# *BIOSAFETY LEVEL* DI LABORATORIUM MIKROBIOLOGI PT SCI

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## *ABSTRACT*

*Protection of personnel in microbiological testing laboratories should be conducted. One of the efforts that can be used for preventive action is the determination of the biosafety level. This study was conducted with the aim of knowing how important the biosafety level is seen from the readiness level of laboratory personnel regarding knowledge, training, and competency assessment of laboratory personnel. Moreover, this study was also based on the application of biological risk assessment and the planned biosafety implementation program. The sampling method used was secondary data with document review and data recording from the implementation of activities in the microbiology laboratory. Meanwhile, the primary data collection was done through in-depth interviews with respondents using questionnaires and direct interviews. The results of data collection and data processing showed that 74% of laboratory personnel had the appropriate competence in carrying out the assessment by determining the biosafety level. This was supported by the biosafety program which might be planned and implemented with laboratory readiness. This had a percentage of 73% in terms of biological risk assessment and laboratory facilities. Determination of biosafety level is important for personnel who is working in dangerous facilities which is exposed to microbiological agents such as bacteria, viruses, fungi, and other microbiological products. This is because, determining the biosafety level not only protects laboratory personnel, but also the environment from biological hazards.*

***Keywords*** ***:*** *Biological Hazard, Biosafety, Laboratory, Microbiology, Risk Assessment*

## ABSTRAK

Pekerja yang dapat terkena paparan dari hazard biologis diantaranya adalah personil laboratorium. Perlindungan terhadap personil di laboratorium pengujian mikrobiologi harus dilakukan. Salah satu upaya yang dapat digunakan untuk tindakan pencegahan adalah dengan penentuan tingkat keamanan hayati (Biosafety Level). Penelitian ini bertujuan untuk mengetahui seberapa penting Biosafety Level dilihat dari tingkat kesiapan personil laboratorium terkait pengetahuan, pelatihan dan penilaian kompetensi personil laboratorium. Selain itu, juga didasari oleh penerapan penilaian risiko biologi dan program pelaksanaan Biosafety yang telah direncanakan. Pengambilan sampel menggunkan metode observasi dan studi literatur untuk data sekunder dengan review dokumen dan rekaman data dari pelaksanaan kegiatan di laboratorium mikrobiologi, serta pengambilan data primer melalui wawancara yang mendalam terhadap para informan dengan menggunakan kuesioner dan interview secara langsung. Hasil pengambilan dan pengolahan data menunjukan bahwa sebesar 74% personil laboratorium telah memiliki kompetensi yang sesuai dalam pelaksanaan penilaian dengan penentuan Biosafety Level. Hal tersebut didukung oleh program Biosafety yang akan telah direncanakan dan akan dilaksanakan dengan kesiapan laboratorium. Hal tersebut memiliki presentase sebesar 73% dilihat dari penilaian resiko biologi dan fasilitas laboratorium. Penentuan Biosafety Level penting untuk personel yang bekerja di berbagai fasilitas yang terpapar agen mikrobiologi seperti bakteri, virus, parasit, fungi, dan agen terkait serta produk mikrobiologi lainnya. Hal tersebut karna, penentuan Biosafety Level tidak hanya melindungi personil laboratorium, tetapi juga dan lingkungan sekitarnya dari bahaya hazard biologis.

**Kata Kunci** **:** Biosafety, Hazard Biologis, , Laboratorium, Mikrobiologi, Risk Assessment

## INTRODUCTION

Biological hazards in some cases that affecting workers can be included in occupational diseases. The hazard involves biological agents that can cause infectious diseases. Workers who are generally exposed are workers who work directly with the biological hazards, such as doctors, health workers, and laboratory analysts. Companies or institutions that have relevance and obligation to the application of biosafety guidelines are medical, clinical and microbiological laboratories, research laboratories, teaching and training laboratories, and other health care institutions (Rim and Lim, 2014).

