Factors affecting emergency evacuation of Iranian hospitals in fire: A qualitative study

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Abstract:

BACKGROUND: Fire is one of the most important threatening factors for hospitals and needs special attention. The present study was conducted to explain the factors affecting hospital emergency evacuation following fire based on hospital administrators' experiences.

MATERIALS AND METHODS: This was a qualitative study conducted employing the content analysis approach. Participants included 22 hospital administrators in Tehran, Lorestan, Kurdistan, and Ilam provinces. The participants were purposefully selected and included until reaching principle of data saturation. Data were collected through in-depth semi-structured interviews from November 2019 to August 2020 and analyzed by the content analysis method.

RESULTS: Factors affecting hospital emergency evacuation during fire were categorized into five main categories and 17 subcategories including response to incident (five subcategories of fire nature, emergency evacuation, service provision, coordination and communication; and collaboration and companionship), human factors (two subcategories of individual characteristics and competencies), hospital preparedness (three subcategories of planning, safety and security; and information management system), environmental factors (two subcategories of hospital design and infrastructure; and weather condition), and finally ethical values (five subcategories of human dignity, trust, altruism, responsibility and accountability; and empathy).

CONCLUSION: The results of this study indicated that during fire in Iranian hospitals, several factors in addition to available standard guidelines affect the emergency evacuation process that need to be considered. Hospital emergency evacuation during fire is a complex process and necessitates a full and high-level hospital preparedness, so using the results of this study can be used to develop and practice evacuation plans and improve the hospital preparedness.

Keywords:

Emergency, evacuation, fire, hospital, qualitative study

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Introduction

As one of the most important infrastructures of any society, hospitals have a complex and potentially vulnerable structure and need to be adequately prepared to respond to various predictable or unpredictable incidents.[1-3] Fire is one of the incidents that hospitals should be prepared to encounter. This is because of the presence of electrical equipment, flammable liquids and medical gases in hospitals, which increase the likelihood of fire compared with other places.[4,5] Example in low- and middle-income countries in 2018 showed that the fire safety condition in hospitals is unsatisfactory.[6]

Fire is among the most dangerous incidents which in addition to inflicting financial damage imposes a major health threat toward hospital residents. Therefore, the occurrence of fire in the hospital is, more than any other place, associated with financial and human losses,[7,8] and this may be related to

various factors such as the presence of sick and disabled people; a lack of knowledge about how to fight against fire, the difficulty of evacuating patients and controlling fire, the potential for rapid spread of fire, and production of excessive smoke.[9,10] On the other hand, controlling fire in a hospital is more difficult than other places, and such incidents can be associated with high casualties because of patients' physical inabilities and incapability to escape the fire.[5,11,12] Therefore, the availability of a plan for rapid evacuation and transferring patients to a safe location are among fundamental steps for achieving hospital preparedness.[13] The results of a review study in 2020 showed a low level of hospital preparedness in fire, especially regarding emergency evacuation.[14]

Although hospital evacuation is a rare incident, it has many potential consequences[15] and a complex mechanism due to limited resources and a large number of patients.[16] In hospital evacuation, patients due to their disability and unfamiliarity with hospital procedures generally wait for receiving alarm messages and evacuation orders from the staff.[17] On the other hand, hospital evacuation is a time-consuming process which needs considerable human resources. Despite being in an unfavorable situation, patients and staff must quickly and safely evacuate the hospital,[13] which highlights patients' safety and health as two essential parameters during hospital evacuation.[18]

The goal of hospital emergency evacuation is to evacuate as many people as possible within the shortest time.[19] The low speed of transferring patients due to their immobility and disability increases the duration of emergency evacuation of hospitals compared to other buildings. Moreover, factors such as hospital design and residents' condition affect evacuation time.[20,21] Since preparedness programs can reduce the consequences of disasters.[22] Therefore, it is necessary to develop a hospital evacuation plan under all circumstances.[13] Considering the complexity of the hospital emergency evacuation during fire, the knowledge and experience of hospital managers can be helpful to identify and improve the factors affecting hospital preparedness. Based on a comprehensive literature review, there is no study in Iran to divulge the experiences and knowledge of hospital managers to identify the factors affecting emergency evacuation of a hospital during fire. This qualitative study then was designed to scrutinize hospital managers' knowledge and experiences in Iran to reveal the factors influencing hospital emergency evacuation after a fire.

