

Original Research

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



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Identifying the Challenges of Simulating the Hospital Emergency Department in the Event of Emergencies and Providing Effective Solutions: A Qualitative Study

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Abstract

Introduction: Emergencies and disasters occur in any society, and it is the hospitals and their emergency department staff who must be prepared in such cases. Therefore, 1 of the effective methods of training medical care staff is the use of simulators. However, when introducing new simulation approaches, we face many challenges. The aim of this study was to identify challenges of the simulation of the hospital emergency department during disasters and provide effective solutions.

Methods: This conventional content, thematic, analysis study was conducted in 2021. Participants were selected from Iranian experts using purposeful and snowball sampling methods. Data were collected using semi-structured interviews and were analyzed by the content analysis.

Results: After analyzing the data, the challenges of simulating the hospital emergency department during disasters were identified in 2 main components and 6 perspectives, which included organizational components (inappropriate and aimless training methods, lack of interaction and cooperation, lack of funding, and inadequate physical space) and technological components (weak information management and lack of interdisciplinary cooperation). Solutions included management (resource support) and data sharing and exchange (infrastructures, cooperation and coordination).

Conclusion: The simulation technology can be used as a method for training and improving the quality of health care services in emergencies. Considering that most of these challenges can be solved and need the full support of managers and policy makers, by examining these issues, supporting staff of health care centers are advised to make a significant contribution to the advancement of education and problem reduction in the event of disasters.

Simulation is one of the learning methods in medical education.¹ Simulation is a copy of some real device or work situations which attempts to represent certain behavioral aspects of a physical or abstract system by the behavior of another system more commonly used in natural and human systems. It is also the representation or re-creation of an object, a real subject, or a situation. This technique, like a mirror, simulates facts. In addition, there is no possibility of harm to participants.²

Innovation in health simulation technologies has led to virtual simulation. Virtual simulation is the re-creation of reality on a computer screen and involves real people in simulated systems. It is a type of simulation which puts people in a central role in a variety of settings of hospital emergency departments by performing motor control skills, decision-making skills, and communication skills using virtual patients.³ Virtual simulation can provide an educational strategy, can act as a facilitator of knowledge retention, improve learning satisfaction, and self-efficacy.⁴ Simulation has many benefits, including improved learning, increased critical thinking, reduced anxiety before entering a health care setting, increased safety for the injured, increased communication skills, and increased decision-making skills.⁵ The emergency departments of different hospitals accept about 30 million patients worldwide every year and put them under emergency care.⁵ The development and preparedness of hospital emergency departments against disasters is of great importance and the healthcare system should pay special attention to strengthening the various components of this department in order to properly respond to emergencies and disasters.⁶ However, when introducing new teaching and simulation approaches, we will face a lot of challenges.⁷ In a study conducted by Valerie *et al.* in the United States in 2011, it was found that the lack of experience in technology, learning time constraints, and time limits for planning, were some simulation challenges.⁸ The study by Minidi *et al.*, conducted in the

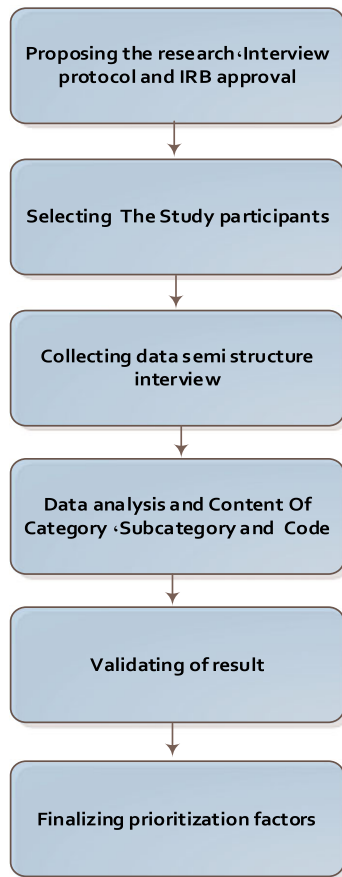


Figure 1. An overview of the key steps of the research project.

