http://www.jhpr.ir
Hosp Pract Res. 2022 Feb;7(1):23-27
doi 10.34172/hpr.2022.05
HPR
Hospital Practices and Research
Original Article

Investigating Fire Protection Condition in the Units of Imam Khomeini Hospital Tehran, Iran

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Received May 23, 2021; **Accepted** December 8, 2021; **Online Published** February 14, 2022

Abstract

Background: Various studies indicate that in many cases, fire has broken out in hospitals.

Objectives: This study aims to assess fire protection in the selected units of Imam Khomeini hospital located in Tehran, Iran in 2020.

Methods: In this descriptive-analytic study, first, a researcher-made checklist was developed for the data collection by valid scientific resources (CVI = 0.90 and CVR > 0.62). After revising and the final confirmation of reliability, the checklist was separately completed by two members of the risk management committee in 22 units of Imam Khomeini hospital, Tehran, Iran. Cronbach's weighted Kappa statistical test was calculated.

Results: The domain of Ability and Capability of Fire Prevention was 66.1%; the domain of Responsiveness was 65.1%, and the domain of Urgent Evacuation Ability was 27.3%. In the domain of Responsiveness, the highest scores were relevant to accessing fire extinguishers cylinder in the units (95.5%) and holding fire extinguishing practice courses, and doing seasonal practices with that region's fire station (90.9% for both). The highest scores in the domain of Urgent Evacuation Ability were assigned to accessing adequate ambulances to evacuate patients (90.9%) and mapping the units as well as determining patient evacuation routes when a fire breaks out (72.7%).

Conclusion: The essential protection measures should be taken in order to improve the hospitals' fire protection by better access to the exits, increasing the number of the exits and standardizing the emergency exits, enhancing the due fire extinguishing practices and hospital evacuation as well as training the staff.

Keywords: Safety, Fire, Hospitals

1. Background

Hospitals are considered the hub of the countrywide health-medical services; they are responsible for providing around-the-clock medical care throughout the week. Any kind of disruption in the hospital's functions and activities results in the health system's vulnerability.[1] Over 70% of the health budget in the countries is spent in hospitals. Hospitals are responsible for providing the highest level of care for society.[2] Hospitals and health centers have met numerous challenges in the 21st century. There are many internal, external, random, or international threats,[3] and one of the most remarkable threatening dangers to hospitals is fire. Every year, more than 8000 hospital fire cases happen worldwide. In the U.S., from 2004 to 2006, annually around 6400 cases of fire occurred in health-medical centers, which led to 1.2 deaths and 25.6 injuries in every 1000 cases of fire and $5312 economic loss in each fire. In England, from May 1994 to May 2004, 10662 cases of fire were reported totally in health-medical centers. Every year, around 500 cases of fire in hospitals cause emergency evacuation of 477 people, 65 injuries, and 2 deaths. In Kolkata hospital fire in 2011, for instance, 91 patients passed away.[4-6]

Hospital statistics from the American Hospital Association indicate a declining trend in the number of fire outbreaks, the number of hospitals, and the likelihood of hospital fires. This point indicates that when safety and risk management in hospitals increases, it is possible to decrease fire incidence.[5] The World Health Organization (WHO) has been working on hospital safety improvement programs for more than 25 years, and these efforts have led to the establishment of the regional and national policy-making committees, and developing the technical and supportive instructions for the co-working countries and organizations among the six regions of the WHO. In order to decrease hospital vulnerability, hospital safety evaluation is a giant significant step in this respect.[6]

2. Objectives

Because fire protection in hospitals and medical centers is one of the significant issues in health and medical field, the present study aims to determine fire protection in the selected units of Imam Khomeini Hospital in Tehran, Iran in 2020.

