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Original

Safety Risk Assessment in Educational Environments: A Case Study in Qom University of Medical Sciences

Ahmad Soltanzadeh [1*], Abolfazl Mohammadbeigi [2], Mohammad Fahiminia [3], Alireza Omidi Oskouie [4]

[1] Department of Occupational Safety & Health Engineering, Faculty of Health, Research Center for Environmental Pollutants, Qom University of Medical Sciences, Qom, Iran • [2] Department of Epidemiology & Biostatistics, Faculty of Health, Neuroscience Research Center, Qom University of Medical Sciences, Qom, Iran • [3] Department of Environmenta Health Engineering, Faculty of Health, Research Center for Environmental Pollutants, Qom University of Medical Sciences, Qom, Iran • [4] Department of Public Health, Faculty of Health, Qom University of Medical Sciences, Qom, Iran • *Corresponding author: Ahmad Soltanzadeh, E-mail: soltanzadeh.ahmad@gmail.com, Tel:+98-912-0187486.

Abstract

Background: Consideration of safety principles can decrease the risk of incidents, damage, human and financial impacts, and guarantee a high effectiveness and efficiency and consequently, continuous productivity in an organization. The most important step in providing an optimal safety condition is analysis of the present safety conditions in an organization. In this regard, the present study aims to evaluate the safety risk in the faculties of Qom University of Medical Sciences. **Methods:** The population of this HSR research includes the Faculties of Health, Medicine and Paramedicine, Dentistry, Nursing and Midwifery, the Iranian Traditional Medicine, and Health and Religion of Qom University of Medical Sciences. This research was performed in 2019, and it has investigated the safety risk resources (fire and explosion, the objects and individuals' falling, electricity incidents, and secondary risks). The research was performed in three phases including: 1) system analysis, 2) recognition of the safety risks, and 3) evaluation of the safety risk in accordance with the US Military Standard (MIL-STD-882). **Results:** Based on the results of system analysis, 228 risk resources were identified in the studied faculties. The results of evaluating the safety risk based on a two dimensional risk matrix (probability- severity) showed that 39 resources have a low and acceptable risk, 71 resources have a high and unacceptable risk, and 118 resources have a medium-level risk. **Conclusion:** According to the findings, in spite of the widely accepted assumption of safety of the educational environments, there should be more attention to safety issues in these environments. It is suggested to design a risk management model for identifying and evaluating the risks in these environments and proposing practical solutions for decreasing the safety risks and providing a safe environment.

Keywords: Safety; Risk assessment; Educational environment; Qom University of Medical Sciences

Introduction

The experiences gained from different incidents occurred in non-industrial environments such as service organizations or educational departments such as universities suggest that the safety-related issues can be never ignored; because the consequences of this ignorance can threaten the credit and even the survival of an organization.[1-3] So, in addition to decreasing the incidents and their consequent costs and damages, application of the safety principles can promote the quality and quantity of the activities in an organization. Also, it can promise a

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better future by increasing the number of safety-oriented organizations and their positive effect on the subordinate groups and even the parallel organizations.[4, 5] It can be certainly stated that the central point of the safety systems is the issue of risk management and assessment. In fact, all the safety-related measures are taken aimed to identify the actual and potential risks in the shortest time, estimate the threats of the safety risks, and manage these risks. Accordingly, all the safety management system programs are developed and applied in order to facilitate this process.[6-8]

Several studies have shown that in spite of the limited number of risk resources in educational environments, sometimes these few resources have caused disastrous incidents. The instances of such incidents include the incidents occurred in Tarbiat Modares University (2006) and Science and Research University (2018). So, developing a proper risk assessment program including the recognition and assessment of the risk resources identified in the educational environments can provide an accurate estimation of the risk level and prioritization of the controlling actions to decrease the incidents risk in such environments; also, it can prevent the disastrous incidents and improve the effectiveness, efficiency, and profitability of an organization. So, it can be stated that without an appropriate safety risk assessment program, it is impossible to prevent the workplace incidents and achieve a higher profitability and sustainability.[5, 9] So, one of the actions that can decrease the damage caused by different incidents is assessment of safety status by an appropriate safety risk assessment system. In other words, decreasing the risk of incidents and their consequences can be achieved only in the workplaces where the employees are faced with the minimum level of unaccepted risks. Also, in such environments, there is a minimum level of the factors threatening the safety of the employees, facilities and equipments, and time waste (caused by the employees' absence or the equipments failure).[10]