United States in 2012, identified lack of time, equipment, and support from managers as some of the challenges of simulation use.⁹ We aimed to identify the challenges of simulating the hospital emergency department in the event of a disaster and provide effective solutions.

Methods

Research design

The content thematic analysis approach was used to analyze the data. This method is 1 of the most feasible ways to explore the sociocultural beliefs and values of a society.¹⁰ Figure 1 depicts the research and data analysis processes.

Participants

The participants consisted of specialists in the field of simulation, artificial intelligence, and medical informatics; specialists in the field of emergencies and disasters; and head nurses of the hospital emergency department. The inclusion criteria for the study were that participants had to have experience in a disaster situation. As the aim of this study was to determine factors influencing the design of a simulation model of the hospital emergency department in disasters or emergencies, specialists of artificial intelligence and medical informatics were also selected as non-clinician participants. The participants also had to be familiar with the subject of triage and patient prioritization in the health care system.

Purposeful and snowball sampling methods were used to select the participants (Table 1).

Data collection

Face to face and semi-structured interviews lasting between 30 and 75 minutes were conducted in the workplace and at a convenient time for participants. The interviews were conducted by the first author (FBS) from October to December, 2021. An interview guide was developed based on the purpose of the study, related literature, and the research team experiences. The researcher (FBS) piloted the interview questions during the first 2 interviews with a triage nurse and emergency medical technicians. There were no modifications made in the interview guide and questions. Since there were no changes in the interview questions, the data collected in the pilot interviews were used in data analysis. At the beginning of the interview session, the interviewer explained the aim of the study. Then participants were asked to describe 1 of their triage experiences. Subsequently, the interviewer asked them the following questions: (1) *Did you experience any challenges in patient prioritization at the time of triage?* and (2) *What were your challenges?*

As the topic was explored, questions progressed from general to specific to generate details. The major explorative questions of the interview were: (3) *Did you face any type of challenges when prioritizing victims in disaster triage?* and (4) *What criteria should be used for the prioritization of victims in disaster triage?*

Probing questions were also asked to ensure the interviewer understood the participant's responses and to provide an opportunity to obtain in-depth information. After 24–25 interviews, no new codes were generated from the interview data; however, 5 more interviews were performed to ensure data saturation and for capturing data run-off.

Data analysis

Data were analyzed using 'content analysis' suggested by the Graneheim and Lundman-proposed method.¹¹ First, interviews were recorded and then transcribed verbatim, anonymously, and were reviewed several times to allow the first author to reach an overall understanding. To preserve participants' privacy, all personal identifiers were transformed to a de-identified study number in the study files. Second, sentences or phrases providing information about the ethical principles of patient prioritization in the triage were selected as semantic units. Third, the semantic units were condensed, abstracted, and coded by FBS and SHM. Fourth, codes were sorted into categories and subcategories based on constant comparison of their similarities and differences and consensus discussion by FBS, SHM, and GHM. The separate category of coding sheets was then checked by the other authors for further comments, and then collaboratively interpreted and integrated. Finally, codes, subcategories, and categories were developed.

Trustworthiness

Graneheim and Lundman proposed the credibility, dependability, and transferability of the data to ensure the trustworthiness of results in content analysis studies.¹¹ Confirmability and credibility of data were enhanced by maximum variation of sampling and prolonged engagement with data. Furthermore, the research team members talked over the results to reach an agreement on the codes, categories, and subcategories. Peer checking was carried out by 2 other researchers who were not members of the research

