Air ambulance base development for responding to traffic accidents in Iran

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Abstract

Background: Road Traffic accidents are one of the most common accidents killing 1.35 million people annually around the globe. Approximately 86% of deaths occur from trauma before hospitalization. In such circumstances as a pre-hospital service, air ambulance can play an important role in accessing the patients and transferring them from the accident scene securing survival of patients.

Objective: This study aimed to identify the affecting factors in air ambulance response to traffic accident sites.

Methods: This qualitative study conducted from November 6, 2019 to April 6, 2020, in which a semi-structured interview was carried out on 17 participants. To analyze the data of this qualitative study, the Graneheim and Lundman method was used, and a conventional content analysis approach was employed.

Results: The majority 41% were in the age range of 30-40 years. Individuals with a master's or doctoral degree made up 70% of the participants. People with 11-20 years of work experience made up 52% and 58% of the participants were at the managerial level.

Factors influencing the development of air ambulance bases in 6 main categories, included resources and infrastructure, training of specialized personnel, indicators and standards, information and communication, safety and security, and management factors were studied.

Conclusion: Based on the findings, infrastructure improvement and allocation of resources as well as training specialized forces can play an important role in developing air ambulance bases in Iran. Further research is needed to develop a measurement tool to evaluate the affecting factors before establishing air ambulance bases in Iran.

Keywords: Air ambulance, Traffic accidents, Iran.

Introduction

Traffic accidents as a man-made disaster are among the most common accidents killing 1.35 million people annually worldwide, and 3700 people die on the roads every day.1 About 90% of traffic casualties are observed in developing and low- and middle-income countries; that is, countries with more than 84% of the world’s population and 53% of the world’s vehicles which raises the importance of these accidents in these countries.2 Traffic accidents in Iran are among the most common causes of injuries, and Iran is among the countries where traffic accidents are higher than the global average.3

Approximately 86% of deaths occur from trauma and 64% from cardiac arrest before the hospitalization.5 It may be due to a variety of factors including the distance between the scene of accident and emergency services, lack of access to the scene, or the need for secondary transfer from the primary care center to a specialist hospital and advanced trauma centers.6 In such circumstances, the air ambulance as a pre-hospital service can play an important role to access the patients and transfer them from the scene of accident and affect the survival of patients and the injured.7 Many experts believe that the first 60 minutes after the accident as a golden hour has the greatest effect on saving the lives of the injured.8 Considering the essential role of time in the survival of severely injured trauma patients, reducing the transfer time of critically ill and injured patients and the ability to provide more medical services and fast transfer to medical centers...
with appropriate services are essential requirements that air ambulance system can play a key role in this matter and the survival of the injured. Considering the role and importance of air ambulance, it is necessary to develop emergency facilities with the aim of maximum coverage of areas and optimal service to patients. Therefore, the proper development of air ambulance bases is of particular importance because deciding on the distance and time of transfer to service centers can seriously impact on the health consequences of the type and timing of services for patients and the injured.

In many studies, time was considered an important factor for developing the air ambulance bases. Furthermore, some studies have considered the appropriate distance from emergency medical service centers as an effective factor in developing air ambulance bases. A review of related literature showed that quantitative methods and mathematical modeling did most of the studies conducted in this field.

Objectives

To fill this gap, the present study was conducted to identify the effective factors in developing Iranian air ambulance bases in traffic accidents to provide a deeper understanding of the effective factors, an opportunity to plan and improve the development by policymakers and provide high-quality emergency medical services.

Materials and Methods

The present research was a qualitative study which used the conventional content analysis method to analyze the data and interpret the factors influencing the development of air ambulance bases. The knowledge gained was based on the views of participants.

Setting

Iran is one of the countries where traffic accidents are higher than the global average so that 1 person loses his life every 19 minutes due to traffic accidents. Moreover, 13.5% of the lost lives are the result of traffic accidents which this ratio is high compared to the world and the region. Considering the huge volume of traffic accidents and the lack of 100% coverage of roads by ground ambulances, using air ambulances to provide services is on the agenda and, as one of the main programs of transformation plan in Iran. The present study was conducted to identify the effective factors in developing Iranian air ambulance bases in traffic accidents.

