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EVALUATION OF OCCUPATIONAL HEALTH AND SAFETY IN A HOSPITAL

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Abstract
Occupation Health and Safety in the modern world has become a critical issue because of its hazards. It has occupied a critical place in a hospital because it is not general realized that unawareness about health and safety can pose biological hazards which in extreme case could act as self-inflicted catastrophe. Employers have legal responsibility to provide a safe work place and system of work, to consult with employees and to keep them informed about health and safety matters. The present study was aimed to critically analyze the occupational health and safety in a tertiary care hospital in Lahore. It was an attempt to study all the issues and point out the weaknesses for the further improvement of OHS in the Hospital. Results showed that there is a proper occupational health and safety management system in the hospital and approximately all the hospital staff members are well known about the OHS. Some of the answers represent 60-70% results in favor of OHS because of new employees. While conducting this study different suggestions were given for the further improvement of OHS in the hospital.

Keywords: health education; KAP study; tertiary care hospitals; hand hygiene.

Introduction

Occupational Safety & Health is the discipline concerned with preserving and protecting human and facility resources in workplace. The Occupational Safety and Health Administration (OSHA) estimates that more than 5.6 million workers in health care and related occupations are at risk of occupational exposure to blood borne pathogens, including human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV) and other potentially infectious agents (Moyo et al., 2015). Occupational transmission of blood borne pathogens (including HBV, HCV and HIV) has been well documented. Ongoing surveillance of needle stick injuries (NSI's) and other sharps related injuries indicate that occupation blood borne pathogen exposure remains an important public health concern (Almost et al., 2018; Steel et al., 2018a).

Pakistan is developing country and very poor in educational point of view in respect to other developed countries. Due to low literacy rate, the people are not well aware about the health and safety procedures and precautions (Almost et al., 2018). Due to this, serious health problems are generated. Health conditions are also bad in Pakistan. Hygienic conditions and unhygienic conditions are not well awarded by the Pakistani people (ÇOBAN and ORTABAĞ; Gul et al., 2017).

The present study is made on Safety and Health in tertiary care hospital. Cancer is an abnormal growth of cell with tends to proliferate in an uncontrolled way and in some cases, to metastasize (spread) Cancer is not one disease (Ramos et al., 2015; Tompa et al., 2009). It is a group of more than 100 different and distinctive diseases. Cancer can involve any tissue of the body and have many different forms in each body area (Çalış Boyacı and Selim, 2022). No data about (OHS) is available in Pakistan because the majority of accidents are not reported to the labor department. Disease and accidents in the work place are an appalling tragedy. The incidence of occupational diseases and injuries is very high in Pakistan because thousands of workers are routinely exposed to hazardous chemicals. Pakistan has poor (OSH) legislation and infrastructure to promote the (OHS) (Badida et al., 2023; Gul, 2018).

The occupational health specialist plays an important role in maintaining the health and safety of employees by assessing the work site for hazards and potential hazards and reducing the risk (Steel et al., 2018b). OHS affect not only the worker but also affect his family and his community. Center for disease control and prevention reported that each day an average of 137 persons dies from work related diseases and an additional 17 die from injuries on the job (Tashia and Jamaluddin, 2023). Each year 74,000 workers require treatment in hospital emergency departments for work related injuries (Constantinidis et al., 2011; Cudjoe, 2011). The aims and objectives of the study were to observe working methods in hospital and provide guidance to help organization to develop and improve OHS procedures and to evaluate the health hazards in the hospital. To observe the safety measures, precautions in the hospital. To suggest the control methods for existing health hazards.

MATERIALS AND METHODS

The topic Evaluation of Occupational Health and Safety in a hospital comprises the study about health and safety of different departments of a tertiary care hospital. For this, different questionnaires were prepared to know how Health and Safety is managed in the hospital (Ahmed et al., 2020; Rizvi et al., 2020).

Few workplaces are as complex as in the hospital. Not only it provides the basic health care needs for large number of people, but it is often teaching and research center as well. As a result, the hospital workers are at high risk to expose to many potential hazards. Modern occupational safety and health legislation usually demands that risk assessment be carried out prior to making an intervention. This assessment should:

- Identify the hazards by walk through survey and personal observations.
- Evaluate the risk by assessing light, noise and radiation exposure of film badges.

Methodology

Following methodology was adopted to complete the study.