Qom University of Medical Sciences is the most important department of Qom educating the expert human resources in the area of occupational health and safety. Therefore, there should be proper conditions to promote the level of health and safety in the society and workplaces in order to achieve the goal of qualitative and quantitative promotion safety in organizations. The present research has been conducted to investigate the safety risk assessment and recognize the risk resources in the Faculties of Qom University of Medical Sciences regarding the necessity of safety considerations in macro management areas of the mentioned university.

Methods

This research is a descriptive analytical study performed in 2019 in administrative and educational departments, warehouse, installations, and laboratories of all the Faculties of Qom University of Medical Sciences including the Faculties of Health, Medicine and Paramedicine, Dentistry, Nursing and Midwifery, the Iranian Traditional Medicine, and Health and Religion. The risk assessment areas include the fire resources, building risks, the objects and individuals' falling, exposure to chemicals, electrical shock, and the emergency conditions caused by such risks. These areas have been determined based on the primary investigation of the risk resources. The research population includes the experts of safety and risk assessment and the management, executive, and technical-engineering authorities of the studied faculties.

Method

The comprehensive risk assessment programs are performed based on a three-sage process. Also in this study, the safety risk assessment process includes the three stages of 1) system analysis, 2) identifying the risk resources, and 3) evaluation of the risk parameters and safety risk assessment.

System analysis

System analysis includes the description of the studied system including the buildings, installations, equipments, tools, materials, and all the activities. First, the system analysis team is formed in the studied environment and then, the boundaries of the studied system are specified. In the next step, the studied system is analyzed and described in terms of the research goals (safety risk assessment). The system analysis team is composed of the experts trained in the area of risk assessment. In addition, some of the members are selected out of the educational environments in which risk assessment is performed. All the team members are trained in the risk assessment process including the system analysis, identifying the risk resources, and risk assessment in terms of the research goals.

Identifying the risk resources

The risk resources were identified based on the risk triangle model. The risk triangle is composed of the three

sides of the risk agent, the incident process, and the threat/outcome (figure 1). The process of risk recognition was done by a risk checklist and the record of the failure of equipments or minor incidents such as chemical splash or electrical system deficiency. The records of such incidents were collected by interviewing the members about their past experiences.

Evaluation of risk parameters and safety risk assessment

Based on MIL-STD-882 standard, safety risk parameters include the probability and severity of the incident.[11] According to the guidelines of this standard, the extent of each parameter is determined based on the experts' viewpoints and the confidence levels defined for each sector. In this study, the expert team was composed of 10 risk assessment specialists including 6 experts with a master's degree and an at least 6-year background of risk assessment activity and 4 experts with a Ph.D. degree and an at least 9-year background of risk assessment activity. According to the experts' final viewpoint and regarding the risk assessment environment the parameters of probability and severity and the risk assessment matrix have been evaluated according to tables 1 and 2. The risk levels include acceptable (green), bearable and precautionary (yellow), and inacceptable (red) risks.

The research tools and variables

Data collection tools include a safety risk checklist including the risk resources of fire, building, the objects and individuals' falling, exposure to chemicals, electrical shock, and the emergency conditions caused by risks. The safety risk assessment table was designed based on the US Military Standard (MIL-STD-882).[11, 12] It is worth mentioning that this standard has been developed for assessment of safety risks and it measures the safety risks in terms of the two parameters of the incident probability and severity of its consequences. In other words, risk is a function of the two parameters of the probability of the incident and severity of its consequences; this function can be drawn in the form of a two-dimensional matrix, and it can be used for estimating the acceptability of the safety risk level (table 2).