3. Methods

In this descriptive-analytical study, first off, a researcher-made checklist was developed to collect the data utilizing some valid scientific resources. To this end, by reviewing the resources and information database, the checklist items related to protecting the medical units against fire were extracted, and then by adapting these items and finding the key questions, the checklist was finalized. The checklist was designed consisting of these three areas: A) domain of Ability and Capability of Fire Prevention, B) domain of Responsiveness, and C) domain of Urgent Evacuation Ability. The content validity ratio (CVR) and content validity index (CVI) were used to qualitatively analyze the content validity of data-collection instruments, and for this reason, the questionnaire was emailed to 30 experts in the disasters and calamities field, and after constantly pursuing the matter, 17 people answered and the intended indices were calculated (CVI = 0.90 and CVR > 0.62). Then, the qualitative face validity of the researcher-made checklist was evaluated by the item impact score.

After revisions and final adaptation, for the due reliability, the checklist was separately completed by two of the risk management committee members in ten units of Imam Khomeini Hospital affiliated with Tehran University of Medical Sciences, Tehran, Iran. The weighted alpha of the statistical Kappa test was calculated. The results were interpreted based on the instructions designed by Cicchetti and Sparrow[7]. (Weak: below 40 -59, good: kappa equals 60 t- 74, excellent: kappa above 74).

4. Results

In this study, 22 hospital wards were evaluated pursuant to three domains, namely, A) domain of Ability and Capability of Fire Prevention, B) domain of Responsiveness, and C) domain of Urgent Evacuation Ability. According to the medical wards' evaluation, in the domain of Ability and Capability of Fire Prevention, the mean score of the medical wards was 66.1354, and the standard deviation was 29.75822, and in the domain of Responsiveness, the mean score of the medical wards was 65.1515, and the standard deviation was 16.96140, and in the domain of Urgent Evacuation Ability, the mean score of the medical wards was 27.3539, and the standard deviation was 19.08521.

4.1. Domain of Ability and Capability of Fire Prevention

In this domain, five questions were designed, and the questions, the number as well as the percentage of the positive and negative answers to each of them are illustrated in Table 1.

In this domain, the highest scores were relevant to the questions Regularly visiting and controlling electric devices to be in good working condition; Evaluating the extent of electric and connection system safety in the units (77.3% for both), and Managing hazardous and flammable material in medical departments (72.7%).

4.2. Domain of Responsiveness

In this domain, eight questions were designed and the questions, the percentage as well as the number of the positive and negative responses are illustrated in Table 2.

In this domain, the highest scores were related to the questions Accessing fire extinguisher cylinder in the units (95.5%); Holding periodical fire extinguishing practices; and Doing seasonal practices with the fire station of that region (90.9% for both).

4.3. Domain of Evacuation Ability

In this domain, eight questions were designed and the questions, the percentage and the number of the positive and negative responses are presented in Table 3.

The highest scores in this domain were related to the questions accessing adequate ambulances to evacuate patients (90.9%); and mapping the units and determining patient evacuation route in case of fire (72.7%).

5. Discussion

Fire in hospitals causes miserable disasters. Numerous death cases of patients take place in different countries worldwide. Fire prevention in hospitals requires fundamental measures.[8] In this study, the evaluations conducted on the score of the domain of Ability and Capability of Fire Prevention was 66.1%, which denotes that despite the accreditation of hospitals in the country,

Table 1. The domain of Ability and Capability of Fire Prevention

Questions	Number of Questions Obtained	Number (%) of Positive Responses	Number (%) of Negative Responses
Regularly visiting and controlling electric devices to be in good working condition	22	17 (77.3)	5 (22.7)
Building resistance, and the physical environment of the department against fire, and nonflammable devices and equipment	22	8 (36.4)	14 (63.6)
Managing hazardous and flammable material in medical departments	21	16 (72.7)	5 (22.7)
Evaluating the extent of electric and connection systems safety	22	17 (77.3)	5 (22.7)
Evaluating fire danger in ward and hospital regularly and periodically	22	14 (63.6)	8 (36.4)

