ORIGINAL ARTICLE

Hospital Occupational Safety and Health Risk Assessment

BEHZAD SARANJAM[1], LEILA NAGHIZADEH[1], ELNAZ RAHIMI[1], MOZHGAN ETEMAD [1], BAHRAM KOUHNAVARD[2], ZEINAB MOSAVIANASL[2], AMIN BABAEI POUYA[1]

[1]Department of Occupational Health Engineering, School of Health, Ardabil University of Medical Sciences, Ardabil, Iran

[2] Student Research Committee, Larestan University of Medical Sciences, Larestan, Iran.

Correspondence to Dr. Amin Babaei-Pouya, Email: amiin.pouya@yahoo.com Tel: +984533513775

ABSTRACT

Background: Safety in hospitals is highly important for economic, human, and ethical viewpoints. Risk management in hospitals is a measure to lower the risk and frequency of preventable accidents.

Aim: To assess occupational safety and health risks in educational hospitals using the HOSHRA index in 2019.

Methods: The study was carried out using a cross-sectional method in 24 wards of four Ardabil-based educational hospitals in 2019. The data were collected using the HOSHRA checklist and analyzed using the recommended formulas.

Results: The highest obtained score in the physical factors field was for radiation subgroup and the lowest score was for chemical factors. The scores of chemical, ergonomic, psychological, physical, and biological hazards were at moderate level.

Conclusion: The highest level of safety level in the hospitals under study was in the physical factors field and in radiation subgroup and the lowest safety level was with chemical hazards. The assessment of chemical, ergonomic, psychological, physical, and biological risks showed that the risk level was not acceptable and further modifications were needed in the future.

Keywords: occupational safety and health, hospitals, HOSHRA method

INTRODUCTION

Safety risk is the probability of an accident. The higher the probability, the higher the risk[1]. Risk management in health cares refers to a wide range of measures to improve quality of and guarantee safety of services to patients[2]. The health-therapeutic organizations are in charge of providing services to care-seekers and ensure a safe environment for patients and personnel[3]. The care environment is comprised of three factors, namely buildings, equipment, and personnel and these factors are effective in creating a sense of peace and relaxation for patients, families, and personnel[4]. Since, hospital environment and the type of works in it are characterized with many risks, risk assessment programs can improve efficiency and efficacy of the services [5-6]. Different studies have emphasized on the necessity of using risk management in clinical programs and diagnosing and imaging services in hospital[7]. Safety in hospital is highly imperative for economic, humanistic, and ethical viewpoints. Risk management in hospital is a measure to decrease incidence and frequency of preventable accidents[8]. The WHO has emphasized on the necessity of implementing risk management programs in hospitals so that such programs are of the factors in the success of hospitals in realizing the motto of “health for all.” Several studies have highlighted the necessity of using risk management in hospitals[9-11]. In many countries, hospitals represent a major part of health and treatment centers and attract the main part of health and treatment costs. The main health risks in hospitals are rooted in the failure to implement health regulation and professional hazardous factors like physical, chemical, biological, ergonomic, and psychological factors. All patients, visitors, personnel, and the whole society are faced with these risks[12]. There are several methods for identifying and assessing risks. Choosing the right method to conduct a risk assessment in an organization or industry depends on a variety of factors like the objective of risk assessment, type of the expected results, type of information available, and time and stage of assessment[13-14]. To detect risks in hospital, risk assessment methods that encompass all potential risks in health centers are recommended.

Hospital occupational safety and health risk assessment (HOSHRA) were introduced by Jahangiri et al. (2015)[15]. This index categorized potential risk in health and therapeutic centers in five fields of physical hazards, biological hazards, ergonomic hazards, chemical hazards, and psychological hazards. This method is a good choice for risk assessment given its quantitative nature, novelty, and inclusion of all occupational risk factors. Several studies have been conducted on hospital hazard risk assessment using different methods. Still, there is no such study using the novel HOSHRA method. Thereby, the present study was an attempt to assess occupational safety and health risks in educational hospitals using HOSHRA in 2019.