Results

Table 3-8 presents the results of risk assessment in the studied faculties of Qom University of Medical Sciences. According to the results of this study, 228 risk resources were recognized in the 6 faculties out of which, 39 resources have an acceptable level of risk; 118 resources have a bearable level of risk that requires safety action; and 71 risk resources have an inacceptable level of risk that requires taking immediate measures to decrease the risks. According to the findings obtained from the safety risk assessment in Qom University of Medical Sciences Campus, out of the 41 identified resources of risk, 1 resource had an acceptable level of risk; 20 resources had a bearable level of risk; and 20 risk resources had an inacceptable level of risk (table 3).

According to the risk assessment findings in Health Faculty of Qom University of Medical Sciences, out of the 20 identified resources of risk, 9 resources had an acceptable level of risk; 6 resources had a bearable level of risk; and 5 resources had an inacceptable level of risk (table 4).

Figure1. The risk triangle

Table1. The guideline of evaluating the parameters of probability and severity

Coefficient	Probability	severity
1	The probability of the occurrence of incident once a year	A minor damage / operational failure for less than 8 hours
2	The probability of the occurrence of incident once a semester (6 months)	Injury and damage / operational failure for 1-3 days
3	The probability of the occurrence every 3 months	Minor disability / operational failure for 3-7 days
4	The probability of the occurrence of incident once a month	Severe disability / operational failure for1 week-1 month
5	The probability of the occurrence of incident once a week	Vital failure and death / operational failure for more than 1 month

Table2. Risk assessment matrix

Probability / Severity	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	3	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

According to the risk assessment findings in Nursing Faculty of Qom University of Medical Sciences, out of the 74 identified resources of risk, 5 resources had an acceptable level of risk; 38 resources had a bearable level of risk; and 31 resources had an inacceptable level of risk (table 5). According to the risk assessment findings in Dentistry Faculty of Qom University of Medical Sciences, out of the 44 identified resources of risk, 9 resources had an acceptable level of risk; 27 resources had a bearable level of risk; and 8 resources had an inacceptable level of risk (table 6). According to the risk assessment findings in the Faculty of Health and Religion of Qom University of Medical Sciences, out of the 6 identified resources of risk, 5 resources had an acceptable level of risk; 18 resources had a bearable level of risk; and 3 resources had an inacceptable level of risk (table 7). According to the risk assessment findings in the Faculty of Iranian Traditional Medicine of Qom University of Medical Sciences, out of the 23 identified resources of risk, 10 resources had an acceptable level of risk; 9 resources had a bearable level of risk; and 4 resources had an inacceptable level of risk (table 8).

Table3. The results of risk assessment in the Faculty of Medicine and Paramedicine (Campus)

Risk recognition			Place/ location	Risk assessment		
Risk/ incident	Causes	Consequences		Probability	severity	Risk
Fire and explosion	Combustible materials, inappropriate warehousing, spark resources, lack of gas leak detector, lack of fire extinguisher, lack of personnel training in the area of proper use of combustible materials and fire extinguishing, dropped ceilings made of combustible materials	Human and financial damage, building collapse, biological threats, failure of equipments, disturbance of educational and research processes	Laboratory	3	5	15
			Class	2	5	10
			Warehouse	4	5	20
			Installations	4	4	16
Electrical shock	Various electrical equipments, lack of block and label on switchboards, lack of supplementary equipments and amplifier, inefficiency of the technical and safety inspections, short circuit	Electrical shock, death, fire	Laboratory	1	5	5
			Installations	2	5	10
			Switchboards	3	5	15
Exposure tochemical	Safety threatening and harming chemicals, inappropriate warehousing, inefficient ventilation systems, inadequacy of emergency equipments, lack of personnel training, inappropriate layout of the equipments and materials in warehouses, and the use of chemicals	Human problems such as acute poisoning, burn, respiratory harms, irritation, allergy and other physical effects, fire and explosion	Laboratory (carrying chemicals)	3	5	15
			Laboratory (washing the containers)	4	4	16
			Warehouse	4	5	20

