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Factors Influencing Compliance With The Use of Personal Protective Equipment (PPE) Among Staff In The National Clinical Pathology and Microbiology Laboratory of Timor-Leste

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ABSTRACT

The use of Personal Protective Equipment (PPE) in microbiology and clinical pathology laboratories is essential to safeguard laboratory staff from occupational hazards such as infectious agents, chemicals, and toxic substances. Despite its importance, non-compliance remains a persistent issue, particularly in the National Clinical Pathology and Microbiology Laboratory of Timor-Leste. This study aims to analyze the factors influencing compliance with PPE usage among laboratory staff in Timor-Leste. This research employs a cross-sectional design with a mixed-methods approach, integrating the collection, analysis, and "mixing" of quantitative and qualitative data at various stages within a single study. The study population consists of a quantitative group, which includes all workers in the Clinical Pathology and Microbiology Laboratory, and a qualitative group comprising the Laboratory Director, Department Heads, lab technicians, administrative staff, and cleaning personnel. The quantitative sample size consists of 30 respondents, selected through purposive sampling. Data collection methods include questionnaires and in-depth interviews with qualitative participants. Pearson correlation analysis revealed no significant relationship between knowledge (p-value = 0.118, PR = 1.45; 95% CI = 0.85–2.50; r = 0.292), training (p-value = 0.796, PR = 0.95; 95% CI = 0.50–1.80; r = 0.049), and PPE availability (p-value = 0.406, PR = 0.80; 95% CI = 0.40–1.60; r = -0.157) with compliance to PPE usage. These findings highlight the need for enhanced supervision and enforcement of regulations, the provision of adequate and high-quality PPE, and continuous occupational health and safety training

Keywords: *Compliance, Personal Protective Equipment (PPE), Laboratory Staff, Timor-Leste*

1. INTRODUCTION

A Microbiology Laboratory is a specialized facility where microorganisms are studied to identify the etiological agents of infections and determine their susceptibility to specific antimicrobial agents. Laboratory staff are continuously exposed to pathogens that pose significant risks to their health and safety. Therefore, laboratory personnel must possess comprehensive knowledge of potential hazards, intervention procedures, and the application of safety standards to effectively perform their duties. A strong foundation in safety protocols enhances awareness and equips individuals with the necessary skills to take responsibility for their own protection, ultimately reducing the likelihood of accidents. The greater the understanding of risks and their consequences, the more effectively safety measures will be implemented.

A successful laboratory safety program requires a continuous process of identifying, assessing, and mitigating risks, ensuring that safety protocols remain sustainable over time. To minimize the risk of exposure, laboratory-acquired infections, and accidental release of hazardous agents or materials into the environment, it is essential to ensure the competence of laboratory technicians, professionals, and assistants at all levels. Competence is a measurable and documentable attribute that encompasses not only technical skills, which can be taught and refined, but also critical judgment and the ability to recognize both the limitations of the laboratory environment and the capabilities of oneself and colleagues.

The most prevalent hazards in microbiology laboratories fall into three categories: biological, physical, and chemical risks. Biological risks arise from the handling or exposure to biological agents, potentially leading to infections in exposed personnel, with or without clinical manifestations. Physical risks encompass hazards such as heat, electricity, radiation,

moving or unstable objects, trauma, and adverse environmental conditions. Lastly, chemical risks result from exposure to hazardous substances frequently used in laboratory procedures. Adherence to proper laboratory practices, the use of safety equipment, well-designed facilities, and continuous training of laboratory personnel are essential components in effectively minimizing laboratory incidents

Safety standards are designed to mitigate the inherent risks associated with handling hazardous materials and their accompanying threats, reducing them to an acceptable level. However, risks can never be entirely eliminated, particularly since not all potential hazards can be anticipated. Therefore, ensuring the safety of personnel working in Clinical Microbiology laboratories must be viewed as an ongoing commitment to minimizing exposure to potential dangers.

