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An Intervention Study Aimed at Preventing the High-Risks with Risk Analysis in the Operating Rooms of Hospitals

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Abstract:
Risk can be described as the probability of occurrence of a certain hazard and overall damage, loss or injury severity caused by the consequences of the hazard. This study was conducted with the aim of mapping and assessing the risk foci that might be seen during the provision of services and accordingly preventing high risks by ascertaining and implementing the precautions at the operating rooms of the relevant hospital between 2015, January-June. Prior to evaluating the operating room, a risk identification team consisting of unit quality heads, assistants and quality managing director, operating room supervising doctors, who are highly knowledgeable about the service, was established. Occupational safety specialists were also included into the process with the new occupational safety law and upon identifying them, the risks were analyzed. In the study, 11 main hazards regarding the operating room and in line with these hazards 19 risks were identified. Remedies were suggested for these risks. When these 11 main hazards were examined, according to the risk values, out of these risks, 10 were identified as Insignificant, 5 as Significant, 3 as Fundamental Risk and 1 as Intolerable Risk. It was seen that these risks mostly arose out of chemical wastes, radiation and ergonomic hazards.

Keywords: *Fine-Kinney method, operating room, risk analysis, risk management*

1. Introduction

Risk can be defined as the combination of the probability of occurrence of a particular hazardous event and overall damage, loss or severity of injury caused by the consequences of this incident (*Zhang-Lin et al.,2007*).

In health sector, not only the health professionals but also the patients and patient relatives who apply to healthcare organizations may encounter several risks. For this reason, risk analyses and effective risk methods are important in terms of not only the health professionals working at the healthcare organizations but also maintaining the public health. While some of the risks that may occur at hospitals are most frequent but cause minimum severity(e.g. loss of patient's belongings), others (the setbacks that might arise during the surgery and anesthesia, etc.)may happen at minimum frequency but lead to a serious damage for patients and to negative consequences that can later recur for the hospital (*ECRI, 2003*).

Risk analysis is conducted for many reasons. In general, they can be listed as the following (*Turgut, 2014*):

- of the institution,
- Raising the level of awareness regarding the risks that can inflict damage upon the patients, visitors and workers with regard to health,
- Ensuring that the incidents and/or accidents that can occur at the institution are reported safely (*Griffin, 2006*).

The first step that must be taken for an effective risk management is to identify what kind of risks the institution encounters and to assess these risks. Identifying the nature, the type of impact and the source of risk is one of the importantstagesin risk analysis. The primary objective in determining the risks is to handle the potential risks that an institution may face on the way of achieving its goals in a timely, regular, fast and complete manner (*Aydeniz, 2008*). The risks within the processes must be determined depending on the past, present and future activities.

In health sector, especially health personnel, patients, relatives of patients, administrative personnel, employees belonging to suppliers, image of the institution, physical areas, machines, medical devices, income of the institution etc. are all at risk. The factors that create these risks show different characteristics in each unit.

The major risks that can be encountered in healthcare sector can be listed as follows:

- Infections/Microorganisms/Biological Risks,
- Chemical agents/Hazardous substances,
- Radiation,
- Hazardous wastes,
- Sharp Object and heavy equipment injuries,

- Physical violence
- Psychosocial Risks,
- Noise,
- ErgonomicRisks,
- Cytotoxic Risks, AllergicReactions,
- Ventilation,
- Food poisoningetc. (Özyurt, 2013).Apart from these, different risks might arise according to the working field of the healthcare institution.

The damages to be inflicted upon patients and personnel during healthcare service provision can result in injury, prolonged hospitalization, disability and even death for the patients and exposure to more diseases and injuries with respect to the healthcare workers. In addition to the risks that threaten human health, financial and environmental risks have reached a risk level threatening health care institutions in recent years (Aksay et al.,2012). Within the scope of the material loss and reputation risk, healthcare institutions, particularly hospitals, become obliged to manage negative processes such as the service costs incurring from the mistakes and human life loss (Aksay, 2003).Risk management process in healthcare first manifested itself in the USA during a legal case in the mid-1970s. It became necessary to develop a method to identify, analyze, reduce and assess the risks in the provision of healthcare so as to decrease majority of the undesired medical mistakes and incidents and accidents associated with the healthcare (East, 1999). The aim of risk management is to help individuals and organizations develop practical and simple techniques that clearly indicate risk and uncertainty, and also define, analyze and manage the risks by providing understandable information based on the decision maker judgment (Ersarı, 1996). Risk analysis is the combination of the methods ensuring that the risk relevant to the variable dealt within the strategic decisions is comprehended comprehensively. Risk analysis is not only necessary for regulatory purposes. It is the only means of ascertaining the required precautions to design these products, and it should also be a part of each process development (Steven and Krishna, 1999)

