

# Risk Analysis of Occupational Disease and Accident in Environmental Health Laboratory

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## Abstract

Risk analysis is a process to identify hazards by calculating the size of the risks and determining whether a risk is acceptable or not. The purpose of this study is to do hazard identification and risk assessment in environmental health laboratories at Faculty of Public Health at Universitas Airlangga. This study was included in an observational and cross sectional study based on the time of his research. Primary data is obtained through laboratory observations and interviews with reports presented in the form of tables and diagrams then analyzed descriptively. The results of this study indicate that in environmental health laboratories Faculty of Public Health Universitas Airlangga there are 10 potential hazards with 12 risks out of 4 activities. Based on the results of the risk assessment, from 12 risks there are 5 types of risks with low risk category, 4 types of risk for with moderate risk category, and 3 types of risk with high risk category. The conclusion of this study is that the greatest risk level in environmental health laboratories is low risk category of 41.67%. While for the moderate risk category was 33.33% and the high risk category was 25%. Risks with high risk categories include power failure, fire, and explosion at a time caused by the flow of electric current and chemical reactions carried out in the laboratory.

**Keywords:** *environmental health laboratory, hazard identification, risk assessment*

## Introduction

The laboratory is a place for conducting scientific research, experiments, scientific measurements or training. Environmental health laboratories are usually used to test food safety, solid waste, wastewater treatment, environmental exposure assessment, drinking water quality, radiation exposure assessment, and biomonitoring.<sup>(1)</sup> One of the aims of this laboratory is to provide services to the community related to provide information about the quality of the natural environment that is beneficial for citizens as well as their own natural environment.<sup>(2)</sup> Activities in the laboratory may have chance to cause work accidents and work-related diseases such as sampling, pipetting, pouring and mixing of materials for experiments. Occupational health and safety risks that can occur when conducting an activity in an environmental health laboratory are

exposure to the use of chemicals, exposure to biological hazards such as microbes and experimental organisms, physical hazards such as non-ergonomic positions when conducting research, scratched materials and research equipment, fires, electrical zips and explosions.<sup>(3)</sup>

Based on accidental survey statistics in the laboratory at the junior high school laboratory in Hong Kong during the 2014/2015 there were 241 cases of accidents that occurred to students and 10 cases occurred to employees and a total of 280 cases of accidents in the laboratory such as scratches, burns on hands, heat burns, eyes splattered from outside materials, and exposure to chemicals.<sup>(4)</sup> According to other data from the Berkeley Laboratory the number of accident cases occurred from October 2017 to May 2018 as many as 70 injury cases recorded and first aid were given, accidents in Berkeley's laboratory such as non-ergonomic working positions when moving the material, loss of hearing function, transportation accidents, exposure to chemicals, splashes in the eyes, and falling objects.<sup>(5)</sup> Other cases also occurred at the Laboratory of High Schools in the

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suburbs of Nashville, United States in 2018 as many as 17 people including students along with teachers who were teaching science experiments were experiencing fires due to the reaction of chemicals used.<sup>(6)</sup>

Actually these work accidents can be prevented by risk analysis of activities carried out in environmental health laboratories. The identification activities and risk assessment are able to determine the various risks so that control efforts can later be carried out to reduce these risks so that accidents or health problems will not occur.<sup>(7)</sup> Same as determined in ISO 45001, laboratories as workplaces that have potential hazards must be controlled so accidents will not occur. It is one of the international standards in occupational safety and health management systems that provides a framework for an organization to manage risks and opportunities to help prevent work-related injury and ill health to workers. The outcome of this system is to improve and provide a safe and healthy workplace. One of the provisions in ISO 45001 in clause 6, the company is required to do hazard identification and assessment of risk and opportunities proactively.<sup>(8)</sup>

Therefore, based on the potential hazards that can occur in environmental health laboratories the authors are interested in conducting research related to Risk Analysis of Occupational Disease and Accident in Environmental Health Laboratory at the Environmental Health Laboratory of Universitas Airlangga. The general objective of this study is to identify the hazards, assess the risks and determine the level of risk at the environmental health laboratory of the Faculty of Public Health, Universitas Airlangga.