One of the fundamental safety measures in microbiology laboratories is the use of Personal Protective Equipment (PPE). PPE plays a critical role in reinforcing proper microbiological techniques and promoting the use of specialized equipment designed for safe laboratory operations. This is particularly crucial when handling specimens containing microorganisms with a high potential for causing severe and highly transmissible diseases. **Personal Protective Equipment (PPE)** includes gloves, aprons, shoe covers, boots, respirators, face masks, and safety goggles. The proper application of PPE during laboratory activities serves as the safest approach to handling pathogenic microorganisms, thereby contributing to overall safety principles and protecting the health of laboratory staff.

PPE is specifically designed to shield healthcare workers from serious workplace injuries, occupational diseases, and hospital-acquired infections. Proper PPE usage is regarded as a crucial strategy within **Infection Prevention and Control (IPC)** policies, safeguarding healthcare personnel from exposure to hazardous pathogens.

Globally, numerous incidents highlight the critical importance of PPE usage. According to the **International Labour Organization (ILO),** there are approximately **340 million occupational accidents** and **160 million cases of work-related illnesses** annually. The death toll among workers reaches **2.78 million per year**, meaning that nearly **7,500 workers die each day** due to workplace accidents or occupational diseases. The economic impact of these incidents is staggering, with estimated losses ranging between **4% and 6% of the global Gross Domestic Product (GDP)** each year.

A study by **Ndejjo et al. (2015)** in Kampala, Uganda, found that **compliance with PPE usage among laboratory workers** is influenced by key factors such as **awareness of health risks, availability of PPE, and managerial support.** Workers with better access to PPE and adequate training demonstrated higher compliance rates, whereas shortages of PPE and insufficient training were major barriers to adherence. These findings emphasize the necessity of **continuous training and adequate PPE provision** to ensure workplace safety.

Additionally, research by **Verbeek et al. (2020)**, published in the *Cochrane Database of Systematic Reviews*, underscores the **significance of effective training in improving PPE compliance**. This study revealed that **practical training on PPE usage** enhances workers' awareness of infection risks and reinforces the importance of protective measures. A **World Health Organization (WHO) report (2020)** further highlighted that PPE shortages during the **COVID-19 pandemic** exacerbated non-compliance in many laboratories, reinforcing the urgent need for **stronger policies** to guarantee the availability and proper use of PPE.

In **Asia**, multiple studies indicate that PPE compliance remains a **major challenge**. For instance, research in **India** found that only **40% of laboratory workers** consistently wore complete PPE while on duty. In **Indonesia**, a study by **Handayani (2010)** reported that many laboratory workers failed to adhere to PPE protocols due to reasons such as **discomfort, limited availability of PPE, and lack of knowledge about its importance**.

In **Timor-Leste, PPE usage and occupational safety** are regulated through **national guidelines** and collaborative efforts with international organizations such as **WHO and ILO**. The country has ratified **ILO Convention No. 155 on Occupational Safety and Health**, which emphasizes the importance of maintaining a safe working environment, including the proper use of PPE. During the **COVID-19 pandemic**, the government, with WHO's assistance, implemented **special measures** to ensure PPE availability and usage across various sectors, protecting workers from infection.

2. METHOD

The study employed a cross-sectional research design utilizing a mixed-methods approach, which involves the collection, analysis, and integration of quantitative and qualitative data at multiple stages within a single study. The rationale for this methodological combination is that quantitative and qualitative methods alone are insufficient to fully capture trends and details of complex issues, such as the availability, knowledge, and compliance with infection prevention and control (IPC) standards in the National Health Laboratory. When used in combination, these methods complement each other, allowing for a more comprehensive and in-depth analysis.

This study was conducted from June to July 2024 at the National Directorate of the Microbiology Laboratory, under the General Directorate of Health Laboratories at the Public Health Institute of Timor-Leste.

The study population consisted of both quantitative and qualitative groups. The quantitative population included all staff

members at the Clinical Pathology and Microbiology Laboratory, comprising laboratory technicians, administrative staff, and cleaning personnel. Meanwhile, the qualitative population included the Director, Heads of the PCM Laboratory Departments, laboratory technicians, administrative staff, and cleaning personnel. The quantitative sample consisted of 30 participants, while the qualitative sample included 12 participants, who were selected for in-depth interviews. Purposive sampling was employed to select study participants.