**Figure 1. Standard Biohazard Symbol**
Source : (Shroder, 2016)

Infectious diseases among workers exposed to biological hazards can generally cause systemic infections involving the respiratory organs as well as the immune system. Biological hazards can be an allergen or toxic causative agents that form bioaerosol, which can cause diseases of the respiratory tract and skin. Bioaerosol is a biological particle that can be in the form of dust or droplets that are suspended in the air (Feng *et al.*, 2019). Bioaerosol consists of viruses, bacteria, endotoxin, fungi, fungal secondary metabolites, fecal particles, mite and insect bodies, as well as hair, feces, and urine from animals. Furthermore, the presence of biological hazards can also be a zoonotic causative agent which can be insects or other vectors that often cause respiratory and skin disorders (Rim and Lim, 2014).

A laboratory is an organization that carries out testing, calibration, and sampling activities. The laboratory can also be interpreted as practical workplaces for professional scientists, technicians, and students in carrying out research or learning activities. The laboratory is a system that is required to have a management that can be responsible for all laboratory activities. Things that are required to be considered in working in a laboratory are safety and security. Various personal protective equipment has to be worn while in the laboratory, such as laboratory coats, safety shoes, and safety glasses. This is because the laboratory is a special field that requires careful planning, adequate resources, and close supervision (Nayeem, 2016).

One of the efforts that can be made to minimize exposure to biological hazards is by pursuing a program to reduce hazard exposure for both workers and the surrounding environment by identifying and assessing risks. Risk is the probability for a person will be harmed or experience any bad effects for health. It may also apply to situations where the loss of property or equipment, or the occurrence of harmful effects to the environment (Health and Safety Authority, 2016). Risk assessment can be done by determining the level of biosafety. PT SCI CI provides inspection services for the quantity and quality of agricultural, forestry, marine, and fishery products/ commodities, food, industry, mining, oil and gas, consumer products, as well as the environment. In general, these services are intended to protect the interests of the parties that concerned and to ensure compliance with technical standards for trading products and commodities. PT. SCI also provides audit services to ascertain the capacity and capability of potential suppliers. One of the business domains of PT. SCI in laboratory testing is microbial parameters (Ahmad *et al.*, 2019).

The need to carry out a risk assessment in determining the biosafety level is related to the likelihood that a biological hazard in the laboratory might cause disease. Moreover, the severity of the disease may infect laboratory personnel or be exposed to the environment. Hazard in the microbiology laboratory is generally pathogenic bacteria. Pathogenic bacteria strains could be dangerous and crucial not only in laboratory scope but also in national and strategic biological resources (Jiang, Liu and Wei, 2019). Pathogenic bacteria and microorganisms that available in microbiology laboratory of PT SCI consisting of *Escherichia coli, Salmonella typhimurium, Staphylococcus aureus, Bacillus cereus, Bacillus subtilis, Legionella pneumophilla, Vibrio cholerae, Candida albicans, and Aspergillus niger*. Thus, a risk assessment needs to be carried out in order to determine the appropriate biosafety level for the safety and security of laboratory personnel in the microbiology laboratory of PT. SCI. This study was conducted with the aim of knowing whatever is important. The level of biosafety is seen from the readiness level of laboratory personnel regarding the knowledge, training, and competence of laboratory personnel. Furthermore, this study was based on biological risk management and the planned biosafety implementation program (Public Health Agency of Canada, 2018).

Risk is defined as an event, a change in circumstances, or a consequence that creates uncertainty and the effect of uncertainty on the objective. Risk can be defined as the chance of loss or the unwanted result of some action. Uncertainty is a state of not knowing what will happen in the future. The risk might occur can be as big the uncertainty of that. Risk is also possible to make a profit. This is because if there is no risk, there will be no return on the ability to manage that risk for any decisions that require a risk-return trade-off. Possible losses due to risk have to be balanced with profit opportunities (Crane *et al.*, 2013).

Risk assessment is a series of systematic activities that refer to quantitative calculations by measuring the impact or loss caused by a particular phenomenon. Risk assessment can be carried out with three steps by risk identification, analysis, and assessment. The result of that is a basis for risk management. Risk assessment is based on the process of comparing the results of the risk analysis carried out with the referred risk criteria. It can also be interpreted as the process of comparing the results of personalized risk analysis to determine the level of risk severity in a situation, activity, or place. The results of the risk assessment can be used to make risk mitigation or prevention (Li *et al.*, 2019).