METHODS

The study was carried out as a descriptive cross-sectional study in 24 wards of four Ardabil-based educational hospitals in 2019. Data collection was done using the HOSHRA checklist by two occupational health experts. Data analysis was done using the available formulas. The HOSHRA index was introduced by Mostafavi and Jahangiri in 2015[15]. The index categorizes potential risks in hospitals in five categories:

1. Physical hazards (PHH) including the subgroups electrical shock (ELH), fire and explosion hazard (FEH), feel and sleep hazard (FSH), and radiation hazard (RH).
2. Chemical hazards (CH) including the subgroups exposure to acid and base materials, exposure to

alcohol, ether, and formaldehyde, and exposure to detergents.
3. Biological hazards (BH) including needle stick hazards, hospital waste hazards, and infectious disease hazards.
4. Ergonomic hazards (ERH) including musculoskeletal problems and environmental condition.
5. Psychological hazards (PSH) including violence, work shifts, and job stress.

To calculate the total HOSHRA score, the score of each question in the checklist is determined first. To calculate the score of each one of the questions, the checklists were filled out for 10 workstations, wards or individuals and scores were determined as dashes either in safe or unsafe columns. Afterwards, the score of each question was determined as follows:

- One to three dashes in the safe column: score =0 (failure to observe safety codes);
- Four to seven dashes in the safe column: score =1 (imperfect safety);
- More than seven dashes in the safe column: score = 2 (perfect safety);

The final score for each category is obtained as follows:

$$N = \frac{\sum x_i n_i}{\sum 2\, n_i} \times 100$$

Where, N is the final score for a category; n_i is the importance factor; and x_i is the obtained score.

Total score of HOSHRA was obtained as the sum of scores of all categories (physical, chemical, biological, ergonomic, and psychological factors).

$$HOSHRA = (N_{PHH} \times 0.107) + (N_{CHH} \times 0.120) + (N_{BIH} \times 0.341) + (N_{ERH} \times 0.243) + (N_{PSH} \times 0.183)$$

Table 1 lists the final score of HOSHRA index.

Table 1- Hazard risk level

Status	Measures	Risk level	Score
Unacceptable	Stopping the activity	Very high risk	0-35
Unacceptable	Urgent and fundamental changes	High risk	36-65
Unacceptable	Changes are necessary in the near future	Moderate risk	66-100
Acceptable	Preserving status cue and continuous monitoring	Acceptable risk	100<

Ardabil University of Medical Sciences issued a permission and ethical code for the study and all ethical requirements were observed.

RESULTS

The highest score was obtained in the physical factors field (radiation subgroup)and the lowest score was obtained for the chemical factors. The obtained scores of chemical, ergonomic, psychological, physical, and biological hazard risks were at a moderate level (Diagram 1). All the identified risks were at moderate levels, which were unacceptable and needed changes in the near future.

The obtained score for chemical hazards was 69.95 and the majority of identifying problems were about the ineffective general ventilation system, ineffective room ventilation (hood) where chemicals are used, lack of or non-functional showers and emergency eyewashes, unsafe storage of chemicals, and unreadable labelson chemical containers.

In terms of ergonomic hazards, the obtained score was equal to 74.47. The toughest problems were with ergonomic hazards, non-adjustable tables, improper chair height and cushion for user, non-standard shape, weight, and dimension of objects that must be carried(load safety standards), non-standard moisture level, lack of light coverage to avoid direct or indirect glare vision.

As to psychological hazards, the obtained score was 77.50. The main risks in this field were about the lack of a daycare for children in hospital, lack of an alarm button to call for help in the case of violence, lack of awareness in the personnel about safety alarm, and lack of rotating work process.

With regard to biological hazards, the obtained score was 88.38. The main problems were in biological hazard categoriesincluding lack of filtration in general ventilation of microbiology labs, no education about safe injection, failure to replace plastic tube with glass tubes, lack of AD syringes for vaccination, lack of coverage for sharp and pointy objects, failed to monitor biological hoods, no quarantine room for infectious diseases, failure to use needle clipper to remove surgical sutures from the scalpel.

