RESEARCH ARTICLE

•Arch Hyg Sci 2016;5(4): 245-253
•Journal Homepage: http://jhygiene.muq.ac.ir

Assessment of Safety Condition in One of the Teaching Hospitals in Kermanshah (2015): A Case Study

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A-R-T-I-C-L-EI-N-F-O

Article Notes:
Received: Mar 4, 2016
Received in revised form: May 23, 2016
Accepted: Jul 25, 2016
Available Online: Sep 25, 2016

Keywords:
Safety
Hospital
Fire
Crisis
National Building Regulations
Kermanshah
Iran

A-B-S-T-R-A-C-T

Background & Aims of the Study: Many working conditions-related stress factors that can produce injuries and illnesses are important in hospital environments. So, the health and safety of nurses and patients from workplace-induced injuries and illnesses is important. In this study, we have assessed the safety condition of one of the teaching hospitals in Kermanshah (2015).

Materials and Methods: This descriptive and cross-sectional study was conducted in one of the teaching hospital of Kermanshah University of medical sciences. For this aim a checklist was prepared based on the Occupational Safety and Health Administration's standards and Part 3 of the manual of National Building Regulations. These checklists comprised (The final checklist had 239 questions of 9 dimensions) various sections of safety including; fire safety, building safety, electrical safety, emergency exit routes safety, heating and cooling equipment safety, operating room and laundry room and salty home safety. Eventually, using SPSS 16 and descriptive statistics, data were analyzed.

Results: According to the results of this study, 66.6% of the units had poor safety and 33.4% of them were moderately safe. As well as, only ICU and CCU unit, heating and cooling equipment and operational room showed moderate compliance with safety requirements and other sections were poorly complied.

Conclusion: The results of this study showed that safety conditions of hospital were not at favorable level. These poor safety statues can jeopardize patients and hospital personnel. Thus some interventions such as improvement of working conditions, compliance with safety acts and implementation of health, safety and environmental management system would be necessary.

Please cite this article as: Ghanbari Kakavand M, Rostami E, Poursadeghiyan M, Abbasi M, Omidianidost A, Avakh A, Yarmohammadi H. Assessment of Safety Condition in One of the Teaching Hospitals in Kermanshah (2015): A Case Study. Arch Hyg Sci 2016;5(4):245-253.

Background

The means of safety is relative freedom from danger, risk or threat of harm, injury or loss to employees and property whether caused accidently or by deliberate phenomenon (1). In other words it means a series of acts, regulations and activities aimed to prevent and reduce accidents by eliminating or controlling the risks (2). Nowadays, the variety of risks are often so high that practically compensation of its consequences is impossible, thus, safety science has adopted a proactive approach (3,4). One of the noteworthy characteristics of this

science is its function, in a way; it focuses on all involved elements at all stages of identification, assessment and control. Main elements of the safety system are including personnel, equipment, materials and the environment (5). In all organizations, especially those which provide immediate service to community, an environment in which damage and injuries don't threat employees and visitors is required (6). Hospitals like another workplace have some risk for staff and property, for example it has been reported that approximately 650 surgical fires are reported in US hospitals each year (7). So the hospital staff should attempt to protect themselves from hospital related risk and also to provide a safe environment for patients (8). In relation to the hospital accidents, it is clear that the hospitals are threatening in two area, first is the accidents that occur within the hospitals environment including (9); firings, explosions, ionizing and laser radiation, chemical events, burst in water pipes, oxygen cylinders and boilers and second area is external factors such as earthquake, flood, tornado, hurricane, lightning, etc. that this accidents can affect first group adversely (10). The Calcutta hospital firing in India, which killed 89 people (85 patients and 4 staffs), is an obvious sample of hospital accidents (11). Hospitals safety is one of the most important components of improved management of medical units, which is important due to its economical and ethical aspects. Compliance with safety and hygiene principles in hospitals can lead to an increase in the effectiveness of activities, performance and finally productivity (12). The slogan of World Health Day in 2009 entitled in "Immunization hospitals for emergency conditions" emphasized on safety issues of hospitals (2). In this regard, attention to safety of hospitals as a most important health care service and due to its critical role in response to emergency conditions is of great importance. In other words, hospitals must provide a secure environment to protect the health of patients and staff, as well as, it must have necessary preparation to fulfill their mission in an emergency situations without jeopardizing the health and safety of their employees and patients (13). Hence, building a safe hospital that in the cases of emergency disasters could maintain its efficiency and performance is of high importance. As well as, determining the current level of safety of hospitals is as an important step in the risk reduction strategy (14). As well as immunization and compliance with safety requirements in hospitals is of particular importance and assessment of safety level of hospitals to improve it is necessary (15).