Materials and Methods

Study design
This was a qualitative research applying the qualitative content analysis method and the inductive approach for extracting codes, subcategories, and categories.[23] This study was conducted between November 2019 and August 2020.

Setting
To conduct the study, specialists and experts who had practical experience or theoretical knowledge in the hospital emergency evacuation during fire were chosen. They were working in the Deputy of Treatment of the Ministry of Health and Medical Education, as well as the managers in the Deputy of Treatment of the country's medical universities and hospitals, hospital disaster managers, nursing managers and supervisors, and head nurses in Tehran, Lorestan, Kurdistan, and Ilam provinces.

Participants' selection
In this study, those who had either the knowledge or operational experience regarding hospital emergency evacuation during fire were interviewed. Inclusion criteria were willingness to participate and the ability to express experiences and perspectives. The only exclusion criterion was reluctance to participate in the study. Purposeful sampling method, which is the most popular strategy in qualitative research was employed. In this method, considering the study's aim, the researcher selects the most knowledgeable people who are able to answer the research questions.[24] The number of participants was determined based on achieving data saturation. In this regard, the interviews were continued until no new data were obtained, when the sampling was stopped. Finally, 22 face-to-face interviews were conducted.

Data collection
In order to generate concepts, four unstructured interviews were initially conducted. After that, using the interview guide, 18 semi-structured face to face interviews were performed in a calm place where the participant felt comfortable. The interviews were initiated with simple and general topics, and based on the answers provided; they were gradually directed toward specific questions. Some of the questions were as follows: "In your opinion, what are the factors affecting hospital emergency evacuation during fire?" and "What factors affect the duration of hospital emergency evacuation during fire?" Also, Examples of probing questions during interviews include: "In your experience, how trust affects the process of hospital emergency evacuation during fire?" and "In your opinion, what services patients need during fire evacuation?"

The new topics in each interview and also the topics that were less addressed formed the questions of future interviews. This process continued until the last interview and principle of data saturation. After

determining an appointment, the interviews were conducted in a location selected by the participants. Initially, permission from the participants to record the interviews by a digital recorder was asked. In order to increase data accuracy and precision, the interviews were immediately transcribed after the end of each interview. Each interview lasted between 25 and 65 (average of 45) minutes. In all steps, items such as informed consent, confidentiality, and the right to withdraw from the study were observed.

Data analysis

Data analysis was performed using the five-step Graneheim and Lundman content analysis approach.[23] Immediately after each interview, the recorded file was listened and typed in the Microsoft Office Word software. The interview's text was studied several times, and based on the research question, all the sentences related to the participants' experiences in the form of meaning units were identified. Finally, the summarized meaning units were labeled as codes. Afterward, the extracted codes were categorized based on similarities and differences to subcategories, and this process was conducted for all interviews until the formation of main categories. In this section of the study, data analysis was conducted by AS, with the supervision of KJ and DKZ. In order to obtain the final concept, subcategories and categories were discussed by research team members.

Trustworthiness

The data trustworthiness was determined based on credibility, confirmability, dependability, and transferability.[25] Credibility was fulfilled by dedicating sufficient time for data collection and analysis, as well as considering a long-term interaction with the participants. Furthermore, the member check and peer check were used for ensuring data credibility. In the member check strategy, after data analysis, credibility was checked by sending a summary of initial results to a number of the participants to determine whether or not the results were compatible with their experiences. In the peer check method, parts of some interviews and the initial codes and categories were qualitatively examined by the researchers and supervisors. To ensure confirmability, the researchers tried to remain neutralized regarding the study data and obtain their perspectives toward the findings by taking notes. In this study, the dependability was not meant to be the reproducibility of the findings in a similar design, but it was tried to include different perspectives in data analysis through the triangulation method. Data transferability was met by mentioning all the study's steps in details including participant selection, data collection methods and tools, as well as data analysis and interpretation methods.