Participant selection

Participants in the study included specialists at the national level, including the Ministry of Health and Medical Education, and at the regional level, including universities with knowledge, expertise and scientific experience in air ambulance. Participants were managers of the Ministry of Health and Medical Education, medical universities, and air ambulance bases at medical universities and Red Crescent bases. Purposeful sampling continued until reaching the data saturation stage. A total of 17 participants from Tehran, Alborz, Qazvin, Ilam, Kermanshah, and Fars were included in the interview.

Data generation

In-depth semi-structured interviews were used to collect research data. At first, three in-depth unstructured interviews were conducted to gain general insights. After extracting the interview axes, in-depth semi-structured interviews were used to collect research data. Fourteen participants were interviewed face to face and then, due to the prevalence of COVID-19 disease, three telephone interviews were conducted.

The interview method was that first the researcher introduced himself/herself and stated the purpose of the study, then the interviews were started with general questions in the field of research and then ended with specialized questions.

The main structure of the interview was the following questions: Based on your experience and knowledge, what are the factors influencing the development of air ambulance bases? The researcher also tried to get saturated with a deeper study during the interview with explorative questions.

The interviews lasted for six months, from November 6, 2019 to April 6, 2020, and the average duration of the interviews was 30-60 minutes. In each interview, this study verbally aimed to the participants and a written consent was signed by them to participate in the interview.

Data analysis

Data collection and analysis were simultaneously performed. The researcher recorded all interviews and was transcribed verbatim immediately after each interview, then was typed with 2007 Microsoft software. The data analysis
method was content analysis with the Granheim approach. To fully understand interview content, the researcher first listened to the recorded file for several times and fully transcribed it. Then, the whole text of interview was matched with the ZE researcher audio file and read many times, and the units of meaning and the initial codes were extracted. Finally, under the supervision of ZGH and SS, the primary and similar codes were placed in a subcategory, and finally the main categories were determined.

Rigor

Four criteria of Guba and Linko, including credibility, data dependency, confirmability, and transferability, were used to evaluate the validity and reliability of the data.

The researcher was fully involved in the data collection process and established correct and appropriate communication with the participants to credibility the data. To examine the data dependency, the research process was monitored by a research team member who was more competent in the field of research or research methods. To ensure confirmability, the researcher measured the opinion of two independent individuals about the accuracy and significant relationship of data. To make sure transferability, the researcher provided more details about the participants such as age, gender, education, work experience, and environmental characteristics, but in the end, the data transferability will be according to the readers.

Results

17 subjects were participating in the interview. According to Table-1, 82% of participants were male, and 18% were female. The majority of participants, with a frequency of 41% were in the age range of 30-40 years. Individuals with a master's or doctoral degree made up 70% of the participants. People with 11-20 years' work experience made up 52% and 58% of the participants were at the level of middle managers. (Table-1).

As shown in Table-2, the factors influencing the development of air ambulance bases in 6 main categories including information and communication, resources and infrastructure, training of specialized humans, safety and security, indicators and standards, and management factors, were extracted.

Resources and infrastructure

The majority of participants in the interview mentioned access to specialized human resources and allocation of financial resources, and the existence of necessary infrastructure as one of the most important factors in development.

| Table-1. Demographic characteristics of the participants |
|-----------|--------|--------|
| Gender   | Male   | 14 (82%) |
|          | Female | 3 (18%)  |
| Age      | 30-40 years | 7 (41%) |
|          | 40-50 years | 6 (35%) |
|          | Above 50 years | 4 (24%) |
| Education level | Bachelor | 5 (30%) |
|          | Master | 6 (35%) |
|          | PhD   | 6 (35%) |
| Work experience | Under 10 years | 4 (24%) |
|          | 11-20 years | 9 (52%) |
|          | Above 20 years | 4 (24%) |
| levels   | Senior Managers | 3 (18%) |
|          | Middle managers | 10 (58%) |
|          | Operational staff | 4 (24%) |

Human resources

The existence of specialized human resources and using different combinations of medical staff to provide services by air ambulance and access to different combinations, training, and coordination between medical staff and the existence of a common language between medical staff and flight crew is very important.

