



## Factors Affecting the Location of Road Emergency Bases in Iran Using Analytical Hierarchy Process (AHP)

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### ► ABSTRACT

**Objective:** To identify and prioritize factors affecting the location of road emergency bases in Iran using Analytical Hierarchy Process (AHP).

**Methods:** This was a mixed method (quantitative-qualitative) study conducted in 2016. The participants in this study included the professionals and experts in the field of pre-hospital and road emergency services issues working in the Health Deputy of Iran Ministry of Health and Medical Education, which were selected using purposive sampling method. In this study at first, the factors affecting the location of road emergency bases in Iran were identified using literature review and conducting interviews with the experts. Then, the identified factors were scored and prioritized using the studied professionals and experts' viewpoints through using the analytic hierarchy process (AHP) technique and its related pair-wise questionnaire. The collected data were analyzed using MAXQDA 10.0 software to analyze the answers given to the open question and Expert Choice 10.0 software to determine the weights and priorities of the identified factors.

**Results:** The results showed that eight factors were effective in locating the road emergency bases in Iran from the viewpoints of the studied professionals and experts in the field of pre-hospital and road emergency services issues, including respectively distance from the next base, region population, topography and geographical situation of the region, the volume of road traffic, the existence of amenities such as water, electricity, gas, etc. and proximity to the village, accident-prone sites, University ownership of the base site, and proximity to toll-house.

**Conclusion:** Among the eight factors which were effective in locating the road emergency bases from the studied professionals and experts' perspectives, "distance from the next base" and "region population" were respectively the most important ones which had great differences with other factors.

**Keywords:** EMS; Road emergency bases; Analytic hierarchy process (AHP).

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## Introduction

One of the most important parts of the health systems is pre-hospital centers, and emergency care and services are a vital component in the treatment of critically ill patients [1]. Pre-hospital care and services include the care and services that begin at the patients' bedside on the accident scene and end in the hospital emergency department. The pre-hospital emergency services have had many developments from their birth in 1960 until now, including in the field of personnel and equipment [2].

In Iran, also the Emergency Medical Services 115 (EMS 115), which is responsible for providing pre-hospital services, was launched in 1976. Because it is the confluence of the treatment area with the community and is the first point of dealing directly with patients and their families, the timely presence of the pre-hospital team on the scene is very important [3]. Fast, efficient and effective services provided by this team can save the lives of many patients in vital stages. Identifying high-risk patients as quickly as possible and providing the required treatment for them is an important objective of pre-hospital care [4]. If upon the occurrence of an accident and in the first 2 to 8 minutes the required care and services are received by the injured and patients, up to 40% of their lives can be saved from certain deaths [5].

One of the indicators used for the evaluation of pre-hospital centers, which has been mentioned in previous studies, is the response time or the time of getting to the accident scene and emergency patients [6]. Response time is a very important factor in increasing the chance of patients' survival and decreasing the side effects caused by the accidents [7, 8]. In Iran, traffic accidents are the main cause of injuries and the second cause of deaths after cardiovascular diseases [2, 9, 10], and its prevalence is four times more than that in the developed countries [11]. According to the World Health Organization report 2015, the Iranian officials and authorities reported 17994 deaths caused by traffic accidents in Iran in 2013-2014, while the World Health Organization has estimated this figure as 24896 deaths [12].

The results of some studies have shown that factors such as population, accidents, placement position, time, roads, population, space under cover, traffic network, land application, the potential dangers, travel time and distance to the service provider center, and urban road network data have effects on the location of road emergency bases [13-16]. Thus, given the importance of response time and the high number of road accidents in Iran, locating the road emergency bases is very essential. Because of the lack of enough evidence and studies in this field, it is required to conduct researches and studies on determining factors affecting the location of road emergency bases using valid and reliable methods. The present study aimed to identify and prioritize factors affecting the location

of road emergency bases in Iran using Analytical Hierarchy Process (AHP).

## Materials and Methods

This was a mixed method (quantitative-qualitative) study conducted in 2016. The participants in this study included the four experts in the field of pre-hospital and road emergency services issues working in the Health Deputy of Iran Ministry of Health and Medical Education, , which were selected using purposive sampling method. The inclusion criteria for selecting these four experts were having at least 10 years work experience in pre-hospital emergency services, having at least four years of management experience and having pre-hospital emergency knowledge.

