Research Paper

Factors Influencing the Arrival Time of Pre-hospital Emergency Services at Emergency Scenes: A Qualitative Study

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ABSTRACT

Background: The time taken for pre-hospital emergency services to arrive at the scene of an accident plays an effective role in saving patients' lives, and identifying factors affecting this time needs to be investigated. Therefore, the present study was conducted to explain the factors influencing the arrival time of pre-hospital emergency personnel at the emergency scenes.

Materials and Methods: The present qualitative study was conducted at Shahrekord University of Medical Sciences in 2022 using the conventional content analysis method. Seventeen pre-hospital emergency staff members were purposively selected based on inclusion criteria, which included willingness and ability to express experiences, as well as having at least six months of experience working in pre-hospital emergency settings. Data were collected through in-depth, individual, semi-structured interviews and analyzed using Granheim and Lundman's approach.

Results: The results included three categories (barriers to care, systemic barriers, and environmental barriers) and seventeen subcategories (human barriers, barriers related to inter-organizational inconsistency, inappropriate urban planning, unsafe care environment, facility and equipment deficiencies, lack of professional staff, and systemic barriers).

Conclusion: Effective training and the provision of sufficient manpower to meet regional needs play an important role in improving the performance of the emergency response system. Coordinating with city managers to improve area and city addresses can significantly reduce the time it takes for personnel to reach the scene of an incident.

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Introduction

Accidents are one of the challenges of today's world, and the deaths caused by them rank among the most common causes of death in different countries, including Iran [1]. The high statistics of accidents and subsequent deaths, and disabilities have led to the recognition of the pre-hospital emergency system as one of the most important and inseparable components of the healthcare system [2]. Trauma patients at the scene of an accident are the primary type of patient requiring pre-hospital care [3]. In Iran, pre-hospital emergency centers are responsible for transporting the injured and patients from the accident site to the first medical center [4]. Such medical services aim to provide appropriate treatment at the right place and time using available resources [5].

The speed of service provided by pre-hospital emergency centers plays an essential role in reducing death and disability, especially in the first minutes after an accident [6]. Surveys have shown that with the development of pre-hospital care, mortality due to hospital trauma will decrease dramatically [7]. In this context, the most important indicator for evaluating emergency care is time [8]. According to the existing standards for calculating the response time, there can be different benchmarks. Among them are the time of the first phone call from the caller, the time the operator answers the phone, the time the dispatcher begins speaking with the caller, and the time the information is recorded in the computer system for dispatching an ambulance. In these cases, the first phone call is considered the starting point for time calculation [9, 10].

Arriving at the scene of an accident as quickly as possible, caring for casualties at the scene, and transferring them to the hospital are of particular importance and require proper management and supervision. The ambulance, personnel, and equipment play an important role [11]. Arriving on time can be a valuable factor in patient survival and reducing side effects [12]. Skinner states that a response time of less than eight minutes to reach the scene, rescue the sick or injured, and transport them to the hospital is ideal [13]. For many traumas and accidents, such as falls, drowning, burns, and road traffic accidents, there is very little and limited golden time available to provide vital services. Therefore, the proper functioning of different parts of this system leads to rapid dispatch and timely emergency care, which can potentially prevent disability and death among the injured [14-16].

The results of various studies on the causes of delays in the pre-hospital emergency mission have pointed to factors, such as the number of ambulances, equipment, and emergency bases required according to population density. Monsef et al. stated that the mean time for an ambulance to reach a patient's bedside in Gilan was 8 minutes for traffic accidents and 6 minutes for urban accidents [16]. Moradian et al., in their study aimed at investigating the response time to emergency cases and the causes of delays in the missions of 115 emergency center in Shiraz, stated that reducing the time requires the ability to accurately assess the number of ambulances, equipment, and emergency bases needed, taking into account the population density and people's demands in each urban area [17]. Soltani et al. determined that the time required for the emergency forces in Islam Shahr to arrive at the scene of an accident is 5 minutes. They noted that the variable of the working day did not affect this time, while the variable of the type of season had a positive effect [18].