Biological hazards or commonly referred to as biohazards are organisms or organic materials that are metabolized from organisms that have properties that are harmful to health. These organisms can include viruses, bacteria, and fungi. There are three main routes for these microorganisms to enter the human body, namely through the inhalation, oral, and transmission through contact with the body fluids of an infected person or contact with contaminated objects or skin. The harmful effects caused to human health by these biohazards are infections, allergies, and poisoning (OSHC, 2003). Diseases that can be found as a result of these hazardous pathogenic microorganisms include Salmonellosis, Listeriosis, Campylobacteriosis and Yersiniosis (Pigłowski, 2019).

Biological safety, which is commonly abbreviated as biosafety in the laboratory, is the principle of containment, both in the form of technology and practice applied to prevent exposure to pathogens. The main purpose of biosafety is the containment of potentially hazardous biological agents (biohazards). The scope of biosafety is that of safe

methods, facilities, and equipment for managing infectious materials a type of bio risk that can affect humans and the environment. Personnel who is working in laboratories may be exposed to biosafety hazards, particularly those who work directly with infectious agents, or those who work indirectly or closely with infectious agents. People living in an environment outside the laboratory or facilities can also face biosafety hazards if the agent is released either intentionally or unintentionally into the environment (Smith, 2014).

Biosafety risk assessment is a systematic work program that involves an assessment of the hazards of pathogenic microorganisms, laboratory testing activities, laboratory facilities and equipment, personnel in the laboratory, laboratory methods, natural disaster mitigation methods, and protection from fire hazards, electrical equipment, hazardous chemicals, and hazardous gases. Biosafety Risk Assessment can be carried out qualitatively and quantitatively. Risk assessment is the most important component of biosafety implementation. This is because the risk assessment determines the relative nature of the laboratory, both activities, test results, and environmental risk assessment. This is necessary in order to understand a broader risk assessment concept, namely a way to deal with uncertainty and incomplete data from laboratory results. Therefore, decisions can be made with full consideration of the consequences of being influenced by policy choices, individual experiences, and public reactions (Traynor, Frederick and Koch, 2002).

In its implementation, Biosafety Risk Assessment considers the activities carried out in the laboratory, the hazard characteristics of pathogenic microorganisms, and the prevalence of pathogens in the environment around the laboratory. Risk assessment is consists of four components which are hazard identification, hazard characterization, exposure assessment, and continuous review and improvement. Biosafety Risk Assessment in its assessment can provide guidance for the selection of suitable biological safety measures. This may include methodologies in microbiological practice and safety equipment, security measures, and facility protection aimed at mitigating defined risks to acceptable or manageable levels. The results of the risk assessment can be conclude that some risks can be controlled using relatively straightforward measures, such as properly cleaning up spills and splashes, reducing fall hazards, and lock all containers containing dangerous pathogens. Risk assessment is an important instrument to assist in risk reduction. This is because laboratory risks can never be completely eliminated. The purpose of the research conducted was to assess the readiness of the microbiology laboratory at PT SCI in facing the biosafety risk assessment assessed from the Biosafety Knowledge and Training as well as Competency Assessment and Biosafety Program and Biological Risk Assessment (Public Health Agency of Canada, 2018).

## METHODS

Data were obtained from two sources, primary data and secondary data. The method used in collecting the primary data was in-depth interviews with respondents using questionnaires and direct interviews with the ethical approval number: Ket- 61/ UN2.F10.D11/PPM.00.02/2021.
Meanwhile, secondary data were taken from document review and data records of activity implementation in the microbiology laboratory. The scope of data collection was seen from various aspects in the microbiology laboratory, namely demographic data and general question data regarding biosafety (WHO, 2004).

***Biosafety Knowledge and Training as well as Competency Assessment***

Human resources at the PT SCI Microbiology Laboratory were mapped from the managing manager to the laboratory staff totaling 12 people. The PT SCI Microbiology Laboratory was a laboratory that receives samples daily from various sources with various types of samples. This requires a suitable and concentrated laboratory environmental condition concerning the safety of its personnel from possible biological hazards. Besides environmental conditions and biosafety level standards, the knowledge and competence of personnel need to be taken into account as part of the biosafety assessment in the Microbiology laboratory of PT SCI.