### **Material and Method**

This study use an observational and cross-sectional research design then conduct interview with related party to Faculty of Public Health Universitas Airlangga environmental health laboratories. This research is included in descriptive research because this study does not make comparison or relation between variables and only describes a situation objectively. This research was conducted at the Environmental Health Laboratory, Faculty of Public Health, Universitas Airlangga. The variables to be examined in this study are hazard identification, risk assessment and risk level determination at Faculty of Public Health Universitas Airlangga Environmental Health Laboratory.

The data collected in this study are the primary

data obtained through observation and interview which are used to find out the activities in the laboratory, the potential hazards that exist, the magnitude of the risks and the condition of the work environments. Data processing and analysis techniques are carried out based on data from observation and interview. Based on the data we will know potential hazards and the value of likelihood and severity, then they are analyzed using the risk assessment matrix table based on AS/NZS 4360:2004 Risk Management.<sup>(9)</sup> The results of the analysis can determine level of risk of potential hazards with low, moderate, high, or extreme risk categories.

### **Findings**

The environmental health laboratory is included in one of the laboratories owned by the Faculty of Public Health, Universitas Airlangga. It is functioned to support the learning process of public health study program. Environmental health laboratories have various potential hazards that can cause safety and health risks for laboratory users, workers and people in the vicinity of laboratory. Activities carried out at this place include the use of electrical power equipment and roll cables while the learning process, lectures and lab activities, the cleaning of the room after lab activities. In addition, there are several source of danger potentially cause harm to occupational health and safety such as electricity that is not in accordance with the MCB used, cable roll circuit, noise and hot temperature from outside, chemicals that are in direct contact with the skin and respiratory tract, eyes that exposed to foreign objects, sitting position, equipment and part of the room that can cause injury, chemical interactions/reactions, and blockages in water installations.

Based on the results of the study, it is known that there are three levels of risk that may occur in this laboratory, namely there are 3 high risks category, 4 moderate risks category and 5 low risks category. Activities that have a high risk are the use of equipment with electric power and excessive use of cable while the learning process with the risk of power failure and fire at any time as well as interactions or reactions between chemicals during lectures or labs which also pose a risk of explosions and fires in the laboratory that will cause harm to people in the location. The total risk of high risk category at this place is 10. Control can be done to reduce the level of risk is to minimize electricity use, manufacture cable lines/electrical installations, arrange the layout of chemicals in accordance with the MSDS,

obtain appropriate work procedures and use of adequate personal protective equipment(PPE).

**Table 1. Hazard Identification Table and Environmental Health Laboratory Risk Assessment**

No	Activities	Source of Damage	Risk	L	S	Total Risk	Risk Level	Control
1.	Use of equipment with electric power when the learning process.	Electric current is not in accordance with the MCB used	Power failure and fire at any time	2	5	10	H	Minimizing electricity usage.
2.	The overuse of roll cable when the learning process.	Cable roll circuit.	Stumbled	3	1	3	L	Make grooves of roll cable that will be used from the front to the back of the room
			Can cause fire at any time.	2	5	10	H	Make grooves of roll cable that will be used from the front to the back of the room and minimize the electricity usage
3.	Lecture and practicum	Noise from outside room.	Interferes the concentration of learning process.	3	1	3	L	Install sound absorbers in the laboratory area
		The heat from outside room.	Disturbing learning process.	3	1	3	L	Arrangement of room ventilation and installation of air conditioner
		Chemicals in direct contact with skin, inhaled.	Irritation of the skin and respiratory tract.	2	3	6	M	Use latex mask and gloves.
		Foreign substances get in the eye or exposed to chemicals.	Eye irritation	1	3	3	L	Use the eye rinse or clean your eyes in the bathroom
		Sitting position	MSDs symptoms	5	1	5	M	Replace the wooden chair with an ergonomic chair (adjustable height with cushioning)
		Equipment/interior parts that can cause harm.	Scratched and slashed by the sharp edge of the room during practicum.	4	1	4	L	First aid giving
		Chemical interactions/ reactions	Irritations of the skin, eyes and respiratory tract	3	3	9	M	Providing special storage and fume hoods that meet storage requirements
			Explosion and fire	2	5	10	H	Arranging the layout of chemicals in accordance with the MSDS sheet
4.	Laboran cleans the room after practicum.	Blockages in water installations.	Irritation of the skin and respiratory tract	5	1	5	M	Reconstruction of water installation channels Using PPE latex gloves and masks