The process of analyzing and managing the risks in health institutions encompasses assessing the hazards and the risks that arise out of these hazards. It is necessary to conduct risk analysis in an accurate and a detailed manner and define them in order to carry out an efficient risk management in healthcare institutions. In health sector, while risk analysis is conducted, it is significant to take into consideration all units, the working systems of these units and the quality of the personnel in the healthcare institution. It is required to determine at which units and at which frequency these risks will be encountered by defining the identified risks (Güleret al., 2011). Ergonomic risks include staying in a fixed position for a long time, incorrect body postures, fall or overturn of the materials, tools and equipment, which are strongly mounted on the wall and the floor at the departments, falling, squeezing, hitting or injuries resulting from the improper placement of the tools and equipment in the work site, musculoskeletal system disorders and vascular disorders that develop due to standing for a long time, body injuries that occur during patient transfer and rotation, body injuries that recur while the tools and equipment in the work site are relocated, wrist problems that result from the usage of computer for a long time, hitting, strain and injuries as a result of sliding, stumbling and falling on the slippery ground in duty (*Citi, 2013*).For example, an ergonomic working department installs, regulates and controlsthe physical structure, office chair and desk design, computer monitor and keyboard position, the place of the folders, the location and the voltage of the working area illumination. With the implementation of working area ergonomics, it is possible to eliminate or minimize disorders such as neck, shoulder, back and headaches, carpal tunnel syndrome, which result from working with a computer for a long time (*Baslo, 2002*).It wouldn't be enough only to identify the potential risks and minimize their impact on the result in dynamic risk management. Accurate assessment of near-miss risks is vital for an active risk management. Identification of the risks in a real-like manner is an important factor that affects the correct identification of the goals (*T.C.SB, 2012*).

Operating rooms are places where various surgical techniques and methods are applied within the light of the new and advanced knowledge, cutting edge technology tools/equipment are used, and where a great many of risks affecting patient and worker's life exist. The risks that may arise out of the surgical intervention can lead to injuries or deaths and create undesired consequences on the patients and patient relatives such as psychological trauma. Risk prevention is of utmost importance in order to ensure the safety of the operating room personnel and patients.

This study was carried out in order to identify and assess the risk foci that may occur during the provision of the services in the operating rooms and accordingly to determine the precautions and prevent high risks by implementing the precautions.

2. Material and Method

This study was conducted at the operating rooms of Maternity and Pediatric Hospital affiliated to the General Secretariat of Samsun Province Public Hospitals Union between 2015, January-June. Fine-Kinney Risk Assessment Team was created by including the operating room unit head and assistants, quality management director, occupational health and safety specialist.

2.1. The Methods Used In Risk Description;

- Accident reports
- Risk records
- Patient complaints
- Safety (building) visits

So as to identify the hazards, analyze and rate the risks and conduct the necessary control measurements, all the undesired incidents at the hospital, which can lead to death, disease, injury, damage or other loss, were described. At the second step of the risk rating, it was determined which risk or risks could occur as a result of the hazards. Upon completing the stage of determining the risks, risk rating was completed with the preferred qualitative or quantitative methods. In the present study, Fine-Kinney method was utilized in order to rate the risks. Fine-Kinney method is a technique which is used in determining which works should be prioritized and where the sources should be transferred primarily according to the rating results in risk rating. Rating is done by calculating the weight ratio, and it is determined whether or not taking precautions is needed. Fine-Kinney risk assessment method is composed of Probability(P), Severity(S) and Frequency (F) scales and Risk Rate (RR) is calculated as follows (Table 1 and 2):

RR = Probability (P) x Severity(S) x Frequency (F).