Data were collected during the 2015-2020 period according to the year of entry for the majority of staff and training that began at the Microbiology laboratory. The training included occupational safety and health training, training on biological hazards, methods and basics of microbiological testing, to handling biological hazards at the PT SCI Microbiology laboratory. Sample data were devoted to laboratory personnel who work directly on samples and executive management.

***Biosafety Program and Biological Risk Assessment***

Interviews and questionnaires submitted to laboratory personnel were based on the standards outlined in the Laboratory Biosafety Manual such as the 5$^{th}$ edition of Biosafety in Microbiological and Biomedical Laboratories (BMBL) and the Laboratory Biosafety Manual (3$^{rd}$ Edition) by the World Health Organization (WHO) in 2014. The questions raised indicate the respondents' general knowledge, including standard sample testing procedures, identification and assessment of biological hazards, decontamination protocols, use of biosafety cabinets, standard operating procedures for handling biological hazards, transport and disposal of biohazard waste, and management roles in managing laboratory based on biosafety standards. Moreover, interviews were conducted with respondents regarding the availability and use of laboratory personal protective equipment (PPE) as well as biosafety devices such as facilities with appropriate biosafety levels.

***Data Management and Statistical Analysis***

The sampled data were then processed and analyzed using Microsoft Excel 2018 and SPSS. The results of data collection were used to determine the readiness status of laboratory personnel for biosafety implementation at the PT SCI Microbiology Laboratory. A numerical scoring system was undertaken to assess general knowledge of biosafety, use of biosafety devices and appropriate PPE, as well as personnel attitudes and their competencies to standard laboratory practice, and level of awareness in biosafety application using One-Factor Anova Correlation Test for Biosafety Knowledge, Training & Competency and Laboratory Record of Year Service and also Linear Regression Correlation Test for Biosafety Knowledge, Training & Competency and Biosafety Program and Biological Risk Assessment.

**RESULT**

***Demographics of Laboratory Personnel***

The demographic level of respondents consisted of 12 people including three categories, namely laboratory management, analysts, and laboratory assistants. The respondents' average response rate was 100% visualized in Table 1. The characteristics of laboratory

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personnel were dominated by those in the age of 21-30 years old of 75% (Figure 2) with male dominance of 67% (Figure 3). Most of them were experienced in the laboratory for 1 to 5 years with a percentage of 75% of the total laboratory personnel (Figure 4).

**Table 1. Category of Laboratory Personnel in Microbiology Laboratory PT SCI in 2020**

| Category | Person Attended | Person Response | Response Rate (%) |
|---|---|---|---|
| Manager | 1 | 1 | 100 |
| Supervisor | 1 | 1 | 100 |
| Analyst | 9 | 9 | 100 |
| Lab Staff | 1 | 1 | 100 |
| **Total Participants** | 12 | **Average Response Rate** | 100 |

