A Survey of Fire Safety Management Based on the Howarth Model (Case Study: one of super Specialized Hospital in Tehran)

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Abstract

Background: Most of the global fire events have occurred due to failure in Fire Safety Management (FSM), which is the most important aspect of fire safety. Several risk assessment techniques developed in the field of fire safety management over time. This indicates a failure of the FSM. The purpose of this study is to evaluate fire safety management using the 10-item categories of the Howarth model in a Super Specialized Hospital in Tehran, Iran. Methods: This paper studies ten important factors which are used to evaluate the safety level of fire in a super Specialized Hospital in Tehran. To do it, the analytical hierarchy process (AHP) was used to rank FSM criteria based on their importance. The questionnaire was given to 15 FMS experienced fire safety experts. Data were analyzed using "Expert Selection" software. The evaluation model is suggested based on the experts' judgment. In order to test the model, a physical inspection was conducted at one of the Super Specialized Hospital in Tehran. Results: The results of studying the ten important parameters of risk management showed that the maximum weighing (0.126) was related to risk assessment and the minimum weighing (0) was related to the compliance with fire safety regulations. The total score of the ten parameters of FSM was 0.414 which indicates that the hospital was at a very low level of FSM. Conclusions: the FSM level, based on using the FSM assessment, showed that the FSM score was very low, so preventive measures are needed.

Key words: Fire Safety Management, Safety Performance, Analytic Hierarchy Process (AHP), Financial Risk

Introduction

Fire causes death, losses, and damages to the properties, society, economy, environment, and so on. According to this, managing the factors which cause such damages is called fire safety management. Heat and smoke of a fire cause direct damages to properties. Furthermore, fire causes the collapse of buildings. (UK Government, 2008) According to research conducted in Iran, in the 1970s, per one million people, 600 to 900 fire incidents have been recorded in Iran. The report says that each year about one million people is damaged by fire. However, in Iran over the past two decades, the safety level promotion against fire considerably taken into account.

Nowadays, fire safety is one of the greatest challenges facing designers and users of health care services.

The awareness deficiency, low mobility and high dependence on fixed equipment reveal the importance of patients' safety in fire events. (Charters, 1996) This is despite the fact that modern construction rules have not provided enough safe for patients in different conditions. (Ramachandran, 1999) Studies show that if safety principles were observed, 75% of fire incidents could be predicted and prevented. (Beranek, 2005) One can resemble a hospital to a floating ship so it is better to keep the patient away from the fire until the patients get out of the firing scene. Therefore, in the first step, designers and the owners of the hospitals should use methods that prevent fire. Thus, at the beginning of a fire incident, it can be detected and controlled. This way, the losses will be minimized. (Charters, 1996) Jaime Santos et al. (2001) in a study on "A Systemic Approach to Fire Safety Management" concluded that the fire safety management system not only leads to more effective fire safety management in the oil and gas industries but also each organization can benefit from safety management in The health and environment sectors. (Santos-Reyes and Beard, 2001)

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Umar et al. (2014) in a study titled "Fire Safety Management Model for the Building of Plastic Industries in Nigeria" included that the fire safety management assessment model should be used for any existing residential building and other buildings. Of course, all 10 categories of fire safety management system are acceptable for the other residential buildings. In addition, their study showed that there is a high potential risk due to the fire safety management system at the factory. (Umar et al., 2014)

Chowdhury et al. (2013) in the study of "Fire in Indian Hospitals" provided suggestions for a change in system performance that complies with the American Fire Protection Association, which is likely applicable to prevent fire in all hospitals in the developing countries with hot weather conditions. (Chowdhury, 2014)

Fire safety management is fundamentally based on mentality because one person's assessment is based on his or her knowledge and experience and it does not mean that the evaluation is good or bad. Therefore, the basis for judging the fire safety cannot be based on objective judgment because it is based on the use of certain guidelines. Therefore, to have a satisfactory subject, it should be stated with numbers, and then it can be closer to the objective judgment and a better understanding of fire safety management. (Baker et al., 2013) The management of fire safety in hospitals is a very sensitive issue, because many hospitals are controlled by national systems, and it is believed that the community through the government is responsible for the care of people who are ill for any reason. For this reason, if patients or employees are harmed by external factors such as fire, this will have a direct reflection on the quality of overall system management and health care. In addition, during the fire of hospitals, the people's lives are seriously threatened due to the lack of awareness and the immobility and disability of individuals when escaping from the hospital. On the other hand, the hospital is one of the places where its activities should not be interrupted or stopped. Meanwhile, because of the high cost of purchasing equipment, as well as their replacement problem, the financial risk of fire in a hospital is very high and of particular importance. (Cote, 1991)

Therefore, the evaluation of fire safety management in hospitals is essential, especially in developing countries, which does not pay much attention to fire safety management. Fewer studies on fire safety management have been conducted in Iran. Therefore, an assessment of fire safety management can be a better option for determining the level of fire safety. The purpose of this study is to evaluate fire safety management using the 10-item categories of the Howarth model in a Super Specialized Hospital.