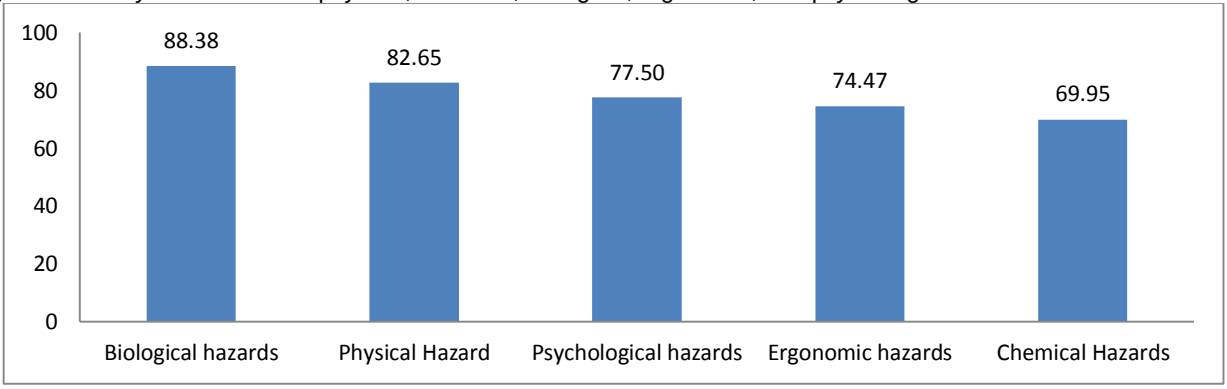
In terms of physical hazards and the subgroup electrical shock the obtained score was 77.28. The main area of the problem were with no earthing system for the general grid, emergency power system, and central power room; failure to check earth system resistance by authorized personnel periodically;lack of safety switch for electrical equipment; no electricity insulation on the floor near power panels;and failure to use lock out/tag out to service electrical equipment.

In addition, the obtained score of the fire and explosion subgroup of physical hazard was 80.66. The main problems in this subgroup were lack of emergency calls in elevators, lack of fireproof doors and walls, lack of smock ducts to prevent penetration of smoke and flames into floors, lack of fireboxes, no fire resistant construction, no fire extinguisher system, no firefight team in the hospitals, failure to hold firefighting practice over the past six months.

Moreover, the score of a subgroup of fall and slip hazard was equal to 76.52. The main hazards in this subcategory were about lack of safety signs for slippery surfaces, no safety signs on staircases, no sign to alarm changes in surface height, failure to use safe shoes for slippery surfaces, non-standard surface to create adequate friction force and prevent slippage, failure to use warning signs and barrier while the floors are washed, and failure to use suitable materials for surfaces to create adequate friction on moist surfaces.

Additionally, the obtained score for the subgroup radiation in physical hazard category was equal to 92.50. The main problems in the radiation subgroup were failure to collect and dispose of radioactive wastes based on the instructions by the Nuclear Energy Organization of Iran, and failure to check surface contaminations on a routine basis.

Diagram 1- Safety level indices of physical, chemical, biological, ergonomic, and psychological hazards



DISCUSSION

The highest level of safety was found in the physical hazard field and the subgroup radiation; while the lowest level of safety was with chemical hazards. Assessment of chemical, ergonomic, psychological, physical, and biological hazard risks showed that the risk level will be unacceptable and needed changes in the near future.

Omidvari et al (2016) showed the necessity of defining and introducing measures to control chemical and ergonomic factors[16]. They showed that the safety condition in most of the wards and units was not acceptable. Such a condition may lead to safety hazards to personnel and patients and there is a need for emergency interventions[17]. Zaboli et al. (2011) surveyed personnel's knowledge of risk, risk management, organizing, policies and procedures for risk management, and place of risk management in hospitals. They highlighted the necessity of risk management for the qualitative development of treatment services and creating a safe environment for the personnel and patients[17].

With regard to the chemical hazards, there was a need to improve performance of general and special ventilation systems, provide eyewashes and showers, supply chemicals to the volume that is needed, and label the containers properly. The results in this regard are consistent with Khalooei et al. (2013)[18].