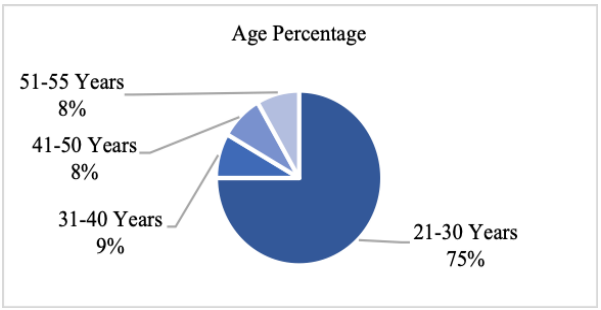


**Figure 2. Age Distribution of Laboratory Personnel**

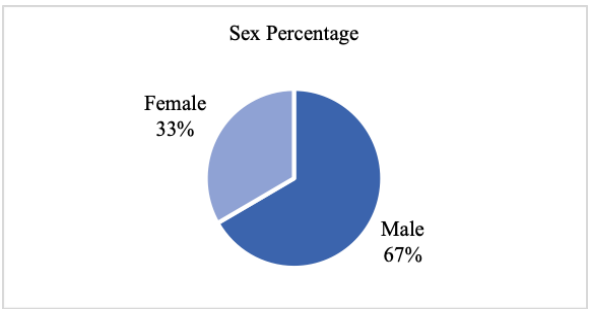


**Figure 3. Gender Distribution of Laboratory Personnel**

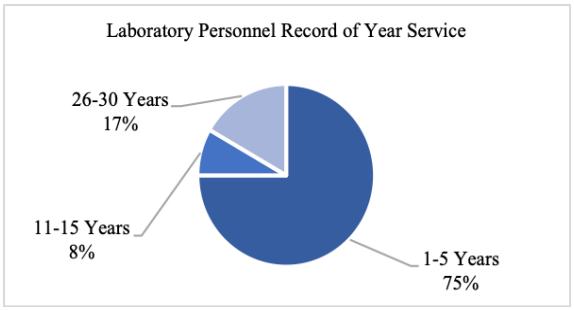


**Figure 4. Working Period of Laboratory Personnel**

### *Biosafety Knowledge and Training and Competency Assessment*

Based on the results of data collection and processing, it was found that 74% of the 12 laboratory personnel had the appropriate competencies related to the implementation of the assessment by determining the Biosafety Level (Figure 5). The results of the data on the correlation between the tenure of laboratory personnel and the knowledge and training data of biosafety and competency assessments showed that there was no correlation between personnel tenure in the laboratory and knowledge, training and competence regarding biosafety application in the laboratory (Table 2).

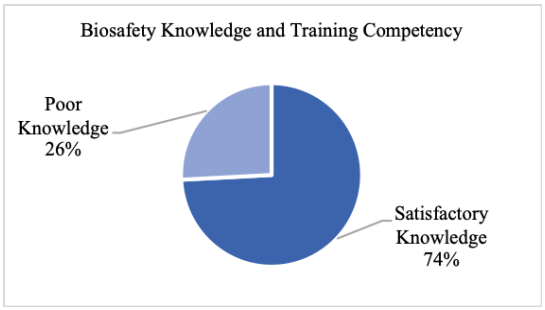


**Figure 5. Biosafety Knowledge and Training and Competency Assessment**

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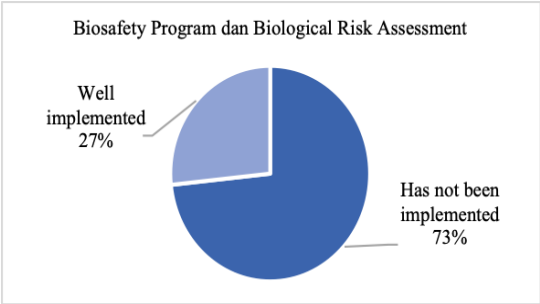


**Figure 6. Biosafety Program and Biological Risk Assessment**

**Table 2. Results of One-Factor Anova Correlation Test for Biosafety Knowledge, Training & Competency and Laboratory Record of Year Service**

| Biosafety Knowledge, Training & Competency | | | | | |
|---|---|---|---|---|---|
| | Sum of Squares | df | Mean Square | F | Sig. |
| Between Groups | 1.750 | 2 | .875 | .750 | .500 |
| Within Groups | 10.500 | 9 | 1.167 | | |
| Total | 12.250 | 11 | | | |

***Biosafety Program and Biological Risk Assessment***

Data obtained from the planning of the Biosafety program carried out related to laboratory readiness with a percentage of 73% seen from the biological risk assessment and laboratory facilities (Figure 5). The results of the correlation test data between biosafety knowledge and training as well as competency assessments and the Biosafety Program and Biological Risk Assessment show that there is a strong correlation with R = 0.912 (Table 3 dan Tabel 4).

