Implementation Of The Occupational Safety And Health Management System (Smk3) In The Public Health Laboratory Of Teuku Umar University: A Qualitative Study

[1]Azwar, [2]Aulya Fazira

[1,2] Public Health Laboratory, Public Health, Faculty of Health Sciences, Teuku Umar University
Corresponding author: Azwar, e-mail: azwar@utu.ac.id

Abstract

Occupational Safety and Health (OSH) is an important aspect in the management of public health laboratories due to the potential risks of biological, chemical, physical, and ergonomic hazards. This study aims to describe the implementation of OSH in the Public Health Laboratory of Teuku Umar University based on a literature review. This study uses a descriptive qualitative method with a literature study approach. Data were obtained from various sources, including regulations related to SMK3, reference books, laboratory safety guidelines, and relevant national and international journal articles. The data were analyzed descriptively by grouping the information into main themes related to SMK3 policies, implementation, and challenges in public health laboratories. The results of the study show that the implementation of SMK3 in public health laboratories includes the development of standard operating procedures, the provision of personal protective equipment, hazard risk management, and efforts to increase OSH awareness.

Keywords: OSH, OHS, laboratory, public health, qualitative research

Introduction

Public health laboratories are not merely rooms filled with equipment and practical materials, but rather living learning spaces where students hone their skills, conduct experiments, engage in discussions, and interact directly with various occupational hazards (Seftiatullaeli, 2024). Every day, lecturers, laboratory assistants, and students carry out activities such as weighing chemicals, heating solutions, preparing water or food samples, observing microorganisms under a microscope, and cleaning glassware. These activities may seem simple, but behind the routine lies a real potential for danger. Chemical spills, broken glass, needles or sharp instruments, exposure to microbes, and fatigue due to poor ergonomic work positions can cause injuries or health problems if not managed properly (ILO, 2020).

In practice, minor accidents such as cuts from glass, skin irritation from chemicals, or slipping on wet floors are often considered trivial. However, these incidents are signs that the safety system is not yet functioning optimally. Moreover, most laboratory users are students who are still learning and do not yet have full experience in working safely. The lack of personal protective equipment, ignorance of emergency procedures, or the habit of rushing through work can increase the risk of accidents. This situation shows that occupational safety and health in laboratories is not only the responsibility of the management, but a shared need to protect every individual who works there (Rahmantiyoko et al., 2019).

Efforts to protect workers and everyone in the workplace are clearly mandated in national regulations. Law No. 1

of 1970 on Occupational Safety stipulates that every workplace must ensure the safety of workers and other people in the workplace, including preventing accidents and occupational diseases (UU RI No. 1 Tahun 1970, 1970). This means that educational laboratories, as places where work and practical activities take place, are also included in the scope of protection. Furthermore, Government Regulation No. 50 of 2012 concerning the Implementation of the Occupational Safety and Health Management System (SMK3) stipulates that every organization needs to implement a planned, structured, and integrated management system to control occupational risks through planning, implementation, evaluation, and continuous improvement (Peraturan Pemerintah, 2012). This regulation emphasizes that safety aspects are not sufficient in the form of written rules alone, but must be realized in a functioning system.

In the context of university laboratories, the implementation of SMK3 is highly relevant because this environment brings together many users with diverse backgrounds and experiences. SMK3 assists laboratories in identifying potential hazards, developing standard operating procedures (SOPs), providing personal protective equipment, conducting safety training, and fostering a culture of safety (Arfiana & Fanika, 2023). More than just preventing accidents, the implementation of SMK3 also plays a role in shaping students' character so that they become accustomed to working in a disciplined, careful, and responsible manner, habits that they will carry with them when they enter the workforce as public health workers (Pangaribuan et al., 2022). However, the reality on the ground shows that the implementation of SMK3 in educational environments is often not optimal. Limited facilities, incomplete procedural documentation, lack of supervision, and low user awareness are challenges that are often encountered. It is not uncommon for safety to only become a concern after an incident has occurred (Indramanik et al., 2019).

This reactive approach is certainly not in line with the principle of prevention emphasized in SMK3. Therefore, a comprehensive evaluation of occupational safety practices is needed so that laboratory management can be carried out more systematically and sustainably. The Teuku Umar University Public Health Laboratory is an important facility that is used intensively for practical activities, student research, and community service. The high volume of activity means that interactions between users and potential hazards occur almost daily. This situation requires an occupational safety system that is not merely a formality, but is genuinely implemented in daily work practices (Friansa et al., 2025). To that end, the implementation of SMK3 in the laboratory, in terms of policy, procedures, and user experience, still needs to be studied in depth.