To improve the provision of pre-hospital care, it is necessary to consider regular quality reviews, improvements in equipment, enhancements to the educational curriculum, and updates to treatment protocols [19]. Khorasani-Zavareh et al. identified several important factors that affect reaching the accident site and transferring victims, including the way community members cooperate with pre-hospital emergency services, their involvement at the scene of the accident, the number and location of pre-hospital emergency facilities, the type and number of ambulances, and the availability of manpower [20].

Regarding the challenge presented by various studies in this field, it should be said that various quantitative studies have examined the time taken to reach the scene of an accident. These studies play an effective role in determining the position of pre-hospital emergency systems regarding global standards, and various reasons have been stated and examined in this regard. However, few studies have addressed and examined this issue from the perspective of staff of emergency medical services (EMS) who are directly involved in reaching the scene of an accident. In other words, in addition to quantitative studies, it is necessary to consider the experiences of the staff to reveal as many dimensions of this issue as possible. Furthermore, given that the qualitative study of this issue can be different under the environmental and structural conditions of different regions of Iran, this study was planned in this specific area, taking into account its unique geographical conditions and characteristics.

Considering the importance of the pre-hospital emergency center in providing vital and urgent services to those in need, as well as the significance of time management—which is a key element of service delivery in these centers and high-quality care—the present study was conducted to explain the factors affecting the arrival time of pre-hospital emergency workers at the accident scene in the emergency centers.

Materials and Methods

This study was conducted in 2022 using a qualitative method and a conventional content analysis approach. Since the question of the present study was related to the experiences of pre-hospital emergency workers regarding factors affecting the time to arrive at the scene of the accident, and due to the lack of sufficient studies in this area, the qualitative content analysis approach was used. Also, due to the lack of a specific model and theoretical structure in this area, conventional content analysis was used [21].

A purposive sample of pre-hospital emergency staff, communication center workers, and emergency center managers was selected. After obtaining a license from Shahrekord University of Medical Sciences and referring to the emergency Management Center of the city, we gained access to the list of emergency workers in Borujen City. Then, employees who met the entry criteria were selected from different bases within the city. The inclusion criteria included the ability to express experiences, having provided care at the scene of an accident, or having been involved in the process of personnel arriving at the scene of an accident, as well as possessing at least 6 months of work experience in the pre-hospital emergency work environment.

Participants entered the study individually and were interviewed. The analysis of the interviews was conducted simultaneously with the interviewing process. The analyzed results informed the sampling in the subsequent steps. This process continued until data saturation was reached. To achieve maximum variation in the sample, participants were selected to ensure maximum diversity in age, educational level, number of years of service, and type of organizational position.

Data were collected through in-depth, face-to-face, semi-structured, individual interviews. The place and time of the interviews were determined by the participant's preferences and convenience. The interviews took place in the Pre-hospital Emergency Department. Before conducting the interview, an interview protocol was designed. First, a list of general questions on the subject of the study was prepared. At the beginning of the study, the researcher introduced themselves, stated the purpose of the study, and obtained informed written consent for conducting the study and recording the audio. Demographic information of the subjects was also collected. The interview process began with open-ended questions, such as, "Please describe the process of your dispatch to the scene of the accident" and "Explain your daily work process". Following the continuation of the study process and in accordance with the participants' responses, the study progressed by asking semi-open-ended questions, such as, "What factors are effective in the arrival of pre-hospital emergency personnel at the scene of the accident?" "What factors facilitate or hinder the arrival at the scene of the accident in terms of management?" "Describe your experiences in this field." and "What role does the pre-hospital emergency communication system play in the arrival of personnel at the scene of the accident? Describe your experiences in this field". To increase understanding and deepen the experiences expressed by the participants, probing questions such as "Please explain further," or "What do you mean by this sentence?" were utilized. All interviews were recorded in Persian using a voice recorder.

