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Risk Factors for Needle Stick Injuries (NSIs) Among Medical Solid Waste Handlers at Hospital X, Lampung Province, Indonesia

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ABSTRACT:

Background: Needle Stick Injury (NSI) is an occupational accident that poses a risk of transmitting infectious diseases to personnel responsible for managing solid medical waste. The occurrence of NSI is presumed to be influenced by compliance with the use of Personal Protective Equipment (PPE), the implementation of safety boxes, adherence to Standard Operating Procedures (SOPs), and Occupational Health and Safety (OHS) training.

Objective: To analyze the association between compliance with PPE use, safety box implementation, adherence to SOPs, and OHS training with the occurrence of NSI among solid medical waste management personnel at Hospital X, Lampung Province.

Methods: A quantitative study with a case–control design was conducted from May to July 2026 involving 45 respondents, consisting of 9 cases and 36 controls. Data were collected through questionnaires, observations, and secondary data, and were analyzed using the Chi-square test with a 95% confidence level.

Results: A total of 20.0% of respondents had experienced NSI. No significant associations were found between PPE compliance ($p = 0.171$), safety box implementation ($p = 0.086$), or adherence to SOPs ($p = 0.118$) and the occurrence of NSI. However, OHS training was significantly associated with NSI ($p = 0.048$). Respondents who had inadequate OHS training were six times more likely to experience NSI than those with adequate training (OR = 6.000; 95% CI = 1.238–29.069).

Conclusion: OHS training was identified as a factor significantly associated with the occurrence of NSI, whereas compliance with PPE use, safety box implementation, and adherence to SOPs showed no significant associations. Strengthening structured and comprehensive OHS training programs is essential to reduce the risk of Needle Stick Injury.

KEYWORDS: Needle Stick Injury, Occupational Health and Safety training, Personal Protective Equipment (PPE), safety box, Standard Operating Procedures (SOPs).

INTRODUCTION

Hospitals are healthcare facilities that generate various types of waste as a consequence of providing promotive, preventive, curative, and rehabilitative healthcare services. One type of waste requiring special attention is solid medical waste, which contains hazardous and toxic materials (HTMs), such as needles, syringes, intravenous infusion tubing, and other sharp objects that may cause injuries and transmit infectious diseases if not managed in accordance with established standards (Ministry of Health of the Republic of Indonesia, 2020; World Health Organization [WHO], 2020). The management of medical waste in Indonesia is regulated under the Regulation of the Minister of Environment and Forestry No. P.56/Menlhk-Setjen/2015, which governs all stages of waste management, including segregation, storage, transportation, and final disposal. Nevertheless, occupational accidents resulting from exposure to medical waste, particularly Needle Stick Injury (NSI), remain a major challenge to occupational health and safety (OHS) systems in hospitals.

Needle Stick Injury (NSI) refers to an injury caused by needles or other sharp objects contaminated with blood or body fluids, thereby posing a risk of transmitting infectious diseases such as Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and Human Immunodeficiency Virus (HIV) (Nuramalah et al., 2023). The World Health Organization (2020) estimates that approximately 16 billion injections are administered worldwide each year, resulting in nearly three million NSI incidents among healthcare workers. In Indonesia, the Workers Social Security Agency (BPJS Ketenagakerjaan) reported that the healthcare sector

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has consistently been one of the major contributors to occupational accidents, with 1,723 cases recorded in 2019 and 1,548 cases in 2022, following a decline during the COVID-19 pandemic (BPJS Ketenagakerjaan, 2024). In Lampung Province, 887 occupational accidents were reported in 2025, including 13 fatal cases (Mareta, 2026). These data indicate that occupational accidents in the healthcare sector remain a significant public health concern requiring comprehensive preventive measures.

Most studies on NSI have primarily focused on physicians, nurses, and other healthcare professionals performing invasive procedures, whereas solid medical waste management personnel are also exposed to substantial occupational risks. These workers are directly involved in the collection, segregation, transportation, and storage of medical waste, placing them at considerable risk of injury when improperly discarded needles or other sharp objects are encountered. In addition to the risk of infection, NSI may also result in psychological consequences, including anxiety, post-traumatic stress, and economic losses associated with laboratory examinations, post-exposure prophylaxis, and reduced work productivity (Sain et al., 2025). Therefore, medical waste management personnel should receive the same level of attention within hospital occupational health and safety programs as other healthcare workers.