#### Hazard identification

There are four main activities carried out in this environmental health laboratory, each of which has the potential to cause disruption to health and safety for example the use of equipment with electric power when the learning process takes place with a source

of electrical hazards not in accordance with the MCB used causing the electricity failure and fire at any time, excessive use of chlorine cables during the learning process with hazardous sources of cable roll circuits that causing tripping and the occurrence of fire. Lecture

and practicum with sources of danger of noise and hot temperatures from outside of the room which is disrupting the concentration learning process. Direct contact with chemicals that can be inhaled and irritate the skin, respiratory tract and eyes. Sitting position which has a risk of causing symptoms of MSDs, equipment/parts of the room that can cause injuries that risk the body part of being scratched and slashed when using equipment, and the reaction between chemicals with a risk to irritate the skin, eyes and respiratory tract and cause an explosion as well as fire. Cleaning the room after practicum by laboratory assistant with a source of danger of blockages in water installations that cause waste disposal in water installations to irritate the skin and respiratory tract.

### **Risk Assessment**

The risk assessment carried out at the environmental health laboratory is by determining the likelihood and severity based on the AS/NZS 4360:2004 risk management category.<sup>(9)</sup> The biggest risk is electricity failure and fire at a time with a source of danger of electricity that is not in accordance with the MCB used, fire due with the source of danger of a series of roll cable that is too much and irregular, explosions and fires due with the source of chemical reactions with the probability of each occurring is 2, the possibility of occurring is rare or the frequency of occurring is annual. The severity of 5 is causing death, very large financial losses, damage to equipment that causes the cessation of the activity. On all three risks, the total value of the risk that causes electricity to fail, fire, and the occurrence of an explosion of 10 with a high risk category requires control measures and consideration of resources to reduce the risk.

MCB(Mini Circuit Breaker) functions to disconnect electric current when the electricity network is overloaded. MCB is one of the safeguards so that the risks and dangers caused by excessive use of electricity do not occur. But if the use of the MCB is not in accordance with the standard of use are able to trigger a short circuit and even a fire at a time, if the use of the MCB is in accordance with the standards then there will be an electricity failure.<sup>(10)</sup> The use of a roll cable that exceeds the usage capacity has potential to cause electrical short circuit and fire. Whereas for explosions and fires due to the danger source of a chemical reaction can be caused by a reaction between chemicals with one another whose use is not accordance to material safety data sheet, certain chemicals cannot be used together or placed in the same place.<sup>(11)</sup>

### **Risk control**

Risk control can be done so that the risk level can decrease so that the risks for the occurrence of occupational health and safety disturbances can be minimized when conducting activities in an environmental health laboratory<sup>(12)</sup>, namely by applying appropriate and established laboratory work procedures, minimizing electricity use by using electricity as needed, make grooves of roll cable that will be used from the front of the room to the back of the room, arrangement of layout and use of chemicals material safety data sheets (MSDS), in addition also provides a special place for chemical storage and fume hoods that are eligible for activities that related to chemical reactions and the use of PPE in accordance with the designation.

Applying appropriate and established laboratory work procedures aims to ensure that activities are carried out in accordance with the standards, organizational goals, and the effectiveness and efficiency of an activity. The existence of work procedures can be used as work guidelines for various interested parties and to determine work control measures as precisely as possible.<sup>(13)</sup> Minimizing the use of electricity with the necessary use so as not to exceed the load capacity that can risk triggering electrical short circuit and fire, in addition to make the cable roll grooves is aimed to arrange the cable neatly, not blocking the people, and minimizing the potential short circuit. The arrangement of the layout and use of chemicals is applied for the chemical according to the MSDS in order to avoid unwanted reactions that have the potential to harm people around the laboratory<sup>(11)</sup>

### **Conclusion**

The hazards identified in the Faculty of Public Health Environmental Laboratory Universitas Airlangga are 10 potential hazards with 12 risks out of 4 activities which include the use of electrical power equipment during the learning process, lectures and practices, using roll cables during the learning process, and cleaning the room after practicum activities by laboratory staff. Based on the results of the risk assessment, there were 12 risks in 4 work activities with 5 types of risk in the low risk category, 4 types of risk for the moderate risk category, and 3 types of risk for the high risk category. Control measures that can be taken to reduce risk are by implementing work procedures, minimizing the use of electricity, arranging the cable neatly and not blocking the people, minimizing the potential short circuit,

arranging the layout and use of chemicals and applying MSDS and the use of PPE in the laboratory.

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