Table4. The results of risk assessment in the Faculty of Health

Risk recognition			Place/location	Risk assessment		
Risk/incident	Causes	Consequences		Probability	severity	Risk
Fire and explosion	Combustible materials, inappropriate warehousing, spark resources, lack of gas leak detector, lack of fire alarm system, the long distance between the fire extinguishers and the fire sources in laboratories	Human and financial damage, building collapse, biological threats, failure of equipments, disturbance of educational and research processes	Laboratory	3	5	15
			Installations	2	5	10
			Warehouse	4	4	16
5E8lectrical shock	Various electrical equipments, lack of block and label on switchboards, improper design of the electrical circuit, lack of earth system, inappropriate quality and layout of outlets, surplus load of the electrical systems	Electrical shock, death, fire	Installations	2	5	10
			Switchboards	3	5	15
Objects and individual's falling	Inobservance of the safety principles in construction of the building, lack of strength of the glasses and suspending objects such as video projectors, the high level of platforms before the boards, and inobservance of safety principles	Physical damage	Classroom	2	4	8
			Administrative office	3	4	12

Table5. The results of risk assessment in Nursing Faculty

Risk recognition			Place/location	Risk assessment		
Risk/incident	Causes	Consequences		Probability	severity	Risk
Fire and explosion	Gas heaters, inobservance of the safety principles in using the gas heaters, combustible materials, inappropriate warehousing, inefficiency of hardware and human fire alarm and distinguishing systems	Human and financial damage, building collapse, failure of equipments, disturbance of educational and research processes	Installations	4	5	20
			Classroom/administrative office	4	4	16
Electrical shock	Various electrical equipments, lack of block and label on switchboards, improper design of the electrical circuit, lack of earth system, inappropriate quality and layout of outlets, surplus load of the electrical systems	Electrical shock, death, fire	Classroom/administrative office	2	5	10
			Switchboards	3	5	15

Table6. The results of risk assessment in Dentistry Faculty

Risk recognition			Place/location	Risk assessment		
Risk/incident	Causes	Consequences		Probability	severity	Risk
Fire and expl5osion	Lack of manual and automatic fire detection, alarm, and extinguishing systems, the personnel's inability to distinguish the fire, dropped ceilings made of combustible materials, non-standard gas piping, lack of spark extinguisher in the circuit, lack of appropriate distance between the devices and the outlets, existence of chemicals, lack of proper ventilation, excessive number of pipes, excessive wiring, non-standard oven	Human damage and burn, financial losses, building collapse (due to lack of strength), circuit failure, failure of equipments, overload (in wire) disturbance of educational and research processes	Installations	3	5	15
			Classroom/administrative office	2	5	10
			Laboratory	4	5	20
			Laboratory	4	4	16
Electrical shock	Various electrical equipments, lack of block and label on switchboards, lack of interlock system, dispersion of wires in the switchboard and availability of bare wires, improper design of the electrical circuit (imbedded and surface circuit, existence of wire on the floor, and the outlets layout), lack of earth system, unpermitted electrical supply, availability of bare wires, placing the outlets near the water resources, the wires getting out of the walls, inefficiency of safety and technical inspections	Electrical shock, death, fire	Classroom/administrative office	1	5	5
			Switchboards	2	5	10
			Laboratory	3	5	15
Exposure to chemical	Using disinfectant chemicals, the materials used for dental restoration, safety threatening and harming chemicals, inefficient ventilation systems, inadequacy of emergency equipments, lack of personnel training, inappropriate layout of the equipments and materials in warehouses, and the use of chemicals	Human problems such as acute poisoning, burn, respiratory harms, irritation, allergy and other physical effects, fire and explosion	Warehouse	3	4	12
			Laboratory	3	5	15
			Laboratory	4	4	16
			Laboratory	4	5	20
Objects and individual's falling	Inobservance of the safety principles in construction of the building, lack of strength of the glasses and suspending objects such as video projectors, inobservance of proper layout (placing the heavy objects in higher levels), level difference	Physical damage	Classroom	2	4	8
			Administrative office	3	4	12
			Classroom	3	2	6