Ethical consideration

This study was a part of a doctoral dissertation approved by Shahid Beheshti University of Medical Sciences, Tehran, Iran under the code of IR.SBMU.PHNS.REC.1399.151.[26] To observe ethical issues, either oral or written informed consent was obtained from all participants. In addition, they were explained about the research aims, interview method, confidentiality of personal information, and the right to either participate or abstain and assured that the collected data would only be used for research purposes.

Results

In this study, 22 participants were interviewed, whose demographic information has been presented in Table 1.

In the present study, 924 primary codes were identified in the initial version, which after removing duplicate codes and purification, the number of final codes reached 343. After data analyzing, as shown in Table 2, the parameters affecting hospital emergency evacuation during fire were classified into five main categories and 17 subcategories including response to incident (five subcategories of fire nature, emergency evacuation, service provision, coordination and communication; and collaboration and companionship), human factors (two subcategories of individual characteristics and competencies), hospital preparedness (three subcategories of planning, safety and security; and information management system), environmental factors (two subcategories of hospital design and infrastructure; and weather condition), and finally ethical values (five subcategories of human dignity, trust, altruism, responsibility and accountability and empathy).

Table 1: Participants' demographic characteristics in identifying factors affecting emergency evacuation of Iranian hospitals in fire

Variables	Mean/*n*	Range/percentage
Age (year)	40.7±90.41	31-53
Work experience (year)	18.7±27.29	7-30
Gender		
Male	12	55
Female	10	45
Education		
Bachelor	5	22
Master	13	60
Doctoral	4	18
Occupation		
Hospital manager	4	18
Nursing manager	5	22
Hospital disaster manager	4	18
Supervisor	4	18
Head nurse	2	20
Accreditation expert	3	14

Table 2: Codes, subcategories and main categories of the factors affecting hospital emergency evacuation during fire in Iran

Main category	Subcategory	Example of codes
Response to incident	Fire nature	Extent
		Intensity
		Location
		Smoke toxicity
		Smoke density
	Emergency evacuation	Time
		Area
		Extensity
		Type
	Service provision	Patient care and treatment
		Prioritizing patient transferring
		Discharging patients
		Visiting patients
		Providing consulting services
	Coordination and communication	Supporting organizations
		Notification
		Coordination
		Communication
	Collaboration and companionship	Collaboration between the hospital and support organizations
		Collaboration between companions and personnel
		Companionship of patients with personnel
		Companionship of companions with personnel
Human factors	Individual characteristics	The number, age, and gender of personnel
		The number, age, and gender of patients
		The number and physical strength of patients' companions
	Competency	Personnel's skills
		Personnel's experience
		Managers' attitudes
		Patient familiarity with an evacuation plan
Hospital preparedness	Planning	Exercise and drill
		Plan
		Training
		Equipment
	Safety and security	Patients' safety and security
		Personnel's safety and security
		Managers' safety and security
		Hospital's safety and security
		Companions' safety
	Information management system	Recording patients' data and medical status
		Sending patients' data and medical status
		Gathering the incident information
		Recording the incident information
Environmental factors	Hospital design and infrastructure	Hospital area
		The number of floors
		Safe location
		Emergency exit
	Weather condition	Temperature
		Weather condition
		Season
		Air pollution
Ethical values	Human dignity	Keeping patients' privacy
		Respecting staff
		Engaging patients
		Communicating with patients

Contd...

Table 2: Contd...