"There are two different teams in the air ambulance, one is the medical staff team, and the other is the pilot and flight engineer team, and the interaction between these two teams is very important" (Participant No. 4).

Financial resources

Financial resources are one of the most influential factors in developing air ambulance services because in Iran, providing services is in the form of purchasing services, also, the cost of repairing and maintaining the helicopter equipment is very high, however, given the importance of justice in access to services. It is necessary to provide these financial resources and develop air ambulance services.

"From any point of view, an air ambulance can be a valuable service. The only big problem is that it is expensive, meaning that every flight now costs over 20 million with easy maintenance costs for the government" (Participant No. 4).
Table 2. Factors influencing the development of air ambulance bases

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<tr>
<th>Category</th>
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<td>Resources and infrastructure</td>
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<td>Management factors</td>
<td>Extra-organizational cooperation</td>
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Training

Training is critical to improving air ambulance services because the lack of training of staff and their misunderstanding of the conditions of physical change during the flight on the physiology of patients will aggravate the condition of patients and adverse events.

"We are young in this area, and we need training. The hospital supervisor needs to be trained in this area. All of these needs to be developed so that a complete air emergency service can be provided in the country" (Participant No. 10).

Research

It is possible to try to find appropriate solutions to solve the problems and expand the existing knowledge and open new horizons for the future through the research. It is possible to upgrade the air ambulance services according to the indicators by scientific analysis and periodic review of the location of air ambulance bases.

"See, the same research that you are doing is the concern of all the people who are working. In my opinion, the most important issue is to set up an air emergency based on a scientific and logical criterion." (Participant No. 7).

Indicators and standards

Determining the indicators and standards of air ambulance services is essential in order to achieve the development goals of the bases. On the other hand, presenting the results of indicators analysis to higher levels will lead to the intervention and modification of air emergency processes and the improvement of indicators. The majority of participants emphasized the use and observance of indicators and standards at the time of the Ministry's notification response to provide services to the injured to develop air ambulance bases.

Response time standard

Time should be considered an important and influential factor in planning to develop air ambulance bases. Providing services in the shortest possible time and saving time is one of the advantages of using an air ambulance. In addition to trauma patients, the prevalence of cardiovascular disease and stroke has proven that in all of them, a golden time is crucial in transporting patients to the nearest medical center.

"Patient bedtime is one of the main items in developing the air ambulance” (Participant No. 10).
Input and output indicators

Attention to input indicators such as the number of helicopter flights, the number of trauma treatment centers, and output indicators such as the number of traffic accidents, the number of injured in the area, accident hotspots are important factors that should be considered in the development discussion and, based on these indicators, he planned for development, because reducing post-accident injuries is one of the main strategies that is the responsibility of community health care providers. Planning to provide pre-hospital services by air ambulance will significantly reduce the number of deaths from trauma patients due to traffic accidents.

Access criteria

Access of the base to crowded centers, transportation routes, and proximity to high-risk roads, fuel centers, and Disaster management shelters are considered the effective factors in development. Because these accesses play a key role in responding appropriately and in a timely manner to emergencies and emergencies.

"The issue of refueling helicopters is very important because the helicopter fuel is not like car fuel, it is a special fuel, so this vehicle must have fuel available wherever it wants to be stationed" (Participant No. 10).

Evaluation and monitoring criteria

Objective and systematic evaluation of processes will help determine the efficiency and effectiveness, and effects of air ambulance development, which, if desirable, can be considered a lesson learned and used in future decision-making processes.

"A large number of accidents and emergencies such as the statistics of pregnant mothers who die during childbirth in remote parts of the country may not be recorded anywhere because there are no strong rules and regulations for registration. This issue shows that we need a lot of services." (Participant No. 10).