In this study at first, the initial factors affecting the location of road emergency bases in Iran were identified using literature review and the results of previous studies. Then, a semi-open questionnaire containing the identified factors and an open question was used to localize them and remove the existing factors or add the new ones. The second author was responsible for conducting interviews with the experts and explaining the aim of study and the quality of determining the factors and answering the open question, and completing the questionnaire. After completing the questionnaires, the answers given to the open question were analyzed using content analysis method through MAXQDA 10.0 software. For reaching the final agreement on the factors, the nominal group technique was used. Next, the identified factors were scored and prioritized using the studied professionals and experts' viewpoints through using the analytic hierarchy process (AHP) technique and its related pair-wise questionnaire. The collected data were analyzed using Expert Choice 10.0 software to determine the weights and priorities of the identified factors.

AHP is used when there are several competing alternatives and decision criteria in the decision-making. The criteria can be quantitative or qualitative. This technique is based on pair-wise comparisons. The decision maker begins his/her work by providing a decision hierarchical tree, which shows the studied competing alternatives and factors. Then, the weight of each alternative and factor is determined using a series of pair-wise comparisons. Finally, the matrixes derived from the pair-wise comparisons are being combined to make the optimum decision [17].

## Results

In this study at first, 16 factors affecting the location of road emergency bases in Iran were identified using literature review and conducting interviews with the studied professionals and experts, which included: response time, distance from the next base, the

height difference of the road and visibility, signaling the communication lines, the existence of amenities such as water, electricity, gas, etc., accident-prone sites, the volume of road traffic, distance from the Red Crescent bases, topography and geographical situation of the region, being located in the road bottlenecks, proximity to rail lines, proximity to toll-house, proximity to military bases and barracks, synergies with air bases, seasonal mobile patterns (mobile and temporary bases), University ownership of the base site, and region population.

Next, eight factors were identified as the effective ones using the viewpoints of the research team members and the professionals and experts participating in the present study, and were entered into the AHP pair-wise questionnaire. This pair-wise questionnaire was completed by four professionals and experts in the field of pre-hospital and road emergency services issues working in the Health Deputy of Iran Ministry of Health and Medical Education. Table 1 shows the selected factors and their weights.

**Table 1.** The factors affecting the location of road emergency bases in Iran and their weights from the viewpoints of the studied professionals and experts.

Factors	Weights
Distance from the next base	0.313
Region population	0.281
Topography and geographical situation of the region	0.110
The volume of road traffic	0.110
The existence of amenities such as water, electricity, gas, etc. and proximity to the village	0.096
Accident-prone sites	0.049
University ownership of the base site	0.025
Proximity to toll-house	0.016

## Discussion

The results of the present study showed that eight factors were effective in locating the road emergency bases in Iran from the viewpoints of the studied professionals and experts in the field of pre-hospital and road emergency services issues, including respectively “distance from the next base”, “region population”, “topography and geographical situation of the region”, “the volume of road traffic”, “the existence of amenities such as water, electricity, gas, etc. and proximity to the village”, “accident-prone sites”, “University ownership of the base site”, and “proximity to toll-house”.

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Therefore, “distance from the next base” was the most important factor in locating road emergency bases in Iran from the studied professionals and experts’ viewpoints, which is similar the results of the Goli and colleagues’ study (2015) [14]. The results of other studies have shown that the distance of road emergency bases from each other is an effective factor in locating the road emergency bases [18-20]. Therefore, according to the importance of the distance of road emergency bases from each other, determining an index or formula to find the proper distance of these bases from each other is very important and should be a high priority for future studies.

In the current study, the second factor which was effective in locating the road emergency bases was “region population” from the studied professionals and experts’ perspectives, which is confirmed by the results of the Pedigo and Odoi (2010) [21] and Schuurman and colleagues’ (2009) [22] studies. Therefore, based on the importance of identifying and determining the population living in a region to establish a road emergency base, the cooperation of different organizations such as the Statistical Center of Iran, etc. with the health officials and authorities seems necessary so that the population of a given region will be estimated more accurately.

In conclusion, the results of the present study showed that eight factors were effective in locating the road emergency bases from the studied professionals and experts’ perspectives. Among these factors, the most important ones were respectively “distance from the next base” and “region population” which had great differences with other factors.

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