**Table 3. Results of the Linear Regression Correlation Test for Biosafety Knowledge, Training & Competency and Biosafety Program and Biological Risk Assessment from SPSS**

| Coefficients[a] | | | | | | |
|---|---|---|---|---|---|---|
| **Model** | | **Unstandardized Coefficients** | | **Standardized Coefficients** | **t** | **Sig.** |
| | | **B** | **Std. Error** | **Beta** | | |
| 1 | (Constant) | 19.949 | 5.643 | | 3.535 | .005 |
| | Biosafety Knowledge, Training & Competency | 1.044 | .148 | .912 | 7.049 | .000 |

a. Dependent Variable: Biosafety Program and Biological Risk Assessment

**Tabel 4. Results of the Linear Regression Correlation Test for Biosafety Knowledge, Training & Competency and Biosafety Program and Biological Risk Assessment**

| Variable | R | $R^2$ | Line Equation | p-Value |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Biosafety Knowledge, Training & Competency | 0.912 | 0.831744 | Biosafety Program and Biological Risk Assessment = 19.949 + 1044 (Biosafety Knowledge) | 0.005 |

## DISCUSSION

Based on the results of the research conducted, it was found that the personnel had a good level of awareness regarding the application of biosafety in the microbiology laboratory. The results of sampling with laboratory personnel show that the average response rate is 100% as shown in Table 1. The survey response rate of 100% indicates that the motivation of laboratory personnel is good, where this percentage also implies the level of attention of laboratory management who is already concerned with the implementation of laboratory biosafety. The total number of personnel is dominated by the age range of 21-30 years as shown in Figure 2 with a male population of 67% more as shown in Figure 3. The average of the entire working period of personnel in Figure 4 is the last 5 years amounting to 75% and the rest are in managerial and supervisory positions. This will affect the test results of the relationship between competence and knowledge gained during work.

Most laboratory personnel have a general knowledge of good and correct laboratory practice. This includes training and use of acceptable biosafety devices and PPE demonstrated with a score of 81.6%, occupational safety and health training at 85%, knowledge of biological hazards with a score of 73.3%, exposure to specific risks to microbiological agents 75%, knowledge about how to handle testing equipment / supplies in the laboratory by 76.7% and the use of biosafety cabinets by 71.6%. Laboratory analysts working with pathogens were found to have good knowledge and competence related to occupational safety and health in the laboratory and related to daily analytical work. The results of questionnaire data processing showed that most laboratory personnel had good laboratory biosafety scores. The data showed that this survey was the first to be conducted at PT SCI which aimed to evaluate biosafety in a microbiology laboratory facility. The importance of personnel competence in the application of biosafety is required in every laboratory staff, so that they must be given understanding and training, starting from understanding the characteristics of the chemicals and biological agents used, as well as good and correct laboratory techniques in the laboratory where they work. This can be seen from the percentage of 74% of the personnel shown in Figure 5 regarding the Biosafety Knowledge and Training and Competency Assessment of all laboratory personnel (Syahputra, 2017).

The Anova value obtained from statistical testing of the One-Factor Anova Test (Table 2) is F = 0.750 with a p-value = 0.500 (p> 0.005). The null hypothesis shows that there is no correlation between the tenure of laboratory personnel and Biosafety Knowledge, Training & Competency, while the alternative hypothesis shows that there is a correlation between the tenure of laboratory personnel and Biosafety Knowledge, Training & Competency. By using alpha = 0.005, the conclusion from the above results is that the null hypothesis (Ho) is accepted. Thus, the conclusion is that there is no relationship between the tenure of laboratory personnel and Biosafety Knowledge, Training & Competency. This is because training and competency improvement are carried out routinely every year in the microbiology laboratory in accordance with the specific Training Needs Analysis study and in accordance with the hazards and laboratory testing needs However, the development of the microbiology laboratory towards biosafety has only been carried out for the last 5

years, especially training for employees and analysts who have recently joined as employees at the microbiology laboratory of PT SCI (Hastono, 2018).

The results of other linear regression correlation statistical tests related to Knowledge Training and Competence as well as the Biosafety Program and Biological Risk Assessment in Table 3 show that the knowledge and training variables have a positive and significant effect on the biosafety program. The correlation between Biosafety Knowledge, Training & Competency with the Biosafety Program and Biological Risk Assessment shows a positive correlation with high strength/closeness of the relationship (R = 0.912 close to +1) as shown in Table 4. This means that the higher the Biosafety Knowledge, Training & Competency, the better the Biosafety Program and Biological Risk Assessment in the laboratory will be implemented. Biosafety Knowledge, Training & Competency variables can explain 83.2% of the variation in the Biosafety Program and Biological Risk Assessment variables. This relationship is a statistically significant relationship which is indicated by a P value of 0.005 <0.05 (Sabri and Hastono, 2014).