Communication and information

According to the participants, communication and information are effective factors in the development and provision of services by air ambulance which itself includes 3 subcategories.

Information Technology

Some participants considered pre-hospital information technology and access to hospital information as important and necessary factors in development. Because it is possible to extract effective variables in response time and challenges in this area by analyzing the information of hospitals and air ambulance bases.

"I think it can help you in two areas, the hospital information which the treatment deputy should provide, the pre-hospital emergency where the emergency centers are at your service" (Participant No. 7).

Information infrastructure

One of the most important and influential factors in developing the information about the infrastructure and information of other organizations, especially security, military, and defense information in the development area, not considering the information about these organizations may cause many problems in providing services in the region.

"So one of the factors influencing the choice of helicopter location is the availability of security information such as military information and defense information for development" (Participant No. 10).

Informing

Most of the participants considered informing about flight indications to emergency medical staff and hospital staff as one of the essential factors in development. Lack of knowledge of flight indications causes delays in the provision of services and sometimes mistakes in using helicopter services for patients who do not have indications, which ultimately leads to a waste of resources.

"Our information are very limited. Many people do not even know that there is an air emergency. Even our medical colleagues are not aware of the indications for requesting a helicopter" (Participant No. 5).

Safety and security

Considering the importance of observing the safety and security of the base, staff and equipment, and tools to respect the rights of the service recipients and employees, some participants said that observing safety and security issues is necessary for developing the bases.

Base safety

Considering the structural safety, not the structural safety of base structure is of great importance also, the distance of the base from natural and man-made hazards is one of the
things that should be considered for developing the base to observe safety.

"See, when your country is earthquake-prone and flood-prone, if the air ambulance bases are actually located in safe locations, it can do more to make sure they will not be damaged" (Participant No. 2).

**Helicopter safety**

Safety should be observed to prevent unwanted accidents during landing and takeoff of the helicopter. The safety officer must observe the necessary points to prevent the unwanted accidents, such as lifting or shaking the hand under the main propeller of the helicopter, how to properly transport long items to the helicopter and, has to be trained in this regard and the subset should be trained.

"The issue of helicopter safety is important. You see a Russian helicopter that has been operating for 30-40 years, we are using it now. Do they really have the necessary safety, or did we just have to go to it because we have no resources?" (Participant No. 7).

**Staff security**

Regarding the importance of justice to access the services, some air ambulance bases were established in the border areas of the country that, considering the border conditions of the country, the security of workers in these areas and some cities should be considered.

"Because of the contamination of the area with miscreants which is now happening in certain provinces, in those provinces, we have more challenges in terms of staff security. On the other hand, air emergency is one of the most important services in these areas" (Participant No. 10).

**Security of the base development area**

In some cities of country, considering the ethnic conditions, some groups should consider some insecurity, which should be considered in development discussions to respect the rights of service providers and prevent damage to resources. "Security at our border points should be taken into account. Now we have an air emergency there, but they are facing problems. Security is a very important item at the border points" (Participant No. 5).

**Management factors**

Some participants considered extra-organizational cooperation, coordination challenges, and political challenges in the region necessary to increase the effectiveness of timely services for the development of bases.

**Extra-organizational cooperation**

Inter-organizational collaboration is one of the most important management tools to improve the activities that can fill the gap between existing resources and requirements in the future and provide synergies which are needed to be considered in the development discussions by the managers by providing organizations with access to external resources.

"I think we need to have a relationship with the Red Crescent and Air Force as partner bodies so that we can use their resources" (Participant No. 7).

**Coordination challenges**

To integrate the activities of individuals in related support and partner organizations and properly allocate resources to achieve the goals of air ambulance, extra-organizational cooperation should be considered one of the influential factors in the development to minimize costs, share human and physical resources.

"In the country, accident hotspots are known. When I wanted to build a base, I coordinated with the Ministry of Roads and said that if I want to establish a base now, Mr. Ministry of Roads, the priority you say is the same in terms of accident hotspots. I think the priority has to be coordinated with the Ministry of Roads" (Participant No. 2).