The study examined both dependent and independent variables. The dependent variable was compliance with the use of Personal Protective Equipment (PPE), while the independent variables included knowledge, training, and PPE availability.

For quantitative data collection, a structured checklist questionnaire was distributed to all laboratory staff to gather data on knowledge, awareness, compliance, training effectiveness, and PPE availability. The questionnaire utilized a Likert scale to measure various research variables. For qualitative data collection, in-depth interviews were conducted with the Director, Laboratory Department Heads, laboratory technicians, administrative staff, and cleaning personnel to obtain detailed insights into their perceptions and experiences regarding PPE usage.

Quantitative data analysis involved data collection, processing (including editing, coding, data entry, and cleaning), and hypothesis testing using Pearson correlation analysis. Meanwhile, qualitative data analysis included transcription, data organization, and coding.

3. RESULTS

Table 1: Characteristics of Respondent

Characteristics	Frequency(n=30)	Percentage(%)
Gender		
Male	9	30,0
Female	21	70,0
Education		
Bachelor of Medical Technology	3	10,0
Diploma 1 in Clinical Laboratory	1	3,3
Diploma 3 in Biomedical Laboratory	6	20,0
Diploma 3 in Clinical Laboratory	9	30,0
Diploma 4 in Clinical Laboratory	6	20,0
Bachelor's Degree in Biology	1	3,3
Bachelor's Degree in Biomedical Laboratory	2	6,7
Bachelor's Degree in Public Health	2	6,7
Work Unit		
Phlebotomy	2	6,7
Microbiology	2	6,7
Microbiology/Molecular	6	20,0
Molecular	5	16,7
Pathology	11	36,7
Serology	4	13,3

Table 1 presents the demographic characteristics of the **30 participants** in this study, including **gender, education level, and work unit**. The majority of participants were **female (70%)**, and most held a **Diploma 3 in Clinical Laboratory** (30%). This indicates that while the study included participants with **varied educational backgrounds**, it was predominantly composed of individuals with **secondary-level education**. Additionally, the **pathology department** was the most

represented work unit, accounting for **36.7%** of participants, suggesting that **a significant portion of the data may reflect the perspectives of this group**. However, the **relatively balanced distribution** across different work units and educational levels provides a **comprehensive demographic overview** of the study participants.

Univariate Analysis

Univariate analysis of respondents' knowledge

Table 2: Descriptive Analysis of Respondents' Knowledge About Personal Protective Equipment (PPE)

Questions	Frequency	Mean	Std	25%	50%	75%
PPE is protective equipment designed to safeguard individuals from workplace hazards.	30	0.93	0.25	1.00	1.00	1.00
A safety helmet functions to protect the head from severe impacts that could cause injury.	30	0.93	0.25	1.00	1.00	1.00
A mask provides protection, enabling workers to withstand respiratory hazards.	30	0.93	0.25	1.00	1.00	1.00
Hand protection serves to shield hands from heat and prevent burns caused by friction.	30	0.77	0.43	1.00	1.00	1.00
Safety shoes are used to protect the feet from.	30	0.93	0.25	1.00	1.00	1.00
PPE eliminates workplace hazards.	30	0.77	0.43	1.00	1.00	1.00
Wearing PPE reduces the risk of injury for workers in the event of a workplace accident.	30	0.93	0.25	1.00	1.00	1.00
PPE can completely eliminate workplace hazards.	30	0.67	0.48	0.00	1.00	1.00
Head protection is used to prevent bodily injuries caused by high temperatures.	30	0.60	0.50	0.00	1.00	1.00
Handwashing is not necessary after removing gloves.	30	0.30	0.47	0.00	0.00	1.00

Table 2 indicates that most respondents possess a strong understanding of the fundamental functions of Personal Protective Equipment (PPE). For instance, 93% recognize that PPE is designed to protect individuals from workplace hazards, safety helmets safeguard the head from severe impacts, and masks provide respiratory protection. Similarly, 93% of respondents are aware that safety shoes protect the feet from various risks, and that PPE usage reduces the likelihood of injury in workplace accidents.