The study data were subjected to analysis by the methodology delineated by Graneheim and Lundman, which entailed the following systematic steps: 1) verbatim transcription of the interviews followed by multiple thorough readings to achieve a holistic understanding of the transcripts, 2) segmentation of the text into condensed meaning units, 3) abstraction of these condensed meaning units and their subsequent designation as codes, 4) organization of the codes into subcategories and overarching categories based on comparative analysis of their similarities and distinctions, and 5) formulation of themes that encapsulate the latent content inherent in the text [21]. In line with the aforementioned procedural steps, the researcher conducted the interviews and engaged in multiple readings of the interview text to grasp its content comprehensively. Subsequently, meaning units within the interview text were delineated, and coding was performed. The codes were then subjected to comparative analysis and classified based on their similarities, differences, and thematic content. All interviews were conducted and analyzed by the researcher, with oversight provided by the research team.

Lincoln and Guba's criteria were used to increase the methodological accuracy of the research [22]. In this research endeavor, to establish credibility, the transcribed interviews and the derived codes were submitted to the

participants for their evaluation regarding the accuracy and comprehensibility of the content (member check). Furthermore, an effort was made to implement sampling that encompassed maximal diversity. To ensure dependability within this study, a research audit, which entails a comprehensive assessment of the data conducted by an external observer, was employed to strengthen the stability of the research findings. The prolonged engagement of the researcher with the data, as well as the application of pre-determined solutions for the participants, were also integral to this process.

To achieve confirmability in this investigation, all phases of research, including data collection, analysis, and the construction of subclasses and categories, were thoroughly documented to facilitate verification by external parties. In pursuit of transferability, an effort was made to incorporate a diverse array of perspectives and experiences from various participants regarding the same phenomenon while maximizing diversity in the sampling process. Additionally, transferability was further enhanced by presenting comprehensive and detailed findings supported by relevant quotations.

Results

The interviews with the participants were conducted over 5 months. Seventeen individual and face-to-face interviews were held with 17 participants. The interviews continued until data saturation was reached, with no new data or categories emerging. Data saturation occurred after the 15th interview. Two more interviews were conducted to ensure data saturation. The mean duration of each interview was 20 minutes. To manage the data, MAXQDA software, version 10 was used. The characteristics of the participants are shown in Table 1.

The study yielded three categories (barriers to care, systemic barriers, and environmental barriers) and 17 subcategories (human barriers, barriers related to inter-organizational inconsistency, inappropriate urban planning, unsafe care environment, deficiencies in facilities and equipment, insufficient specialized human resources, and barriers related to the system). The categories and subcategories of the study are shown in Table 2.

Interfering factors in care

This category refers to the factors that disrupt the process of providing care at the scene due to human obstacles and the inconsistency between different participating organizations, thereby affecting the timeliness of care for patients and injured individuals.

Human barriers

Pre-hospital emergency workers reported that obstacles created by others can act as a barrier to care and delay the delivery of services. These barriers included telephone interruptions, which can waste time and disrupt the provision of care to those in need. Issues, a lack of awareness on the part of the person requiring care regarding the correct way to seek help, as well as resistance from the patient's companions and others present at the scene, can prolong both the arrival of staff and the provision of care.

"The wrong address provided by people makes us spend a lot of time finding the place of the accident, and we lose time..." (36 years old, expert).

"Some telephone intruders cause the emergency line to be occupied, delaying service to patients who need help" (43 years old, management).

Barriers related to inter-organizational inconsistency

One factor that can interfere with the delivery of care and prolong the time taken for care delivery is the obstacles related to the inconsistency among the organizations involved in providing care on the ground. The lack of a standardized protocol among the aid organizations, the absence of unified management, and the lack of knowledge in the field of patient care contribute to interference between these organizations and delay the provision of care.

"The other relief organizations on the scene were doing their own thing. I expected them to respect our opinion" (36 years old, expert).

"Many times, the presence of different rescue services at the scene of an accident does not help us... because there is no uniform operating manual for them" (50 years old, expert).

Environmental barriers

This category refers to inappropriate urban design as a significant factor hindering the arrival of pre-hospital emergency services at the scene of an accident, as well as the presence of an unsafe environment for care, which prevents emergency services from calmly delivering assistance and consequently prolongs the time required to provide care.