As for ergonomic hazard risk, there was a need for adjustable work tables, providing standard chairs suitable for the users, and providing light coverage to prevent direct or indirect glare. These results are consistent with Madadzadeh et al. (2019)[12] and Dehdashti et al. (2015)[19].

With regard to the psychological hazards, there was a need to provide daycare services for children, install an alarm call system in the case of violence in the wards, familiarize personnel with safety alarm, and introduces a rotating work shift schedule.

With respect to the biological hazards, there was a need to use filtration in the general ventilation systems of labs, educate personnel about safe and standard injection, replacing plastic tubes with glass tubes, using AD syringes for vaccination, place sharp and pointy objects in proper covers, and monitor functionality of biological hoods. Consistent with our findings, Mansouri et al. Highlighted the need for safe dispose of sharp and pointy objects [20]. In addition, the results are consistent with the findings by Yarmohammadian et al.(2014)[21].

As to the physical hazards and the subgroup electrical shock, there was a need to equip hospitals with earthing systems, measure earth system resistance, equipment, electrical devices to life safety switch, provide floor electrical insulationunder power panels, and use lock out/tag out for maintenance services of electrical equipment.

Moreover, another subgroup of physical hazards the needed improvement was fire subgroup. Among the necessary measure in this regard were equipping elevators with emergency call, providing fireproof walls and doors and smoke ducts to prevent penetration of smoke and flame between floors, using fiberglass, equipping the buildings with fire alarm system, designating an active firefight team, and holding firefighting practice every six months. Jahangiri et al. (2016) reported consistent results about fire safety in hospitals[22].

As to the subgroup fall and slip hazard, there was aneed for installing warning signs for slippery surfaces and staircases, marking a surface height change with proper signs, and using safety signs and barriers while washing floors.

The subgroup radiation, under the physical hazards, needed measures like collecting and disposing of radioactive wastes based on the instructions of the Nuclear Energy Organization of Iran and conducting routine surface checks. The results in this regard are consistent with Habibi et al. (2007) in radiology wards. They showed that total safety level was at moderate level[23]. Norozi et al. (2012) assessed the mean percentage of observing safety requirement in educational hospitals and found that radiation safety was at moderate level[24].

CONCLUSION

Chemical, ergonomic, psychological, physical (electrical shock, fire and explosion, fall and slip, and radiation), and biological hazard risk assessment confirmed an unacceptable condition of hazard risk that needed changes in the near future. Risk management role in the qualitative development of care services and provision of a safe environment for the personnel and patients is undeniable. In addition, it is important to program education and supervision measures for risk management in hospitals

Conflicts of Interest: The authors declare no conflict of interest.