Aims of the study:

Therefore, this study was done to assess the safety condition of one of the teaching hospitals in Kermanshah

Materials & Methods

This descriptive and cross-sectional study was conducted in a teaching hospital in the city of Kermanshah in 2015. In the first stage of this study, some checklist were prepared based on the Occupational Safety and Health Administration's (OSHA) standards and Part 3 of the manual of National Building Regulations (NBR) and as well as occupational health specialists opinions. These checklists comprised various sections of safety including; fire safety, building safety, electrical safety, emergency exit routes, heating and cooling equipment safety, operating room and laundry room and salty home safety. The final checklist had 239 questions, of which 55 questions was about safety of buildings, 21 questions about fire safety, 23 question about electrical safety, 25 safety questions about clothes washers unit, 16 questions about safety of ICU and CCU, 21 questions about safety of heating and cooling equipment, 19 questions about safety of emergency exit equipment, 40 questions about power house safety and 19 questions about operating room safety. Since these checklists are designed based on OSHA and NBR context,

they are valid and reliable. To collect required information, the researchers went to the hospital and completed checklist through observation and interviews with official staff, and by inspection of documents and recorded information. This checklist included239 questions with a two point Likert scale (0 = Compliance with standards, 1 = Non-compliance with the standard).Finally, compliance rate with safety requirements for each aspect was calculated by dividing the obtained scores for each aspect divided to the total scores multiplied by 100.

$$\text{compliance rate with safety requirements} = \frac{\text{obtained scores for each section}}{\text{total scores for all sections}} \times 100$$

The final score of safety Level of hospitals categorized into the following levels: low level (less than 50 percent), medium (50-75 percent), medium (20-28), and favorable (75-100 percent). Finally, in relation with fire safety, fire load in hospital wards was calculated. Fire load is an important parameter in determining the growth and severity of fires. The volume of different types of material are calculated (in m^3) and multiplied by its density to get its mass (in kg). This value is then multiplied by its calorific value (in MJ/kg) to get the fire load. This value divided by the floor area gives the fire load density of a compartment as shown in the equation (1)

$$qc = \frac{\Sigma mv \times Hv}{Af} \quad (1)$$

Where q_c = fire load density (in MJ/m^2); Af = floor area (in m^2); mv = total mass of the combustible material (in kg) and Hv= calorific value of the combustible material (in MJ/kg) (16).

Finally, gathered data were analyzed by SPSS 16 and EXCEL.

Results

In this study safety status of 9 various aspects of one of the teaching hospital in Kermanshah province were assessed. Based on the obtained results, ICU and CCU unit had the highest percentage of safety. On the other hand, emergency exit routes had lowest rate of compliancy with safety requirements mentioned in OSHA and NBR acts. Among all studied aspect of safety only ICU and CCU unit, heating and cooling equipment and operational room showed moderate compliance with safety requirements and other sections were poor. More detailed information is presented in a table 1.

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Table 1) Compliance rate with safety requirementsaccording to various aspects of safety

row	Safety	Safety percent	Safety statues
1	Building	36.36	Poor
2	Fire	47.61	Poor
3	Electricity	43.47	Poor
4	Clothing washing house	36	Poor
5	ICU and CCU unit	68.5	Moderate
6	Heating and cooling equipment	57.1	Moderate
7	Emergency exit routes	31.5	Poor
8	Powerhouse	47.5	Poor
9	Operational room	63.1	Moderate