The occurrence of NSI is influenced by various behavioral and workplace-related factors. Consistent use of Personal Protective Equipment (PPE) serves as the primary means of protection against exposure to contaminated sharps and body fluids. Likewise, the proper implementation of safety boxes plays a crucial role in preventing unsafe disposal of used needles that may endanger medical waste management personnel. Compliance with Standard Operating Procedures (SOPs) is essential to ensure the safety of every stage of medical waste management, while Occupational Health and Safety (OHS) training enhances workers' knowledge, skills, and safe work practices. Conversely, non-compliance with PPE use, improper implementation of safety boxes, violations of SOPs, and inadequate OHS training may increase the likelihood of NSI (Suma'mur, 2014). These factors constitute fundamental components in establishing a strong culture of occupational safety within healthcare facilities.

Previous studies have demonstrated that NSI is a multifactorial occupational health problem influenced by the interaction between individual characteristics and workplace conditions. Vanitha et al. (2023) reported that 10 nurses in Bengaluru, India, experienced NSI, which was associated with inadequate knowledge and negative attitudes toward occupational safety. Similarly, Roozbeh et al. (2023) found that 23% of 122 healthcare workers in Iran had experienced NSI, with most incidents occurring during intravenous injection procedures due to working under time pressure. These findings suggest that unsafe work practices, adherence to safety procedures, and organizational support play important roles in determining the risk of NSI. Nevertheless, studies specifically evaluating operational factors—including PPE compliance, safety box implementation, adherence to SOPs, and OHS training—among solid medical waste management personnel remain limited.

Hospital X in Lampung Province generates at least 9,387 kg of medical waste per day, necessitating an effective and safe waste management system. Hospital records from 2025 documented nine NSI cases, while previous reports from the Hospital Occupational Health and Safety Committee (K3RS) indicated that most reported occupational accidents were caused by needle stick injuries. The K3RS team also noted that these figures likely underestimate the actual situation because many incidents remain unreported by both healthcare and non-healthcare personnel (Yulyani et al., 2018). These findings indicate that NSI continues to represent a significant occupational safety concern, particularly among solid medical waste management personnel who have frequent exposure to sharp medical waste.

Based on the above considerations, NSI among solid medical waste management personnel remains an important occupational safety issue in hospitals. Although numerous studies have identified risk factors for NSI among healthcare workers, scientific evidence specifically examining the associations between PPE compliance, safety box implementation, adherence to SOPs, and OHS training with the occurrence of NSI among solid medical waste management personnel at Hospital X, Lampung Province, is still lacking. This research gap highlights the importance of the present study in generating scientific evidence regarding the factors contributing to NSI. The findings are expected to provide a basis for developing hospital policies, strengthening occupational health and safety programs, and designing more effective prevention strategies to protect medical waste management personnel from sharp-object injuries.

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METHODS

This study employed a quantitative analytical observational design using a case–control approach to analyze the risk factors associated with Needle Stick Injury (NSI) among solid medical waste management personnel at Hospital X, Lampung Province. The study was conducted at the Medical Waste Treatment Unit of Hospital X, Lampung Province, from May to July 2026. The study population consisted of 306 medical waste management personnel. The case group included nine workers who had experienced NSI and were selected using total sampling. The control group consisted of 36 workers who had never experienced NSI and were selected using simple random sampling with a 1:4 case-to-control ratio, resulting in a total sample of 45 respondents. The dependent variable was the occurrence of Needle Stick Injury (NSI). The independent variables included compliance with Personal Protective Equipment (PPE) use, implementation of safety boxes, adherence to Standard Operating Procedures (SOPs), and Occupational Health and Safety (OHS) training. Primary data were collected through structured questionnaire-based interviews and direct observations to assess compliance with PPE use. Secondary data were obtained from the Occupational Health and Safety (OHS) reports of Hospital X, Lampung Province. The research instrument was tested for validity using the Pearson Product–Moment correlation test and for reliability using Cronbach's Alpha, with a coefficient of $\alpha > 0.60$ considered acceptable for reliability.

Data were processed through the stages of editing, coding, data entry, and data cleaning, and subsequently analyzed using IBM SPSS Statistics software. Univariate analysis was performed to describe respondents' characteristics and the distribution of each variable using frequencies and percentages. Bivariate analysis was then conducted using the Chi-square test to examine the associations between compliance with PPE use, safety box implementation, adherence to SOPs, and OHS training with the occurrence of NSI. Statistical significance was determined at a p-value < 0.05, while the magnitude of risk was expressed as the Odds Ratio (OR) along with its corresponding 95% Confidence Interval (95% CI). This study was approved by the Health Research Ethics Committee of Hospital X, Lampung Province.

RESULT

Respondent Characteristics

Based on the data collected, the characteristics of the respondents are presented as follows:

Table 1. Characteristics of the Respondents

Variable	Frequency (n)	Percentage (%)
Age		
20-29 years	15	33.3
30-39 years	15	33.3
40-49 years	12	26.7
50-59 years	3	6.7
Gender		
Male	19	42.2
Female	26	57.8
Education Level		
Diploma/Bachelor's Degree	4	8.9
JHS/SHS	41	91.1
Total	**45**	**100**

Based on Table 1, the majority of respondents were aged 20–29 years and 30–39 years, with 15 respondents (33.3%) in each age group. Most respondents were female (26; 57.8%) and had attained a junior or senior high school level of education (41; 91.1%). Overall, the respondents in this study were predominantly females of productive working age with a junior or senior high school educational background.

