systems have been introduced in the dispatch centers [45]. As an example, while the Shiraz EMS uses a two-scale triage system (emergency run or non-urgent), some countries have developed EMS using a four-scale triage method when dispatching an ambulance.

Although there was a decrease in the scene time in 2012, compared to the 1999–2000 year data, the response, and evacuation times have slightly increased. Though not significant, the trend of prolonged response times may

be due to 1) increasing demand for EMS services and 2) traffic congestion. Other studies have also pointed out factors such as inadequate public education on EMS use and increasing distances between the patients and the emergency departments as main reasons for longer response times [46,47]. As demonstrated in study one, another 8.8% of the patients were transferred to hospitals by private cars. Taking this figure into consideration, the response time would have been higher than presented if ambulances had transported all of the patients. Lack of confidence in the availability of ambulances and/or in the staff's skills may be another reason why people use private cars to transport patients to hospitals, which is an important issue for EMS authorities in Shiraz to deal with in the future.

Study one also revealed that 36.2% of the patients were not transported to the hospital at all and were either not in need of medical attention or received definitive treatment at the scene since the Shiraz EMS has the authority to refuse a transport from the scene. As a comparison, all patients requesting ambulance transport in most developed countries are transported to the hospital and the ambulance crew has no right to refuse a transport. This, in turn, would lead to the insufficient use of ambulances and jeopardize the regional preparedness for major incidents and disasters [48]. Although Shiraz's healthcare may avoid these problems by discharging patients directly at the scene, the quality of the care should be investigated by identifying whether these patients receive the correct diagnosis and adequate treatment.

In the routine work conducted on a daily basis, all the vital signs of the patients are registered and thus demonstrate the severity of the cases. However, they also imply the necessity of creating a new protocol to define the priorities of patients at the scene and during the transportation [49]. In addition, although the physician at the dispatch center can be used as a consultant in dubious

cases, different physicians may have varying opinions on one specific case, which also necessitates the creation of disease-related protocols [50,51].

There are thus some issues in the evaluation of the Shiraz EMS that must be addressed. These include the increasing ambulance response times, the lack of follow-up of patients discharged at the scene as well as the lack of a standardized protocol for patient evaluation and treatment.

5.2 Response Times

We have already emphasized that EMS response time is an important factor for patients in critical conditions [19]. Although some studies could not find any association between response times and outcome due to the small sample size or focused on severe cases such as trauma [52,53], it is logical to assume that shorter response times are beneficial to reduce mortality [54,55].

The aim of the second study in this project was to evaluate whether it is possible to achieve a reduction in the response time by using temporarily stationed (TS) ambulances (fluid deployment). The outcome was measured as early mortality. Since the concept was used sporadically, it resulted in a maldistribution of missions (98% PS and 2% TS). The statistical analysis of these data was possible by using a model called “Bootstrapping.” The results showed a statistically significant reduction in both the response times and mortality. However, the distribution of missions raised a concern about the validity of the findings. This made us conduct a follow-up study in which close to 500 missions were registered for a defined period of time. Consequently, the distribution of missions became more equal. The statistical analysis confirmed the reduction of the response times, but could not verify any decrease in the mortality rate.

With regard to mortality, fewer patients were dead upon the arrival of the EMS,

in the group of patients attended to by the TS ambulances (1.5%) as compared to the other group (2.3%) ($P < 0.05$). Since the call-takers dispatched an ambulance based on their medical index/interview criteria, which is based on ABCD (Airway, Breathing, Circulation and disability) it seems logical to assume that patients were alive when the calls were received. Thus, since the patients in both of the groups were matched by diagnosis, age, and gender, a shorter response time might increase the chances of early survival.

5.3 Patients 'follow-up

The major tasks of EMS are short response times to the scene, accurate triage, proper treatment, and quick and safe transfer to the hospital [56-58]. In the first study, we showed that one-third (36%) of the patients were not sent to the hospital. Although the Iranian EMS staff has the authority to discharge a patient at the scene after consultation with a physician at the dispatch center, no follow-up and quality control was conducted. Since the patient outcome was unknown, the safety of this practice could certainly be questioned. Therefore, we followed up a group of identified discharged patients, 4–12 months after the EMS missions. The results obtained in this study implied that a large number of patients requesting an ambulance had non-emergency cases and could be treated at medical facilities other than hospitals.

