

## Policy Implications of Helicopter Emergency Medical Services in Isfahan Province

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### Original Article

#### Abstract

**INTRODUCTION:** Helicopter Emergency Medical Services (HEMS) provide medical care to critically ill patients and the injured immediately and provide faster treatment, thereby reducing the length of hospitalization. This study aimed to identify the policy implications of HEMS in Isfahan province.

**METHODS:** This qualitative study was conducted using the thematic analysis method. The study population included the managers, personnel, and flight crews of Isfahan HEMS. The participants were selected using the purposive sampling method, followed by the snowball method. Initially, 14 individuals from the HEMS personnel were interviewed using the interview guide form, and then, the opinions of 15 participants from the flight crews were collected through an open questionnaire. MAXQDA-2018 software was used for data coding.

**FINDINGS:** The research findings were classified into challenges, opportunities, and implications. In terms of challenges, 11 themes and 34 categories were identified in this study. HEMS opportunities were also divided into 8 themes and 11 categories. The policy implications provided by the participants were also categorized into 8 themes and 28 categories.

**CONCLUSION:** Considering that one of the most important known challenges was the lack of specialized helicopters and medicopters, according to the results, it is suggested that the managers of Isfahan HEMS take measures to solve the existing challenges and develop plans to strengthen the capacities and utilize the opportunities.

**Keywords:** Challenges; Emergency medical services (EMS); Helicopter emergency medical services (HEMS); Opportunities; Medicopter; Policy implications

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#### Introduction

Today, the significance of Helicopter Emergency Medical Services (HEMS) and time management in accidents and transporting the injured to medical centers has become more vital. In cases where there is a long distance between the accident site and medical centers, or when time plays a key role in patient treatment, air medical transport of patients can be effective (1) since small delays in the care and transfer of patients may lead to death (2). In such a situation, the helicopter can overcome geographical obstacles, such as distance, mountains, and trees, as well as man-made obstacles, including traffic jams on bridges, narrow roads, and tunnels, thereby rescuing patients from inaccessible areas (1). The benefits

of HEMS have been mentioned in many studies (3-6). Reducing the time of emergency patient transfer, as well as the presence of an experienced treatment team with advanced equipment at the patient's bedside, have been mentioned as the main advantages of HEMS in other studies (7).

The results of a study by Ghaffarad indicate that the HEMS missions in Tabriz have reduced the patient transfer time and also brought the mortality rate closer to international standards (8). However, the provision and development of HEMS may face serious challenges. High costs, effectiveness, and safety concerns of HEMS, compared to ground ambulance services, are among the challenges in this regard that limit the use or development of helicopter emergency in

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some countries (9). In Iran, HEMS is facing different challenges. The results of a study conducted by Sorani showed that infrastructure deficiencies; safety concerns for personnel, patients, and people; insufficient resource management; and problems related to staff competencies are among the challenges of HEMS (9).

On the other hand, most of the helicopters used in Iran are military helicopters that do not have such possibilities as being flown at night and in bad weather conditions, as well as being landed in rough places, mountainous, and inaccessible areas. For this reason, purchasing or leasing specialized helicopters and improving the equipment of the HEMS are of necessary significance (1). In addition, being aware of experiences and lessons learned from challenges can help to optimize planning and improve productivity and effectiveness (10). Isfahan province is one of the central provinces of Iran. Considering the vastness of this province, the great distance of cities and villages from the center of the province, the existence of some impassable desert and mountain roads, as well as its high population, and the ever-increasing urban traffic, it seems necessary to equip this province with HEMS.

Moreover, the provision of relief in some secondary roads requires multiple increases in road bases and ground ambulance fleet; however, considering the low possibility of an accident, such a thing is not cost-effective, and it will impose a very heavy structural and personnel cost on the 115 Emergency Center of the province. Accordingly, regarding the geographical location and the centrality of Isfahan province in Iran, this study aimed to identify the challenges and opportunities of Isfahan HEMS and provide implications in this regard.