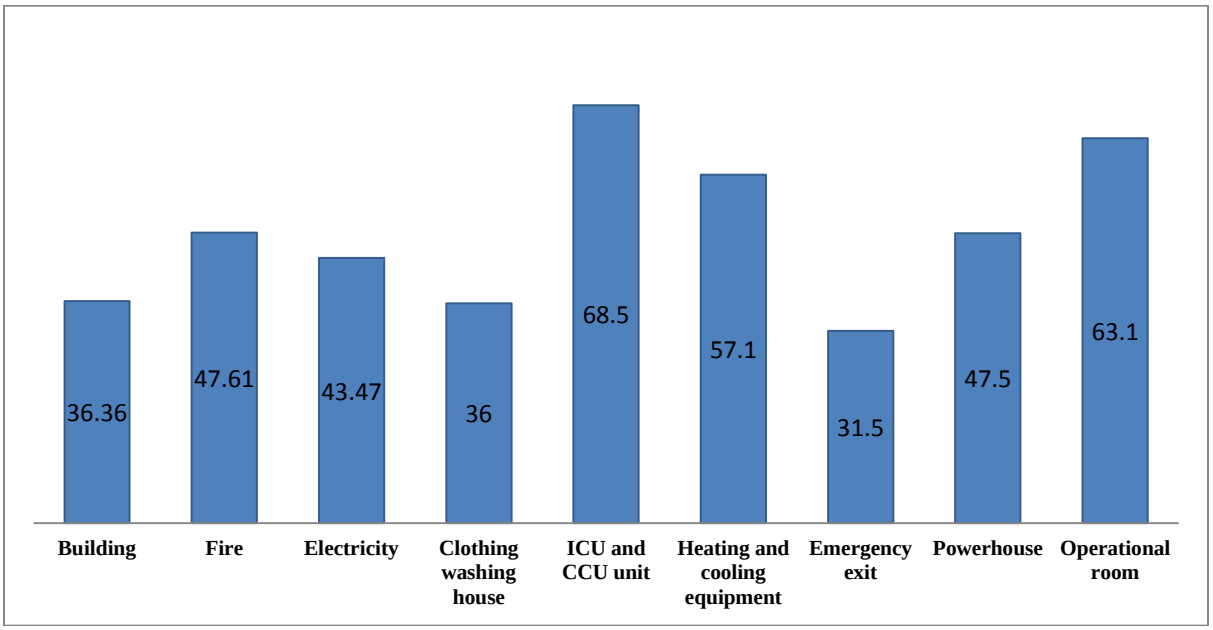

Figure 1) Percentage of compliance with safety requirements in all sections

According to the result, 66.6% of the units had poor safety and 33.4% of the units were moderately safe. As well as, the hospital had not favorable safety score in any of different aspects of safety.In other words, it can be said that safety statues of hospital was unfavorable.

As shown in fig 1, it can be said that hospital is not a safe environment for both of staff and patients because from the point of view of safetyit is not designed in accordance with safety requirements. Thus, if an accident happens, all the people that are present at the hospital are at risk. As well as, because of infrastructure problems in the design of hospital and failure to comply with safety requirements, the properties and equipment may be damaged due to possible accidents such as fire or earthquake.

According to Table 2, all evaluated points in terms of fire load density are at first category of fire risk. Accordingtothe inspection of emergency ward, the numbers of fire extinguishers in emergency ward was as follow:

Three CO_2 capsules with weight of 6 kg,

Three capsule containing fire extinguishing powder and gas weight of 12 kg and,

Four water-gascapsules with weight of 10 kg

According to the fire density and NFPA10 standard, amended numbers of fire extinguishers in emergency ward should be as follow:

Table 2) Determination of fire load density in emergency ward

Raw	Firing load	Status
room physician	5.32	Low risk
ECG room	2.75	Low risk
drugs stock	19.16	Low risk
records stock	23.33	Low risk
Admitted part 1	14.33	Low risk
Admitted part 2	7.38	Low risk
Admitted part 3	25.31	Low risk
Reception room	12.38	Low risk
teaching class	12.16	Low risk
Gentlemen pavilion	12.32	Low risk
Ladies Pavilion	19	Low risk
Nurse station	36.5	Low risk
Isolation room	2.84	Low risk

Note: density range size into three categories: low risk (0-50), medium (50-100), high risk (100-150)(17).