An overuse of ambulance services leads to decreased availability of ambulances and overcrowding in EDs, thus, limiting the possibility of offering emergency care to more severely ill patients [59-61]. Although some studies criticize the practice of discharging patients at the scene by the EMS staff due to patient safety issues, it is logical to assume that a better cooperation between the EMS staff and a consultant physician as well as training in decision-making [62] may increase the accuracy and safety of such practice [63, 64]. This strategy will specifically be useful in low- and middle-income countries, where

the infrastructure and human resources are inadequate [65-67]. A better standard in decision-making, such as a guideline or a protocol, can make this strategy more fruitful [68-70].

A concern in this study was the 5.1% mortality rate, which was the same in both groups of patients, i.e., those who decided to go home on their own volition and those who were left at home/discharged by the EMS. Even if the EMS personnel were actively involved in the latter group, the impact of their presence or advice to the patients in the first group cannot be overlooked. The causes of death were not available in this study due to the National legislation; thus, no comparisons could be made and no conclusions could be drawn. However, it can be assumed that increased educational levels of EMS staff supported by an evidence-based protocol or staffing ambulances with a physician will increase the possibility of a better selection and correct diagnosis, as has been shown recently [71].

5.4 New protocols

Transporting the right patient by ambulance to the right hospital is a significant challenge for EMS staff. Proper triage will help to prioritize medical resources for the right patients [72]. In a Franco-German EMS, physicians are actively working with the patients and decisions can be made at the scene based on their medical experience and the patient's physiology and anatomy. In Anglo-American EMS organizations such as the one in Iran, EMS staff need to consult with a physician in doubtful cases [31]. The medical decision made by the physician in charge, however, depends basically on his or her knowledge, experience, and the accuracy of the information (physiology and anatomy) received from the ambulance crew. In order to standardize the information flow, there are some protocols and guidelines for evaluating a patient's vital signs [73]. However, these signs may not always be indicative of illness since

patients with severe illnesses initially may have normal vital signs [74]. Previous studies have shown that targeted guidelines for specific conditions decrease mortality and morbidity and increase patient safety [75,76].

There are many protocols and guidelines for triage and evaluation of life-threatening conditions, which are based on age, vital signs, respiratory function, and level of consciousness [77]. However, only a few studies have discussed guidelines and protocols for non-life threatening and non-urgent patients [78], and there are no evidence-based pre-hospital guidelines [79]. In the fourth study and for testing a protocol, non-traumatic abdominal pain patients were chosen. This choice was made for the following reasons:

1) We aimed to evaluate an emergency case with vital signs that could have an impact on the EMS decision at the scene,

2) Non-traumatic abdominal pain was one diagnosis of emergency character, with a low possibility of being a life-threatening condition,

3) In addition, it is a challenge for all physicians to establish a correct diagnosis in these cases since it can be caused by a wide range of diseases, from minor to potentially deadly conditions.

While using this protocol, there was always a possibility to change the decision made by contacting the physician at the dispatch center. Lammer et al. compared six protocols for non-traumatic abdominal pain and concluded that there is no significant difference between these six protocols, in terms of helping the EMS staff with on the scene decision-making [80].

In this study, we used a new protocol, based on RETTS-A triage together with other validated scales (e.g., PBS and VAS). The new protocol was approved by four professionals. The sum of points obtained by using this new protocol

(NOTRAPS) indicates transportation to the hospital. The outcome was then compared to the traditional pathway with the EMS crew consulting a physician at the dispatch center.

