



Health Hazard Identification in University Research Laboratory : A Literature Review

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Abstract

Background : Health science and technology continues to grow. The university research laboratory is one of the scientific development centers in the medical field. The laboratory is an important part of universities and research centers that have health hazards. Health hazards include chemical hazards, physical hazards, biological hazards and ergonomic risk factors. **Method :** This literature review using academic databases such as PubMed and ScienceDirect including all listed journals, classified, and analyzed over 12 years, from 2010 to 2022. **Conclusion :** The health hazards present in university research laboratories are varied. Therefore it is necessary to carry out a control and prevention so that the existing health hazards do not cause workers to experience health problems.

Key Words : Hazard identification, Health hazard, University research laboratory

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Introduction

Health science and technology continues to grow. Work that was previously done manually is now automated. Job automation in the health sector is expected to speed up service to patients. Fast and precise service is expected to improve the patient's quality of life (Ekwempu *et al.*, 2018).

Researchers continue to develop the latest laboratory methods. Most research is carried out in research centers, especially in university research laboratories (Tripković *et al.*, 2022). The university research laboratory is one of the scientific development centers in the medical field (Yang *et al.*, 2019).



The laboratory is an important part of universities and research centers that have chemical and biological hazards. Occupational safety and health in the laboratory is a joint responsibility of leaders, workers and researchers (Bhusnure *et al.*, 2018). Hazards in the laboratory can affect the learning activities of students and researchers and reduce efficiency and performance (Yang *et al.*, 2019).

Every workplace needs to carry out hazard identification to find out the potential hazards that exist (Ebens, 2007). So that steps can be taken to prevent and protect workers. In Republic of Indonesia Government Regulation number 50 year 2012 article 7 paragraph 2, states that every entrepreneur must provide an explanation regarding OHS conditions. The explanation includes hazard identification, risk control and assessment (Minister of Manpower, 2012).

Laboratory risk assessment is a dynamic and systematic work. The scope of the assessment includes the evaluation of pathogenic microbial hazards, experimental activities, facilities and equipment, personnel, experimental methods, etc. The risk of exposure to aerosols is the most common in experimental activities. Facilities and equipment are fundamental to the safe operation of a biosafety laboratory. Research laboratory risk assessments should be carried out regularly to ensure the safe operation of the laboratory (Beauchamp, 2020).

The United States Department of Labor explains that the identification of

health hazard exposure to workers is often more complex than physical safety hazards. Often the hazard is invisible such as dust and vapor which are very small in size. Health hazards include chemical hazards, physical hazards, biological hazards and ergonomic risk factors (OSHA, 2016).

Methods

This study uses a literature review approach. Literature review is carried out through the stages of collecting, identifying, evaluating, and interpret information about health hazards. The research articles obtained were selected according to the inclusion criteria which included: 1) research articles published in 2010-2022; 2) freely accessible full text. While the exclusion criteria are articles that are the published articles are not in their original form such as letters to the editor, abstracts only, and book reviews. Literature review was carried out in Science Direct and PubMed. To carry out the relevant journal research process efficiently, the keywords used are in accordance with the title writings such as health hazards include chemical hazards, physical hazards, biological hazards and ergonomic risk factors.

Results and Discussion

The search results obtained as many as articles. From the Science Direct database, 377 articles were obtained, and from Pubmed, 214 articles were obtained. From several search results articles, a review was carried out and obtained 16 articles that matched the inclusion and exclusion criteria.



Physical Hazard

Types of Physical Hazard

Physical hazard is a hazard caused by environmental conditions which can be in the form of noise, radiation and temperature. In a university research laboratory, of course, there are laboratory equipment that is used in daily activities (Satrio and Fuadi, 2020). This laboratory equipment has a wide range of noise. OSHA explains that the allowed noise limit is not more than 90 dBA for 8 hours (Murphy and Franks, 2002). Violation of these limits can result in impaired hearing function of workers (Satrio and Fuadi, 2020).

Research laboratories are often equipped with a variety of equipment with certain methods. One of the methods used in research laboratories is using radiation exposure such as radioimmunoassay (Felber, 1978). Besides that, there are also compound readings using certain laser radiation. Although radiation is not a major concern for safety in the laboratory, it is necessary to pay attention to the potential hazards that arise (Klein *et al.*, 2020). The dose of radiation in the laboratory may not be large, even so, radiation still has the potential to cause somatic effects that will appear after a long exposure (Choudhary, 2018). Potential somatic effects that will occur including cancer manifestations. So if a laboratory uses radiation in its work process, it is advisable to always carry out regular monitoring of the radiation dose exposed to the worker's body and carry out routine health checks every year

(Peraturan Kepala Badan Pengawas Tenaga Nuklir, 2015).

Laboratory equipment generally requires an environment with low temperature and humidity. In the U.S., FDA regulatory guidelines outline an optimal temperature for labs as being between 20 °C and 25 °C with humidity levels somewhere between 30% and 50% (FDA, 2019). This is done in order to prevent sample contamination, prevent bacterial growth, static buildup on some instruments, etc. However, there are some workers who cannot stand low temperatures, causing health problems. Some people can experience itchy, stuffy nose, sneezing, shortness of breath to hives on the skin (Farideh *et al.*, 2022).