Materials and Methods

This is a cross-sectional descriptive-analytic study conducted in a Super Specialized Hospital. In this study, the sample volume was evaluated using the AHP weighing index. The data were analyzed using fire safety management checklist, decision making software and the rating scale table.

To evaluate and analyze the multi-criteria decision making, different methods and models have been innovated (Karam 2005). Analytic hierarchy Process (AHP) is one of the multi-criteria methods of assessing and analyzing decision making which has a wide application in earth science and planning for space and environment. In the 1970s, the analytic hierarchy Process (AHP) was introduced by Saati (1980) and then was used by many researchers for evaluating and planning.

Howarth explains FSM as the approach or application by a policy manager, practices, information, tools, and standards to the task evaluating, analyzing and controlling fire safety. Howarth Model include often categories with short and brief definitions that covered the assumed perfect and complete range of elements included in the term, FSM. (Howarth and Kara-Zaitri, 1999) This list could be used as a classification and could go forward to potentially supersede any other, less complete, FSM model if it was robust if it captured the whole of the subject and if it could be universally accepted. The Howarth Model presents a head start in the process of categorization and eventual measurement of the subject. (Baker et al., 2013)

This study was performed on 10 groups (listed in Table 3) of fire safety management (Baker et al., 2013) and according to the corresponding comparison with the AHP judgment' scale, they were arranged in the form of a questionnaire. (Saaty, 1987) A combination of fifteen experts from various professional backgrounds with enough experience in fire safety management participated in this survey. Experts were asked to identify ten categories according to their importance. Experts' feedback was obtained using the expert selection software. Then a physical inspection of the Super Specialized Hospital was conducted using the checklist base in ten categories approved by the fire safety management. The ranking value of the physical inspection, along with the questionnaire scale, obtained for each group, its output integrated with the experts' opinion and resulted in the categories scores (**Table 1**). Afterward, the scores were summed up to determine the final score of the FSM evaluation in that hospital. The hospital staff's avoidance to cooperate is one of the limitations of this research.

Physical Observation Checklist						
Categories	Assessment criteria	Observation	Assessment Ranking			
Organization	Verify	-	-			
	-Fire safety statement in place	No	3			
	-Supporting fire safety standard	No	-			
	-Director of fire safety in the organization	No	-			
	-Fire safety manager appointed	Yes	-			
	-Quality management system in place	Yes	-			

Then ratings were determined based on their performance during the inspection. The rating scale has the verbal meaning and numerical value as shown in **Table 2**. At the last stage, the weighting of each group was multiplied by the relevant ranking value and the final score of each group was obtained. Finally, the total score showed the FSM level of the Super Specialized Hospital.

Table 2. Ranking scale with verbal meaning and numerical value

Ranking scale	Verbal meaning	Numerical value
1	Not available	0
2	Very low compliance	0.25
3	Low compliance	0.50
4	High compliance	0.75
5	Total compliance	1.00

Results

Based on the results, the weights obtained from the questionnaire analysis are shown in **Figure 1**. According to the results, among 10 categories of fire safety management, the highest weight (0.126) is for risk assessment and the lowest weight (0) related to the compliance with fire safety rules.

Assessment Rank x Weightage = Final Score					
Catagorias	Assessment rank	Categories weightage	Final score		
Categories	(A)	(C)	(A x C)		
Organization	3(0.50)	0.163	0.081		
Risk assessment	3(0.50)	0.253	0.126		
Compliance with FS regulations	1(0)	0.146	0		
Emergency plans and fire procedures	2(0.25)	0.140	0.035		
Reporting and investigating fires	4(0.75)	0.093	0.07		
Fire training	3(0.50)	0.057	0.029		
Main. Of fire equipt. (FEM)	2(0.25)	0.051	0.013		
Budget	4(0.75)	0.041	0.031		
Communication	4(0.75)	0.031	0.023		
Audit	2(0.25)	0.025	0.006		
Total	-	-	0.414		

Table 3. Summarized results of the assessment rank and weightage of the categories



Figure 1. Weightage of the categories obtained from experts' judgment

The results of the surveys showed that after summing up the total points, from 10 items of fire safety management, the Super Specialized Hospital acquired a rank of 2 with a total score of 0.414, which indicates hospital safety management level is at a very low level. According to the point between 0.25-0.49, the rating criteria have a very low compliance with fire safety management regulations (**Table 2**). The best score for fulfilling the requirements of fire safety management is between 0.75-1. In addition, the result indicates that the level of risk that hospital residents are exposed to is very high and in fire events, it may lead to a large number of casualties.