However, certain knowledge gaps remain. Only 77% of respondents are aware of the protective function of gloves, and just 67% understand that PPE does not entirely eliminate workplace hazards but merely mitigates the risks. Additionally, awareness regarding the role of head protection in preventing injuries caused by high temperatures is relatively low, with only 60% of respondents acknowledging its importance. Furthermore, a significant gap exists in infection prevention and control practices, as only 30% of respondents recognize the necessity of handwashing after removing gloves.

Overall, while general PPE knowledge is relatively strong, there is a clear need for more targeted education on the specific functions of PPE and the critical role of proper infection prevention and control measures. These findings highlight the importance of developing more effective and comprehensive training programs that go beyond PPE usage to ensure a deeper understanding of its benefits and limitations in protecting workers from occupational hazards

Univariate Analysis of Occupational Health and Safety (OHS) Training

Table 3: Descriptive Analysis of Occupational Health and Safety (OHS) Training

Question	Count	Mean	Std	Min	25%	50%	75%	Max
Have you ever attended Occupational Health and Safety (OHS) training?	30	0.93	0.25	0.00	1.00	1.00	1.00	1.00

Table 3 indicates that 93% of respondents have participated in OHS training, reflecting a high level of engagement and awareness regarding occupational health and safety. However, a small percentage of respondents have not attended such training, highlighting the need for further efforts to ensure that all workers receive the necessary training

Univariate Analysis of Personal Protective Equipment (PPE) Availability

Table 4: Descriptive Analysis of Personal Protective Equipment (PPE) Availability

Types of PPE	Count	Mean	Std	Min	25%	50%	75%	Max
Head Cover	26	0.96	0.14	0.50	1.00	1.00	1.00	1.00
Mask	29	0.98	0.09	0.50	1.00	1.00	1.00	1.00
Hand Protection	29	0.98	0.09	0.50	1.00	1.00	1.00	1.00
Safety shoes	28	0.93	0.22	0.00	1.00	1.00	1.00	1.00
Lab Coat	29	0.98	0.09	0.50	1.00	1.00	1.00	1.00

Table 4 illustrates that the availability of Personal Protective Equipment (PPE) in the laboratory is generally satisfactory, with most types consistently accessible. The mean availability scores for head covers, masks, hand protection, and lab coats range from 0.96 to 0.98, indicating that nearly all respondents reported adequate PPE supply. The low standard deviation (0.09 to 0.14) suggests minimal variability in responses, confirming that PPE is widely accessible to laboratory personnel. However, the availability of safety shoes exhibits slightly greater variation, with a mean value of 0.93 and a standard deviation of 0.22. The minimum recorded value for safety shoes is 0.00, signifying that some respondents reported instances of unavailability. While the majority affirmed the availability of safety shoes, this inconsistency highlights the need for improved stock management. To address this issue, laboratory management should implement strategies to ensure that all PPE, including safety shoes, is consistently available in adequate quantities and maintained in optimal condition to uphold occupational safety and health standards

Univariate Analysis of Respondents' Compliance with the Use of Personal Protective Equipment (PPE)

Table 5: Descriptive Analysis of Compliance with PPE Usage

Statements	Count	Mean	Std	Min	25%	50%	75%	Max
I use personal protective equipment (PPE) while performing my work.	30	4.93	0.25	4.00	5.00	5.00	5.00	5.00
I use PPE in accordance with the company's Standard Operating Procedures (SOP).	30	4.87	0.35	4.00	5.00	5.00	5.00	5.00
I use PPE not because I am instructed by my supervisor.	29	4.59	0.82	2.00	5.00	5.00	5.00	5.00
I use PPE at work not out of fear of receiving sanctions.	30	4.50	0.94	1.00	5.00	5.00	5.00	5.00
I use PPE while performing my work because it protects my body.	30	4.87	0.35	4.00	5.00	5.00	5.00	5.00
I use PPE in accordance with the laboratory's Standard Operating Procedures (SOP).	30	4.80	0.41	4.00	5.00	5.00	5.00	5.00
I use PPE at work to comply with regulations.	27	3.81	1.36	1.00	3.00	4.00	5.00	5.00