### Methods

This qualitative study was conducted using the thematic analysis method. The study population included managers, personnel, pilots, and flight crews of HEMS in Isfahan province, among which 14 subjects were selected purposefully using the snowball method. Face-to-face interviews were conducted using the interview guide form until data saturation. It is worth mentioning that since the pilots and flight crews

of the HEMS are in the military, face-to-face interviews were not permitted by the "Islamic Republic of Iran Army Aviation (more commonly known as Havānīrūz)" and an open questionnaire was used to collect information from 15 individuals from the HEMS flight crews. All questionnaires were completed descriptively, and a total of 29 subjects participated in this study. The inclusion criteria were all managers of Isfahan 115 Emergency Center, managers of Isfahan HEMS, emergency personnel with at least one year experience in HEMS missions, as well as pilots and flight crew including co-pilots and security forces with experience in HEMS missions in Isfahan province. On the other hand, those who refused to be interviewed were excluded from the study. Thematic analysis method and MAXQDA-2018 software were used for data analysis. Furthermore, to determine the data reliability, four criteria of credibility, dependability, confirmability and transferability by Lincoln and Guba were utilized in this study (11). It should be mentioned that the study protocol was approved by the Ethics Committee of Isfahan University of Medical Sciences, Isfahan, Iran (IR.MUI.RESEARCH.REC.1398.320).

### Findings

The findings were classified into challenges, opportunities, and policy implications. Regarding challenges, 11 themes and 34 categories were identified (Table 1).

One of the mentioned challenges was related to the helicopter. The participants believed that the non-specialization of the military helicopter (being worn-out and unsafe), as well as the inadequacy of the number of helicopters (n=1) in Isfahan province, were among the issues that have created challenges regarding helicopters. The non-specialization of the military helicopter makes it difficult to fly at night and it is not possible to carry out any missions at night.

Participant 13: "...The helicopters currently being used by Isfahan HEMS are those that are each forty years old or more."

Moreover, regarding the communication challenges that almost all the participants acknowledged, it can be stated that due to the lack of walkie-talkies in the rear cabin of the helicopter, the emergency technicians and the emergency

**Table 1.** Helicopter Emergency Challenges in Isfahan Province

Theme	Category	Sub-category
Helicopter	Non-specialization of military helicopters	The problem of moving and unloading the patients from the stretchers in the military helicopter/the impossibility of doing medical procedures, such as resuscitation and setting up the IV drip, in the military helicopter/the problem of sunset and the impossibility to fly at night/improper place and not fixing the equipment in the helicopter/lack of medical equipment, such as oxygen capsule and ventilator/ impossibility to fly in bad weather conditions/lack of electricity in the cabin and carrying portable devices to the base compound for charging/lack of ventilation, as well as cooling and heating system/difficulty moving in the helicopter cabin and disrupting the balance of the helicopter/negative effects of vibration, noise, and heat caused by the helicopter engine/restriction of using the helicopter in the city/inability to land and take off several times
	Unsafe and worn-out helicopters	Unsafe position and seating of emergency personnel in the rear cabin of the helicopter/ single-engine army helicopters and a high probability of falling/technical failure during the mission
	Inadequacy of the number of helicopters (n=1) in Isfahan province	Air coverage of the entire province of Isfahan with one helicopter and one base
	Lack of appropriate internal and external communication systems	Lack of communication platforms between the helicopter and the destination hospital and delay in handing over the patient from the hospital to the helicopter/lack of communication between the helicopter and the dispatcher or the hospital to inform the exact arrival time of the helicopter/lack of direct communication between the emergency dispatch and Havānīrūz command center
Communication	Lack of proper communication systems in the helicopter	Lack of wireless communication (walkie-talkies) with the helicopter during flight/inconsistency and lack of communication among the helicopter, the emergency center, and ground ambulance/incomplete SMS and mobile phone communication from the helicopter to the emergency center/need for permission to install wireless devices from Havānīrūz command center in the helicopter/impossibility to communicate and consult with the physician in the center during a flight in the helicopter/no permission to communicate with the military radio of the helicopter and Havānīrūz command center/no communication between the flight crew and the medical technicians in the helicopter/no communication between the two technicians in the helicopter due to the noise and lack of radio equipment
Coordination	Long process of between-hospital and pre-hospital helicopter dispatching due to coordination	Extending the coordination time between the emergency and Havānīrūz command center for dispatching the helicopter/checking the patient's condition, indications and the presence of the helipad by the emergency center/checking the request time, geographic location, distance, weather, and security conditions by Havānīrūz command center/dispatching to the accident site after the request by road emergency personnel/the lengthening of the dispatch and coordination process for road accidents
	Coordination problems with the police to ensure the safety of the accident site or helicopter landing site	Non-attendance or lack of timely attendance of the police in order to prevent people gathering at the accident site and to ensure the safety of the helicopter landing and taking-off area