The vast majority of patients requesting an ambulance in Shiraz due to non-traumatic abdominal pain were transported to a hospital. A total of 170 patients were evaluated in two different groups; with or without the new protocol. The outcomes in both groups were comparable and were obtained by following the patients for 30 days. Of those admitted to the hospital, the number of true cases with abdominal pain selected by NOTRAPS was more prominent. There was a slight but statistically significant difference in the safety and accuracy of the decision made by EMS paramedics on the transport of patients to the hospital using NOTRAPS, compared to that of group B (p 0.02).

The protocol also showed a higher sensitivity. However, almost half of the patients not transported (Two patients out of four in NOTRAPS group and six out of eleven in group B, without NOTRAPS) were during the follow-up period admitted to the hospital in both groups. Thus prehospital assessment of non-traumatic abdominal pain and decision on which patients that need in-hospital treatment continues to be a challenge for EMS staff and NOTRAPS was not found to be the final solution to this problem.

6 Limitations

During this project, we faced some restrictions and limitations as follow:

Study I:
In this study, data were collected from a digital source (2008–now) and a manually registered source (before 2008). There were some difficulties with data collection before 2008 and some missing data. The handwritten data were sometimes not easy to evaluate and demanded exact analysis by the administrative personnel; thus, some detailed data categorizing patients, type of injuries, their causes, exact treatment, patients' outcome, etc. were not accessible.

The data collected in the second study period (2011–2012) were not coded. The raw data were sometimes difficult to sort out. As an example, abdominal pain could be found under different phrases. Another important issue was the missing data, particularly, at the treatment section on site and during transportation and the section dealing with various procedures.

Another limitation in this study was the lack of information and data from other registries in Iran, which makes it impossible to compare the results with other similar entities.
All of these factors might influence the conclusions drawn in this study. However, we aimed to have a general understanding of the changes and development of the system over a 10-year perspective, and it seems logical to believe that our conclusions are valid and in line with EMS development in other countries.

Study II:

A limitation to this study is the absence of a 30-day follow-up for all the patients in the hospital or after being discharged from the hospital. However, the primary goal of this study was to evaluate the mortality rate of the pre-hospital phase and not in the hospital or post-hospital phases. We made an attempt to study both 24-h mortality and at-discharge mortality and morbidity at all the hospitals involved in this study. Unfortunately, the registries at all of the hospitals were not reliable; data were missing too frequently, thus, no real conclusions could be drawn. Therefore, we decided to study the mortality upon arrival at the scene and during transportation, as the outcome indicators.

Another issue to consider in the first study was the fact that we have not measured the response times for the PS ambulances, which were running simultaneously with the TS ambulances. Although ambulance response times will be influenced by the actual distance to the patient when the ambulance is being dispatched, measuring the mean time (± SD), the times between the two groups of ambulances can be compared. However, a possible increase in the response times for the PS ambulances, when running the systems in parallel, will obviously not be detected. In the second period of study II, the response times for both groups were measured simultaneously, and the mean 2 min discrepancy between the two groups in study two may indicate no increase in the PS ambulances response time while using TS ambulances at the same time. The average number of missions was also the same in both groups, which may also indicate no overloading of the PS ambulances.

An important point in this report is the number of people who were discharged at the scene either based on their own volition or following the assessment of an ambulance crew. Since there is no follow-up for this group, the rate of morbidity or mortality associated with decisions made by ambulance crews

could not be calculated or assessed. This issue should be addressed in a future study.

The highly unequal distribution of missions between the PS and TS ambulances has been addressed by applying a specific statistical method (Bootstrap). A second follow-up study with more similar group sizes was also conducted to address this issue.

Study III:

A serious limitation of this study was the low response rate (33%) despite numerous attempts to contact the patients. This illustrates the difficulties in conducting pre-hospital research and following-up on pre-hospital cases. Furthermore, lack of a 30-day follow-up of the patients after being discharged at the scene and the lack of autopsy results may influence our conclusions. In both cases, the absence of registration and guidelines are evident. Nevertheless, the results obtained are indicative and might lead to new guidelines and policy changes, which will improve the EMS activities in the future.

One more issue to consider is the impact of the EMS staff on the patient's decision-making. Even if the EMS staff were actively involved with the group of patients who left the scene on their own volition, the impact of the EMS staff's presence or advice to the patients cannot be underestimated.