Main category	Subcategory	Example of codes
	Trust	Patients' trust in personnel
		Personnel's trust in companions
		Managers' trust in personnel
		Patients' trust in support organizations
	Altruism	Personnel's sacrifice
		Companions' sacrifice
		Personnel supporting of patients
		Managers supporting of personnel
	Responsibility and accountability	Personnel commitment to patients
		Accountability of managers
		Accountability of support organizations
		Accountability of personnel
	Empathy	Empathy of managers with personnel
		Empathy of personnel with patients
		Empathy of managers with patients

Response to incident

One of the main extracted categories in this study was response to incident. The participants repeatedly stated that the timing of the fire had a significant impact on the hospital emergency evacuation process. In the night shift, the number of personnel is not proportionate to patients, and managers are also not present in the hospital. On the other hand, the identification of fire location, fire control, notification, and therefore hospital evacuation are delayed during the night shift. Another important point extracted from the interviews was the importance of the extent of the fire. Thus, depending on whether the fire occurs in a single ward or in the entire hospital, emergency evacuation will be influenced.

"… The fire in our hospital was at night shift. In each ward, two nurses and one service worker were present. The supervisor who was alone had a delay in announcing the incident which started at midnight and progressed to the wards from the yard. Unfortunately, the hospital management team and firefighters had also delayed…" (Participant 5).

Human factors

"Human factors" was a main category extracted in this study. Hospital evacuation actually means the evacuation of patients and is influenced by patients' characteristics. Participants emphasized that the type of hospitalized patients affected the hospital evacuation. In fact, patients due to their diseases, limited mobility, and the therapeutic interventions received are not easy to be evacuated and need portable medical equipment, transport devices, critical medicines, and human force to move. Therefore, based on patients' condition, evacuating a hospital may need more personnel who, in addition to having a full understanding of patients' condition, are able to perform the evacuation plan while keeping calm and avoiding fear and anxiety. It was

also noted that hospital managers, as the commander, should have enough experience and expertise and be adequately aware of hospital evacuation plans during fire.

"….Sometimes, we want to evacuate infants or children… it is easy as one can evacuate two infants at the same time or hold the hands of two children and quickly take them down… or hug an infant incubator, which is light, and move it quickly… but sometimes we need to evacuate patients in the surgical and orthopedic wards, who can neither get down off the bed nor walk alone. Here, our work is difficult and time consuming, which requires more staff to be done." (Participant 4).

Hospital preparedness

This was also a main category extracted in this study and included the sub-categories of planning, safety and security, and information management system, the most important of which being hospital planning. Regarding the recent subcategory, it was noted that each hospital needs to develop its own fire evacuation plan, and hospital's personnel and managers should also receive the necessary training regarding the plan which must be accessible and continuously updated. It has also noted that hospitals can operate the hospital fire evacuation program through regular and periodic exercises to effectively upgrade the hospital's preparedness and response to disasters. The participants also emphasized on the important role of educating patients and their companions in terms of fire evacuation plan at admission to the hospital.

"… Our maneuvers and training were very effective because if we waited for emergency medical services and firefighting, it would have been a disaster…., but because our staff were trained, they acted very quickly which contained the fire …. and we moved the patients, and fortunately none of our patients or staff were harmed…" (Participant 3).

Environmental factors

According to the participants' perspectives, hospitals should have appropriate and standard emergency exit routes separately in each ward of the hospital. Emergency exit routes should be both as ramps for stretcher patients and as stairs for outpatients. It is also necessary to provide adequate ventilation and lighting in these routes. This is because during evacuation, the smoke may impair vision and delay the evacuation process. In addition, the hospital evacuation may occur during the night shift, which requires adequate lighting. The participants stated that emergency exit signs should be implemented and visible in all wards of the hospital. In addition, these signs should be clear and understandable to avoid confusion for both patients and staff.

"… Sometimes, emergency exit signs are faint and unclear, and sometimes not in the sight. In some hospitals, the word "exit" is written on emergency exit signs, this is an English word and understandable for staff, but not for an old rural man who may not even know Persian…" (Participant 1).

Values and ethical issues

Of other extracted categories was the values and morality. According to the participants, although the priority is to save the hospital residents' lives, the privacy and respect for individuals, as a human's right under any circumstance, should also be considered during emergency evacuation. The participants also noted that during fire evacuation, the needs of people especially that of patients, should be considered. As emergency evacuation of a hospital requires empathy between patients and staff, effective communication should be established with patients, and sufficient information should be provided to them. Also, patients need effective trust during an emergency evacuation.

