

Risk Management by Implementing Hazard Identification, Risk Assessment and Determinant Control (HIRADC) Method in the Research Center of the University in Surabaya, Indonesia

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Abstract

The Research Center of the Faculty of Dentistry, Universitas Airlangga is one of workplaces that have various risks to cause occupational accidents. The use of various chemicals, specimens, and special instruments at the Research Center has potential to cause various risks that can threaten workers, assets, and environment. To prevent and control every hazard with potential negative risks, a risk management using HIRADC method must be implemented. This study aims to implement Hazard Identification, Risk Assessment and Determinant Control (HIRADC) method in the Research Center of the Faculty of Dentistry, Universitas Airlangga. This study is descriptive research with a cross-sectional design. Data collection was done through direct observation in the workplace and interview with a laboratory worker at the Research Center. The Research Center of the Faculty of Dentistry, Universitas Airlangga has a moderate risk. The research results showed that of the 5 work activities, there were 20 potential hazards with 20 risks identified. Based on the risk assessment, there are 1 extreme risk, 1 high risk, 11 moderate risks, and 7 low risks. The extreme risks identified are explosion, fire, and death caused by LPG. The high risks identified are explosion, poisoning, and death caused by CO₂ gas. Based on the determinant control, there are 15 controls implemented including substitution control, engineering control, administration control, and wearing personal protective equipment. However, there are still 5 controls that have not been implemented. Further recommendations are needed for 5 controls that have not been implemented in every activity conducted in the Research Center of the Faculty of Dentistry, Universitas Airlangga.

Keywords: HIRADC, Hazard Identification, Risk Assessment, Determinant Control, Research Center, Laboratory

Introduction

Every job has its own potential hazards depending on the production type, machines and instruments used, materials used, environment, and management and worker quality. Hazards are everything including situations or actions that have the potential to cause occupational accidents or injuries to humans, damage

or other disturbances⁽¹⁾. If a hazard is linked to the likelihood of occurrence of an accident and the severity it causes, it becomes a risk. Uncontrolled risks that are not managed effectively have potential to cause occupational accidents to workers.

According to data from the International Labour Organization (ILO) (2017), as many as 2,780,000 workers die each year due to occupational accidents and occupational diseases. About more than 380,000 (13.7%) of work deaths were caused by occupational accidents. In addition to causing high number of deaths of workers, occupational accidents also cause losses. Estimates of

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losses due to occupational accidents reach 3.94% of global Gross Domestic Product (GDP) each year⁽²⁾. In Indonesia, the number of occupational accidents is also quite high. According to data from the Ministry of Health of the Republic of Indonesia (2015), from the number of occupational accident cases in Indonesia during 2011-2014, the highest number occurred in 2013 with 35,917 cases. Therefore, it is known that every hour as many as 4 workers die due to occupational accidents⁽³⁾.

The Research Center of the Faculty of Dentistry, Universitas Airlangga is one of workplaces that have various risks to cause occupational accidents. The Research Center of the Faculty of Dentistry, Universitas Airlangga is a research center that aims to facilitate basic research, applied and innovative research for prevention of various diseases in oral cavity based on science and technology. The Research Center has five laboratories in it, which include immunology laboratory, molecular biology laboratory, karyotype laboratory, microbiology laboratory, dental biomaterial laboratory and stem cells.

The large number of work activities carried out at the Research Center has potential to cause various risks that can threaten workers, assets, and environment. The use of various chemicals, specimens, and special equipment at the Research Center also has potential to cause explosions, fires, occupational accidents such as being cut off, slashed, poisoning, exposed to chemicals, and also occupational diseases such as contact dermatitis, infertility and cancer. To prevent and control every hazard with potential negative risks, a risk management using HIRADC method must be implemented.

Hazard Identification, Risk Assessment and Determinant Control (HIRADC) method as part of risk management is one of requirements that must exist in implementing Occupational Health and Safety Management System in an organization based on ISO 45001:2018 in clause 6.1.2. In that clause it is stated that an organization must create, implement and maintain procedures to identify hazards from ongoing activities, risk assessments, and determine the controls needed⁽⁴⁾.

HIRADC method is a system for conducting risk analysis consisting of 3 stages, including hazard identification, risk assessment and determinant control. The output of risk management using the HIRADC method is to minimize any risk that can cause occupational accidents in the workplace⁽¹⁾. Therefore, the objective of this study is to implement Hazard Identification, Risk Assessment and Determinant Control (HIRADC) method at the Research Center of the Faculty of Dentistry, Universitas Airlangga.

Material and Method

This study is a descriptive research, which is a study conducted to describe or explain a phenomenon that occurs⁽⁵⁾. This study is an observational study with a cross-sectional design. The population in this study was a laboratory worker at the Research Center of the Faculty of Dentistry, Airlangga University. This study uses the total population as respondents. This study was done during October 2018. The data collected in this study is primary data through direct observation in the workplace and interview with a laboratory worker. The variables that will be used in this study are hazard identification, risk assessment and determinant control.