Probability: The possibility of occurrence of a hazard.

Severity : Severity is the estimated damage that will be inflicted upon people and/or environment.

Frequency: Frequency is the times of exposure to the hazard.

3. Findings

In the study, with regard to the operating rooms,11 major hazards and 19 risks basedon these hazards were detected. When 11 major hazards were examined, according to the risk values, out of these risks, 10 were identified as Insignificant (precautions are not of top priority), 5 as Significant(need to be corrected in the long-run "within a year/years"), 3 as Fundamental Risk (need to be corrected in the short run "within a few months") and 1 as Intolerable Risk(necessary precautions should be taken immediately /or it could be contemplated to halt the work or shut down the facility or the building).

Primary risks identified after Fine-Kinney analysis and the risk scores calculated after the recommendations offered are as follows: From the main topic of hazards that can arise during waste collection and waste sorting (chemical wastes), the probability of infection development hazard as a result of the medical waste accidents risk degree is found to be540 (Intolerable Risk), which is the highest score. After precautions were taken, intolerable risk was reduced to a great extent (RR: 18).

RR score 270 (Fundamental Risk) that develops due to the radiation hazard and that might occur as a result of personnel exposure to the radiation was reduced to 45 (Potential Risk) after necessary precautions were taken. The study by Özcan et al. (*2014*) demonstrated that in the Central Operating Room in 21 rooms 5 C-armed scope devices were used and there was no armored room. The personnel did not have personal dosimeters, and biological and environmental radiation impressions were not conducted. Scope devices were used by the subcontracted laborers and blue-collared workers, who were not trained on radiation and were not authorized. 74.4% of the workers reported that they knew that lead shielding or thyroid protective equipment were available scope imaging, however, only 14.6% of them use them. The reasons for not using protective equipment was listed as the inadequate number of equipment, that the works needed to be completed in a quick manner and also ergonomic reasons. There were no radiation warning signs in Central Operating Room and 64.9% of the personnel were aware of this. 53.2% Central Operating Rook personnel described their radiation and protection knowledge as intermediate, 46.8% as insufficient. 90.8% of them expressed that they did not receive any training on radiation. It was seen that their knowledge about the hazards of radiation and protection principles were insufficient (50.0%; 80.6%, respectively).The results of this study are in parallel with our study. Therefore, ionizing radiation must be accepted as a major risk factor in the operating rooms.

RR score 252 (Fundamental Risk) that might be obtained due to the health risks such as varicose veins and herniated disc that develop because of standing for a long time, ambient temperature and humidity, musculoskeletal system disorders associated with ergonomics hazard was reduced to RR score 7 (Insignificant Risk) (Table 3) after the necessary precautions were taken.

4. Discussion

From the main topic of hazards that can arise during waste collection and waste sorting (chemical wastes), orientation training was provided to the personnel in charge of collecting, carrying and storing the wastes before they started their duties in order to prevent the risk of infection development in relation to the medical waste accidents. Routine in-service training was offered twice a year, and they were repeated when necessary. The in-service training offered to the cleaning personnel was performed in practice with all steps following the training at all units. Records of all the trainings were recorded. All the personnel were examined against Hepatitis B infection immunity, and those who were susceptible were vaccinated. According to the health scanning program of the workers, it was made sure that health scans were conducted regularly. Third parties were prevented from entering the waste containing areas. Regularly conducting cleaning services, correcting and properly using antiseptics, disinfectants and sterile fields, carrying out sterilization and disinfection procedures strictly in line with the current rules and proper management of medical wastes can minimize the hospital-acquired infection risk.

As a result of the probability of exposure of the personnel to the radiation, which is associated with the radiation hazard, personnel health training (personal protective equipment) was provided. Radiation safety measures were taken. Suitable ventilation system and air-conditioning control was ensured. It was made sure that personal protective (radiation protective) equipment were supplied and used. The efficiency of the radiation protective equipment was checked via x-rays or scope at least every 6 months in the event that there was a suspicion of damage. Radiation protection trainings were offered to the personnel and participation of the personnel was ensured. Maintenance and calibration controls of the

imaging machines were conducted regularly. The female personnel in breastfeeding period were not given duties which bore radioactive contamination risk.