Table 1. A summary of the participants' demographic characteristics

No.	Age (y)	Work Experience (y)	Education Level	Organizational Position
1	43	18	Masters' degree	Management
2	42	18	Masters' degree	Management
3	45	22	Bachelors' degree	Management
4	36	10	Bachelors' degree	Clinical expert
5	35	9	Bachelors' degree	Clinical expert
6	26	4	Bachelors' degree	Clinical expert
7	43	19	Bachelors' degree	Management
8	45	22	Bachelors' degree	Management
9	35	10	Bachelors' degree	Clinical expert
10	37	12	Bachelors' degree	Clinical expert
11	43	18	Bachelors' degree	Clinical expert
12	32	10	Bachelors' degree	Clinical expert
13	33	10	Bachelors' degree	Clinical expert
14	35	12	Bachelors' degree	Clinical expert
15	28	7	Bachelors' degree	Clinical expert
16	50	25	Bachelors' degree	Clinical expert
17	25	3	Bachelors' degree	Clinical expert

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Inappropriate urban planning

The participants stated that the poor state of the roads and some streets makes it difficult for ambulances to navigate. The lack of awareness on the part of other drivers in the presence of an ambulance on a call, along with heavy traffic and the absence of clear street and alley addresses, also delays the arrival of paramedics.

"Sometimes we have to search for the address for a long time when we arrive at the scene. Sometimes some streets do not have specific addresses" (33 years old, expert).

"There was one address where there was no car at all, and we had to travel a long distance, wasting our time" (43 years old, expert).

Unsafe care environment

Staff experience has shown that conditions, such as an unsafe and difficult traffic environment for the ambulance to arrive at the scene, as well as unforeseen risks posed by the environment or the nature of the incident, can make the environment unsafe for service delivery and cause delays in providing care.

"When we arrived at the scene of the accident, we were threatened by the companions of the patient, who were worried about the patient's life; this is not the way to work" (25 years old, expert). "Sometimes, when there is an accident, we are threatened by the risk of the car exploding, and in this situation, we cannot provide services quickly" (28 years old, expert).

Systemic barriers

This category refers to the three factors—people, management, and facilities within health systems—that contribute to time delays in providing care and in the arrival at the scene of an accident.

Table 2. Category and subcategories and examples of the codes

Category	Sub-categories	Examples of the Codes
Interfering factors in care	Human barriers	People's false requests and telephone harassment
		It is time-consuming to justify the companions to provide a specific type of care
		Involvement of other people on the scene in providing care
	Barriers related to inter-organizational inconsistency	Lack of a uniform protocol for coordination between aid agencies
		Lack of clarity in care management between different organizations
		Lack of awareness among some personnel in the organizations regarding the provision of care
Environmental barriers	Inappropriate urban planning	Lack of awareness of drivers when dealing with emergency ambulances
		Lack of clear addresses in some streets and alleys
		Inability of some streets to pass emergency ambulances
	Unsafe care environment	Endangerment of personnel's lives by the patient's companions
		Unforeseen environmental hazards (debris, slippery road, fire)
Systemic barriers	Deficiencies in facilities and equipment	Lack of spare parts for ambulances
		Lack of a GPS system in some areas
		Disturbance in the client's mobile phone lines when making calls to dispatch
	Insufficient specialized human resources	Lack of specialized trained personnel
		Inadequate driving skills of new personnel
		Insufficient awareness and experience among some personnel in providing services
	Barriers related to the system	Absence of a local dispatch system in some areas
		Unfamiliarity of dispatch personnel with local locations
		Lack of mastery of the local dialect by dispatch operators when communicating with clients

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Deficiencies in facilities and equipment

Emergency personnel reported that the existence of some outdated facilities and ambulances, as well as the lack of spare parts, make it difficult to provide timely service. The low speed and sometimes intermittent nature of the Internet, the lack of a GPS to reach the scene of an accident, and the disruption of telephone lines are also among the problems that generally delay workers from reaching the scene of an accident on time and providing services.

"Some parts of ambulances are expensive or rare, which reduces the number of ambulances available and leads to a reduction in service and an increase in delivery time" (43 years old, management).

"In some cases, internet failures cause problems in our systems and delay arrival at the scene" (42 years old, management).