Hazard identification completed through direct observation in the workplace using the HIRADC form and interview with a laboratory worker at the Research Center using an interview sheet. Based on the results of hazard identification, the potential hazards and risks in each work activity carried out are known. Then, the level of likelihood and severity at each risk are determined using risk assessment matrix of Australian Standard / New Zealand Standard 4360:2004 (AS/NZS 4360:2004)⁽⁶⁾. The results of multiplication between likelihood and severity level scores will result in total risk. Based on the total risk, the analysis is carried out using a risk assessment matrix to determine the level of risk. After knowing the level of risk, then determinant controls were given in accordance with the level of risk.

Table 1. Categories of Likelihood Level Based on AS/NZS 4360:2004

Levels	Description	Explanation
1	Rare	The likelihood of hazards is very small, almost never happens
2	Unlikely	It usually not happens, but the likelihood is unlikely, the frequency is annual
3	Possible	The likelihood of hazard is small hazard or a coincidence, the frequency is monthly
4	Likely	The likelihood of hazard in a particular circumstances, the frequency is almost 100%
5	Almost Certain	Very likely to happen, the frequency is certain

Table 2. Categories of Severity Levels Based on AS/NZS 4360:2004

Levels	Description	Explanation
1	Insignificant	No injury
2	Minor	First aid kit, employees continue to work
3	Moderate	Injuries that need medical treatment, employees do not go to work
4	Major	Severe injuries (limb or partial disability), loss of production capacity
5	Catastrophic	Death

Table 3. Risk Assessment Matrix Based on AS/NZS 4360:2004

Likelihood		Severity				
		Minor	Moderate	Major	Catastrophic	
Insignificant	1	2	3	4	5	
Almost Certain	5	Moderate	High	High	Extreme	Extreme
Likely	4	Low	Moderate	High	High	Extreme
Possible	3	Low	Moderate	Moderate	High	High
Unlikely	2	Low	Low	Moderate	Moderate	High
Rare	1	Low	Low	Low	Low	Moderate

Findings

Hazard Identification

Hazard identification is a systematic process carried out to identify all circumstances and events that have potential to cause occupational accidents and occupational diseases that may arise in the workplace⁽¹⁾. Hazard identification method in this study is a proactive

method using Job Safety Analysis (JSA). There are 5 work activities identified at the Research Center, including research in immunology and histology laboratory, research in microbiology laboratory, research in molecular biology laboratory, research in stem cell laboratory, and cleaning of research medium used.

When carrying out work activities in each

laboratory at the Research Center, there are various potential hazards that can threaten workers health and safety. Based on the results of the hazard identification, it is known that from 5 work activities carried out at the Research Center of the Faculty of Dentistry, Universitas Airlangga there are 20 potential hazards with 20 risks that can occur. Potential hazards identified at the Research Center include physical hazards, chemical hazards, biological hazards, electrical hazards, and ergonomic hazards. Physical hazards identified at the Research Center are illumination, syringe, and fire. Chemical hazards identified at the Research Center are formalin, acids, dental paint, CO₂ gas, and LPG. Biological hazard identified at the Research Center is bacteria. Electrical hazard identified at the Research Center is electricity. Ergonomic hazard identified at the Research Center is long sitting positions while conducting research.

In addition, the risks that identified at the Research Center of the Faculty of Dentistry, Universitas Airlangga are eye fatigue caused by inadequate illumination; finger puncture wound caused by using syringe; fire caused by using fire; suffering from cancer and gas poisoning caused by formalin exposure; skin and eye irritation caused by exposure to acids; stains marks that are hard to remove on the hands caused by dental paint exposure; explosion, poisoning, and death caused by CO₂ gas; explosion, fire, and death caused by LPG; disease from residual organisms in research activity caused by bacteria; mild electric shock in workers caused by electricity; Musculoskeletal Disorders (MSDs) caused by long sitting positions while researching.

Risk Assessment

After all potential hazards and risks were identified, a risk assessment was then carried out. Risk assessment method used in this study is a qualitative method. Risk assessment includes 2 stages, namely risk analysis and risk evaluation. Risk analysis is carried out to determine the total risk that is the result of multiplication between the level of likelihood and the severity at each risk. Meanwhile, a risk evaluation is carried out to assess whether the risk is acceptable or not, compared to the applicable standards or the ability of the organization to face a risk⁽¹⁾. Risk assessment is done by finding the value of relative risk using risk assessment matrix of AS/NZS 4360:2004⁽⁶⁾.

According to AS/NZS 4360:2004, the risks included in the low risk category is risks with a relative risk

score of 1-4, the moderate risk category is risks with a relative risk score of 5-9, the high risk category is risks with a relative risk score of 10-19, and the extreme risk category is risks with a relative risk value of 20-25⁽⁶⁾. Based on the results of the risk assessment, in the risk analysis it is known from 5 work activities carried out at the Research Center of the Faculty of Dentistry of Universitas Airlangga, there are 20 risks consisting of 1 extreme risk, 1 high risk, 11 moderate risks, and 7 low risks.