Helipad	Lack of helipads in most areas	Lack of helicopter operations due to lack of helipads at the accident site or the destination hospital in Isfahan province/lack of helipads in urban areas/lack of landing pads in different hospitals of Isfahan/lack of runways on the towers/occurrence of accidents for personnel due to lack of helipads and appropriate landing area/landing problems on the road or on the side of the road due to the lack of a helipad/problems in constructing a new helipad, long bureaucracy procedures, and non-implementation of approvals
	Insufficient number of helipads	The vastness of Isfahan province and the inadequacy of the helipads built in the hospitals of the province and high-accident areas
	Poorly-equipped helipads	Poorly-equipped helipads in hospitals with the necessary equipment
Management	Non-independence of helicopter emergency	The use of Havānīrūz military helicopter and its leasing conditions/reduction of dispatches by Havānīrūz due to technical, life, and security issues/no permission from the army to make changes and install equipment inside the helicopter/the effect of not paying flight fees to Havānīrūz on the operations/lack of food supply/poor condition of the hangar where helicopter emergency technicians rest and are accommodated/failure to pay the mission allowance to the emergency personnel on time
	Non-compliance of helicopter emergency missions with the main emergency missions	Inter-hospital transfer of patients from hospitals in distant cities to Isfahan only because of the distance/not transferring the patient to the nearest medical center and transfer by helicopter only to Isfahan/leveling of stretchers in the helicopter due to prioritizing economic issues over human issues in inter-hospital transfer/unnecessity of some indicators for helicopter dispatch
	Lack of adequate response to needs	Inadequacy of dispatches due to the vastness of the province and flight restrictions due to various reasons, such as the distance, fuel issues, and lack of operation at night
	Lack of specific assessment and evaluation criteria for helicopter emergency	The importance of the quantity and number of operations for Tehran regardless of the urgency of the missions
	Restrictions on the transfer of chemically, biologically, and nuclear-infected patients Non-transportation of foreign nationals by helicopter ambulance	The impossibility of transporting infected patients with military helicopters Prohibition of transporting foreigners by helicopter due to security issues
Geographical	Distance limitation and helicopter fuel problem	The vastness of Isfahan province and the large distance between the cities and the center of the province/the limited flight radius declared by Havānīrūz/operation based on a flight circle radius of 150 km/lack of provision of services to the cities further than the flight circle radius/refueling only in Havānīrūz headquarter in Isfahan/transfer by ground ambulance according to the flight radius
	Failure to identify the exact location of the aid seeker	Lack of sufficient information about the location of the injured or the patient who directly seeks help
	The distance of helicopter emergency bases in Iran	The long distance between air bases in Iran
Bases	Lack of hangar and independent helicopter base	The helicopter base in the military area of Havānīrūz/the helicopter emergency technicians being stationed in the CONEX boxes in the area of Havānīrūz/ lack of permission to construct a building in the military area of Havānīrūz/ lack of permission to use the buildings of Havānīrūz for the helicopter emergency technicians

Safety	A long distance from the base shed to the helicopter	The distance of five hundred meters from the CONEX boxes to the helicopter
	Structural and non-structural vulnerability of the helicopter emergency base shed	Poor conditions of the CONEX boxes in the summer and winter
	Inadequacy of the number of air bases (n=1) in Isfahan province	Lack of aerial coverage of the entire province by a helicopter and a base
	Lack of helicopter safety	Unsafety due to the presence of worn-out and long-life helicopters in Havānīrūz
Educational	Poorly-equipped helicopter emergency technicians (no special clothes, helmets, anti-noise headsets)	Lack of safety helmet, or anti-noise headsets, and hearing protection devices for the use of emergency technicians during the flight/possibility of hearing damage due to the high noise of the helicopter engine/not providing special flight clothes for the use of emergency technicians
	The presence of electric towers in mountainous areas and the risk of helicopter crashes	Lack of visibility markers (big yellow, orange, white or red balls hanging from power lines)/no access to the exact location of power towers in mountainous areas
	Training challenges at different levels	Lack of giving adequate instructions to the public/lack of sufficient training to pilots regarding the helicopter emergency/ lack of giving sufficient instructions to the HEMS personnel regarding flight regulations, safety, and in-flight medical emergencies/lack of giving sufficient instructions to helicopter emergency code personnel in hospitals/ lack of giving sufficient instructions to the students of Emergency Medical Services at the university
Economy	Inadequate familiarity with the indications for requesting a helicopter	Incorrect request from road emergency personnel to send a helicopter/incorrect request from hospitals in distant cities
	Maintenance cost	High maintenance cost of helicopters
	The cost of failure of some missions by helicopter emergency	Lack of cost-effectiveness of air missions based on Rials (Iran's Currency)
Coordination	The culture of using helicopter emergency medical services among people	Lack of people justification regarding requesting and using helicopter emergency services
	The culture of people waiting at the accident site	Lack of patience and people gathering at the scene of the accident until the arrival of the helicopter
	People gathering around the helicopter	People crowding and gathering out of curiosity around the helicopter and creating potential dangers