"… During hospital fire, saving the lives of patients, staff, and companions is a very important priority for us. Nevertheless, we also should observe their dignity, but saving their lives is our main priority." (Participant 17).

Discussion

To the best of our knowledge, the present study is the first qualitative research to extract and scrutinize the factors affecting hospital emergency evacuation during fire based on managers' and administrators' experiences in Iran. Based on the findings of the present study, the nature of emergency evacuation, service provision process, coordination and communication, competency, safety and security, hospital design and infrastructure, and dignity and trust are among the most important factors in hospital emergency evacuation during fire.

The nature of the emergency evacuation process can affect hospital evacuation following fire. Our participants stated that hospital evacuation is influenced by the shift so that evacuation during the night shift is more complicated and difficult compared with the day shift. The results of a study in Japan showed that emergency evacuation during night was prolonged because of a lower number of staff in the night shift, which delayed the evacuation process as transferring patients with restricted mobility would require more personnel.[27] In a study in the United Kingdom, the performance of hospital staff in evacuating sedentary patients using transferring devices was investigated. The results showed that even with using fastest transferring equipment, evacuating the hospital took a longer time at night.[28]

Hence, it can be concluded that evacuating a hospital is under the influence of the work shift. Accordingly, hospitals should develop and exercise their evacuation plan based on different work shifts.

The participants highlighted that the hospital evacuation requires between and within organizational communication and coordination. The results of a study in India showed that coordination improved the hospital evacuation process.[29] The results of another study in the USA showed that continuous and effective coordination and communication are necessary for the evacuation process during fire.[30] The results of these studies, in line with the present study. Since evacuating a hospital is a complicated process requiring the presence of knowledgeable and skilled staff, as well as different support organizations with different duties, effective coordination and communication can facilitate the process.

It is necessary to provide necessary health care and treatment to patients and prioritize them for transferring during fire emergency evacuation of the hospital. Other studies on the emergency evacuation of patients during fire have shown that most patients need help and cannot move independently due to restriction in mobility. In fact, prioritizing patients for transferring based on their ability to move prevents the blockade of the evacuation route.[31-33] Also, the patients who need supportive measures should receive constant treatment services during translocation to a safe place.[34] This is also effective in the hospital and prehospital condition and their interaction.[35,36] On the other hand, transferring the patients hospitalized in the intensive care unit, who are medically unstable, is a riskier procedure and requires more personnel.[37] Based on the findings of the present and other studies, it is expected that in addition to transferring patients, personnel provide health care and treatment measures to patients during evacuation to avoid any harm to them.

Of other factors affecting the hospital emergency evacuation following the fire was human factors competency. Findings of this study stated that the necessity of personnel being familiar with the hospital evacuation plan and having sufficient experience and skills in procedures such as firefighting and emergency evacuation. The results of a case study in the USA showed that all healthcare providers should be aware of evacuation routes, various fire extinguishers, and how to fight against fire.[38] Regarding the results of other studies, personnel's knowledge and performance are especially important in preventing fire,[39] and educating and training personnel in terms of fire safety are among primary protective measures to prevent and encounter the hospital's fire.[40] Hence, it is essential for all health care workers to acquire fire safety knowledge.[41,42] Based on the findings of the present and other studies, it can be said that hospital staff, as the first responders during emergency evacuation following fire, should have sufficient expertise and experience

Safety and security were among other factors affecting the hospital emergency evacuation following fire. The participants believed that patient's safety was a key element to avoid any harm to patients during the evacuation process. The results of other studies have shown that patient's safety[18] and providing a safe place for patients and staff[30] are important and necessary factors during the hospital emergency evacuation. A study reported a low-moderate safety level in Iranian hospitals in disasters.[43] Also, the results of a review study revealed a moderate preparedness level for the emergency department of Iranian hospitals in disasters.[44] Considering that patient and hospital safety is of great importance and interrelated during the evacuation process, it is recommended that health managers improve the safety and preparedness of hospitals.