Study IV:

Prehospital research is demanding due to the emergency nature of the diseases. One of the limitations of this study might be the random selection of patient vs. EMS staff. Since the number of ambulances and staff is limited, there is an obvious risk that one EMS personnel receives both patients who should be evaluated based on the standard routines as well as those who should be

evaluated based on the new protocol. Consequently, there is a risk that the protocol and its design might influence the staff´s further assessment. Although this risk exists and such knowledge retention is quite possible in such a short-term, we found no alternative method of selection to avoid this type of bias.

Another limitation may be the design of the protocol. The points given for each section and the final cut-off points as a basis for decision-making were all a product of evaluation by five senior health professionals. This is particularly interesting as the patients transported to the hospital were basically selected based on the scales given in the protocol. Especially, the fourth scale in the NOTRAPS, which is based on the duration of the pain and which was not a validated scale. However, the effects of pain duration have already been established in the literature.

To be on the safe side the points given might be too high to safeguard the patient's ´safety. This obviously could lead to a larger number of patients being transported to the hospital. Lower points, on the other hand, may jeopardize patients 'safety with the larger number being left at home or at the scene. Consequently, in both situation, the real value of the protocol might be overlooked.

As this is a research study, there is a need for evaluation and further investigations of the points given and their relation to the severity of the condition by new studies to find out the real cut-off values.

7 CONCLUSION

EMS in middle-income countries have the same challenges as other nations, worldwide, with longer ambulance response times, unnecessary ambulance use, and the lack of standardization. A shorter ambulance response time can be achieved by utilization of the fluid deployment concept. However, the method should be further evaluated and reproduced in new studies. One of the reasons for unnecessary use of ambulances is the assumption that it might be easier to get access to the healthcare services by using the ambulance entrance. There is however a risk that this trend will overload the pre-hospital resources, increase the response times and thus, decrease the number of available ambulances. One measure to cope with this new pattern is to discharge patients with benign conditions directly at the scene/home. However, this will only be possible if the patient safety is guaranteed and necessitates good quality follow-up and utilization of relevant protocols. NOTRAPS was a new protocol used in this study for the assessment of non-traumatic abdominal pain. Although this protocol does not substitute a physician´s knowledge and ability in decision-making in non-traumatic abdominal pain, it might increase the safety and accuracy of EMS decision on transport to the hospital in the absence of a physician. Particularly, it might be valuable for countries with fewer physicians to staff at the dispatch centers or in the ambulances to ease the process of decision-making. The result of this study may be indicative, however, it is a small-scale study and conducted in a single cultural context. New studies in favor or against our results are needed.

8 FUTURE PERSPECTIVES

To the best of our knowledge, there is no standardized or validated triage guideline in the pre-hospital setting between dispatch centers, ambulance crews, and emergency departments in Iran or elsewhere. A common triage guideline will influence the whole chain of management from prehospital scene to the ambulance transportation and emergency departments. Recent management of terror victims in Paris clearly demonstrates this statement (26,27). Patients were triaged into three groups: 1) Absolute emergencies (Red and Orange), 2) Relative emergencies (yellow and Green), and 3) Expectant (Blue). This simple triage was a common denominator for prehospital and hospital patient care and eased the communication between different parts of the chain. It would be a challenge in Iran to effectively use the EMS, but it is also possible to take new initiatives by using new communication alternatives such as common triage method and new communication systems.

Lack of confidence in the availability of ambulances and/or in the staff's skills may be another reason why people use private cars to transport patients to hospitals. This is an important issue for the EMS authorities in Shiraz to deal with in the future. Increasing the quality of care, follow-up, and establishing a good connection with the public are ways of addressing this issue. Using standardized protocols, yearly follow-up of all missions, publishing the results of follow-ups, open discussion and case evaluations are some of the important factors to not only improve the quality of care, but also ensure the people´s trust in the EMS.