Insufficient specialized human resources

Another systemic obstacle that increases the time it takes to reach the scene of an accident is the lack of specialized personnel to provide care. The lack of EMS personnel, the inexperience of new personnel in driving and providing services to patients at the scene of an accident, and the fear regarding the speed of action in reaching the scene can all delay the arrival of EMS personnel.

"In one instance, my new colleague, who was inexperienced in driving, delayed our arrival at the scene" (43 years old, expert).

"Because I had an accident once and paid a lot of money for the ambulance repair, I try not to drive fast anymore. This delays our arrival at the scene of the accident" (37 years old, expert).

Barriers related to the system

The pre-hospital emergency responders identified some barriers, such as the lack of a local dispatch system in some cities, the lack of familiarity of the central dispatchers with local locations and addresses in some cities, dispatchers' lack of proficiency in the local dialect. This can delay the arrival of pre-hospital emergency services at the scene of an accident.

"Some of the local addresses could not be identified by the dispatching expert, resulting in a delay in the dispatch of resources" (45 years old, management).

"The dispatch expert's lack of control over the caller's location disrupts the dispatch of the closest resources to the scene" (37 years old, expert).

Discussion

The present study aimed to explain the factors that influence the arrival time of pre-hospital emergency services at the scene of an accident. The results showed that factors, such as interfering factors in care, systemic barriers, and environmental barriers can affect the arrival time of pre-hospital paramedics at the scene of the accident.

Bidari et al., in a study designed to evaluate the performance of Tehran's Pre-hospital emergency Department for patients transferred to Hazrat Rasool Akram Hospital, found that the mean arrival time of emergency services from the Emergency Department to the scene of the accident was 12 minutes. The study also showed that to improve pre-hospital care, factors, such as regular quality review, enhancement of equipment, quality improvement of training curriculum, and treatment protocols need to be considered [19]. Moradian et al., in their study of the causes of delays in the response of Shiraz Emergency Center, found that attention and planning should be given to the number of ambulances and equipment according to the needs of each region [17].

Panahi et al. in their investigation of the performance of EMS rooms for children in Tehran showed that, depending on the types of disorders considered in children, special attention should be given to the training of personnel in the field of internal problems and pediatrics. Additionally, the mean time to reach the accident site was reported as 15.1 minutes in this study [23]. Haghani and Sadeghi also stated that individuals entering the profession of pre-hospital emergency often lack the necessary educational sufficiency corresponding to this field, and that appropriate attention should be paid to the special training of students in this area [24]. Turner et al. also highlighted deficiencies in training and experiential knowledge, as well as inaccuracies in assessment and decision-making processes among pre-hospital emergency personnel [25]. Dianti et al. further underscored the importance of focusing on the cognitive understanding and practical efficacy of EMS responders concerning issues pertinent to their profession [26].

According to the results of these studies, it should be noted that limitations in the knowledge and performance of pre-hospital emergency personnel were emphasized. In the current study, one of the barriers causing delays in arriving at the scene of the accident was the lack of knowledge and experience among the personnel. The absence of specialized knowledge, along with factors related to inexperience, prevents individuals from performing their roles effectively and efficiently, leading to delays in the provision of care.

To reduce these barriers, as suggested by these studies, it should be emphasized that paying attention to the quality of education of pre-hospital emergency students, expanding and improving the status of in-service education in line with current evidence, utilizing a combination of experienced individuals in staff shifts, and paying attention to the role of mentors at the beginning of service for less experienced staff can play an effective role in addressing the educational and clinical experience deficiencies of staff.

In a qualitative study, Bayrami et al. identified factors, such as individual characteristics of staff, staff dissatisfaction, structural challenges, lack of equipment and human resources, and socio-environmental and cultural challenges as obstacles in pre-hospital emergency care [27]. Eri et al. delineated the obstacles associated with delivering services in the Pre-hospital Emergency Department of Golestan Province, categorizing these challenges into organizational, individual, and extra-organizational issues. The scholars elucidated that the organizational challenges predominantly pertain to areas,

such as management, human resources, and equipment, whereas the individual challenges are primarily related to employee motivation. Within the extra-organizational sphere, difficulties concerning public attitudes, as well as deficiencies in knowledge and collaboration with other organizations, have been documented [28].