Based on this background, this study aims to analyze the implementation of the Occupational Safety and Health Management System (SMK3) at the Teuku Umar University Public Health Laboratory using a qualitative approach. This approach was chosen to explore the experiences, perceptions, and actual practices of managers, laboratory assistants, and students as direct users of the laboratory. Through a closer understanding of the real conditions in the field, it is hoped that this study can provide a comprehensive picture of the implementation, obstacles, and improvement efforts in the application of SMK3, thereby creating a safer, healthier laboratory environment that supports a sustainable learning process.

Methods

This study used a qualitative method with a systematic literature review (SLR) approach that referred to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The systematic review approach was chosen to ensure that the process of searching, selecting, and analyzing literature was carried out

systematically, transparently, and replicably. This method allows researchers to comprehensively identify, evaluate, and synthesize scientific evidence related to the implementation of the Occupational Safety and Health Management System (SMK3) in public health laboratories (Siswanto, 2019). Literature searches were conducted online through several academic databases, namely Google Scholar, Garuda (Garba Rujukan Digital), and national and international journal portals relevant to the field of occupational safety and health. The keywords used included a combination of the terms "SMK3", "K3 Management System", "occupational safety and health", "educational laboratory", "health laboratory", "laboratory safety", and "occupational health and safety management system".

The search was limited to publications within the last ten years to obtain the most up-to-date references, with the exception of national regulations and basic literature that were still used as a theoretical basis. Inclusion criteria include: (1) research articles, literature reviews, or official documents discussing the implementation of SMK3 or occupational safety in laboratories; (2) relevant to the context of education, health, or laboratory facilities; (3) available in full text; and (4) published in Indonesian or English. Exclusion criteria include duplicate articles, literature that is not relevant to the research focus, non-scientific opinions, and sources whose credibility cannot be verified.

The literature selection process followed the PRISMA steps, which consisted of identification, screening, eligibility, and inclusion (Rachmawati et al., 2025). In the identification stage, 245 articles were obtained from the initial search in various databases. After removing duplicate articles and screening based on titles and abstracts, 120 articles were deemed relevant. Next, a full-text review was conducted to assess the suitability of the content with the research objectives, resulting in 45 articles that met the eligibility criteria. In the final stage, based on the suitability of the substance, methodological quality, and relevance to the public health laboratory context, 5 articles were selected and included in the final analysis (inclusion).

Data from selected literature was then extracted using a data sheet containing information about the author, year of publication, research location, study design, focus of discussion, and key findings related to the implementation of SMK3. All data were analyzed using thematic content analysis techniques by grouping the findings into several main themes, namely OSH policies and regulations, SMK3 planning and organization, implementation in laboratories, supporting and inhibiting factors, and the impact of implementation on user safety. The results of the analysis were then synthesized to obtain a comprehensive picture of the patterns of SMK3 implementation and its compliance with national regulatory standards, particularly Law No. 1 of 1970 concerning Occupational Safety and Government Regulation No. 50 of 2012 concerning the Implementation of SMK3.

To maintain the validity of the results, source triangulation was carried out by comparing findings between literature, as well as repeated reviews of the data extraction and interpretation process to minimize researcher subjectivity bias. With this PRISMA-based systematic review approach, the study is expected to produce a more objective, structured, and data-driven synthesis of evidence, which can serve as a basis for formulating recommendations for improving the implementation of SMK3 in public health laboratories.

Results

Based on the literature search and selection process using the PRISMA approach, five articles were obtained that met the inclusion criteria and were directly relevant to the application of occupational safety and health in educational laboratories and health laboratories. The five articles consisted of three quantitative descriptive studies, one cross-

sectional study, and one literature review. In general, all of the literature shows that educational laboratories have various potential hazards, including chemical, biological, physical, ergonomic, and administrative risks due to weak safety management systems. Although most laboratories have basic safety rules and provide personal protective equipment (PPE), the overall implementation of SMK3 is still not optimal.

Selected articles show that educational laboratories and health laboratories have diverse and interrelated occupational risk characteristics, including chemical, biological, and physical risks, as well as weaknesses in behavioral aspects and safety management systems. In general, potential hazards in laboratories originate not only from the materials or equipment used, but also from the working methods of users and suboptimal safety management systems (Redjeki, 2020). Exposure to hazardous chemicals and biological agents is reported as a major risk in most laboratories. The use of reagents, irritants, chemical vapors, and the handling of biological samples can potentially cause skin irritation, respiratory disorders, and even infection if safe working procedures are not consistently implemented. International review studies emphasize the importance of implementing biosafety principles, infection control, and the use of personal protective equipment (PPE) as preventive measures to minimize such exposure. These findings confirm that health laboratories require a structured risk management system, not just written rules or general appeals.