Table 1. Characteristics of participants

No.	Age	Gender	Education	Type of responsibility	Work experience	Interview duration (Minutes)
1	36	Male	MS (Nursing)	Emergency Nurse Head	11 years	30
2	37	Female	BS (Nursing)	Emergency Nurse Head	17 years	30
3	38	Female	BS (Nursing)	Emergency Nurse Head	15 years	35
4	39	Female	MS (Nursing)	Emergency Nurse Head	13 years	40
5	34	Female	BS (Nursing)	Emergency Nurse Head	14 years	35
6	42	Female	BS (Nursing)	Emergency Nurse Head	25 years	30
7	36	Female	BS (Nursing)	Emergency Nurse Head	18 years	40
8	37	Female	MS (Nursing)	Emergency Supervisor	16 years	20
9	42	Female	PHD (Nursing)	Emergency Nurse Head	18 years	35
10	39	Male	MS (Nursing)	Faculty member	14 years	30
11	48	Male	MS (Nursing)	Emergency Nurse Head	22 years	35
12	35	Female	MS (Nursing)	Emergency Nurse Head	10 years	20
13	48	Female	PhD (Nursing)	Emergency Nurse Head	20 years	45
14	37	Female	MS (Nursing)	Faculty member	8 years	25
15	52	Female	PhD (Health Emergency and Disasters)	University faculty member	25 years	45
16	48	Male	Emergency Medicine	Health Promotion Office	20 years	40
17	56	Male	Emergency Medicine	International Crescent Vice President	26 years	20
18	43	Female	PhD (Health Emergency and Disasters)	Expert of the Accidents and Disaster Headquarters	23 years	60
19	54	Male	PhD (Health Emergency and Disasters)	University faculty member	25 years	60
20	53	Male	Emergency Medicine	Emergency medicine specialist	18 years	50
21	44	Male	PhD (Artificial Intelligence)	University faculty member	14 years	45
22	35	Male	PhD (Informatics)	University faculty member	4 years	35
23	54	Male	PhD (Informatics)	University faculty member	23 years	45
24	46	Male	PhD (Artificial Intelligence)	University faculty member	12 years	50
25	53	Male	PhD (Artificial Intelligence)	University faculty member	10 years	40
26	49	Male	PhD (Artificial Intelligence)	University faculty member	17 years	45
27	42	Male	PhD (Artificial Intelligence)	University faculty member	10 years	20
28	48	Female	PhD (Informatics)	University faculty member	15 years	35
29	54	Male	PhD (Medical Education)	University faculty member	21 years	50
30	47	Male	PhD (Management and Information)	University faculty member	14 years	45
31	41	Male	PhD (Medical Education)	University faculty member	8 years	20

team to enhance the dependability of the results. In addition, to increase the transferability of the results, researchers tried to provide a clear and distinct description of sampling, data collection, data analysis, and reporting of the results.

Results

A total of 31 interviews were conducted to gather the data in this study; 15 participants were male and 16 were female. The mean age of the participants was 40 years. The job experience of participants ranged from 8 to 25 years with a mean of 15 years. There were 11 participants in the field of artificial intelligence and medical informatics, 14 in the field of health, and 6 in the field of emergencies and disasters.

The results of the data collected through the semi-structured interviews showed the organizational components (inappropriate and aimless training methods, lack of interaction and cooperation, lack of funding, and inadequate physical space) and technological components (poor information management and lack of interdisciplinary cooperation). Solutions included management (resource

support) and data sharing and exchange (infrastructures, collaboration, and coordination) (Table 2).

1. Organizational factors

Challenges in the design of emergency department simulators were divided into 4 organizational component inputs (inappropriate and aimless training methods, lack of interaction and cooperation, lack of funding, and inadequate physical space).

1-1- Inappropriate training methods

Since emergency department staff are more likely than other hospital staff to be in unforeseen situations, they constantly face the challenge of caring for very critically ill patients in a complex hospital setting, and having enough time to access information or practical skills in advance. It is more important to train staff of this ward on the use of this technology than staff of other wards, and staff must have received the necessary training and be able to provide appropriate medical services in critical situations.