1. Personal observation.
2. With the help of questionnaire to hospital staff.
3. Monitoring of working environment (Noise, Light, Radiations)

Personal observation

During study, working procedures, methods and precautions in different departments of the hospital were observed; such as;

- Dealing and handling of patients by the doctors and staff nurses.
- Blood drawn techniques.
- Working on blood testing analyzers.
- Disposal of waste.
- Radiation areas.

With the help of questionnaire to hospital staff

Different questionnaires for workers of different departments were prepared to get information about health and safety.

Monitoring of working environment (Noise, Light, Radiations)

During study, different work monitoring instruments have been used to monitor the working areas.

- Sound Level Meter (for noise measurement)
- Digital LUX meter (for light measurement)
- Radiation Film Badges (for radiation exposure determination)

Operating procedure for sound level meters and digital LUX meters are available in appendix III. Radiation Film Badges are used for the determination of radiation exposure. Each film labeled with name and specific code. Workers of radiology department used double coated radiation film badges. After 30 days each film is tested for radiation exposure in Pakistan Atomic Energy Commission, Islamabad.

RESULTS AND DISCUSSION

Health and safety in hospital has a supreme importance among all staff members (Doctors, Nurses, and Paramedical Staff etc.) and Patients (Habib et al., 2016; Tompa et al., 2006). Unawareness about health and safety is seriously affecting the health of hospital staff and patients. Views of doctors, staff nurses, operation theater staff, radiology staff, laboratory staff and house keeping staff concluded that how much awareness about health and safety they have. Information was gathered through questionnaires and personal observation.

Information from Questionnaires:

Staff members of different departments of hospital gave their views that are presented and discussed here. Detailed study of the views that were gathered through questionnaires resulted in the following information:

Views of Doctors

Doctor's views about health and safety were observed with the help of questionnaires that consist of 15 questions and were solved by 15 doctors. Description and analysis of the questions is given below with the help of Tables.

Numbers of doctors who gave their views: 15

Numbers of questions: 15

Facility of PPE's

The respondents showed 100% response in favour of PPE's facility. Doctors are more susceptible to exposure to the infection while handling the cancer patients. The result was outstanding because all doctors have the facility of PPE's (personal protective equipments) PPE's includes gloves, gown, face masks, apron etc. The results were appreciative because 80% respondents have awareness about waste disposal guidelines and only 20% are unaware because they were new employees in the hospitals. 67% doctors showed that they are fully aware to handle and administrate chemo. Other 33% doctors did not knows about chemo handle and administrate because they belong to irrelevant departments. Chemo is strong medicine that is used for cancer treatment. Chemo is administered to patients in different cycles in specific time intervals. The results were excellent because 93% doctors are immunized against Hepatitis B and only 7% are not immunized because they immunization course against Hepatitis B was in process. The results were outstanding because respondents showed 100% results about proper covering of waste containers. The respondents showed 100% results in favour of cleanliness in the hospital. 45% doctors did not know about fire safety because their orientation about fire safety was still pending. The result was 100% as all the doctors showed their awareness about proper disposal of needles, syringes and surgical blades etc. All doctors were knew about the separate employees health clinic for the health care of hospital employees. All doctors knew that smoking is prohibited in all hospital areas. The respondents showed 100% response in favour of this question. Results showed that 80% doctors were fully aware about health and safety, rules and policies and 20% doctors did not aware because they were

new employees. Results showed that 73% doctors were aware about the availability of eye wash station and 27% doctors did not know about eye wash station. All doctors wash their hands before and after dealing with patients. Results of this question was good but some doctors did not cut the syringes and plastic bottles before dispose because of serious patients conditions.

Table 1: Responses of study participants.

Sr. No.	Question	Yes	No
1	Do you have the facility of PPE's (personal protective equipments)?	15	0
2	Do you know about waste disposal guidelines?	12	3
3	Have you got Orientation about handling and administration chemo?	10	5
4	Have you had a full course of immunization against hepatitis B?	14	01
5	Is there waste Containers properly covered with appropriate coloured bags?	15	0
6	Are there walking areas neat & clean to avoid the risk of slips or falls?	15	0
7	Have you got orientation about fire safety?	08	07
8	Is there sharps box available for the disposal of needles, syringes, surgical blades etc?	15	0
9	Is there separate clinic available for the health care of Hospital employees?	15	0
10	Is the smoking is prohibited in all hospital areas?	15	0
11	Have you got proper training to draw the blood samples of patients to avoid needle stick injury?	15	0
12	Do you know about health and safety rules and policy?	12	3
13	Is there eye wash station available for emergency eye wash?	11	4
14	Do you wash the hands before and after dealing of Patients with disinfectant?	15	0
15	Are the syringes and plastic bottles (drips/infusion bags) cut before throw in waste container?	10	5