Table 3) The number and weight of fire extinguishers in separation ofvarious type in emergency ward

Capsule type	Numbers	Weight(KG)
CO_2	3	6
powder and gas	2	18
water and gas	1	10

Table 4) Identified safety risks in the studied sections of hospital

Safety	Hazards
Building	1. Atrium staircase separating doors was not self-closed and had no interlock 2. Lack of foresight for emergency exit routes 3. Lack of fire alarm system in the building 4. Lack of water-based fire extinguishing network in building 5. Separator doors was not resistant to the fire 6. Evacuation routes from building were not directly connected to the general paths 7. Inadequate capacity to emergency evacuation routes due to insufficient lighting on the route
Fire	1. The hydrostatic test for capsules was not performed 2. fire extinguishers was not easily accessible 3. Locations of firefighting equipment was undefined 4. Inappropriate sort of fire extinguishers installation 5. Lack of adequate training courses about fire extinguishers for all staff 6. lack of alternative in case of charging the capsule 7. Lack of responsible expert person for inspection of fire extinguishers 8. Lack of a routine schedule for inspections of capsule 9. Lack of recorded documentations for firefighting equipment
Electricity	1. Lack of earthing system when working on machine 2. Lack of CPR training program and first-aid training for the repairmen 3. Lack of certification for grounding systems
Laundry services	1. Slippery floor of LAUNDRY services 2. Lack of resistant roof and walls against moisture 3. Lack of separation of duties and responsibilities. 4. Lack of safety training course for staff 5. Lack of laundry unit map 6. Lack of emergency exit route 7. Lack of appropriate fire alarm system 8. Lack of resistant material against fire on walls 9. Inappropriate sort of tools and equipment 10. Lack of anti-spark lamp 11. Lack of ventilation and air-conditioning equipment
ICU and CCU unit	1. Lack of proper labeling for each groups of staff and patient 2. Possibility of falling of subjects on patients 3. Failure in using personal protective equipment
Heating and cooling equipment	1. Use of electric heater locally 2. Use of fuel heaters for heating the space 3. Lake of blocking valves for input channels 4. Lack of insulation of channel walls with thermal insulation coating 5. Lack of map for ventilation, cooling and heating system 6. Lack of schedule program for inspection of heating, cooling and ventilation systems 7. Applying electromotor fan that was not anti-sparking
emergency exit	1. lack of certain map of emergency exits route for any unit of the building 2. Lack of emergency exit signs in any unit 3. Lack of necessary training course and proper procedure for emergency responses 4. Lack of exit doors at regular distance 5. Lack of emergency exits labeling 6. lack of sufficient exit door 7. Existence of obstacles in the exit routes
Powerhouse	1. Lack of emergency exit doors 2. Lack of proper color code for Pipe 3. Lack of proper sealing pipes leakage 4. Unfavorable thickness of walls covering plaster 5. Lack of separate system for timely amputation of gas, electricity, water 6. Lack of sewage discharge path for powerhouse 7. Lack of an appropriate fire alarm system 8. Lack of emergency lighting system 9. Lack of electricity board's map 10. Inappropriate earthing system 11. lack of training for qualified people for the maintenance and repairing of system
Operation room	1. lack of emergency exit routes 2. Inappropriate material for covering floor (electrostatic) 3. Insufficient and disproportionate fire extinguisher 4. lack of training for operating room staff to cope and deal with events 5. Mounted lamps in the operating room was not anti-spark