Table 2. Domain of Responsiveness

Questions	Number of Questions Obtained	Number (%) of Positive Responses	Number (%) of Negative Responses
Assurance of fire alarm and informing systems in urgent situations	22	7 (31.8)	15 (68.2)
Accessibility and early detection (of smoke detector and fire alarm system)	21	4 918.2)	17 (77.3)
Holding periodic fire extinguishing practices	22	20 (90.9)	2 (9.1)
Ability of early respond (hospital fire station committee)	20	16 (72.7)	4 (18.2)
Accessing the fire extinguisher cylinder in the department	22	21 (95.5)	4 (4.5)
Rapid access to the fire station	22	17 (77.3)	5 (22.7)
Entering an agreement with a fire station	21	7 (31.8)	14 (63.6)
Doing seasonal practices with fire station of that region	22	20 (90.9)	2 (9.1)

Table 3. Evacuation Domain

Questions	Number of Questions Obtained	Number (%) of Positive Responses	Number (%) of Negative Responses
The ratio of the number of nurses to the number of patients for evacuating the department	21	2 (9.1)	19 (86.4)
Number of adequate equipment for evacuating patients (the number of stretchers, wheelchairs)	22	3 (13.6)	19 (86.4)
Access to emergency exits	22	13 (59.1)	9 (40.9)
Access to a safe location to temporarily accommodate the patients	22	6 (27.3)	16 (72.7)
Periodically practicing the department evacuation	22	3 (13.6)	19 (86.4)
Access to a sufficient number of ambulances to evacuate patients	22	20 (90.9)	2 (9.1)
Developing a plan to evacuate the department and patients	21	3 (13.6)	18 (81.8)
Mapping the department and determining routes of evacuating patients in case of fire	22	16 (72.7)	6 (27.3)

they are still not reaching the standards. It is necessary to develop plans for the enhancement of early fire detection systems in hospitals in order to increase fire prevention ability.

In an analysis performed in 2021 to determine the factors affecting fire risk in a hospital in Qazvin, lack of smart fire detection and extinguishing systems were reported as the most important causes of fire.[9] According to the results of a systematic review and the meta-analysis of patient safety, the performance of Iranian hospitals in terms of vital patient safety standards shows a declining trend over time. In order to become a patient-friendly hospital, it is recommended that hospital managers benefit from the valuable experiences provided by the WHO.[10]

The present study which was conducted to evaluate fire risk of hospitals using fire risk engineering, the results revealed that the safety condition of the medical units in three levels of building, staff and patients, and working processes was on a minimum level. In order to increase the fire prevention ability, the executive suggestions include installing powder and gas fire extinguishers in a sufficient number and proper place, installing fireboxes in hospital stories and inspecting them regularly and periodically, using an automatic fire alarm and extinguisher systems, providing necessary training on fire protection, providing inspection checklists and periodically examining the building's electric installations.[11] In a systematic review and meta-analysis of fire safety in the hospitals in Asia, the results displayed that the three factors of proper

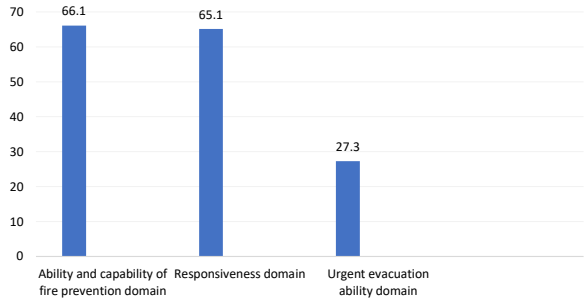

Figure 1. Scores of fire safety assessment areas

management, legal support and financial support have a significant impact on increasing fire safety in the hospitals in Asia.[12]