Views of Nursing Staff

Nursing staff are also more susceptible to exposure to an infection while handling the patients specially cancer patients. Physical condition of cancer patients is very poor so the Nurses have to pay extraordinary attention to these patients. So, they are at high risk of nosocomial infections. Nosocomial infections are the hospital acquired infections such as MRSA infection, Hepatitis B, Hepatitis C and TB (Bahcecik and Ozturk, 2009; de Oliveira Neto et al., 2021).

- MRSA infections caused by a bacterium called Methicillin resistant staph aureus.
- Virus causes Hepatitis B is known as HBV.
- Virus causes Hepatitis C is known as HCV.
- Microorganism causes TB is known as mycobacterium tuberculosis.

Nurses view about health and safety were observed with the help of questionnaire that consist of 15 questions and were solved by 15 Nurses (ICU, ED and Ward Nurses)
Number of Nurses who gave their views: 15
Number of Questions: 15

Questionnaires for Nursing staff consist of all 15 questions are same as of questionnaire for doctors. All questions have the same views, results and value pie graph s as of doctors so they are not discussed in detail.

Views of Operation Theater Staff

View of OT staff about health and safety were observed with the help of questionnaire that consist of 15 questions and were solved by 15 members of operation theater staff. Staff of Operation Theater is at high risk of exposure to BBPs (Blood Born Pathogens) such as:

- HBV
- HCV
- HIV
- MRSA (Joshi et al., 2016; Pasaribu et al., 2022)

Following questions have the same views, results and value pie graphs as of Nursing staff so these are not discussed in detail:

Table 2: Questions to Operation Theater Staff.

Sr. No.	Questions
1.	Do you have the facility of PPE's?
2.	Do you know about waste disposal guidelines?
3.	Have you had a full course of immunization against Hepatitis B?
4.	Is there waste containers properly covered with appropriate coloured bags?
5.	Is there walking area neat and clean to avoid risk of slips and falls?
6.	Have you got Orientation about fire safety?
7.	Is there sharps box available for the disposal of needle, syringes and surgical blades etc?
8.	Is there separate clinic available for the health care of hospital employees?
9.	Is the smoking is prohibited in all hospital area?
10.	Do you know about health and safety rules and policy?
11.	Do you have the facility of eye wash station for emergency eye wash?
12	Do you wash the hands before and after dealing of patients with disinfectants?
13.	Are the syringes and plastic bottles (drips/infusion bags) cut before throw in waste container?

Following are the questions that were different from nursing staff questionnaire.

Table 3: Sterilization of equipment.

Sr. No.	Question	Yes	No
1	Are the equipments sterilized before the start of any surgery?	15	0
2	Are the used equipments sterilized before reuse?	15	0

The respondents showed 100 result as all were aware about the equipments to be sterilized before the start of any surgery. In OT special emphasis was given for sterilization of equipment because if equipments were not sterilized then they can become the major cause for infection among patients. Result was 100% as all the respondents were aware of equipments sterilization before reuse.

Views of Laboratory Staff

Laboratory Staff views (result of questions) are presented below.
Number of workers who gave their views: 15
Number of questions: 14
Lab. staff has to pay extraordinary attention at their work because they have to deal high infectious material (Blood, Urine, biopsies and other body fluids) and perform number of tests on them. In lab, health and safety has a supreme importance. Laboratory staff views for following questions were the same. Result of questions and value pie graph s related to health and safety were same as of OT staff members so these questions were not discussed in detail.

Table 4: Questions to Laboratory Staff.

Sr. No.	Questions
1.	Do you have the facility of PPE's?
2.	Do you know about waste disposal guidelines?
3.	Have you had a full course of immunization against Hepatitis B?
4.	Is there waste containers properly covered with appropriate coloured bags?
5.	Is there walking area neat and clean to avoid risk of slips and falls?
6.	Have you got Orientation about fire safety?
7.	Is there sharps box available for the disposal of needle, syringes and surgical blades etc?
8.	Are the used equipments sterilized before reuse?
9.	Is there separate clinic available for the health care of hospital employees?
10.	Is the smoking is prohibited in all hospital areas?
11.	Do you know about health and safety rules and policy?