As a result of the probability of standing for a long time, health risks such as varicose veins and herniated disc, ambient temperature and humidity, musculoskeletal disorders development associated with the ergonomics hazard, it was made sure that the personnel participated into the training on occupational safety and health (ergonomic hazards and risks), works were distributed in rotation and equally among the workers according to their working conditions, working environment was designed ergonomically and in a way which would not disrupt the work flow, the air conditioners eliminated the humid air in addition to the cooling system, the furniture, cupboards etc. that could cause damage to the workers in case of turnover were fixed, unused patient handling equipment, stretchers, etc. were parked by setting the parking brake in an area chosen by the department, the broken seats, stools etc. which were used by the personnel were no longer used and were sent to the relevant unit for repair, and in case they were not sent, they were labelled with the 'Attention! It is broken, Don't Use' warning, and assistance was provided in case that it was necessary to lift the patients. A study carried out on rating the working areas in operating rooms and intensive care units indicated that most of the doctors, nurses, anesthesia specialists expressed that the ventilation in these units were insufficient, that the illumination was unsatisfactory and the rooms were busy, and less than half of them thought that operating rooms smelled bad and were crowded. It was also found that the participants suffered from herniated disc, varicose veins, leg, back and head aches, hypertension, hemorrhoid, hepatitis and tuberculosis and felt lethargic, sleepy and chronically tired and had the complaints of stress, depression, stomach problems, eye, skin and respiration (Özyaral, 2005). Yet another study reported the top three risks that the hospital personnel face as verbal and physical violence, back and low back pain, sharp object injuries (Ergör et al., 2003). These studies support the results of our study.

5. Conclusion

The study found that personnel, patients and visitors face a great many risks at the hospitals. It was revealed that it is possible to minimize these risks by conducting risk analysis, identifying their causes, training the healthcare workers and helping them be motivated, carrying out necessary corrective and preventative studies and by following the efficiency and continuity of the risk management. Accordingly; Risk management team should also take into consideration assessments regarding the clinic processes at the hospitals. Precautions aiming at preventing the problems should be taken. The inspections during service provisions should be conducted in a continuous manner. Risk analyses should be carried out at the hospitals before the precautions are taken. All the precautions set out by Turkish Atomic Energy Authority should be taken during x-ray imaging regarding radiation exposure.

6. References

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Probability Values	**Probability** the probability of damage occurrence	**Frequency Value**	**Frequency** times of exposure to the hazard within time	**Sverity Value**	**Severity the estimated damage to be inflicted on people and/or the environment**
10	anticipated, certain	10	Almost all the time (a few times a in few hours)	100	More than one deathly accidents / environmental disaster
6	high / highly probable	6	frequent (once or a few times a day)	40	Deathly accident / serious environmental damage
3	probable	3	sometimes (once a week or a few times a week)	15	permanent damage/injury, labor loss / formation of environmental barriers, complaints from close neighborhood
1	Probable but low likelihood	2	Not often (once a month or a few times a month)	7	serious damage/injury, external first aid need / environmental damage outside the field
0,5	Not anticipated but possible	1	rare (a few times a year)	3	Small damage/injury, internal first aid / imited environmental damage within the field
0,2	Not anticipated	0,5	Very rare (once a year or rarer)	1	Having a near miss / no environmental damage

Table 1: Probability, Frequency and Severity Values Table

400 < R	Intolerable Risk, the necessary precautions must be taken immediately / it should be contemplated to halt the work or shut down the facility or building or the environment).
200 < R < 400	Fundamental Risk, Need to be corrected in the short run (within a few months)
70 < R < 200	Significant Risk, Need to be corrected in the long run (within year/years)
20 < R < 70	Potential Risk, Precautions must be applied under control.
R < 20	Insignificant Risk, Precautions are not prioritized