The combination of consultant physician and NOTRAPS protocol can be used to increase the patient safety in cases with non-traumatic abdominal pain. A future study should address this question scientifically. New protocols can be used for other diagnoses and may also help to bypass the emergency

departments by taking the patients directly to the ward or surgery. These protocols should be developed together with the specialists involved as well as the emergency physicians. Although much more advanced in western countries, various diagnostic tracks have been established in different countries. Such a development is fully possible in Iran and EMS is deeply involved in its establishment. Development of new protocols similar to NOTRAPS and for other conditions should thus be addressed.

An improved communication and mutual registry between the hospitals and EMS would increase the ability to collect valid data and also improve the quality of care. The dialogue between EMS and other emergency managers and organizations will ensure a good collaboration, thus ensuring proper use of resources. A common registry will increase the quality of care by enhancing the process of learning from mistakes or successful cases.

Research and education are two important key factors for future improvement of EMS. Looking at the recent terrorist incidents, it is obvious that the EMS is facing a new era with new risks and needs for new treatment guidelines and strategies. New research and new evidence-based guidelines will guarantee a better management of future incidents [26].

Physician-staffed vehicles, used in other countries, might be used as a complementary service in dubious and critical cases. Earlier reports have shown that physician-staffed vehicles might be very useful in many cases, especially in pediatric cases and in additive treatment of patient with advanced care at home [81].

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APPENDIX

Appendix 1

Detailed Statistical analysis

First approach:

In this approach, we used one-sample proportional test. This test will determine whether there is any difference in mortality rate between those transported by PS (the population, control group) vs. TS. P-value less than 0.05 is significance. The result showed a difference in mortality rate in favor of TS (p = 0.0468, % mortality 0.159343, 95% confidence interval 0.01054429-0.02376338)

Furthermore, by using one-sample Wilcoxon test, we investigated whether there is any difference between mean response time in the population (PS) and the temporary stationed ambulances. The result shows statistical difference in response time between TS and control population (PS) (p <0.001).

Second and third approaches

In these approaches, the two/sample test for equality of proportions has been used to compare mortality rate and the Mann/Whitney/Wilcoxon Test, to compare Response time (the distribution of response time is not normal). Also, the 95% Bootstrap percentile confidence interval was reported for the interest parameter as a way of using the data collected for a single experiment to simulate what the results might be if the experiment was repeated over and over with a new sample of subjects. Following steps were taken;

Step 1: obtaining a bootstrap data set

- Sample n observations randomly with replacement from the temporary stationed ambulances

- Sample n observations randomly with replacement from the permanent stationed ambulances

Step 2: Calculate the bootstrap version of the statistic of interest (difference of mortality rate and response time)

Step 3: 1000 times repeat steps 1 and 2 to generate the bootstrap distribution of an interest statistic (difference of mortality rate and response time)

Step 4: Report a 95 % bootstrap percentile confidence interval for the interest parameter. The interval between the 2.5th and 97.5th percentiles of the bootstrap distribution of a statistic is reported as a 95 % bootstrap percentile confidence interval for the interest parameter (difference of mortality rate and response time).

Step 5: the test is significant if the 95 % bootstrap percentile confidence interval for the interest parameter does not include the zero.

Second approach

Mortality; First, we assumed that a 1.5% decrease in the mortality rates is valuable in our samples (1.5% of 81000 missions i.e. around 1200 lives per year) by deploying ambulances as TSA. The minimum sample size (by considering α=0.05, β=0.2, $z_{1-\alpha/2}$=1.96, $z_{1-\beta}$=0.84) will be 1200 cases in each group. Thus, 1200 cases were randomly selected within each group. For more accuracy 95% confidence intervals based on the Bootstrap method was used [14-16]. This protocol has been done when the control groups were two and three times larger than the sample group. The results are shown in the following table, calculating mortality rate in two groups.