Following are the questions that were different in the questionnaire. Results, views and value pie graph s are given below.

Table 5: Prohibition of eating and drinking in lab testing areas.

Sr. No.	Question	Yes	No
1	Is the eating and drinking prohibited in Lab. testing areas?	15	0
2	Have you got proper training to draw the blood samples of patients to avoid needle stick injury?	10	5
3	Are you fully trained to avoid your hands injuries from movement of probes of blood testing analyzers?	12	3

All the respondents were in favour of eating and drinking to be prohibited in testing areas, hence, the result was 100% as reflected in Table 3.20. 65% respondents were fully trained to draw the blood samples of patients to avoid needle stick injury while 35% respondents were unaware about it because they did not get proper training. Result was good but not satisfied because blood sample drawn is very sensitive technique. So proper training of phlebotomists (Lab. workers belong to phlebotomy section) is very necessary. 80% respondents were fully trained but 20% were not familiar to avoid their hands injuries from movement of probes of blood testing analyzers. Result was appreciative and 3 members who gave the answer in no they are new and their training did not completed till at question time.

Views of Radiology Staff

Views of Radiology staff about health and safety were observed with the help of questionnaire that consist of 15 questions and were solved by 15 members of Radiology department. Following questions have the same views, results and value pie graphs as of OT staff so these are not discussed in detail.

Table 6: Questions to radiology staff.

Sr. No.	Questions
1.	Do you have the facility of PPE's?
2.	Do you know about waste disposal guidelines?
3.	Have you had a full course of immunization against Hepatitis B?
4.	Is there waste containers properly covered with appropriate coloured bags?
5.	Is there walking area neat and clean to avoid risk of slips and falls?
6.	Have you got Orientation about fire safety?
7.	Is there separate clinic available for the health care of hospital employees?
8.	Is the smoking is prohibited in all hospital areas?
9.	Do you know about health and safety rules and policy?
10.	Do you have the facility of eye wash station for emergency eye wash?
11.	Do you wash the hands before and after dealing of patients with disinfectants?

Following are the questions that were different from OT staff questionnaire. Results, view and value pie graphs of following 4 questions are same and given below.

Table 7: Facility of radiation safety equipment.

Sr. No.	Questions	Yes	No
1	Do you have the facility of personal monitoring devices (film badges or finger rings) to determine radiations exposure?	14	01
2	Is there X-Ray rooms are equipped with a barrier wall with a lead platted glass window?	14	01

The results were appreciative as 93% respondents were fully aware of personal monitoring devices, X-Ray rooms equipped with barrier wall with lead platted glass windows, separate shielded storage area for radioactive material and signs bearing radiation caution symbols for radiations. However, only 7% did not know because they were either trainees and newly employee.

Radiation Exposure Results

Table 8: Results and standard level of radiation exposure.

Sr. No.	Specific Code	Results	Standard Level
1.	2216	250 mrem	1000 mrem/month
2.	2245	225 mrem	1000 mrem/month
3.	2222	210 mrem	1000 mrem/month
4.	2220	195 mrem	1000 mrem/month
5.	2248	218 mrem	1000 mrem/month

All radiation exposure results are below the recommended standard level i.e. 1000 mrem/month (NIOSH, 1998)

Views of Housekeeping Staff

Housekeeping staff is one of the most important and hardworking staff of the hospital. Views of housekeeping staff about health and safety were observed with same method of questionnaire as before. These questionnaires consist of 10 questions and were solved by 10 persons. Following questions have the same views, results and value pie graphs as of OT staff so these are not discussed in detail.

Table 9: Questions to housekeeping staff.

Sr. No.	Questions
1.	Do you have the facility of PPE's?
2.	Do you know about waste disposal guidelines?
3.	Have you had a full course of immunization against Hepatitis B?
4.	Is there waste containers properly covered with appropriate coloured bags?
5.	Is there walking area neat and clean to avoid risk of slips and falls?
6.	Is there sharps box available for the disposal of needle, syringes and surgical blades etc?
7.	Is there separate clinic available for the health care of hospital employees?
8.	Is the smoking is prohibited in all hospital areas?

Results, view and value Pie graphs of following 2 questions are same and given below.