Table 2. The challenges and effective solutions to simulate the hospital emergency department in times of emergencies and disasters

Content	Category	Sub-category	Code
Challenges	Organizational Components	Inappropriate and aimless educational methods	Aimless training and prioritization
			Training for working to rule
			Unattractive training
			Lack of staff cooperation due to congestion in the emergency department
			Inadequate implementation of educational methods
		Challenges in motivation	
		Low skills of medical staff in the field of disasters	
		Inadequate physical space	Inadequate space in the emergency department of hospitals
			Lack of cooperation of single specialized hospitals
			Zero use of air emergencies in most hospitals
	Lack of interaction and cooperation	Insufficient support of managers in designing and producing software	
		Being unresponsive	
		Inconsistency between institutions	
		Service quality challenges	
		Lack of diagnostic and treatment facilities in the referring hospital	
		Lack of cooperation of emergency department staff	
		Lack of teamwork spirit	
	Weakness in financing	Collapse because of overcrowding due to lack of transfer or slight transfer	
		Poor inter-sectoral cooperation	
	Technology	Poor information management	Cost and resource constraints
Failure to register and maintain triage tags in hospitals during emergencies and disasters			
Lack of a standard format for recording information of injured people in times of emergencies and disasters			
Lack of a system for online monitoring of hospital capacities			
Cost of the software design and production			
Lack of interdisciplinary cooperation		Data misuse	
		Insecurity in data processing	
		Lack of employees' knowledge about the software system	
		Lack of familiarity with simulation program standards	
		Lack of interaction and cooperation between experts of different fields	
Solutions	Management	Support and resources	Proper and applicable planning in case of emergencies and disasters
			Definition of the crisis code in all hospitals for all staff
			Coloring and leveling events
			Monitoring and control
			Resource support
			Providing resources
			Distribution of financial resources
			Determining the cost of effectiveness
			Use of decision support systems to transport the injured
			The need to adopt a diverse response strategy appropriate to the type, severity and level of the emergencies
	Sharing and exchanging data	Infrastructures	Convenient and attractive graphics and animation
			Educational scenario analysis
			Availability for everyone
		Cooperation and coordination	Participation and cooperation of emergency department staff in designing the platform
			Stakeholders' participation
Presence of experts in the field of engineering and health			

Participants in this study stated that remote and operational exercises were less held in hospitals and also stated that it was better for all hospital staff to participate in holding training maneuvers. Training courses for staff preparation had to be held periodically and with the cooperation of all emergency department staff.

'In holding training courses, different methods should be used because the trainings are for rote work, have no educational appeal, and staff are less welcoming.' (P23)

Participants stated that factors such as planning to train managers and employees in the field of emergencies and disasters, dealing

with mass casualties, and evaluating the effectiveness of the provided training, were effective in the success of planning. The implementation of any program had to start with training, and finally, end with training. Hospitals should quickly provide services in the event of a disaster.

'From the very beginning of the planning process, we held training sessions for staff on the importance of triage of the injured, dealing with mass casualties, and time management. We held staff training sessions every month. This put us ahead of many other hospitals in this area.' said the secretary of the Disaster Risk Committee of a leading government hospital for disaster planning. (P8)

2-1- Lack of interaction and cooperation

Most of the participants stated that in case of emergencies and disasters, when the hospital emergency department was full of injured people, it had to be managed by an individual, and this required pre-determined planning. Also, in the command chart which exists in each hospital, each person had his/her own responsibilities and duties, which, with the definition of these roles and tasks, accelerated the actions. This eliminated congestion in the emergency environment, leading to a quick return of the emergency department to the normal situation.

'When an emergency happens, of course, depending on whether the emergency happens inside the hospital or outside the hospital, the situation is completely different from normal. The quality of services may be lower, there may be a lack of coordination between institutions, and due to overcrowding in the emergency department, there is fatigue and there may not be enough space to receive the injured.' (P18)

Participants emphasized the presence of capable staff, especially triage staff, and that skills, knowledge, and good manpower performance, especially in the emergency department, was very important for prioritizing the injured. At the time of the disaster, the hospital emergency department is in a state of emergency with a large number of injured people requesting services. In order to continue the services, the manager prioritized on calling the manpower first from inside the hospital and then from outside the hospital.