center have no communication with each other during the operation. In addition, the walkie-talkies used by the pilots can only make communication with the aviation center, and there is no possibility of communicating with the emergency center. Accordingly, the exact time is not announced by the emergency center to the destination hospitals or the road emergency personnel and aid-seekers present at the accident

site.

Participant 10: "...We don't have wireless communication with the helicopter during flight and in the sky at all."

The next challenge was related to the long process of between-hospital and pre-hospital helicopter dispatching, which was caused by the time-consuming process of coordination between

Table 2. Helicopter Emergency Opportunities

Theme	Category	Sub-category
Social	Culture building and persuading donors, municipalities, and governor's offices to construct helipads	The capacity to convince and persuade donors, municipalities, and governor's offices/donors' financial cooperation to construct helipads in distant cities/free land donation and helipad construction by some municipalities/people's demands to construct helipads
	Support of rescue and relief missions by the partner organization: Red Crescent Society	The existence of support helicopters in the Red Crescent Society
Collaborating and supporting organizations	Isfahan province as the central pole of Iran	Creating more bases due to the geographical vastness
Geographical	The existence of supporting capacities in aviation and helicopter services	The existence of three aviation and helicopter centers in Isfahan province, such as Isfahan Havānīrūz Support Center/Shahid Vatanpour Pilot Training Base of Isfahan Havānīrūz/Hesa ShahinShahr Aircraft and Helicopter Manufacturing Company
	The advantages of non-independence of helicopter emergency	Support by Havānīrūz /the cost-effectiveness of cooperation with Havānīrūz, compared to private sectors
Support	Allocation of medicopter quota to Isfahan province	Advantages of medicopters
Equipment	Easy access to remote and inaccessible areas	Easier and faster access to mountainous and desert places where ground ambulances cannot approach
Service	Adherence to safety precautions by Havānīrūz pilots	Competent and skillful Havānīrūz pilots
Human resource	Locating to construct helipads in 42 points of the province	Identifying important points in Isfahan province for the construction of one to three helipads in each town
	Taking measures to construct helipads in the towns	Persistency of the helicopter emergency officer
	Strong interdepartmental communication among managers in Iran	The possibility of establishing strong communication with Iranian managers to provide resources
Management		

the emergency center and Havānīrūz command center to issue a flight permit. Moreover, in order to ensure the security of the accident site and the landing place of the helicopter, coordination with the police is also necessary, which is a time-consuming process.

Participant 10: "...The process of dispatching takes a long time; we announce the issue to

*Havānīrūz. They then check the weather conditions in the area, the security situation, the sky, the landing place, and other issues. Then, they want to coordinate with Iran's Havānīrūz. This usually takes a long time. One of the main challenges is related to the helipad. The number of helipads is not sufficient in Isfahan province, and some of them are not equipped properly.*

Furthermore, due to the occurrence of helicopter accidents in the past years, only flight permits are issued for missions where the mission area is equipped with a helipad."

Participant 09: "...Another remarkable limitation we have in Isfahan province is the lack of sufficient helipads".

Regarding the management challenges, one can refer to the non-independence of the helicopter emergency. The helicopter used by the helicopter emergency of Isfahan province is military and is on the lease, and according to the interviewees, all the authority and issuance of flight licenses is the

responsibility of Isfahan Havānīrūz, and this has caused chaos in fulfilling the needs. On the other hand, some interviewees believed that many inter-hospital missions that are covered by helicopters do not correspond to the main missions of emergency, and in fact, in their opinion, many dispatches are non-emergency and do not need to dispatch helicopters. Accordingly, there are no specific evaluation criteria in this regard.