Another finding of this study is responsiveness during the fire in the hospital. The results displayed that assurance of alarm and informing systems in urgent situations is available in 31% of medical departments and regarding access and early detection capability (smoke detector system and fire alarm) is available in 18.2% of ValiAsr hospital wards in Imam Khomeini hospital. A fire alarm system is a system designed for automatic detection of fire through heat, flame, light, or other products resulting from fire detected by an information control center and while processing information, a fire incidence is announced by a variety of alarming devices semi-automatically or automatically. As per article 93 of fire prevention and fighting regulation in workshops, portable extinguishing

equipment appropriate to the type of probable fire has to be available in hospital buildings and their surroundings and easily accessible.[13]

In the domain of Ability and Capability of Evacuating the Medical Wards, the results of this study demonstrated that there is 59.1% of accessing emergency exits in hospital wards, but the time required to evacuate patients is not calculated and this issue is absolutely crucial for the appropriate and safe evacuation of medical wards. In the review study conducted by Shokouhi et al on the criteria of preventing fire damage, accessing a safe route to evacuate people in an urgent situation to decrease fire-induced life damage is stated. Predicting people's movement while evacuating in emergency is an important part of function-based analysis and the building design.[14]

The obtained results of our study demonstrated that in medical wards, in terms of the appropriateness of nurse-to-patient ratio for the ward evacuation, the percentage of 9.1% was achieved. Adequacy of sufficient equipment to evacuate patients (number of stretchers and wheelchairs) was present in only 13.6% of wards. There was no access to the sufficient number of ambulances for patients' evacuation in most medical wards (90.9%). In numerous studies, the availability of patients handling equipment, the accessibility of personnel, the accessibility of road and safe transportation, the inter-organizational and intra-organizational contacts and coordination for a successful process of emergency evacuation have been emphasized.[14-19]

Regarding the periodic ward evacuation practices, only 13.6% of the wards implemented them according to the necessary standards. Practicing and training are the influential factors on the staff functioning in hospital, especially, during the fire in hospital this point is more important. Conducting the due practices in a hospital is one of the fundamental principles of risk management.[20]

In a study conducted on medical students, the results showed that it is necessary to design educational content and practice in the field of risk management in the hospital.[21]

5.1. Limitations

One of the limitations of the current study is the reluctance and lack of cooperation in data collection mentioned during the research process.

6. Conclusion

Unfortunately, due to the managerial and budgetary challenges in the hospital, the issue known as fire safety in the hospital does not receive the required attention, and the hospital management has to closely focus on this matter. It is suggested that risk management measures in the hospital be considered more carefully and subtly about fire safety and efforts should be made to increase the expected score in this area.

Research Highlights

What Is Already Known?

Hospitals are exposed to many hazards. Fire is the most common incident in hospitals. Hospital fires are a significant threat to the lives of patients and staff. Numerous cases are involved in the occurrence of hospital fires. Identifying fire safety in the hospital is an important factor in patient safety and medical equipment maintenance.

What Does This Study Add?

In this study, fire safety assessment of hospital wards was performed in the areas of fire prevention ability, response and evacuation capabilities. Hospitals should be planned. Due to a lack of budget, fire safety in hospitals is not always necessary.

Authors' Contributions

MF, and TY contributed to the conception and design of this article. MF and AOT contributed to the analysis and interpretation. MF and AA were involved in the statistical analysis. MF and TY performed the writing and provided critical revision to this paper. AOT presented the final approval for this article. All authors agree to be accountable for all aspects of the work.

Conflict of Interest Disclosures

No conflicts of interest were declared in this study.

Ethical Approval

The protocol of the study was approved by the ethical committee of Tehran University of Medical Sciences, Tehran, Iran under IR.TUMS.CHMC.REC.1399.117 code.

Funding/Support

Current study was supported by Tehran University of Medical Sciences, Tehran, Iran.

Acknowledgments

The authors express their appreciation and gratitude to the Clinical Research Development Unit of the Pediatric Medical Center of Tehran University of Medical Sciences, Tehran, Iran for their support and cooperation in conducting this study.

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