Discussion

According to the result, 66.6% of the units had poor safety and 33.4% of the units were moderately safe. In a study in educational hospitals of Kordistan University of medical science it was shown that only one hospital had good safety and 20-30% of them had weak and moderate safety (18). Another study in Shiraz showed that hospitals had low level of safety, particularly in related to management safety and emergency response plan (2). In the current study, in the ICU ward, 68.5% compliance with safety requirements was obtained and this unit was moderately safe. In the Khaloei et al. study special parts including intensive care units, operating rooms and CCU were evaluated favorable, but less than three-quarters (72.7%) of these units had safe condition (5). Since ICU patients are often dependent on special care equipment and services, it is necessary to provide the best condition of safety (17). Of the other special units of the hospitals is operating room. In this study 63.1% of safety requirements were considered which was at the moderate safety level (5). In a study by Khaloei et.al safety level of operating room was in favorable level, according to the moderate level of the safety status of hospital in present study and as well as, given that operating room is one of the main units of hospital it is necessary to focus on the safety of this unit (5). Evaluating of teaching hospitals of Tehran University of Medical Sciences in 2011 showed that 84.9% of operating rooms were appropriately safe (18). The results of this study was consistent with ours. Other sections of hospital such as laundry, kitchen and technical department plays an important role in safety of patients, staff and facilities, but unfortunately, in the present study these sections were at a low level of safety. In the Khaloei and colleagues study, the safety situation in supportive units was evaluated relatively favorable. The results of this study showed that, the level of safety in central sterilization unit and in the laundry is relatively favorable. In a study conducted in hospitals in Kurdistan, none of the medical centers in their laundry unit, had a good safety (5) which is consistent with the current study. In this study, fire safety was 47.6% that consider as poor level. As well as, fire load in all emergency units was at low-risk area. In the Khaloei et.al study, the fire safety was unfavorable in three-quarters unit sand in another it was evaluated relatively favorable (5). However, the fire safety is one of the most important challenges that designers are facing. According to data published by the National Fire Protection in 2005, in average more than 8,000 hospital fires occurs per year (19). In another study, the safety and prevention status of one of the teaching hospitals of Tehran University of Medical Sciences, the was evaluated as very poor (20). The most important fire safety problems in this study was: lack of performing hydrostatic test for capsules, firefighting equipment were not readily visible and accessible, the location of manual fire distinguishers was not properly mounted, lack of adequate training to all staff about fire distinguishers equipment, lack of viable alternative when charging capsules, lack of a responsible for the inspection of fire-fighting equipment, lack of monthly inspection programs for capsules and sprinkler system has not been used. It is suggested that in some areas such as kitchen which fire possibility is high sprinkler system should be used. The key problem in the present study was the lack of grounding system when working on electrical devices, lack of adequate training about CPR and first aid in electrical technicians and lack of an efficient earthing system (21). In the 1994, Northridge earthquake in California, disruption of power was causes of 14 hospital discharge (22). Also due to the use of several electrical equipment in hospitals, considering the principles of electrical safety for prevention from electric shock and fires caused by defects in electronic systems is of particular

importance. in the present study, at the emergency exit routes, lack of emergency exit routes maps for each floor of the building, emergency exit signs and lack of bright source of light on top of emergency exits were such as defects in this section. In the study of emergency exit route which was conducted at teaching hospitals of Iran University of Medical Sciences it is shown that in all hospitals, emergency exit route signs were determined, but sings and boards were not clearly defined (23). Malekshahi and colleagues concluded that 90% of units of Khorramabad hospitals' had an entering-exit door and in the remaining 10% these doors were locked (24). In this study, it is conducted that in the heating and cooling system unit, there were problems such as use of electric heaters locally, use of fuel heater for heating, lack of blocking valves for input channel, lack of insulation of walls by thermal insulation coating, lack of an overall map of ventilation, cooling and heating system, lack of schedule for inspection of heating, cooling and ventilation systems (25). Amini Qazvini concluded that it is necessary to install this equipment appropriately and they must be tackled to the ceiling or wall (26). However, due to different survey instruments and various ranking of safety parameters it is not possible to perform an accurate comparison between these studies with ours. According to the results, the safety situation in studied hospital in Kermanshah was at poor level and in some cases was evaluated as moderate. The most important reason may be undefined responsibilities and lack of organizational infra structures of safety. Thus, it is necessary to implement an efficient occupational health and safety management system to improve safety condition in hospital. According to the importance of applying safety standards at the medical centers, giving attention to the management and structure of medical centers is required. To maintenance and improvement of health of patients and staff and protection of property, greater attention to safety principle in hospitals is of great importance (5).

Conclusion

The results of this study showed that safety statue in most of hospital sections is not at favorable level. These poor safety statues can jeopardize patients and hospital personnel. Thus in order to, reduce these risks and improve safety, interventions such as improvement of working conditions, compliance with safety acts, implementation of emergency response plan, regular monitoring and targeted safety, designation of workplace based on safety and implementation of health, safety and environmental management system would be necessary. We suggested the ergonomic condition is done in this hospital (27).

Footnotes

Acknowledgments:
This study was supported by grant sponsor number 92080, from Students research Committee, Kermanshah University of Medical Sciences.

Conflict of Interest:
The authors declared no conflict of interest.

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