Frequency Distribution of Needle Stick Injury (NSI), Compliance with Personal Protective Equipment (PPE) Use, Safety Box Implementation, Adherence to Standard Operating Procedures (SOPs), and Occupational Health and Safety (OHS) Training Among Solid Medical Waste Management Personnel at Hospital X, Lampung Province

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The frequency distribution of Needle Stick Injury (NSI), compliance with Personal Protective Equipment (PPE) use, safety box implementation, adherence to Standard Operating Procedures (SOPs), and Occupational Health and Safety (OHS) training among solid medical waste management personnel at Hospital X, Lampung Province, is presented in Table 2.

Table 2. Frequency Distribution of Needle Stick Injury (NSI), Compliance with Personal Protective Equipment (PPE) Use, Safety Box Implementation, Adherence to Standard Operating Procedures (SOPs), and Occupational Health and Safety (OHS) Training Among Solid Medical Waste Management Personnel at Hospital X, Lampung Province

Variable	Total	Persentage(%)
Needle Stick Injury Occurance		
No	36	80.0
Yes	9	20.0
Compliance with PPE Use		
Good	31	68.9
Poor	14	31.1
Safety Box Implementation		
Good	24	53.3
Poor	21	46.7
Adherence to SOP		
Good	32	71.1
Poor	13	28.9
OHS Training		
Good	30	66.7
Poor	15	33.3
Total	45	100.0

Based on Table 2, the majority of solid medical waste management personnel at Hospital X, Lampung Province, had not experienced Needle Stick Injury (NSI) (80.0%). In addition, most respondents demonstrated good compliance with the use of Personal Protective Equipment (PPE) (68.9%), good adherence to Standard Operating Procedures (SOPs) (71.1%), adequate Occupational Health and Safety (OHS) training (66.7%), and proper implementation of safety boxes (53.3%). Overall, these findings indicate that the majority of respondents had adopted appropriate occupational safety practices and had not experienced Needle Stick Injury.

Association Between Compliance with Personal Protective Equipment (PPE) Use, Safety Box Implementation, Adherence to Standard Operating Procedures (SOPs), and Occupational Health and Safety (OHS) Training and the Risk of Needle Stick Injury (NSI) Among Solid Medical Waste Management Personnel at Hospital X, Lampung Province

The results of the analysis examining the associations between compliance with Personal Protective Equipment (PPE) use, safety box implementation, adherence to Standard Operating Procedures (SOPs), and Occupational Health and Safety (OHS) training and the risk of Needle Stick Injury (NSI) among solid medical waste management personnel at Hospital X, Lampung Province, are presented in Table 3.

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Table 3. Association Between Compliance with Personal Protective Equipment (PPE) Use, Safety Box Implementation, Adherence to Standard Operating Procedures (SOPs), and Occupational Health and Safety (OHS) Training and the Risk of Needle Stick Injury (NSI) Among Solid Medical Waste Management Personnel at Hospital X, Lampung Province

Variable	NSI Occurance				p-value	OR (CI 95%)
	Yes		No			
	n	%	n	%		
Compliance with PPE Use						
Poor	5	55.6	9	25.0	0.171	-
Good	4	44.4	27	75.0		
Safety Box Implementation						
Poor	7	77.8	14	38.9	0.086	-
Good	2	22.2	22	61.1		
Adherence to SOPs						
Poor	5	55.6	8	22.2	0.118	-
Good	4	44.4	28	77.8		
Occupational OHS Training						
Poor	6	66.7	9	25.0	0.048	6.000 (1.238-29.069)
Good	3	33.3	27	75.0		
Total	9	100	36	100		

Based on Table 3, respondents with poor compliance with Personal Protective Equipment (PPE) use were more likely to have experienced Needle Stick Injury (NSI) (55.6%), whereas respondents with good PPE compliance were more likely not to have experienced NSI (75.0%). The statistical analysis yielded a p-value of 0.171, indicating that there was no statistically significant association between compliance with PPE use and the occurrence of NSI among solid medical waste management personnel at Hospital X, Lampung Province.

Respondents with poor safety box implementation were more likely to have experienced NSI (77.8%), whereas those with proper safety box implementation were more likely not to have experienced NSI (61.1%). The statistical analysis yielded a p-value of 0.086, indicating that there was no statistically significant association between safety box implementation and the occurrence of NSI among solid medical waste management personnel at Hospital X, Lampung Province.