Table7. The results of risk assessment in the Faculty of Health and Religion

Risk recognition			Place/location	Risk assessment		
Risk/incident	Causes	Consequences		Probability	severity	Risk
Fire and explosion	Lack of manual and automatic fire detection, alarm, and extinguishing systems, the personnel's inability to distinguish the fire, fire expansion to higher floors, non-standard gas piping, burning flame, existence of combustible and flammable materials	Human damage and burn, financial losses, building collapse (due to lack of strength), wire flame, disturbance of educational and research processes	Administrative office	3	5	15
			Administrative office	2	5	10
			Classroom	2	4	8
Electrical shock	Lack of earth and interlock system, instability of the outlets, unpermitted electrical supply, the wires getting out of the walls, lack of block and label on switchboards	Electrical shock, death, fire	Administrative office	2	5	10
			Classroom	3	5	15
Secondary incidents	Inappropriate status of the exit way in terms of the emergency exit parameters, lack of alarming system in the places with a risk of collision and obstacle	Physical damage, death	Administrative office	3	4	12
			Administrative office	3	5	15
Objects and individual's falling	Inobservance of the safety principles in construction of the building, lack of strength of the glasses and suspending objects such as video projectors, level difference	Physical damage, death	Administrative office	2	4	8
			Administrative office	2	5	10

Table8. The results of risk assessment in the Faculty of Iranian Traditional Health

Risk recognition			Place/location	Risk assessment		
Risk/incident	Causes	Consequences		Probability	severity	Risk
Fire and explosion	Lack of manual and automatic fire detection, alarm, and extinguishing systems, the personnel's inability to distinguish the fire, existence of combustible and flammable materials and oven	Human damage and financial losses, building collapse (due to lack of strength), , disturbance of educational processes	Administrative office	1	3	3
			Administrative office	2	5	10
			Classroom	2	3	6
Electrical shock	Lack of earth and interlock system, instability of the outlets, lack of block and label on switchboards	Electrical shock, death, fire	Classroom	1	4	4
			Administrative office	2	5	10
Secondary incidents occurred while evacuating the building after the incidents	Lack of hardware facilities, lack of personnel training for emergency conditions, lack of alarming system in the places with a risk of collision and obstacle	Physical damage, death	Administrative office	1	4	4
			Administrative office	2	4	8

Discussion

According to the results of the previous studies, the most important step in providing an optimal safety condition is analysis of the existing safety conditions in an organization. This action provides the opportunity of recognizing and evaluating the actual and potential risks in the workplace, and it can be considered as a basis of new designs, changes, control methods, promotion of safety, and raising the satisfaction of the stakeholders including the personnel, etc. Approving these results and theories, the results of this study suggested that a careful and detailed investigation can provide a good understanding of the safety status in the organization and risk control and preventive measures can be taken based on this understanding.[10, 13, 14]

The results of the present study are consistent with some of the findings reported by other studies.[15, 16] Although the results suggest that the number of risk resources in educational environments is significantly lower than the other workplaces, the students'

unfamiliarity with the equipments and improper layout of the facilities can increase the safety risks in such environments. Moreover, one of the most important points in this regard is providing a space place for the personnel's gathering in the case of any incident.[17] In general, the findings suggest that in spite of the widely accepted assumption of safety of the educational environments, there should be more attention to safety issues in these environments.[16] Also, it was found that about one-third of the risks identified in educational environments have had a high and unacceptable probability. So, immediate safety measures are necessary to prevent these incidents and their disastrous consequences. Meanwhile, more than half of the identified resources have had a medium-level risk that requires taking safety measures to prevent the relevant incidents and their consequences. According to the results, it is suggested to develop a risk management program including the recognition of the risks and their assessment while proposing practical solutions for decreasing the risks and providing an optimal safety condition.[18]

Conclusion

Based on the results of the present study and the findings reported by the previous studies, it is concluded that in spite of the lower probability of safety risks in educational environments than industrial environments, the limited safety information of the people present in such environments can increase the risk of different safety incidents such as fire, electrical shock, chemical exposure, and falling. Each of these incidents can create an emergency condition. In this study, risk triangle algorithm was used for identifying the resources of safety risks based on the most popular risk assessment approach i.e. US Military Standard (MIL-STD-882). So, the results of this study can be proposed as an appropriate model for evaluating the overall safety status in administrative-educational environments. However, other specific methods can be used for safety risk assessment in laboratories of Qom University of Medical Sciences and administrative and educational buildings. Nevertheless, it should be stated that a more comprehensive study investigating the laboratory, administrative, and educational buildings separately can provide more reliable results that can be used for promotion of safety status in educational environments.