Minor physical accidents are also frequently reported during practical activities. Several studies show a high incidence of cuts from broken glass, punctures from sharp tools, slips due to wet floors, and minor burns from hot liquids or heating devices. In fact, one study reported that more than a third of users had experienced minor incidents while working in the laboratory. This situation indicates that hazards often arise from routine and seemingly simple daily activities, yet they still have the potential to injure users if proper supervision and safety procedures are not implemented (Taofik et al., 2023). Almost all literature highlights low compliance with PPE use as a consistent problem. Even though safety facilities are available, students or trainees often ignore their use because they feel the risk is low or do not fully understand the consequences of danger. Low awareness, lack of training, and irregular supervision are the main contributing factors. This shows that the success of occupational safety is not only determined by the availability of facilities, but also by the formation of a safety culture among users (Institut Teknologi Kalimantan, 2022).

Several studies have found that safety management systems in laboratories are still partial. Standard operating procedures (SOPs) have not been fully documented, hazard identification and risk assessment have not been carried out systematically, and safety evaluations or audits have not been conducted regularly. These conditions indicate that the implementation of occupational safety is not yet fully in accordance with the principles of the Occupational Safety and Health Management System (SMK3) as stipulated in Government Regulation No. 50 of 2012, which emphasizes a planning, implementation, monitoring, and continuous improvement approach. Overall, the results of the literature synthesis indicate that occupational risks in laboratories are multidimensional and require a comprehensive management approach. Prevention efforts are not sufficient through the provision of PPE or written rules alone, but must be supported by a structured management system and increased awareness and safe work behavior among all laboratory users.

Table 1 Literature Review on Safety & Risk in Laboratories

No	Author–Year	Research Setting	Method	Type of Risk	Main Findings
1	Ridasta, 2020	Chemistry Laboratory, Semarang State University	Quantitative descriptive observational checklist	Chemical (hazardous substances), occupational accidents	Initial assessment of the Occupational Health and Safety Management System (OHSMS/SMK3) showed that 57.85% of the criteria were met, while 42.15% were not. OHSMS implementation remains low and requires improved application and compliance with safety procedures. (Ridasta, 2020)
2	Seftiatullaeli & Nelly, 2024	Nutrition Study Program Laboratory, Poltekkes Kemenkes Tasikmalaya	Quantitative descriptive using HIRA and HAZOP methods	Physical (cuts, slips), heat/liquids, vapor, administrative/SOP	Hazard identification revealed many potential risks: disorganized cables, lack of fire extinguishers and first-aid kits, and low PPE compliance; 38% of users experienced minor accidents. Facility reorganization and safety education are needed. (Seftiatullaeli, 2024)
3	Alenazi et al., 2024	Various Medical Laboratories	Literature review on laboratory safety	Biological, chemical, physical, ergonomic	Risk management through hazard identification, infection prevention, and safe practices significantly reduces accidents and exposure to hazards, especially during health crises (e.g., pandemics). (Alenazi, 2024)
4	"Safety in Medical Laboratories" (Taif, Saudi Arabia)	University and hospital medical laboratories	Cross-sectional survey	Awareness and practices (administrative)	Many accidents occur due to ineffective regulations and low safety awareness and practices, indicating the need for stronger policies and safer work habits.

					(Abu-siniyeh & Al-shehri, 2021)
5	Dhawan et al., 2025 (review)	Global research and clinical laboratories	Systematic review	Laboratory infections, needle injuries, PPE control	Major laboratory risks include infections from improper procedures, ineffective PPE use, and unsafe sample handling; reporting systems, biosafety oversight, and strong risk management are required. (Dhawan et al., 2025)

In everyday life, the Teuku Umar University Public Health Laboratory is a fairly busy place. Almost every day, the laboratory is used for student practicals, from morning to afternoon. In one session, there are usually around 25–30 students working together in the room. This condition makes the laboratory atmosphere crowded, with people coming and going, moving equipment, and intense discussions between students. In such situations, safety risks often arise from small details that are frequently overlooked. Students carry and use glassware, pour solutions, turn on heaters, or move chemicals in a confined space. It is not uncommon for work tables to be filled with reagent bottles, practical tools, and notebooks, leaving little room to move. If a liquid spills or a tool falls and breaks, the potential for slipping or injury can occur quickly, even though these activities seem simple.

Interaction with chemicals is also part of the laboratory routine. The pungent smell of chemicals, splashes of solution during mixing, or occasional direct contact with the skin still occur, especially when students are careless or rush to complete their laboratory assignments. In certain laboratories involving environmental health examination samples, biological risks can also arise if work procedures are not carried out in a disciplined manner. This condition reflects what is widely reported in the literature, that chemical and biological risks in educational laboratories are real and present in daily activities. The use of personal protective equipment is actually already a rule in laboratories. Lab coats, gloves, and masks are available and mandatory. However, in practice, there are still students who remove their gloves because they feel uncomfortable, lower their masks when talking, or wear lab coats merely as a formality. This shows that work safety is not yet fully understood as a personal need, but is still considered an obligation during practical work.