The gray rows of the above table show that 1000 times resampling with replacement from two groups results in less mortality rate in the TS compare to that of the PSA and the 95 % bootstrap percentile confidence interval for the difference of the proportions does not include the zero. The white rows of the above table, however, show that the 95 % bootstrap percentile confidence interval for the difference of the proportions includes the zero and the mortality rate in the TS, tends to, but is not significantly less than that of the PS in 40 times (from 1000 times resampling). This means that the mortality rate will significantly differs if large number of patients are involved.

	n	Prop of Dead	SD	diff Prop	P	95 % bootstrap percentile confidence interval for difference of Prop	
Temporary	1200	0.0158	1.30e-05	0.0108	0.09	(-0.0008, 0.0234)	**0.04**
Permanent	1200	0.0267	2.16e-05				
Temporary	950	0.0158	1.63e-05	0.0122	0.06	(0.0011, 0.0238)	**0.02**
Permanent	1895	0.0280	1.43e-05				
Temporary	860	0.0139	1.60e-05	0.0121	0.05	(0.0016, 0.0221)	**0.01**
Permanent	2575	0.0260	9.84e-06				

Response time; the results of the Bootstrap, calculating response time in two groups.

	response time						95 % bootstrap percentile confidence interval for difference of means
stationed	N	median	mean	SD	mean diff	P	
Temporary	1200	381.5	410.5	361.87	116.19	<0.001	**(90.05 , 141.65)**
Permanent	1200	481.5	526.7	242.35			
Temporary	950	384.50	402.50	352.04	128.90	<0.001	**(102.05, 155.46)**
Permanent	1895	491.00	531.30				
Temporary	860	381.5	398.8	358.54	127.14	<0.001	**(101.03, 152.69)**
Permanent	2575	489.0	526.0	226.54			

The table shows that 1000 times resampling with replacement from two groups results in significantly less response time in the TS than the PS and the 95%

bootstrap percentile confidence interval for the difference of the mean response time between two groups does not include the zero.

Third approach

Based on the results the reduction of the means of response time and mortality rate at the scene of incident was significant. To enhance the accuracy of our result, we generated 1000 bootstrap samples without replacement in size of 1571 from permanent stationed ambulances [because of 1571 TS]. We reported descriptive statistics and 95 % bootstrap percentile confidence interval for the interest parameters. The results of the Bootstrap, calculating mortality rate in two groups.

	N	**Prop of Dead**	**SD**	**diff Prop**	**sig**	**95 % bootstrap percentile confidence interval for difference of Prop**	
Temporary	1571	0.0159	9.96e-06	0.0115	0.04	(0.0006, 0.0146)	**0.02**
Permanent	1571	0.0274	1.70e-05				

The table above shows that 1000 times resampling without replacement from the permanent stationed ambulances results in significantly less mortality rate in the temporary stationed ambulances vs. the permanent stationed ambulances and the 95 % bootstrap percentile confidence interval for the difference of the mortality rate between two groups does not include the zero. The results of the Bootstrap, calculating response time in two groups.

	response time					**sig**	**95 % bootstrap percentile confidence interval for difference of means**
	n	median	mean	SD	mean diff		
Temporary	1571	416.0	431.0	353.80	107.19	<0.001	**(83.782, 114.159)**
Permanent	1571	494.0	538.2	247.8			

The table above shows that 1000 times resampling without replacement from the permanent stationed ambulances results in significantly lower mean

response time in the temporary stationed ambulances vs. the permanent stationed ambulances and the 95 % bootstrap percentile confidence interval for the difference of the mean response time between two groups does not include the zero.

Appendix 2

Follow-up questionnaire in non-traumatic abdominal pain.

Patient consent to follow-up Yes No

Patient name:

Recent admission to the hospital:

Questions to be asked or answered by phone/written;

1. What were the main reasons to request an ambulance and your chief complaint?
2. What were your symptoms?
3. Was the decision not to be transported to the hospital your own, or did the ambulance crew make it?
4. If it was the staff's decision, were you satisfied with it?
5. Did your symptoms continue after being discharged? If your answer is yes, what were those?
6. Did you visit a clinic or hospital/physician after being discharged by EMS?
7. What was their diagnosis/opinion when visiting the clinic or hospital?
8. What was the treatment?
9. Have you recovered?