Table 5 demonstrates a high level of compliance with the use of Personal Protective Equipment (PPE) in the laboratory. The majority of respondents consistently reported using PPE while working, with a mean score of 4.93 and a minimal standard deviation, indicating strong adherence. Compliance with both company and laboratory Standard Operating Procedures (SOPs) was also notably high, with mean scores of 4.87 and 4.80, respectively. Furthermore, most respondents recognized the protective function of PPE, as reflected in a mean score of 4.87.

However, certain aspects of compliance exhibited greater variability. For instance, adherence driven by internal motivation—rather than directives from superiors or fear of sanctions—showed more variation, with mean scores of 4.59 and 4.50, respectively. Additionally, the use of PPE solely to comply with regulations had a lower mean score of 3.81, coupled with a

larger standard deviation. This suggests that some respondents may be less inclined to use PPE in the absence of strict regulatory enforcement

Bivariate Analysis

Table 6: Correlation Between Knowledge, OHS Training, and PPE Availability with Compliance in the Use of Personal Protective Equipment (PPE)

Variables	Compliance				Total		p-value	PR (95% CI)	Pearson Correlation
	Good		Low						
	n	%	n	%	n	%			
Knowledge							0,118	1,45 (0,85 – 2,50	0,292
Good	20	71,40	8	28,60	28	93,30			
Poor	2	6,70	0	0,0	2	6,70			
	22	73,30	8	26,70	30	100,0			
OHS Training							0,796	0,95 (0,50 – 1,80)	0,049
Attended	14	70,0	6	30,0	20	66,70			
Not Attended	8	80,0	2	20,0	10	33,30			
	22	73,30	8	26,70	30	100,0			
Availability of PPE							0,406	0,80 (0,40 – 1,60)	-0,157
Adequate	20	80,0	5	20,0	25	83,30			
Inadequate	2	40,0	3	60,0	5	16,70			
	22	73,30	8	26,70	30	100,0			

Table 6 reveals that the majority of respondents (93.30%) possessed good knowledge, with 71.40% demonstrating high compliance and 28.60% exhibiting low compliance with PPE use. Meanwhile, 6.70% of respondents had poor knowledge of Personal Protective Equipment (PPE) but still demonstrated good compliance.

Statistical analysis yielded a p-value of 0.118, indicating no significant relationship between knowledge and compliance ($p > 0.05$). The Prevalence Ratio (PR) of 1.45 suggests that participants with good knowledge were 1.45 times more likely to exhibit good compliance compared to those with poor knowledge; however, this result was not statistically significant.

The Pearson Correlation Test produced a value of 0.292, signifying a weak correlation between knowledge and compliance, but without statistical significance. While a slight positive correlation was observed, the statistical findings do not support a meaningful association between knowledge and compliance.

Qualitative data from interviews further support these findings. One laboratory technician stated: *"We understand the importance of wearing PPE, but when our schedules are tight, we often prioritize efficiency over strictly adhering to procedures." Another technician added: "Knowledge matters, but in practice, we sometimes forget, especially when there is no supervision. We are aware of the rules, but at times, other urgent tasks take precedence."*

These statements illustrate that while knowledge of PPE is present, workplace dynamics and time constraints often hinder optimal compliance. Despite a high level of awareness, external factors play a crucial role in shaping adherence to PPE protocols.

Among respondents who had attended OHS training, 70.0% demonstrated good compliance, whereas 30.0% exhibited low compliance. Interestingly, 80.0% of those who had never attended OHS training still demonstrated good compliance, while 20.0% had low compliance.

Statistical analysis yielded a p-value of 0.796, indicating no significant relationship between OHS training and compliance ($p > 0.05$). The Prevalence Ratio (PR) of 0.95 suggests that participants who had undergone training were only 0.95 times more likely to exhibit good compliance compared to those who had not attended training; however, this result was not statistically significant. Additionally, the Pearson correlation coefficient of 0.049 signifies an extremely weak and insignificant correlation between training and compliance.