In the risk evaluation, it is determined whether the risk is acceptable or not which determines the prioritisation of risk. Based on ALARP concept (As Low as Reasonably Practicable), the risks included in the category of high risk and extreme risk are unacceptable risks. Because these risks cannot be accepted or tolerated, risk controls must be taken so that the risk level can decrease to an acceptable level⁽¹⁾. In work activities carried out at the Research Center, the risk that included in the extreme risk is explosions, fires, and deaths caused by LPG, and the risk that included in the high risk category is explosion, poisoning, and death caused by CO₂ gas.

On the results of the risk assessment of LPG hazard potential, the likelihood level is 4 and the severity level is 5, so the total risk is 20. Based on the results of observations and interviews, it is known that the likelihood of LPG exposure when conducting cleaning activities is likely. The likelihood of hazard in a particular circumstances and the frequency of the occurrence is almost 100%. The severity it causes included to the catastrophic category, which can result in human death. Therefore, the risk of explosion, fire, and death due to LPG included to the extreme risk category.

On the results of the risk assessment of CO₂ gas hazard potential, the likelihood level score is 2 and the severity level is 5, so the total risk is 10. Based on the results of observations and interviews, it is known that the likelihood of CO₂ gas exposure when conducting research is unlikely. The likelihood usually not happens, is unlikely and the frequency of the occurrence is annual. For the severity it causes included to the catastrophic category, which can result in human death. Therefore, the risk of explosion, poisoning, and death due to CO₂ gas included to the high risk category.

Based on the results of the risk assessment, it is known that all hazards at the Research Center must be given determinant controls to minimize the occurrence

of work accidents, especially for extreme risks and high risks. Determinant control is also needed to reduce the impact on worker health and safety.

Determinant Control

After the assessment of all existing risks, the next step is to determinant control. Determinant control aims to minimize or reduce the level of risk to the lowest or tolerable level⁽¹⁾. Based on the results of the risk assessment, then control is determined according to the level of risk that has been analyzed. The determined control is adjusted to the risk control that has been implemented at the Research Center of the Faculty of Dentistry, Universitas Airlangga.

Based on the results of determinant control, there are 15 controls that have been implemented including substitution control, engineering control, administration control, and wearing personal protective equipment. The controls that have been implemented at the Research Center for potential hazards of bacteria are assistance by laboratory workers when conducting research, use of disposable gloves, hand washing with alcohol before and after conducting research, collecting in jerry cans, and washing autoclave 2 times with detergent. For potential hazards of illumination is use of bright colors on the ceiling and wall paints in laboratory, and adjusting use of lighting.

For potential hazards of formaldehyde, risk controls have also been implemented are storing formalin in tight specific places and controlled use of formalin when conducting research. For potential hazards of a long sitting position while conducting research is use of movable seats that can be used for stretching the body. Then, for potential fire hazards are the provision of small fire extinguishers in laboratory and use of fire as sterilization method only carried out by laboratory workers. For potential hazards of dental paint, risk controls have been implemented is washing the stains of dental paint on the hands slowly for several days. For CO₂ gas hazard potential are the provision of backup electricity in the form of generators and UVS in the laboratory, and assistance by laboratory workers when conducting research.

Most of controls have been implemented to every activity carried out at the Research Center of the Faculty of Dentistry, Universitas Airlangga. However, there are still 5 controls that have not been implemented, including potential hazards of syringes, potential electrical hazards,

potential hazards of acids, and potential hazards of LPG.

Conclusion

Based on the results of this study, it can be concluded that the Research Center of the Faculty of Dentistry, Universitas Airlangga has a moderate risk. The research results showed that of the 5 work activities, there were 20 potential hazards with 20 risks identified. Based on the risk assessment, there are 1 extreme risk, 1 high risk, 11 moderate risks, and 7 low risks. The extreme risks identified are explosion, fire, and death caused by LPG. The high risks identified are explosion, poisoning, and death caused by CO₂ gas. Based on the determinant control, there are 15 controls implemented including substitution control, engineering control, administration control, and wearing personal protective equipment. However, there are still 5 controls that have not been implemented to some activities carried out at the Research Center of the Faculty of Dentistry, Universitas Airlangga.

Further recommendations are needed for 5 controls that have not been implemented in every activity conducted in the Research Center. For research activities with potential hazards of syringes, it is recommended to provide temporary waste shelters around the Research Center area. For potential electrical hazards, it is recommended to provide without a small electric current voltage and the installation of protective equipment for laboratory equipment on the outside that is made of metal. For potential hazards of acids, it is recommended in the form of making Material Safety Data Sheets. For potential hazards of LPG, it is recommended to store and put LPG cylinders in a well-ventilated place.

Conflict of Interest: None.

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