'It is very important to select candidates who have been pre-planned and picked according to a specific protocol, and to have the names of the candidates available to call them up whenever necessary.' (P14)

3-1- Inadequate physical space

Most of the participants emphasized the standardization of physical space and hospital services in order to provide more and better facilities and equipment, safer conditions, and suitable working spaces for employees. They also stated that favorable and standard conditions in providing hospital services in the event of emergencies and disasters reduced the mortality rate of the injured and increased the desired services.

'Look at our hospital. It does not have a proper entrance and exit, and the injured enter the emergency department through several doors. This can increase the congestion of the emergency department, reduce the quality of services, and make the staff tired. It is very important to have 1 entrance and exit in the emergency department and the triage room should be large enough for the injured to enter the room on a stretcher. Lack of a proper structure is a big problem we face.' (P30)

Most of the participants stated that most of the hospitals were in good condition in terms of indicators, but in terms of the physical structure, they were relatively inconsistent with the existing standards, which required the special and continuous attention of their managers.

'The emergency department is the most important part of a hospital, where most of the injured people who need immediate medical care are referred in the first place. Therefore, the hospital emergency department must always be ready to respond to emergencies and disasters in terms of physical space, equipment and manpower' (P11)

2- Technology factors

Challenges in the design of emergency department simulators were divided into 2 inputs of information management and cooperation and coordination.

1-2- Information management

Participants stated that in order to design an educational platform, the target groups who were the hospital emergency staff had to participate, and this educational platform had to have a training aspect, and increase the people's access to information. In addition, the platform's graphics had to be attractive to them.

'In my opinion, to design your educational platform, improve the graphics, and the educational aspect. Identify and fix the bugs which may exist in the system. Be sure to pilot your educational platform with the staff of hospital emergency departments and ask them for their opinion.'(P30)

Participants stated that in order to design an educational platform, a suitable scenario had to be written and analyzed because the scenario was the work base and they emphasized its assessment.

'In order to write an educational scenario, all educational materials must be stated from the time the injured patient enters the hospital, the duration of the patient's presence, the duration of each stage of medical services, and the assignment of the injured. All these factors must be analyzed in detail.' (P26)

All participants stated that the cost of producing the software was very important because the design of the software could be very costly and had to be considered from the beginning.

'You should identify the professionals needed to design and produce this software from the beginning, talk to these people to see how much money is needed, and finally have an estimate of the cost.' (P13)

2-2- Lack of interdisciplinary cooperation

Participants stated that there had to be coordination and participation between people in different fields. This coordination and cooperation between people in different fields would strengthen the educational system and eliminate mistakes.

'Lack of cooperation and interaction between different disciplines increases the error in your software system. So you should establish friendly cooperation and interaction with people in the field of technology, emergency and disasters, and other experts in other fields.' (P24)

Participants stated that a standard had to be set for employees and the software had to be defined while they emphasized the need to hold a training class to introduce and work with the software.

'If employees are not familiar with the software, they will not take the initiative to learn it. They should be trained in this field before working with the software and their motivation should be strengthened.' (P6)

2. Solutions

1-2- Management

As leaders, managers are responsible for empowering and guiding employees to provide medical care in the event of disasters. Therefore, hospital managers should use a transformational and participatory leadership style to set a challenging perspective for employees and motivate them to achieve the hospital's vision and organizational goals. They should provide the means to

achieve a diverse response strategy by providing resources, determining the required costs, and effectively guiding staff.¹² Hospital managers must develop and properly manage human resources, use decision support systems to transport casualties, and improve communication between managers and staff. They should also evaluate staff performance and appreciate their efforts. Therefore, 1 of the general goals of organizations should be to strengthen the employee management system, develop the capabilities of employees, and satisfy health care.¹³ According to the study of Arbon *et al.* in Australia, 80% of nurses who volunteered for emergency care had no previous experience in emergency situations. This study about providing care based on nurses' experiences showed that nurses working in the emergency department could play an important role in emergency nursing and perform measures such as triage and life-saving intervention. Nurses who had insufficient experience in this field were unable to effectively act in an emergency situation.¹⁴ Most of the participants stated that the support in terms of resources was effective and practical if it would encompass the following: define emergency in all hospitals for all staff, color and level disasters, use decision support systems to transfer the injured, adopt a diverse response strategy tailored to the type, severity, and level of the emergency, and appropriately and efficiently plan in the event of disasters.