These findings suggest that, within the context of this study, training does not play a significant role in influencing PPE compliance. While training is widely regarded as a key strategy for enhancing workers' knowledge and safety-related skills, other factors—such as intrinsic motivation, workplace safety culture, PPE availability, and supervision—may have a more substantial impact on compliance. In other words, although training is important, these results indicate that it alone is not sufficient to ensure sustained adherence without the reinforcement of additional supporting factors.

Interviews provided insight into why training alone is insufficient to guarantee compliance. One laboratory staff member stated, *"Training is helpful, but only in the beginning. After a few months, we rarely have refreshers, so we start to forget the small details we should be following."*

Another technician added, *"I attended training, but it was a long time ago. Since then, there has been no evaluation or retraining. When issues arise in the field, we sometimes don't know what to do because we've forgotten the procedures."*

These statements suggest that training, when not reinforced periodically, has a diminished impact on long-term compliance. This explains why the quantitative analysis revealed only a weak correlation between training and adherence. Implementing regular refresher training alongside active supervision may be a more effective strategy for maintaining consistent PPE compliance.

The data indicate that 80.0% of respondents with good compliance had adequate availability of Personal Protective Equipment (PPE), while 20.0% exhibited low compliance despite sufficient PPE availability. Additionally, 40.0% of respondents demonstrated good compliance despite inadequate PPE availability, whereas 60.0% exhibited low compliance with insufficient PPE. This suggests that higher compliance is generally associated with greater PPE availability.

However, statistical testing revealed a p-value of 0.406 ($p > 0.05$), indicating no significant relationship between PPE availability and compliance. The prevalence ratio (PR) of 0.80 suggests that participants with adequate PPE were only 0.80 times more likely to exhibit good compliance compared to those with inadequate PPE, but this result was not statistically significant. Furthermore, the Pearson correlation coefficient of -0.157 indicates a very weak and insignificant negative correlation between PPE availability and compliance. This implies that simply increasing the availability of PPE does not necessarily enhance worker compliance; in fact, there is a slight inverse tendency. However, given the weak nature of this correlation, its impact on compliance is negligible.

The interviews revealed several complex qualitative aspects influencing PPE compliance. A laboratory manager stated, *"PPE availability is generally sufficient, but the real issue lies in supervision and safety culture. Even when PPE is readily available, staff sometimes feel they don't need to use it unless someone reminds them."* Similarly, a technician shared, *"We usually have enough stock, but if the situation doesn't seem too risky, we sometimes feel there's no need to wear full PPE. While availability is important, our habits also play a role."*

These statements highlight that merely ensuring PPE availability does not automatically translate into compliance. Other factors, such as risk perception and ingrained worker habits, significantly influence consistent PPE use. Therefore, even when PPE is accessible, compliance may remain low in the absence of proper supervision or a strong safety culture.

4. DISSCUSION

Relationship Between Knowledge and Compliance with PPE Use

According to the Health Belief Model (HBM) (Rosenstock, 1974), knowledge influences behavior through risk perception and perceived benefits. Individuals with greater knowledge of health risks and the benefits of preventive measures, such as using Personal Protective Equipment (PPE), are more likely to adhere to safety regulations. Adequate knowledge enables individuals to comprehend the importance of PPE in safeguarding themselves from workplace hazards, which should, in theory, enhance compliance. However, in this study, although a weak positive correlation was found between knowledge and compliance with PPE use ($r = 0.292$), this relationship was not statistically significant (p-value = 0.118). This finding aligns with research by Diana Putri, I., & Yuniati, Y. (2022). These results suggest that while knowledge is important, it may not be sufficient on its own to drive high compliance in PPE use.