Discussion

A study was conducted in one of the super Specialized Hospital in Tehran. The results of studying the ten important parameters which affect fire safety management (FSM) showed that risk assessment with the weight of 0.126 had the most effect and compliance with fire safety regulations with the weight of 0 had the least effect on fire safety management. Finally, the total weight of the ten FSM parameters showed that the super Specialized Hospital had a very low level of safety. Santos et al. (2001) in a study on "A systemic approach to fire safety management" resulted that fire safety management system leads to the effective fire safety management in the oil and gas industries. It also leads to more effective safety, health, and environment management in other organizations and industries. (Santos-Reyes and Beard, 2017)

Aminu Umar et al. (2014) in a study on "A model of assessing fire safety management in the building of plastic industries in Nigeria" concluded that the model of assessing fire safety management can be used for all existing residential buildings and the other types of buildings, given that all the ten parameters of fire safety management system are accepted for the other residential buildings. The results of this study showed that there is a high potential risk in the fire safety management system of the plants. (Umar et al., 2014) Furthermore, Tseng Wei-Wen et al. (2011) in a study on "the performance of the small-sized hospitals based on the fire safety design" suggested that in accordance with the reaction rules and emergency management in hospitals, some engineering methods for fire safety such as shelters which are used when saving people can improve the fire safety of the small-sized hospitals. (Wei-Wen et al., 2011)

Huang De-Ching et al. (2011) in a study on "the Evacuation of Hospital on Fire during Construction" concluded that widening the door up to 2 meters can prevent the problems of evacuation of hospitals when fire happens. In this case, in comparison with a standard door with the width of 1.8 meter through which the evacuation takes 1160 to 1262 seconds (19.3 to 21 minutes), the time of evacuation decreases 10 percent and reaches 1110 seconds (about 10 minutes). They suggested that for respiratory care departments, the width of the door should be increased up to more than 2 meters. (De-Ching et al., 2011)

Kanchan Chowdhury et al. (2013) in a study on "fire in hospitals of India" suggested that the performance of the fire safety system should be changed in compliance with the U.S National Fire Protection Association. Their suggestion is applicable in all hospitals of the developing countries with hot climate as it can help with fire prevention (Chowdhury, 2014)

Fire safety management is mainly mentally based since one's evaluation is based on his knowledge and experience and it does not matter whether his evaluation is correct or incorrect. Hence, one cannot evaluate fire safety based on his objective judgment since it requires specific clues. To have a satisfying evaluation, it should be expressed numerically. This can be closer to an objective judgment and better understanding of fire safety management. (Baker et al., 2013) Ong and Suleiman in a study on "the problems of implementing fire safety management in hospitals of Malaysia" showed that in managing fire safety, these hospitals have faced problems. Among those problems were the existence of the patients' medical documents which were keeping in the hospital, flammable material, not installing fire protection equipment, using traditional safety technology, doors which were locked due to security reasons, lack of the hospital staff training and locking fire exits. The contractors of managing and maintaining hospitals should cooperate with implementing a fire safety management system in hospitals in order to achieve satisfactory results. (Ong et al., 2015)

Evaluation of the fire safety management (FSM) model components

The model's evaluation is based on 10 fire safety management categories. In fact, the inspection checklist and the questionnaire provided to the specialist were the main components of the model in which ranking and weight value were respectively obtained by the experts. The scores obtained were used to determine the safety level of a particular hospital. **Figure 2** below shows the evaluation process. (Cote, 1991)



Figure 2. Fire Safety Management Evaluation Model

Conclusion

This study was carried out to predict the fire safety management assessment model for buildings a Super Specialized Hospital in Iran. Fire safety performance analysis of the Super Specialized Hospital was performed through physical inspection based on 10 categories of FSM. According to theoretical studies, experts' surveys and physical inspections were performed and the fire safety management assessment in the building was numerically interpreted. According to the score obtained in the result, which indicates that the level of FSM in the hospital building is very low and the risk of accidents is very high, so it's necessary to preventing of accident, controlling and preventing actions as soon as possible. Therefore, the FSM assessment model in this study can also be used for other buildings, since 10 categories in the FSM system are practical for any residential building.

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Footnotes

Conflict of Interests: The authors declared that there was no conflict of interests.

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