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References

1. Mearns K, Hope L, Ford MT, Tetrick LE. Investment in workforce health: Exploring the implications for workforce safety climate and commitment. Accident Analysis & Prevention. 2010;42(5):1445-54.
2. Alimadadi JA, Qasemkhan AH, Hjartabar M, Gholamnia R, Jazani RK, Saeedi R. Evaluation of Health, Safety and Environment status using SWOT matrix to provide continuous improvement strategies: A case study in municipality of Qazvin. Health in the Field. 2016;4(3):36-45.[Persian]
3. Chung YJ. Risk of Accidents Analyzed in the Laboratory of the University. Korean Society of Hazard Mitigation. 2012;12(6):191-9.
4. Ahmadi Marzaleh M, Vosoughi S, Kavousi A, Jameh Bozorg H. Investigation of relationship between level of awareness around health, safety and environment management system and its effects on safety climate and risk perception by employees in an Iran oil refinery, 2015. Iranian journal of health, safety and environment. 2017;4(2):738-45.
5. Mearns KJ, Reader T. Organizational support and safety outcomes: An un-investigated relationship? Safety Science. 2008;46(3):388-97.
6. Lundgren RE, McMakin AH. Risk communication: A handbook for communicating environmental, safety, and health risks: John Wiley & Sons; 2018.
7. Berg H-P. Risk management: procedures, methods and experiences. Reliability: Theory & Applications. 2010;5(2(17)).
8. Shabgard Z, Moradirad R, Mousavi SM. Risk factors affecting occupational accidents and related causes: case study. Archives of Occupational Health. 2020;4(1):521-7.
9. Golbabaei F, Heidari L, Ghazi S, Jabari K. Evaluation of safety management in an Appliances manufacturing company. Health and Safety at Work. 2015;4(4):49-58.[Persian]
10. von Thiele Schwarz U, Hasson H, Tafvelin S. Leadership training as an occupational health intervention: Improved safety and sustained productivity. Safety science. 2016;81:35-45.
11. Defence D. MIL STD 882-E-Standard Practice for System Safety. Washington, USA: USA. 2012.
12. Johnson-Roth GA, Chaudhri GA, Tosney WF. Ground Segment

Systems Engineering Handbook. Aerospace Corp El Segundo Ca El Segundo United States; 2016 Aug 1.

13. Nielsen MB, Mearns K, Matthiesen SB, Eid J. Using the Job Demands–Resources model to investigate risk perception, safety climate and job satisfaction in safety critical organizations. Scandinavian Journal of Psychology. 2011;52(5):465-75.
14. Kilic G, Selvi MS. The effects of occupational health and safety risk factors on job satisfaction in hotel enterprises. Ege Akademik BakışDergisi. 2009;9(3):903-21.
15. Langford L. Preventing Violence and Promoting Safety in Higher Education Settings: Overview of a Comprehensive Approach. Higher Education Center for Alcohol and Other Drug Abuse and Violence Prevention. 2004.
16. Cornell D, Maeng JL, Burnette AG, Jia Y, Huang F, Konold T, et al. Student threat assessment as a standard school safety practice: Results from a statewide implementation study. School psychology quarterly. 2018;33(2):213.
17. Soltanzadeh A, Gohari Motlagh M, Ghiyasi S. Assessing the efficiency of muster point in crisis: a case study in tehran city. Archives of Occupational Health. 2020;4(1):516-20.
18. Zhiqiang Z, Xinxiang Z, Ping H. Discussion on management of dangerous instruments and equipment in colleges and universities. Experimental Technology and Management. 2012;10.