**Regional political challenges**

One of the effective issues in the discussion of development is the regional political challenges that should be considered according to the importance of discussing the safety and security of employees and equipment. Some participants considered the political goals of regional authorities and the political issues of the region to be effective in developing the air ambulance bases.

"A part of our work for development goes back to the political factors. Some officials are looking for other political goals, and they are all looking to say that something has been done" (Participant No. 12).

**Discussion**

This study’s findings are related to the effective factors in developing the air ambulance bases in traffic accidents which showed that the factors influencing the development are very diverse and extensive, and each of them is involved in the development of the bases. According to the research findings,
the most important factors influencing development included resources and infrastructure, communication and information, training of specialized human capital, safety and security, indicators and standards, and management factors.

The present study showed that the resources, including human resources, financial resources, and infrastructure are essential for development. Regarding human resources, organizations can arrange staff to provide services in the air ambulance. These different combinations refer to the necessity of the presence or absence of physician inside the helicopter cabin. In general, there is disagreement about the ideal composition of the medical team. However, some studies have shown that using a physician improves the quality of care provided.

Financial resources are also one of the influential factors for the persistence of air ambulance services. The expensiveness of air ambulance services is one of the most important challenges in developing and using this service to provide emergency services. But in the face of the damage caused by the lack of these services applied to society and the fact that these services are used to save human lives. This issue is quite acceptable in terms of value and morality and, the cost-effectiveness of using air emergency services in five patients, including trauma patients, pregnant women, newborns, heart attacks, and strokes has been proved. According to one of the main goals of health system, justice in access to services, some areas cannot be deprived of this service due to costs.

According to this study’s findings, the training of specialized human capital (education and research) is also one of the effective factors in developing the air ambulance bases. According to some studies in Norway, the United States, and the United Kingdom, there are structured curricula in line with national standards for the training of air ambulance staff because the knowledge as well as the skills of the medical staff is important to provide quality care and safe services in the helicopter. Lack of staff training and their misunderstanding of the effects of flight on patients’ physiology can aggravate patients’ conditions and complications such as hemothorax and pneumothorax. Therefore, it is necessary to develop a suitable training plan and package for air ambulance staff and continuous training in theory and practice.

Based on this study’s findings, indicators, and standards, including response time standard, access criteria, input and output indicators, and evaluation and monitoring criteria, are among the most important and influential factors in developing the air ambulance bases. Because the purpose and philosophy of using air ambulance is to reduce the response time index because the probability of survival of the injured depends a lot of the response time. Many experts believe that the first 60 minutes after the accident as a golden hour has the greatest effect on saving the lives of the injured. Considering the essential role of time in the survival of severely injured trauma patients. It is necessary to reduce the transfer time index of critically ill and injured patients and the ability to provide more medical services and fast transfer to medical centers with appropriate services. That in this regard, air transfer can play an important role in this issue and the survival of the injured. Sánchez-Mangas et al. found that a 10-minute reduction in response time (from 25 minutes to 15 minutes) on the highways and roads reduced the risk of death by one-third.

Many studies have examined time as an important and influential factor in planning for developing air ambulance bases. In addition to trauma patients, the prevalence of cardiovascular disease and stroke, and heart attack has proven that the golden time is crucial in transporting patients to the nearest medical center in all of them. Alen et al. found that adding two air support bases to the previous number can increase the population coverage from 91 percent to 97 percent and reduce response time from 21 minutes to 19 minutes. Time has also been considered an important indicator in many previous studies as an important and influential factor in planning for the development of air ambulance bases. In studies, access criteria, including suitable location of the base, proximity to crowded centers, access to transportation routes, and proximity to high-risk routes, were considered the effective factors in the development.