Participant 09: "...One of the major problems is that the helicopter is on lease and is owned by Havānīrūz. Now everything depends on Havānīrūz."

**Table 3.** Suggested Policy Implications

Theme	Category	Sub-category
Helicopter	Taking measures to deliver two medicopter quotas to Isfahan province	Allocating two medicopter quotas from the country's emergency department to Isfahan province
	Providing more practical helicopters if possible	If possible, drawing up a contract with other organizations to provide helicopters/using the Islamic Revolutionary Guard Corps (also called Sepah-e-Pasdarān) helicopters if possible
	Equipping Havānīrūz helicopters	Installing shelves in the helicopter to place the equipment/installing the equipment and appliances in the helicopter/ designing stretchers according to the conditions of the helicopter/wiring the rear cabin of the helicopter
Helipad construction	Constructing helipads in accident-prone areas	Constructing helipads in accident-prone areas as soon as possible and equipping them
	Constructing helipads in hospitals in Isfahan and surrounding towns	The need for helipads in the hospitals of Isfahan and other towns
Training and instruction	Offering training to the police or law enforcement personnel	On-time attendance at the accident site and ensuring the security of the helicopter landing site
	Offering training to hospitals	Training of helicopter emergency team personnel in hospitals/training to demand the helicopter reasonably/training for sending the patient to the helipad on time
	Offering training to helicopter emergency personnel	Training of helicopter emergency personnel
	Offering training to pilots and flight crews	Training of helicopter emergency pilots
	Offering training to the road emergency personnel	Training to approach the helicopter/training to choose the right place to land/familiarizing with the dangers of helicopter emergency
	Offering training to the dispatch emergency personnel	Training the indications for helicopter emergency dispatch/training for the correct use of helicopter emergency
	Offering training to the public	Training to prevent people gathering around the helicopter and the accident site
	Holding classes and training maneuvers to exchange information and experiences	Holding meetings after completing the missions to overcome the deficiencies
Welfare and comfort	Providing amenities for emergency technicians	Creating a suitable space for the accommodation and rest of personnel and providing their food
	Honoring the personnel	Raising the motivation and morale of emergency technicians and flight crew

Equipment and support	Providing communication equipment	For two technicians to communicate with each other during a helicopter flight/ for emergency technicians to communicate with pilots/technicians' wireless or telephone communication with the center and emergency control room/direct wireless communication of the emergency control room with Havānīrūz control center
	Providing specialized helicopter emergency equipment	Utilizing up-to-date and advanced tools and equipment
Expert human resources	Providing protective and personal safety equipment	Purchasing special clothes, helmets, headsets, gloves, glasses, and shoes
	The possibility to have operations at night	The possibility to have operations (the helicopter can fly) at night
	Providing the helicopter fuel supply	Providing fuel for long distances
	Allocating smoke bombs to signal the helicopter	Equipping road bases with smoke bombs/requiring the provision of smoke bombs by important centers, factories, and large companies
Coordination mechanisms	Recruiting helicopter emergency technicians based on scientific and professional skills	Selection of talented people to study emergency medical services among those who obtained high grades in the entrance exam, and then selection through psychological personality tests/more specialized training of emergency medical personnel in the university
	Training pilots in the field of helicopter emergency	Train special helicopter emergency pilots
	Recruiting Havānīrūz air search and rescue team personnel	The recruitment of Havānīrūz personnel who have undergone specialized courses in mountains, deserts, and skydiving
	Coordination with Havānīrūz	To reduce the coordination time for initiating the mission
	Coordination with hospitals	To send the patient to the helipad on time
	Coordination with the police	For the timely presence of police and law enforcement

Among the geographical challenges that the participants acknowledged were the distance and the helicopter fuel supply, which only cover a radius of 150 kilometers. Furthermore, one of the other geographical challenges was the lack of identifying the exact location of the aid-seeker in mountainous and inaccessible areas.

Participant 11: "...The flight radius is 150 km and fuel supply does not cover the farther distance."