Table 10: Awareness of proper covering and transportation of waste.

Sr. No.	Questions	Yes	No
1	Are the trolley's covered to prevent spillage during transportation of waste for incineration?	8	2
2	Are the trolleys coloured differently for infectious and non infectious waste.	8	2

Eighty percent respondents were aware to properly cover the trolley's to prevent spillage during transportation of waste for incineration and trolley colours for infectious and non infectious waste while other 20% respondents were not aware of these precautions.

Results of Noise and Illumination

Results of noise in different departments of hospital are as under;

Table 11: Results and recommended standard of noise level.

Sr. No.	Location	Noise Level (dBA)	Revised Standard	Remarks
1.	ICU	55	85	Low
2.	OT	57	85	Low
3.	ED	55	85	Low
4.	Laboratory	52	85	Low
5.	Radiology	60	85	Low
6.	Laundry	80	85	Low

Noise levels in different departments of the hospital are below the NEQS recommended standard i.e., 85dBA (PEPA,1997)

Table 12: Results and standard range of light.

Sr. No.	Location	Light in LUX	Revised Standard	Remarks
1.	ICU	600	300-750 LUX	Falling in Standard Range
2.	OT	615	300-750 LUX	Falling in Standard Range
3.	ED	620	300-750 LUX	Falling in Standard Range
4.	Laboratory	600	300-750 LUX	Falling in Standard Range
5.	Radiology	600	300-750 LUX	Falling in Standard Range
6.	Laundry	610	300-750 LUX	Falling in Standard Range

The permissible range for light is 300-750Lux for the health, safety and well being of workers in a hospital environment (OSHA, 1983). Results of light in different departments are falling in standard range i.e., 300-750 Lux.

Conclusion:

Based on the results of data analyzed and personal observation during our thesis work, smoking is totally prohibited in all hospital area since 01 June 2007. Its all credit goes to higher management of the hospital. This discussion was very appreciative because smoking causes cancer and heart diseases. Workplace stress is very closely observed in different departments of the hospital. Main causes of stress are shortage of staff, shift work, fatigue, extra work load due to shortage of staff, emotional situations such as death of patients. Results of awareness about fire safety are not much satisfied. Many flammable chemicals are used in different departments of the hospital. CO2 cylinders are available but many workers did not know about the use of these CO2 cylinders. All the infectious waste was sent for incineration. The management of housekeeping is very strict to implement this. In some times employees did not visit employee health clinic in case of minor injury or back/muscular pain. Walking /Working areas are neat and clean and in sanitary condition. This thing reduces the chance of slips/trips or falls. Results of noise, light and radiation film badges are

satisfied. Employees use PPE's properly while handling patients, hazardous chemicals, drawing patient blood and during injecting chemo and other drugs. The universal symbols of health and safety are displayed in all relevant departments.

Recommendation

Overall quality standard of health and safety in this hospital is excellent and appreciative but sometimes the management strategies were not followed completely by new and untrained employees. Following recommendations can be given for further improvement in the field of Health and Safety.

1. Educate the employees about job stress.
2. Establish programs to address workplace stress such as EAP. These programs can improve the ability of workers to cope with difficult work situations.
3. Orientation must be given to each employee about fire safety and the use of CO2 cylinders in case of fire hazard.
4. Employee with back pain, muscular pain and minor injury must visit to EHC (Employees health clinic).
5. If the sound creating uneasiness, divert the flow of sound energy away from the workers or use of hearing protection. e.g., ear muff or ear plug.

References:

1. Ahmed, N., A. Rizvi, A. Naeem, W. Saleem, A. Ahmed, S. Parveen, and M. Ilyas. 2020. COVID-19 and public awareness. *The Professional Medical Journal*. 27:1710-1716.
2. Almost, J.M., E.G. VanDenKerkhof, P. Strahlendorf, L. Caicco Tett, J. Noonan, T. Hayes, H. Van Hulle, R. Adam, J. Holden, and T. Kent-Hillis. 2018. A study of leading indicators for occupational health and safety management systems in healthcare. *BMC health services research*. 18:1-7.
3. Badida, P., S. Janakiraman, and J. Jayaprakash. 2023. Occupational health and safety risk assessment using a fuzzy multi-criteria approach in a hospital in Chennai, India. *International journal of occupational safety and ergonomics*. 29:1047-1056.
4. Bahcecik, N., and H. Ozturk. 2009. The occupational safety and health in hospitals from the point of nurses. *Collegium antropologicum*. 33:1205-1214.
5. Çalış Boyacı, A., and A. Selim. 2022. Assessment of occupational health and safety risks in a Turkish public hospital using a two-stage hesitant fuzzy linguistic approach. *Environmental Science and Pollution Research*. 29:36313-36325.
6. ÇOBAN, M., and T. ORTABAĞ. Evaluation of Occupational Health and Safety Practices by Hospital Staff.
7. Constantinidis, T., E. Vagka, P. Dallidou, P. Basta, V. Drakopoulos, S. Kakolyris, and E. Chatzaki. 2011. Occupational health and safety of personnel handling chemotherapeutic agents in Greek hospitals. *European journal of cancer care*. 20:123-131.
8. Cudjoe, S.F. 2011. An assessment of occupational health and safety practices on job performance at the Tetteh Quarshie Memorial Hospital, Mampong-Akuapem.
9. de Oliveira Neto, G.C., H.N.P. Tucci, M. Godinho Filho, W.C. Lucato, and J.M.F. Correia. 2021. Performance evaluation of occupational health and safety in relation to the COVID-19 fighting practices established by WHO: Survey in multinational industries. *Safety Science*. 141:105331.
10. Gul, M. 2018. A review of occupational health and safety risk assessment approaches based on multi-criteria decision-making methods and their fuzzy versions. *Human and ecological risk assessment: an international journal*. 24:1723-1760.
11. Gul, M., M.F. Ak, and A.F. Guneri. 2017. Occupational health and safety risk assessment in hospitals: A case study using two-stage fuzzy multi-criteria approach. *Human and Ecological Risk Assessment: An International Journal*. 23:187-202.

12. Habib, R.R., G. Blanche, F. Souha, F. El-Jardali, and I. Nuwayhid. 2016. Occupational health and safety in hospitals accreditation system: the case of Lebanon. *International Journal of Occupational and Environmental Health*. 22:201-208.
13. Joshi, V., E. Victor, E. Vasanth, S. Raghavan, and L. Gopichandran. 2016. Effect of in-service education workshop on occupational health and safety in terms of knowledge and awareness among nurses in a selected tertiary care hospital in India: An evaluation. *J Nurs Pat Care*. 1:2.
14. Moyo, D., M. Zungu, S. Kgalamono, and C.D. Mwila. 2015. Review of occupational health and safety organization in expanding economies: the case of Southern Africa. *Annals of global health*. 81:495-502.
15. Pasaribu, N.R., E. Girsang, S.L.R. Nasution, and C.N. Ginting. 2022. Evaluation Of Planning And Implementation Occupational Safety And Health In Hospital Embung Fatimah Batam In 2021. *International Journal of Health and Pharmaceutical (IJHP)*. 2:225-232.
16. Ramos, D.G., P.M. Arezes, and P. Afonso. 2015. Economic evaluation of occupational safety preventive measures in a hospital.
17. Rizvi, A., N. Ahmed, A. Naeem, W. Saleem, M. Ilyas, and A. Ahmed. 2020. A cross sectional study to evaluate awareness about hepatitis A & E among students in lahore. *Pakistan Journal of Public Health*. 10:160-166.
18. Steel, J., L. Godderis, and J. Luyten. 2018a. Methodological challenges in the economic evaluation of occupational health and safety programmes. *International journal of environmental research and public health*. 15:2606.
19. Steel, J., L. Godderis, and J. Luyten. 2018b. Productivity estimation in economic evaluations of occupational health and safety interventions: a systematic review. *Scandinavian journal of work, environment & health*. 44:458-474.
20. Tashia, O.S., and J. Jamaluddin. 2023. Evaluation Of Occupational Health And Safety Management System At Haji Hospital Medan. *Jurnal Perilaku Kesehatan Terpadu*. 2:62-68.
21. Tompa, E., R. Dolinschi, and C. De Oliveira. 2006. Practice and potential of economic evaluation of workplace-based interventions for occupational health and safety. *Journal of Occupational Rehabilitation*. 16:367-392.
22. Tompa, E., R. Dolinschi, C. de Oliveira, and E. Irvin. 2009. A systematic review of occupational health and safety interventions with economic analyses. *Journal of occupational and environmental medicine*:1004-1023.