'To be ready to provide services in case of emergencies and disasters in the hospital, availability of equipment is very important. You know how scarce resources are when the emergency department is facing a large number of casualties, and providing these resources needs to be planned in advance.' (P 22)

2-2- Sharing and exchanging data

The use of new simulation-based technologies in medical services today has gained a leading position in modern education management strategies due to advances in the design and development of health systems. Their growing number in related environments to provide services in the event of disasters, increases the objectivity of modern healthcare services. Participation in data mining and accessibility are not necessary for everyone because existing data must be stored in a space, and then protected from unauthorized access by various encryption schemes. Timely provision of data services in emergencies is crucial in healthcare scenarios. Access to data and information exchange should be such that individuals can timely access data in emergencies to circumvent strict security walls and access policies.^{13,14} Most of the participants stated that a suitable infrastructure had to be used for an educational software. The software must have appropriate and attractive graphics and animation, be available to everyone, and before that it must be analyzed by a suitable scenario. The participation and cooperation of emergency department staff in designing the platform is very important to motivate them.

'In order for an educational software to be able to attract emergency personnel, it must have an entertainment aspect and not be too boring.' (P 12)
'Stakeholders should be involved in the design and production of the software and be consulted. This is effective in motivating them. Educational needs of the emergency staff should be assessed.' (P 29)

Discussion

Hospitals are 1 of the most important organizations providing healthcare before, during, and after emergencies and disasters. In order to maintain their basic function and return to their original state, they must take measures in this regard. Various factors can affect the simulation design of the hospital emergency department

during emergencies and disasters. An annual emergency plan assessment is required to ensure emergency preparedness. The preparedness assessment should include the following: (1) Disaster planning, (2) Emergency coordination, (3) Communication, (4) Education, (5) Increase in hospital capacity, (6) Personnel, (7) Availability of equipment, (8) Definition of crisis codes in all hospitals for all staff, and (9) Coloring and leveling emergencies based on valid criteria which are measurable and reliable.^{3,15}

Emergency department management in emergencies and disasters was another simulation challenge which touched on a wide range of management tasks such as disaster planning, disaster management knowledge and skills, command systems, and systems of healthcare continuity. Participants in the study emphasized support, monitoring, and funding. Some studies have emphasized the need for practical exercises performed at least once a year, but these exercises need to be performed more regularly in larger groups of people, and on a variety of events.¹⁶ Then, strengths and weaknesses should be identified to take the necessary measures in relation to them.^{17,18} In another study, it was stated that holding training programs related to emergencies and disasters was the best way to deal with mass casualties during emergencies and disasters.¹⁹ The success or failure of any organization largely depends on the leadership and management system of that organization. Due to the nature of hospitals' services, they need smart, wise, capable, experienced, and committed planners and managers.²⁰

Managers are responsible for empowering and guiding employees to provide medical care in the event of disasters. Therefore, hospital managers should use a transformational and participatory leadership style to set a challenging perspective for employees, motivate them to achieve the company's vision and goals, and provide the ground for achieving a diverse response strategy. This strategy can be achieved by providing resources, determining the cost, and effectively guiding employees.^{21,22} Hospital managers must properly develop and manage human resources, use decision support systems to transport casualties, improve communication between managers and staff, evaluate staff's performance, and appreciate their efforts. Therefore, 1 of the general goals of organizations should be to strengthen the employee management system, develop their capabilities and skills, and satisfy staff.²³ In a study by Arbon *et al.* in Australia, 80% of nurses who volunteered for crisis care had no previous experience in crisis situations. The researcher in his study on providing care based on nurses' experiences showed that nurses working in the emergency department could play an important role in crisis nursing and perform measures such as triage and life-saving intervention. Nurses who had insufficient experience in this field were not able to effectively act in a critical situation.¹⁹