Another finding of this study was that the hospital design and infrastructure can affect the evacuation process. The participants stated that hospitals should have necessary infrastructures such as fire and smoke detection and alarm, as well as fire extinguishing systems. The results of a study in Iran showed a minimal safety for hospitals in case of fire, which required installing automatic fire alarm and extinguishing systems to increase hospital fire safety.[45] The results of a study in Turkey showed that having a safe place equipped with medical and nonmedical equipment was a necessity factor for any hospital to prevent disruption in patient care and treatment.[46] Furthermore, here the participants also mentioned the importance of the hospital's and its wards' design. It has been reported that flaws in the design of hospital wards can affect evacuation time,[47] so there is a need to consider patients with disabilities when designing hospitals.[48] On the other hand, a complex design of hospital buildings interferes with evacuating patients by transportation devices and leads to the blockade of the evacuation route due to overcrowding.[49] Regarding that the hospital evacuation is a complicated and difficult process, designers must consider evacuation standards and implement fire safety equipment and systems when constructing a hospital.

Human dignity was another important factor that needs to take into account during hospital emergency evacuation. The participants clarified that observing patient respect and privacy was essential during hospital evacuation. According to the results of other studies, the dignity of patients may be disregarded in health care centers by the hospital rules or staff's behavior, which may lead to negative physical and psychological consequences in them.[50] Moreover, hospital staff can help promote patients' dignity by respecting their privacy and establishing interactions in which the patient feels comfortable.[51] The results of a study in Iran showed that maintaining patient privacy and respecting their identity are necessary ethical values of human dignity.[52] Therefore, patient dignity is a necessity factor, and in addition to other factors, managers and health staff are expected to pay attention to this both in normal and emergency situations.

In this study, the participants stated that hospital evacuation needed mutual trust between personnel, managers, patients, companions, and support organizations. Trust, as an important social capital, has significant roles in emergencies and preventing their consequences. Social trust requires that firefighters and victims interact with each other. On the other hand, a delayed disaster response causes dissatisfaction and weakens social trust.[53] The results of a study in China showed that emergency evacuation in hospital fire requires trust between hospital staff and firefighters.[54] On the other hand, a low organizational trust decreases the activity of employees toward organizational goals and imposes a high level of stress and psychological pressure on them.[55] Also, other studies have shown that effective trust between patients and staff leads to better management and patient satisfaction, and this somehow depends on staff's communicational skills.[56] Hence, strengthening trust, as one of important moral values which is necessary in all conditions, in emergency situations can lead to effective coordination and communication among hospital residents and speed up the evacuation process. Finally, it is suggested that future studies identify the factors affecting hospital emergency evacuation in other emergencies and disasters, including natural disasters.

Strengths and limitations
This study was the first qualitative research to employ hospital managers' and administrators' experiences

to identify the factors affecting hospital emergency evacuation following fire in Iran. From the limitations of this study was the difficulty to reach the participants for the interview. This is because we should have chosen those with the scientific knowledge or sufficient experience in hospital emergency evacuation during fire. Another limitation of this study was the low level of cooperation of hospital administrators at the beginning of the Covid-19 pandemic due to their busy schedule and the fear of contracting the disease, which led to a difficulty in scheduling the interview and prolonged the research process.

Conclusion

The results of this study showed that in Iranian hospitals following fire, several factors such as response to the incident, hospital preparedness, moral and ethical values, and human and environmental factors affect the process of emergency evacuation. Based on the knowledge and experiences of the participants in the present study, in addition to the standard guidelines of hospital emergency evacuation after fire, the mentioned factors are also important and need to be considered. Hospitals are recommended to implement these factors to develop and exercise emergency evacuation programs to improve their preparedness in case of fire. The emergency evacuation of hospitals during fire is a complex process and requires a comprehensive and high-level preparedness. Hence, improving the preparedness of hospitals can result in a successful emergency evacuation and lower negative consequences. Therefore, health policy makers and managers can use the results of this study to design strategies and planning in order to improve hospital preparedness for emergency evacuation. On the other hand, hospitals and medical centers can use our results to identify the factors affecting emergency evacuation in their organization and improve them if necessary.

Conflicts of interest
There are no conflicts of interest.

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