When the results of these studies are examined and compared, it is evident that many of the factors identified as challenges to pre-hospital emergency care are, in fact, the same factors that affect the arrival of personnel at the scene of an accident. Organizational, managerial, and equipment factors, as well as people's knowledge and attitudes, which were identified as challenges, are factors that can affect the time it takes to reach the scene. To reduce these factors, various studies have pointed to issues, such as expanding knowledge and improving the general public's attitude regarding the duties of EMS personnel. Upgrading the organization's facilities and equipment to meet global standards can also be effective in addressing these obstacles.

Bahrami et al. mentioned issues, like a lack of manpower and ambulance equipment that can reduce the effectiveness of the response [29]. Bahadori et al. also suggested that we should enhance the care they provided by enacting appropriate legislation to protect pre-hospital emergency personnel [30]. In their study, Motie et al. also introduced factors, such as insufficient manpower and inadequate facilities, in addition to staff stress, as elements affecting the quality of care provided [31].

According to the results of the mentioned studies, factors related to manpower and equipment can affect the quality of care, as well as the employees. In our study, these factors were expressed as time barriers to reaching the scene of an accident.

One of the limitations of this study is the lack of generalizability of the results. Since this is a qualitative study conducted in a specific context, the results cannot be generalized to other systems in different locations.

Conclusion

Participants' accounts of their experiences showed that several factors, including barriers to care, systemic barriers, and environmental barriers, can affect the arrival of EMS at the scene of an accident.

Given that many of the existing obstacles require interdisciplinary cooperation, it is recommended that senior managers and politicians take important steps by establishing joint working groups between the health system and other relevant systems, as well as allocating appropriate budgets and planning for professional development and equipment upgrades.

It should be noted that, because of the importance of the time taken by employees to reach the scene of an accident, the performance of the emergency system should be monitored regularly by senior managers. This monitoring plays an effective role in identifying the factors and obstacles that effectively increase the time it takes for employees to reach the site of an accident. Many of the aforementioned issues require human resource management. Providing effective training during service and ensuring an adequate workforce according to regional needs are crucial for improving the practice of EMS. Therefore, managers and planners of the EMS are advised to implement necessary strategies to attract sufficient personnel to provide timely services to patients. Additionally, through the required training, they must ensure the improvement of care quality provided at the accident scene.

Regarding the study site, it should be said that due to the mountainous location and the impassability of some of the city's roads, the increase in the time it takes for personnel to reach the scene of the accident is understandable. Nevertheless, necessary plans for accessing hard-to-reach areas should be developed by the urban management organization. Coordinating with city managers to improve spatial organization and address clarity can reduce the time it takes for employees to arrive at the scene of an accident. Therefore, city managers at the macro level are advised to plan and take necessary measures to remove urban obstacles, as well as to ensure the clarity of city-level addresses, which is a significant barrier to the timely arrival of emergency staff at the scene.

It is also recommended to city managers consider special traffic lines for emergency response systems in the city and crowded places to help alleviate many urban obstacles. Additionally, to streamline aid delivery to the accident site by various organizations, it is recommended to develop standardized aid protocols agreed upon by different relief organizations. In this context, it is suggested that one organization take charge and assume responsibility for coordinating the efforts of other organizations at the scene of the accident.

Furthermore, to address cultural barriers that may prevent emergency services from acting promptly at the scene or reaching the accident site, it is recommended to conduct public training through various media. Famil-

iarizing the general public with the process of providing care, as well as the protocol for dispatching services to the location, can help eliminate many obstacles.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Research Ethics Committees of Shahrekord University of Medical Sciences, Shahrekord, Iran (Code: IR.SKUMS.REC.1401.104). The ethical tenets of agency, autonomy, and confidentiality were meticulously evaluated throughout the research. Written informed consent was obtained before the interviews, and consent was also obtained for audio recording during the interview. The subjects were assured of the confidentiality of their information and of their right to withdraw from the study at any time.

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Authors' contributions

All authors contributed equally to the conception and design of the study, data collection and analysis, interception of the results and drafting of the manuscript. Each author approved the final version of the manuscript for submission.

Conflict of interest

The authors declared no conflict of interest.

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