The lack of a hangar and independent air base for Isfahan helicopter emergency was another identified challenge. The participants admitted that one airbase and one helicopter are not sufficient for fulfilling the needs of the entire province of Isfahan. Furthermore, the distance from the emergency technicians' CONEX box to the helicopter is about 500 meters, and they must run this distance along with portable medical equipment to get in the helicopter.

Participant 07: "...We still don't have that main

*helipad equipped with a hangar (for accommodation and helicopter maintenance) independently in the province."*

According to the participants, one of the challenges related to safety issues is unsafe helicopters due to their long life. Moreover, poorly-equipped emergency technicians (no special clothes, helmets, and headsets) were among the things arising concerns. They also pointed out the existence of electric transmission towers in mountainous areas, which pose a potential danger of helicopters falling. It is worth mentioning that there is no detailed information about these towers at all.

Participant 03: "...Helicopters are extremely poor in terms of safety. They are not safe and they are old."

Another identified challenge was the lack of giving instructions (training) at different levels to emergency personnel, Havānīrūz personnel, hospitals, and the public, as well as insufficient

familiarity with helicopter request indications.

Participant 02: "...There is a matter of training and instruction that should be given to the hospital and emergency road personnel."

Considering economic challenges, one of the important issues mentioned by the participants was the high maintenance cost of helicopters. They also stated that some missions were not cost-effective without considering ethical and humanitarian issues. In addition, people gathering and crowding out of curiosity around the helicopter and creating potential dangers, the lack of justification to request and use the helicopter emergency service, lack of patience, and the presence of people waiting at the accident site until the arrival of the helicopter are among the challenges that are rooted in culture.

Participant 12: "...The flight crew and helicopter emergency technicians kept sending messages that people should not come close to the propellers and helicopters."

### **Helicopter Emergency Opportunities**

Helicopter emergency opportunities were divided into 8 themes and 11 categories (Table 2).

Culture-building activities and persuading donors, municipalities, and governor's offices to build a helipad are among the social opportunities that were highlighted in the emergency department.

Participant 09: "...Once we convinced the donors that we need a helipad, or the municipalities or governor's offices paid all their expenses in all the cities themselves."

The geographic location of Isfahan province as the central pole of Iran can be used as an opportunity. Due to the centrality and geographical extent of Isfahan province, the existence of three air bases is necessary to provide service in this province. Furthermore, allocating two medicopter quotas to Isfahan province, if the required space is provided, was one of the opportunities mentioned by the participants.

Participant 07: "...The head of Iran's emergency organization promised that at least two more medicopters will be allocated to the province in addition to the helicopter we have now, provided that there will be space for them."

Moreover, air ambulance provides easier and faster access to mountainous and desert places where ground ambulances cannot approach.

Participant 13: "...One of the advantages of the

air ambulance is that it gives us the possibility to go anywhere in our province, whether it's mountainous, desert, or distant. It can reach there and does the relief mission. This is a privilege and demands that we use this opportunity."

The skill of Havānīrūz pilots and their compliance with safety precautions were identified as human resource opportunities.

Participant 27: "...there are experienced and competent personnel who provide service despite the shortcomings; moreover, we have the best pilots and flight crew who are mostly master pilots."

Moreover, the management opportunities were divided into three categories according to the opinions of the interviewees: locating helipads in 42 points in Isfahan province, taking measures to build helipads in the town, and strengthening the inter-departmental communication of managers across Iran.

Participant 27: "...We have made a lot of progress in locating new helipads in the province and implementing regulations by the authorities, compared to other provinces."

Some participants pointed out that the presence of support helicopters in partner organizations, such as the Red Crescent Society has been very helpful in some cases where rescue is needed and can be regarded as an opportunity.

Participant 09: "...We have other capacities and opportunities. The Red Crescent Society in Isfahan is also equipped with a helicopter, which is very helpful. As soon as we announce that we need help, they dispatch a helicopter."

### **Policy Implications**

The policy implications provided by the participants were categorized into 8 themes and 28 categories (Table 3). Among the most significant categories were, taking measures to receive the medicopter quota and equipping the Havānīrūz helicopter.

Participant 11: "...They have purchased or allocated two medicopters for the Isfahan emergency department, which I think are available in Tehran."

It is also necessary to establish three independent air emergency bases in the province. In addition, considering the construction of helipads, it was suggested that more helipads be built in accident-prone areas of the province, as well as in the hospitals of Isfahan and surrounding

towns.