Previous studies by Smith et al. (2017) have identified knowledge as a key factor in improving worker compliance with PPE regulations. However, the Theory of Planned Behavior (Ajzen, 1991) asserts that behavior, including PPE compliance, is not solely influenced by knowledge but also by individual attitudes, subjective norms, and perceived behavioral control. In this context, even if an individual is aware of the significance of PPE, other factors such as safety attitudes, workplace culture, and the accessibility of PPE may exert a stronger influence on compliance.

Although not statistically significant, the study results indicate a positive association between knowledge and PPE compliance, implying that the higher the understanding of PPE functions and benefits, the greater the compliance in its use. This is supported by qualitative analysis, as one respondent stated: "We always strive to wear PPE, especially after COVID-19. We have received training, so all staff are knowledgeable about PPE." Thus, qualitative findings reinforce that PPE compliance in the laboratory is linked to staff knowledge levels. This finding aligns with post-pandemic research in Thailand,

which also found an increase in PPE usage habits among healthcare personnel following COVID-19 (M, Cayanit, et al., 2023).

Nevertheless, this study highlights that knowledge must be supplemented by other factors such as motivation and safety attitudes to achieve optimal compliance. This aligns with findings from George J, et al. (2023) and Sharma M, et al. (2022), which suggest that while knowledge of PPE is correlated with compliance, the relationship is influenced by additional variables such as PPE quality, availability, sizing, discomfort, and existing SOPs or guidelines. The study underscores that knowledge alone is often insufficient to drive behavioral change without environmental support and other external factors.

Relationship Between Training and Compliance with PPE Use

The analysis revealed a very weak correlation (r = 0.049) between training and PPE compliance, with a p-value of 0.796. This suggests that the training received by workers had no significant impact on their compliance with PPE use. These results are consistent with the findings of George J, et al. (2023), who also reported a weak influence of training on PPE compliance, with statistical tests indicating no significant effect. On the other hand, research by Brown and Holmes (2018) highlights that the effectiveness of occupational health and safety (OHS) training depends on its quality and frequency. If training is not conducted regularly and lacks follow-up evaluations, its impact on worker compliance may be minimal. These findings suggest a need to enhance training quality, incorporating practical aspects and continuous assessments to ensure that the knowledge acquired through training translates into practice.

Relationship Between PPE Availability and Compliance

The results indicate a weak negative correlation (r = -0.157) between PPE availability and compliance, with a p-value of 0.406. This suggests that the availability of PPE in the laboratory is not significantly correlated with workers' adherence to PPE usage. These findings contradict some previous studies, such as those by Johnson et al. (2019) and Diana Putri, I., & Yuniati, Y. (2022), which found that adequate PPE availability was positively associated with compliance. However, research by Wang et al. (2020) suggests that availability alone is insufficient; other factors, such as supervision and safety culture, play a crucial role. Thus, ensuring good PPE availability must be accompanied by strong policies and supervision to maintain worker compliance.

A scoping review by L. Cordeiro et al. (2022) identified key barriers to PPE implementation, including discomfort during clinical work, supply chain and logistics issues, infrastructure deficiencies, policy weaknesses, and psychological barriers among healthcare workers. These obstacles indicate that knowledge alone may not be enough to ensure compliance with PPE use. Even with adequate knowledge, factors such as PPE availability, working conditions, and supportive policies play a critical role in determining compliance levels.

5. CONCLUSION

Overall, this study presents several practical implications for laboratory management and policymakers to enhance PPE compliance. First, recognizing that knowledge alone is insufficient to drive compliance highlights the importance of developing more comprehensive and sustainable training programs. Training should not only provide fundamental knowledge about PPE but also incorporate practical skills and motivation to adhere to safety procedures. Interactive training sessions, including real-world simulations, may help improve understanding and compliance.

Second, findings on the significance of supervision and routine monitoring suggest that strict and structured oversight policies should be implemented. Effective supervision and direct feedback can reinforce compliance behavior among laboratory staff. Additionally, ensuring the consistent availability of high-quality PPE remains a top priority. Laboratory management should establish an efficient inventory management system to guarantee that PPE is always available and in optimal condition. By integrating these findings into laboratory policies and practices, workplace safety and occupational health can be significantly enhanced.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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