Controlling and Eliminating Physical Hazard

Efforts to control physical hazards, namely providing a safe work environment for workers, routine inspections, providing PPE, developing SOPs for workers, conducting occupational safety and health training, etc (Satrio and Fuadi, 2020).

Chemical Hazard

Types of Chemical Hazard

Reagents are chemicals that are widely used in laboratory tests. Reagents certainly have a variety of shapes and properties. Chemical hazards include toxic, corrosive, irritant, carcinogenic, flammable and mutagenic . Chemicals can be harmful to the body through 4 main routes, namely absorption through the skin, inhalation, injection and ingestion (Bhusnure *et al.*, 2018).



The health effects of chemical hazards can be acute (short term) or chronic (long term). Acute health problems including headache, nausea or vomiting, and skin corrosion, while chronic health problems include asthma, dermatitis, nerve damage, or cancer (Papadopoli *et al.*, 2020). Exposure to chemicals can damage tissues due to chemical reactions, namely dehydration by strong dehydrating agents, digestion by strong acids and bases, oxidation by strong oxidizing agents (Anderson and Meade, 2014).

Controlling and Eliminating Chemical Hazard

Various efforts to protect workers and researchers in university research laboratories can be carried out. Some of them are labeling, warning signs, personal preventive methods, PPE and ventilation arrangements. Labeling is done by writing the name of the chemical substance and its composition, the name of the manufacturer, the date of manufacture and expiry date, as well as the hazard warning in the MSDS. The warning signs given are in the form of emergency exit signs and other necessary signs. In addition, it can also be given regulations prohibiting eating, drinking and smoking in the laboratory. PPE can be provided according to the hazard category such as laboratory coats, gloves, masks and shoes. Finally, air ventilation arrangements can be made in the laboratory, so that chemical substances can be removed and not spread in the laboratory (Satrio and Fuadi, 2020)(Bhusnure *et al.*, 2018).

Biological Hazard

Types of Biological Hazard

The university's research laboratory is a center for the development of science and technology. There are many studies about the disease and its causes carried out in the laboratory. Samples are often obtained from patients with infectious diseases. Therefore, patient samples pose a potential biological hazard. Patient samples can be blood, urine, sputum, tissue, etc (Innocent *et al.*, 2022). Some of the consequences of diseases that can be transmitted through blood samples include HIV, Hepatitis, etc (Chan *et al.*, 2020). In addition, there is also the potential for transmission of airborne diseases such as Covid-19 (Dhamanti *et al.*, 2022), tuberculosis, etc. Because workers and researchers in the laboratory will always work on these samples, they are at risk of contracting the disease (Djalante, Shaw and DeWit, 2020)(Chan *et al.*, 2021).

Experimental animals are often used in the research process in the laboratory. The animals used are very diverse, such as mice, sheep, bats, etc. Usually, experimental animals will be infected with certain diseases and then observed. These infected animals can transmit a disease either through their saliva, blood, urine and feces (Carpenter, 2018).

Controlling and Eliminating Biological Hazard

Various efforts to protect workers and researchers in university research laboratories can be carried out. Some of them are labeling, warning signs, personal preventive methods, PPE and ventilation



arrangements. In addition, it can also be given regulations prohibiting eating, drinking and smoking in the laboratory. PPE can be provided according to the hazard category such as laboratory coats, gloves, masks and shoes. Waste disposal must be considered in accordance with each place. Finally, air ventilation arrangements can be made in the laboratory, so that chemical substances can be removed and not spread in the laboratory (Satrio and Fuadi, 2020)(Cahya Laksana *et al.*, 2020).

Ergonomic Risk Factor

Laboratory workers are at risk of injury due to repetitive motions such as pipetting, working at a microscope, operating a microtome, using a cell counter, and operating a keyboard. Injuries can be felt and get worse over time. It often occurs when tendons are inflamed, muscles and joints move, nerves are pinched and blood flow is restricted. Working in a hunched position on a biological safety table can also cause health problems. Health problems that can result from poor ergonomic habits include aches, dizziness, muscle aches, spinal disorders, etc (Mukhtad *et al.*, 2018).

Control of Health Hazard

Efforts to control health hazards, namely providing a safe work environment for workers, routine inspections, providing PPE, developing SOPs for workers, conducting occupational safety and health training,

etc. Support from every stakeholder is needed to create a safe and healthy work environment (Bhusnure *et al.*, 2018).

Conclusion

Health hazards present in university research laboratories are varied. Health hazards include chemical hazards (toxic, corrosive, irritant, carcinogenic, flammable and mutagenic), physical hazards (noise, radiation, temperature), biological hazards (human sample, infectious disease, experiment animals and waste) and ergonomic risk factors (repetitive motions). Efforts to control health hazards, namely providing a safe work environment for workers, routine inspections, providing PPE, developing SOPs for workers, conducting occupational safety and health training, etc.

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