Participant 19: *"...It is suggested to construct helipads in the hospitals of the center of the province and towns."*

Regarding instruction and training, it was suggested that appropriate training courses be designed and held for road police or police forces, hospitals, helicopter emergency personnel, pilots and flight crew, road emergency and dispatch personnel, and the public.

Participant 02: *"...The second issue is the training that should be provided to hospital and road emergency personnel."*

In terms of welfare and comfort, the provision of facilities and amenities for emergency technicians and honoring helicopter emergency personnel and flight crew to raise their morale and motivation were suggested.

Participant 26: *"... the morale of the personnel can be raised by paying the mission allowance on time and inviting the personnel to ceremonies and holidays with their families."*

The suggestions in terms of equipment and support were also extensive and included: the provision of communication equipment, the provision of specialized helicopter emergency equipment, the provision of protective and personal safety equipment, permission to have operations at night, the provision of helicopter fuel, as well as equipping the road emergency personnel with smoke bombs and obliging important factories and centers to have smoke bombs to signal the helicopter.

Additionally, regarding the provision of expert human resources, the participants suggested that HEMS technicians be employed based on scientific and professional skills and after passing specialized helicopter emergency courses. Moreover, helicopter emergency courses should be held for expert pilots. In addition, it was suggested to utilize Havānīrūz personnel who have completed mountain, desert, and skydiving courses, along with helicopter emergency technicians.

Participant 05: *"...To improve helicopter emergency services, it is suggested to train pilots in an emergency."*

### Discussion and Conclusion

The findings of this study were presented as challenges, opportunities, and policy implications. According to the results, it was shown that one of

the main challenges of HEMS is related to helicopters, and the participants pointed out that military helicopters are unspecialized, they are worn-out and unsafe, and the number of helicopters (n=1) is not sufficient for Isfahan province. Similarly, the results of a study by Sorani indicated that infrastructure defects are among the main challenges of HEMS in Iran (9), which are consistent with the findings of this study.

In the same vein, Memarzadeh et al. mentioned the challenges related to military helicopters, which is in line with the results of this study (12). Moreover, they stated that the current helicopters are military, and they are not equipped with special helicopter emergency facilities and equipment; in addition, it is not possible to have operations at night, and they cannot be flown in bad weather conditions. However, other developed countries are not involved with these issues, and Peters states that in the Netherlands, operation with air ambulance helicopters at night is a safe and fast way to transport patients, and he considers helicopters useful for transporting patients at night (13).

The provision of more specialized helicopters and equipping the current helicopters were among the implications given by the participants. In addition, two quotas of specialized medicopters have been allocated to Isfahan province; however, due to the lack of necessary capacities for the construction of an airbase, as well as the maintenance of medicopters, they have not been used in Isfahan province yet. Other studies also highlighted the lack of suitable infrastructure for the use of specialized helicopters (9). Some other studies have recommended the use of rapid response vehicles (14) or pre-hospital quadcopters instead of helicopters since these devices are economically more efficient and reduce the time of patient treatment before the ground and air ambulances arrive at the scene.

However, the air ambulance in Iran is not yet equipped with such devices. In addition, the high cost of helicopter maintenance and lack of cost-effectiveness of some missions by the air ambulance were among the economic challenges, which have also been mentioned in other research regarding the high cost of HEMS in Iran (9).

Considering the challenges in terms of helipads, the lack of helipads in most areas, the insufficient number of helipads, and poorly-

equipped helipads were among the challenges identified in this regard. Other studies also mentioned the inappropriate landing place as one of the challenges related to helipads (15).

Another challenge identified in this study was the geographical challenges and the long distance of helicopter emergency bases. Considering the vastness of Isfahan province, there is only one helicopter emergency base. However, in Finland, which is smaller than Isfahan province, there are six helicopter emergency bases, of which three are urban bases (14). Nonetheless, Savilouto showed that despite the short distance of the helicopter emergency bases, the use of helicopters may not save time (14). However, some studies have highlighted the importance of HEMS and demonstrated that HEMS has reduced the time of patient transportation and brought the death rate closer to international standards (8).

According to a study conducted by Eskandari, the expansion of HEMS bases depends on such factors as flight technical equipment, geophysical criteria, personnel, financial resources, safety equipment, access criteria, political factors, social conditions, and service coverage (16).