The use of technology was another challenge involved in designing a simulation of the hospital emergency department. Inadequate support by managers for using technology in the healthcare system was significant. Its sub-categories included lack of support for professors by managers, lack of support for staff by managers, and lack of support for providing costs by managers. This was mentioned in the studies of Adamson,¹⁷ and Carrington *et al.*¹⁸ In training courses, extra time is spent on learning, and financial support is expected from managers. On the other hand, students expect the managers to provide simulations with high effectiveness so that they have much similarity with real situations. All these expectations lead to financial costs for managers. Since training is costly and its effects are seen in the long run, in most cases managers cannot provide adequate support due to lack of funding.¹⁷

Most of the participants who worked in the hospital emergency department stated that when doing exercises with simulators, they were anxious and worried about not properly providing services, and the fact that not everyone could do it right. However, due to lack of experience, weak teamwork was 1 of the topics mentioned in the text. Some people did not show a desire to continue working with simulators. In view of the above, the solutions mentioned in the review of the texts included the participation and cooperation of the emergency department staff in the design of the platform, its availability to all people and the participation of stakeholders. Also, holding orientation sessions for individuals before using simulations and explaining the need for preparation before going to the patient can be helpful in reducing anxiety.^{24,25}

Before using operational simulation programs, the group of employees who want to execute the relevant scenario should be divided into tasks and asked to perform them. In subsequent practice sessions, they will be asked to select a person as the leader of the team and divide the tasks in the group. During their training, they change the team leader themselves so that all employees can experience all tasks.^{19,26,27}

Conclusion

Based on the performed studies, simulation technology can be used as a method to prepare the staff of the hospital's emergency department before entering an emergency situation. The challenges presented in this study included organizational challenges like the management model and inappropriate training, as well as technology challenges including information management and lack of interdisciplinary cooperation. Considering that most of these challenges can be solved by: the full support of managers, planning for hospital preparation, holding training courses, and general maneuvers in the hospital, the quality of services, and preparedness of staff can be increased in response to various incidents. Therefore, by examining these cases and their support, it is suggested that managers make a significant contribution to the progress of training in accordance with the simulated maneuvers, and to the reduction in the problems of the emergency department staff during emergencies and disasters and dealing with mass casualties.

Limitations

Although this is a qualitative study based on the experiences of Iranian experts in simulation and emergencies, the results can be generalized to similar cultural contexts. As it is well known, the research is based on analysis and inference, and it does not have statistical-probabilistic generalizability.²⁸

Data availability statement. The datasets generated and/or analyzed during the current study are not publicly available due to participant confidentiality, but are available from the corresponding author on reasonable request.

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Author contributions. Fahimeh Barghi-Shirazi conceived and designed the study. She also gathered and analyzed the data, wrote the first draft of the manuscript, supervised the data analysis, read, and approved the final version of the manuscript. Gholamreza Masoumi conceived and designed the study. He supervised the data analysis, read, and approved the final version of the manuscript. Shandiz Moslehi And Mohammad Reza Rasouli designed the study,

supervised the data analysis, read, and approved the manuscript. She also analyzed the data and prepared the first version of the manuscript.

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Competing interests. This study is part of the PhD thesis of the first author in the School of Health Management and Information Sciences of Iran University of Medical Sciences. The authors declare no conflict of interests.

Ethical standards. This study was approved by an Institutional Review Board (IRB). It was approved by the School of Health Management and Information Sciences of Iran University of Medical Sciences with the code of ethics IR.IUMS.REC.1400.633. Participants were informed that participation in the study was voluntary and they could withdraw from the study at any time. Informed consent was obtained from all participants. An IRB (figure1) also confirmed that all methods were performed in accordance with relevant guidelines and regulations.

Abbreviations. IRB, Institutional Review Board; EMT, Emergency Medical Technician; ED, Emergency Department; ST, Simulation Technology

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