From a management perspective, laboratories already have rules and basic regulations for the use of equipment. However, the implementation of work safety is still gradual and adapts to conditions in the field. Some safety procedures are not yet written in detail, and safety reminders are often only given when the practicum is about to begin. Safety evaluations are usually carried out when obstacles or minor incidents arise, so that prevention efforts have not yet become a planned habit.

Overall, the condition of the Public Health Laboratory at Teuku Umar University shows that learning activities are active and productive, but on the other hand, they pose real safety risks. User density, limited space, and varying levels of student experience require more attention to the implementation of occupational safety. Strengthening SMK3 is not only necessary in the form of rules, but also through habit formation, consistent supervision, and instilling awareness that working safely in the laboratory is part of the learning process itself.

Discussion

The findings of this study confirm that safety risks in public health laboratories are not solely caused by the presence of hazardous materials, but rather by a combination of activity intensity, user behavior, and safety management systems that are not yet fully integrated. This condition reinforces the view that educational laboratories have different risk characteristics from industrial laboratories, where users are predominantly students with varying levels of experience (Hidayah et al., 2025). Exposure to chemical and biological materials found in various studies, as well as its relevance to the conditions of the Teuku Umar University Public Health Laboratory, shows that risk control cannot rely solely on individual vigilance. The literature emphasizes that without a clear management system, exposure risks will remain even if the materials used are classified as common or low-risk (Setyaningsih et al., 2023). This reinforces that workplace safety in laboratories must be managed as a system, not merely a collection of technical rules.

Minor physical injuries that occur frequently should also be understood as early signs of weak daily risk control. Previous studies have shown that minor recurring incidents are often overlooked because they do not cause serious immediate impact, even though they reflect gaps in safety monitoring and planning (Seftiatullaeli & Nelly, 2024). In the context of campus laboratories, this condition is exacerbated by the density of practical work and limited space, which increases risk even though the activities carried out are routine (Bahsin & Tualeka, 2024).

User behavior factors, particularly compliance with PPE use, are important findings that reinforce the role of safety culture. The literature shows that low PPE compliance among students is not caused solely by ignorance, but rather by low risk perception and a lack of safe work habbits (Ningrum et al., 2026; Nurdiani & Krianto, 2019). This finding reinforces that safety interventions are not sufficient through the provision of facilities alone, but must be accompanied by repeated education, supervision, and role modeling from laboratory managers.

From a regulatory perspective, the conditions found indicate that the implementation of occupational safety in laboratories is still not fully aligned with the SMK3 framework. PP No. 50 of 2012 emphasizes that SMK3 must be implemented through a continuous cycle that includes planning, implementation, monitoring, and evaluation. When hazard identification has not been carried out systematically and safety evaluation has not become a routine activity, the implementation of SMK3 is still in its early stages. This is in line with the findings of various studies which state that educational laboratories often focus more on the smooth running of practical work than on strengthening safety systems (OSHA, 2021). Additionally, Law No. 1 of 1970 on Occupational Safety provides a clear legal basis that every workplace is obligated to protect the safety of everyone within it. In the context of higher education, students conducting practical work have an equal position as parties who must be protected. Therefore, strengthening SMK3 in campus laboratories is not only technical in nature, but also a form of fulfilling institutional obligations towards the safety of the academic community (Soewardi et al., 2026).

Consequently, this discussion emphasizes that the research findings not only describe the existence of risks, but also indicate an urgent need for a more structured SMK3 in the Public Health Laboratory at Teuku Umar University. An approach that combines a clear management system with the establishment of a safety culture is expected to reduce the

risk of accidents and exposure, while creating a safe and sustainable learning environment.

Conclusion

The implementation of the Occupational Safety and Health Management System (SMK3) in public health laboratories, particularly in the context of educational laboratories, is an urgent necessity. Intensive practical activities, the involvement of students with varying levels of experience, and routine interaction with chemicals and laboratory equipment make safety risks an inherent part of the learning process. Findings from a literature review related to the conditions of the Teuku Umar University Public Health Laboratory show that occupational safety risks are still mostly controlled through basic rules and individual vigilance, not yet fully through a planned and sustainable management system. This condition emphasizes that occupational safety in campus laboratories cannot rely solely on the availability of facilities or momentary compliance, but requires strengthening systems and establishing a consistent safety culture. Referring to Law No. 1 of 1970 and Government Regulation No. 50 of 2012, the implementation of SMK3 in university laboratories should be viewed as an institutional responsibility as well as part of the quality of educational delivery.

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