In addition to the competence of laboratory personnel, management and administrative control of biosafety and assessment of biological hazard risks are also required as part of an effective biosafety program. That is a part of quality management system. Implementing the quality management system in laboratory is more than quality control and quality assurance, because quality management system leads to system plan of laboratory work, documents practices include processes and operating procedures, meets its requirements, checks and evaluates it through audit (Hou *et al.*, 2019). Managing biosafety laboratory provide an important safety platform according to not only protect personnel from pathogenic infection, but also prevents pathogenic sources from leaking to the environment. It can be done by standardize management for ensuring safe operation of biosafety laboratory. This is consistent with what is shown in Figure 6, that the laboratory management has thought about and prepared the Biosafety Program and Biological Risk Assessment with a presentation result of 73% (W *et al.*, 2019).

Most of the laboratory personnel have obtained high scores in the laboratory biosafety program category and assessment of biological hazards which are part of an effective biosafety program. Most of the laboratory personnel received high scores in the laboratory biosafety program category and the biological assessment based on the questionnaire (U.S. Department of Health and Human Sevices, Centers for Disease Control and National Institutes of Health, 2020). This data is strengthened by the demographic data of personnel with a dominance of 1-5 years of work experience, showing that the competence of laboratory analysts is equal in terms of laboratory management related to biosafety. The thing related to biosafety management is the availability of standard procedures, which include sample acceptance, testing, sample quality control, to the decontamination stage with a score of 61.7%.

In addition, the biosafety risk assessment is shown with a score of 60% because the biosafety assessment has not been carried out. Biological hazard control by identifying laboratory activities has a score of 80%, new management control procedures have a score of 68.3%, a list of microorganisms and personnel able to identify them has a score of 80% and the stage of biological hazard control in case of spills and unexpected events has a score of 76.7 %. The last one is management system audits related to biosafety have a score of 68.3%. The facilities for laboratory for example the design or layout, material for furniture and also requirement for room

monitoring are important rules for protect the laboratory personnel, because effective treatment and preventive measures are not usually available (Zhang *et al.*, 2019).

**Figure 7.** Example of Biosafety level-3
Source : (Syahputra, 2017)

The scoring results reflect the readiness and awareness of the importance of assessing and applying biosafety in the PT SCI microbiology laboratory. Bayot & Limaiem, 2020 states that the failure of implementing biosafety systems is due to the absence of technical documents containing specific biosafety guidelines, poor biosafety skills due to lack of personnel training, continuous laboratory hazards and increased risk. due to inadequate risk assessment and management, use of substandard laboratory equipment, poor maintenance of equipment and biosafety guidelines in laboratory facilities. This can occur as a result of poorly written guidelines or procedures, including writing regarding the application of generic and non-specific procedures, unclear roles and responsibilities for each staff involved, lack of a review and update process of existing guidelines and socialization and access to those guidelines that are bad. The assessment of real-time condition about biological risk at laboratory is the first step towards biosafety defense (Zhou *et al.*, 2019).

The results of observations and assessment show that the personnel who work in the Microbiology Laboratory of PT SCI have good biosafety knowledge. Good biosafety knowledge is reflected in their behavior at work, which is related to the availability and proper use of biosafety devices and PPE, good attitudes towards biosafety, and adherence to standard laboratory practices (Bayot and Limaiem, 2019). Good biosafety laboratory practice also cannot be developed if the safety culture is not strong enough to be implemented. Poor implementation of good microbiological practice is the most common cause of laboratory-acquired infections, and training in compliance with procedures and regulations appears to be the best method of avoiding such infections (Huang *et al.*, 2019).

## CONCLUSION

Determination of the Biosafety Level is important for personnel working in facilities exposed to microbiological agents such as bacteria, viruses, fungi, and related agents and other microbiological products. This is because the role of determining the Biosafety Level is not only to protect laboratory personnel, but also the surrounding environment from biological hazards. Safety considerations are the most important thing in biosafety assessment, along with the consideration of laboratory test results that will be more accurate with the safety and risk assessment carried out.

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