Due to the importance of communication, information and subsequent communication processes, which include (information technology, information infrastructure, and informing), come as a separate category and one of the influential factors in development. Because in pre-hospital services, timely notification of accidents and requesting help has a significant effect on accelerating the timely attendance at the patient’s bedside and reducing the time of transfer to medical centers; therefore, access to information recorded in...
hospitals for the descriptive studies and extracting the number of patients transferred by air ambulance and calculating the average flight time and patient transfer time to medical centers can be used to improve service delivery.\textsuperscript{15} Therefore, data analysis should be used for the optimal use and efficiency of air ambulance in responding to accidents and providing timely and safe services to the injured in accident hotspots.\textsuperscript{16} In the study conducted by Manuel et al., technical issues and communication defects have been mentioned as one of the challenges of using air ambulance.\textsuperscript{39}

Informing the dispatch to request assistance in transporting casualties who will benefit from air transport at the scene of an accident is an important challenge, so defining appropriate criteria and indications to prioritize the need to receive air rescue services is an important issue in air transport.\textsuperscript{40,41} Training on dispatch indications is essential because it leads to the optimal use of air ambulances and the timely and safe delivery of services, along with a reduction in transfer time and a reduction in mortality.\textsuperscript{19} In the study of Sorani et al., it was recommended to formulate triage criteria for using air ambulances with regard to the discussion of safety and costs of using air ambulances.\textsuperscript{42}

Based on this study’s findings, safety and security is one influential factors in the development programs of air ambulance bases which include base safety, helicopter safety, staff safety, and security of the development area. For the past two decades, there has been a constant concern for air ambulance safety due to the nature of emergency missions.\textsuperscript{43} The American Transportation Safety Association also had the highest score in the Dangerous Occupations rankings.\textsuperscript{44} Therefore, due to the nature of service delivery by this system, the safety and security of employees should be considered as one of the important factors in development.

Considering the importance of safety, helicopter landing place should be considered in planning to prevent accidents and air accidents to develop this issue and, it should be continuously trained to prevent accidents and improve the knowledge of key stakeholders, including medical staff, staff of medical emergency and security department and partner organizations so that the regulation and implementation of standard safety training was considered one of the ways to reduce the risks of air ambulance.\textsuperscript{33} Besides, US Transportation Safety Association reports recommend the need for safety training and prepared for difficult and dangerous situations for medical staff.\textsuperscript{39}

This study’s findings showed that management factors including extra-organizational cooperation, coordination challenges and political challenges in the region effectively develop air ambulance bases. A memorandum of understanding with partner and support organizations including the armed forces, to purchase services for using the military helicopters to transport patients, according to the country’s economic conditions is one of the effective factors in development. Regarding collaboration, cooperation with the police and other relief organizations is very important to provide a place for the helicopter to land. Policy and legislation are also influential factors in the development of air ambulance bases,\textsuperscript{21,39} in the way that the Japanese government in 2007 passed a special law to facilitate medical emergency services using a dedicated medical helicopter called the "Special Doctor-Heli Law". The purpose of this law was to find ways to reduce local government costs for helicopter operations using health insurance and compensation insurance for workers' accidents.\textsuperscript{21} Since air transport plays a very important role to reduce the mortality rate of trauma patients, such laws can be effective in the development programs of air ambulance bases.

One of the limitations of this study was the impossibility of interviewing some policymakers for development. However, participants in this study helped extract rich data on the factors influencing the development as the owners of service delivery process.

**Conclusions**

Based on the findings, considering infrastructure improvement and resource allocations as well as training specialized human forces can play an important role in developing the air ambulance bases in Iran. Besides, improving the information and communication systems is highly recommended to decision-makers of air ambulance base establishment. Safety and security systems require to be considered important factors for continuous air ambulance base functions. Evaluation of air ambulance base by guideline and indicators is highly recommended for identifying the problems/challenges and future planning. Further research is needed to develop a measurement tool to evaluate the affecting factors before the establishment of an air ambulance base in Iran. Besides, conducting quantitative research to determine the relationship between the extracted factors and air ambulance base outcomes/functions may be needed.
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Conflict of Interests
None declared.

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References
10. SMGJ D. Helicopter Emergency Medical Services For Adults With Major Trauma. Johns Hopkins University. 2012.