Challenges in terms of training and instruction were also identified in this study, and among the main challenges in this regard was training at different levels. The results indicated that general pieces of training should be designed and offered to the public and community, and specialized ones should be offered to pilots, HEMS technicians, hospitals, and traffic police. Other studies also pointed out the importance of comprehensive training programs for the public, doctors, nurses, and flight technical staff (8, 10, and 12).

Moreover, regarding equipment and support, one of the policy implications identified in this study is the provision of communication and specialized equipment. In a study performed by Sahebi, one of the important challenges of helicopter emergency in the Kermanshah earthquake was the lack of concern about the provision and maintenance of specialized equipment in HEMS (10). The provision of specialized human resources was also regarded as one of the implications identified in this study. The recruitment of helicopter emergency technicians based on scientific and professional skills, and the training of pilots in the field of HEMS can help to improve HEMS. Other studies also pointed out the significance of employing

specialized and experienced personnel due to the special working conditions and expertise required in this field (10).

Considering the challenges related to safety, participants stated that the helicopters are unsafe due to being worn-out, and HEMS technicians are not equipped with special clothes, helmets, and headsets; moreover, the presence of electric transmission towers in mountainous areas increases the risk of helicopters falling. Other studies have also mentioned safety issues as one of the most important challenges (9). Pietsch (17) states that the HEMS missions were carried out even at night, and there was no safety problem for the patients and the medical staff. However, the results of the aforementioned study have shown that the mission time for night flight operations increased, and there were safety issues for the patient. It has been mentioned that a rescue specialist or a helicopter emergency doctor was present with all the patients, which confirms the attendance of experienced and trained staff in HEMS (17).

The most important challenges regarding communication were the lack of appropriate internal and external communication systems, the lack of appropriate communication systems in the helicopter, and the long process of between-hospital and pre-hospital helicopter dispatching due to coordination issues with the police to ensure the security of the accident site or the helicopter landing site. These challenges were also identified in other studies (15). One of the challenges mentioned in other studies was the problems related to employees' competencies (9). Accordingly, the findings indicated that the use of HEMS technicians based on scientific and professional skills, the recruitment of Havānīrūz air search and rescue team personnel, and the use of doctors are very necessary for HEMS.

The findings of a study by Memarzadeh also showed that the doctors' capacities are not used in HEMS missions, and only nurses and emergency medical experts were utilized in this condition (12). Sorani has also mentioned the importance of the HEMS program and believes such an approach improves the quality of services provided by the helicopter emergency (9). In the current study, offering training to the police or law enforcement personnel, hospitals, helicopter emergency personnel, as well as pilots and flight crews were recognized as policy implications. In

addition, one of the most important cultural challenges known in this study was related to the people gathering around the helicopter, which was also mentioned in the study by Memarzadeh (12).

### Limitations of the Study

Regarding the limitations of the present study, face-to-face interviews were not permitted by Havānīrūz to interview the flight crew. Accordingly, the researchers used an open questionnaire to seek their opinions. However, some questionnaires were not completely filled out by the flight crew.

According to the findings of this study, the most important challenges in HEMS are related to the lack of specialized helicopters or medicopters and the lack of an independent helicopter emergency base in Isfahan province. The non-independence of Isfahan HEMS and its dependence on Havānīrūz lengthens the coordination process and the dispatch time of helicopters. Moreover, the unspecialized military helicopters and the lack of communication among emergency medical experts during the flight create a disturbance in the process of patients' treatment. Currently, due to the inadequate space in the rear cabin of the military helicopter and the existing non-standard stretchers, the helicopter emergency of Isfahan province only transports patients, and it is not possible to carry out primary treatment measures during operations.

On the other hand, from an economic point of view, the use of Havānīrūz helicopters and the existence of maintenance units are much more cost-efficient than those of the private sector. It is worth mentioning that considering the vastness of Isfahan province, the existence of just one helicopter base and one helicopter is insufficient. Therefore, at least, three helicopter emergency bases are required in Isfahan province. Since military helicopters do not have permission to fly at night and are subject to sunset (sunrise and sunset), the existence of a medicopter is necessary since it can be flown at night. Finally, it is suggested that the HEMS managers and policymakers plan and implement effective measures to improve helicopter emergency conditions in the province using the identified challenges and implications.

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### Conflict of Interests

Authors have no conflict of interests.

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