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REFERENCES

1. Pouya AB, Hazrati S, Vosoughi M, Mosavianasl Z, Habibi E. Evaluation human error in control room. Pakistan Journal of Medical and Health Sciences. 2017 Oct 1;11 (4): 1596-600.
2. Johnstone MJ, Kanitsaki O. Clinical risk management and patient safety education for nurses: a critique. Nurse education today. 2007 Apr 1;27 (3): 185-91.
3. Abazari M, Karimi A, Babaei-Pouya A. Evaluation of musculoskeletal disorders and level of work activity in staff of the public educational hospital of Iran, 2019.Malaysian Journal of Medicine and Health Sciences.16 (1): 137-143.
4. Dargahi A, Farrokhi M, Poursadeghiyan M, Ahagh MM, Karami A. Evaluation of functional preparedness and non-structural safety of different health units of Kermanshah University of Medical Sciences in coping with natural disasters. Health in Emergencies and Disasters. 2017 Jul 10;2 (4): 201-6.
5. Babaei Pouya A, Mosavianasl Z, Moradi-Asl E. Analyzing Nurses' Responsibilities in the Neonatal Intensive Care Unit Using SHERPA and SPAR-H Techniques, Shiraz E-MED J. 2019 ; 20 (6): e81880. doi: 10.5812/semj.81880.
6. Baumer JH. Clinical risk management in Neonatology. Semin Fetal Neonatal MED. 2005;10(1):1.
7. East J. Control of infection in nursing homes: A risk management approach. J Hosp Infect. 1999;43:39-41.
8. Purreza A, Akbari FA, Khodabakh Nejad V. Maintenance and safety management of diagnostic departments in hospitals affiliated in Gilan. Health Inform Manage J. 2006;5(8):5-6.
9. Sibinga S. Risk management: An important tool for improving quality. Transfus Clin Biol. 2001;8:214-7.
10. 10.Attar Jannesar Nobari F, Yousefinezhadi T, Behzadi Goodari F, Arab M. Clinical Risk Assessment of Intensive Care Unit using Failure Mode and Effects Analysis. jhosp. 2015; 14 (2) :49-59.
11. Shahbazi D. Assessing and prioritizing health safety and environment risk in hospitals (Case study: Shahid Beheshti University of Medical Sciences). Scientific journal of Ilam university of medical sciences. 2016 Apr 15;24 (1): 43-54.
12. Madadzadeh, M., Ahmadi Asoor, A., Fallahi, M., Sharifi, Z. RISK ASSESSMENT OF MUSCLUSKELTAL 19.DISORDERS AMONG ELDERY HOME CAREGIVERS OF SABZEVAR IN 1395. Journal of Sabzevar University of Medical Sciences, 2019; 25 (6): 741-748.
13. Pouya, A.B., Esmaeili, F., Jamali, Z. Risk and Human Reliability Assessments at a Tool Factory and Control Suggestions. Pakistan Journal of Medical and Health Sciences. 2018 Apr 1;12 (2): 898-900.
14. Pouya AB, Jame RN, Abedi P, Azimi Z. Identification and Assessment of Occupational Hazards in Informal Waste Pickers Using Job Hazard Analysis. Indian Journal of Forensic Medicine & Toxicology. 2019;13(4):529-34
15. Jahangiri M, Mostavafi A. Compilation and validation of the Occupational Safety and Health Risk Assessment Index in the hospital. Master's Thesis. School of Health, Shiraz University of Medical Sciences, 2015.
16. Omidvari M, Shahbazi D. Assessing and Prioritizing Health Safety and Environment Risk in Hospitals (Case Study: Shahid Beheshti University of Medical Sciences). sjimu. 2016; 24 (1) :43-54.
17. Zaboli R., Karamali M., Salem M., Rafati H.. Risk Management Assessment on selected wards of a Military Hospital. J Mil MED. 2011; 12 (4) :197-202.
18. Khalooei A, Rabori MM, Nakhaee N. Safety condition in hospitals affiliated to Kerman University of Medical Sciences, 2010. Journal of Health and Development. 2013;2(3):192-202.
19. Dehdashti A, Mahjoubi Z, Salarinia A. Impact of nurse's work related body postures on their musculoskeletal disorders . koomesh. 2015; 16 (3) :338-346
20. Mansouri T, Alimohammadi M, Nodehi RN, Yaghmaeian K, Azari A. Risk assessment of sari FatemehZahra hospital using failure mode effect analysis, individualized rapid assessment tool, and preliminary hazard analysis. Journal of Mazandaran University of Medical Sciences. 2018;28(161):89-107.
21. Yarmohammadian M, Jazi M, Khorasani E, Atighechian G. Risk assessment in the intensive care unit. Nurse's perspectives. International Journal of Health System and Disaster Management. 2014 July 1; 2014
22. Jahangiri M, Rajabi F, Darooghe F. Fire risk assessment in the selected Hospitals of Shiraz University of Medical Sciences in accordance with NFPA101. ioh. 2016; 13 (1) :99-106.
23. Habibi E, Soleymanei B, Nateghei R, Lotfirosbehani M, Yarmohammadian M. Risk Management in Radiology Units of Isfahan University of Medical Sciences' Hospitals. Journal Of Health Information Management. 2007;4(1):133-141.
24. Norozi M A, Jahangiri M, Ahmadinezhad P, Zare Derisi F. Evaluation Of The Safety Conditions Of Shiraz University Of Medical Sciences Educational Hospitals Using Safety Audit Technique. payavard. 2012; 6 (1) :42-51.