Table 2: Fine-Kinney Method Risk Assessment Result

Rating Table						Rating Table					Precautions Table	Rating Table			
Department	Activity	Hazard	Risk	Type of Impact	Impacted Parties	Probability	Frequency	Severity	Risk Value	Risk Description	Precautions to be Taken	Probability	Frequency	Severity	Risk Value
OPERATING ROOM	Waste sorting and collection (chemical wastes)	Medical Wastes	The probability of infection depending on the medical waste accidents	Infection (hepatitis –B, Hepatitis-C and HIV) Sharp objects injuries	Doctor, nurse, cleaning personnel, porter	6	6	15	540	Intolerable Risk	Orientation training must be provided to the personnel in charge of collecting, carrying and storing the wastes before they start their duties. Routine in-service training should be offered twice a year and they should be repeated when deemed necessary. The in-service training offered to the cleaning personnel should be performed in practice with all steps following the training at all units. Records of all the trainings should be kept. All the personnel should be examined against Hepatitis B infection immunity and those who were susceptible should be vaccinated. The personnel in charge of carrying, storing the medical wastes and in charge of the gardens should be vaccinated against tetanus. It should be made sure that personnel use the personal protective equipment in line with the duty performed and they are used in a controlled way. When necessary, departmental workers should also offer orientation regarding worker's health. According to the health scanning program of the workers, it should be made sure that health scans are conducted regularly. Third parties should be prevented from entering the waste containing areas. In medical waste collection, red plastic bags, which are tear, puncture, explosion proof and can be carried easily and which are manufactured from original moderately intense polyethylene raw material, double bottomstitched, and which bears "International Biohazard" emblem and "Attention! Medical Waste" sign visible on both faces should be used. Immediately after the wastes are created, they should be carried to the temporary storage area with the elevator which is only allocated for carrying the wastes.	1	6	3	**18**

Department	Activity	Hazard	Risk	Type of Impact	Impacted Parties	Probability	Frequency	Severity	Risk Value	Risk	Precautions to be Taken	Probability	Frequency	Severity	Risk Value
OPERATING ROOM	Scope imaging	Radiation	The probability of personnel exposure to the radiation	Formation of non-healing body wounds, ulcerations in hands, hematopoietic system disorders, skin cancers.	Doctor, nurse, cleaning personnel, porter	3	6	15	**270**	**Fundamental Risk**	Occupational health training (personal protective equipment) should be offered and participation of the workers into the trainings should be ensured. Radiation safety precautions should be taken, proper ventilation and air conditioning should be provided. Personal protective (radiation protective equipment) equipment must be supplied and it must be made sure that they are used by the workers. The efficiency of the radiation protection equipment should be controlled via x-rays or scope at least every 6 months and in the event that a damage occurred. Radiation protection training should be provided to the workers. Maintenance and calibration controls of the imaging devices should be conducted regularly. The female personnel in breastfeeding period should not give duties which bear radioactive contamination risk.	1	3	15	**45**
	Patient lifting-carrying, standing for a long time, usage of assistive devices, ventilation systems	Ergonomics	Health risks such as Standing for a long time, varicose veins and herniated disc ambient temperature and humidity (high temperature, decreasing in thinking and working capacity, attention loss, decrease in success, fall in labor force and productivity, getting anger easily, musculoskeletal system disorders development probability	Occupational diseases, labor force loss, injuries, herniated disc, visual problems, varicose veins, neck-shoulder-arm-wrist-back and lower back pains.	Doctor, nurse, cleaning personnel, porter	6	6	7	**252**	Fundamental Risk	It should be made sure that the personnel participate in to the occupational health and safety trainings (ergonomic hazards and risks). According to the working conditions, the work should be distributed in rotations and equally among the workers. Working environment should be designed ergonomically and in a way which will not disrupt the work flow. Furniture, cupboards etc. which can do damage in case of turnover should be fixed, unused patient handling equipment, stretchers, etc. should be parked by setting the parking brake in an area chosen by the department. The broken seats, stools etc., which are used by the personnel should no longer be used and be sent to the relevant unit for repair. In case they are not sent, they should be labelled with the 'Attention! It is broken, Don't Use' warning.	0,5	2	7	**7**

Table 3: Risk Assessment Table Prepared by Fine-Kinney Method Regarding the Hazards Identified Following the Application and the Risks That They Might Pose