Respondents with poor adherence to Standard Operating Procedures (SOPs) were more likely to have experienced NSI (55.6%), whereas those with good adherence to SOPs were more likely not to have experienced NSI (77.8%). The statistical analysis yielded a p-value of 0.118, indicating that there was no statistically significant association between adherence to SOPs and the occurrence of NSI among solid medical waste management personnel at Hospital X, Lampung Province.

Respondents with inadequate Occupational Health and Safety (OHS) training were more likely to have experienced NSI (66.7%), whereas those with adequate OHS training were more likely not to have experienced NSI (75.0%). The statistical analysis yielded a p-value of 0.048, indicating a statistically significant association between OHS training and the occurrence of NSI among solid medical waste management personnel at Hospital X, Lampung Province. An Odds Ratio (OR) of 6.000 (95% CI: 1.238–29.069) indicated that respondents with inadequate OHS training had a sixfold higher risk of experiencing NSI than those who had received adequate OHS training.

DISCUSSION

1. Needle Stick Injury (NSI), Compliance with Personal Protective Equipment (PPE) Use, Safety Box Implementation, Adherence to Standard Operating Procedures (SOPs), and Occupational Health and Safety (OHS) Training among Solid Medical Waste Management Personnel at Hospital X, Lampung Province

The findings of this study indicate that the majority of solid medical waste management personnel at Hospital X, Lampung Province, demonstrated good compliance with the use of Personal Protective Equipment (PPE) (68.9%), proper implementation of safety boxes (53.3%), good adherence to Standard Operating Procedures (SOPs) (71.1%), and adequate Occupational Health and

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Safety (OHS) training (66.7%). Furthermore, most respondents (80.0%) had never experienced Needle Stick Injury (NSI), while 20.0% had experienced at least one NSI incident. These findings suggest that most personnel have adopted appropriate occupational safety practices through consistent PPE use, adherence to SOPs, proper safety box implementation, and participation in OHS training programs. Nevertheless, the continued occurrence of NSI indicates that the risk of sharp-object injuries has not yet been completely eliminated.

Although most respondents were classified as having good occupational safety practices, a considerable proportion still demonstrated inadequate PPE compliance (31.1%), suboptimal safety box implementation (46.7%), poor adherence to SOPs (28.9%), and insufficient OHS training (33.3%). These findings indicate that occupational safety programs require further strengthening to ensure that all personnel achieve a consistently high level of compliance and competency. According to Green and Kreuter (2005), health-related behaviors are influenced by predisposing, enabling, and reinforcing factors. Within the context of this study, PPE use, the availability and proper use of safety boxes, adherence to SOPs, and participation in OHS training represent complementary components that collectively promote safe work practices and contribute to the prevention of NSI.

The study also revealed that NSI continued to occur despite the generally favorable implementation of occupational safety measures. This finding suggests that NSI is a multifactorial occupational health problem resulting from the interaction of individual and organizational factors. These results are consistent with the findings of Motaarefi et al. (2016), who reported that NSI is influenced by work-related behaviors, compliance with safety procedures, the availability of safety facilities, and organizational support. Similarly, the World Health Organization (2020) emphasizes that effective NSI prevention requires the establishment of a comprehensive occupational safety culture, supported by adequate safety facilities, continuous training, consistent supervision, and the commitment of all personnel to implementing safe work practices. Therefore, continuous evaluation and strengthening of occupational safety programs are essential to further reduce the risk of NSI among solid medical waste management personnel.

2. Association Between Compliance with Personal Protective Equipment (PPE) Use and the Risk of Needle Stick Injury (NSI) Among Solid Medical Waste Management Personnel at Hospital X, Lampung Province

The statistical analysis yielded a p-value of 0.171 ($p > 0.05$), indicating that there was no statistically significant association between compliance with the use of Personal Protective Equipment (PPE) and the occurrence of Needle Stick Injury (NSI) among solid medical waste management personnel at Hospital X, Lampung Province. Nevertheless, respondents with good PPE compliance were more frequently observed in the group that had not experienced NSI (75.0%), whereas respondents with poor PPE compliance were more commonly found among those who had experienced NSI (55.6%). This difference in proportions suggests a tendency for proper PPE compliance to provide protection against occupational injury, although the association did not reach statistical significance.

Personal Protective Equipment (PPE) represents a form of risk control intended to protect workers from occupational hazards in the workplace. According to Suma'mur (2014), PPE constitutes the last line of defense after hazard control measures through engineering controls and administrative controls have been implemented. The effectiveness of PPE largely depends on workers' compliance with wearing complete and appropriate protective equipment in accordance with established procedures. Furthermore, the Regulation of the Minister of Health No. 7 of 2019, reinforced by Regulation of the Minister of Health No. 8 of 2021, requires medical waste management personnel to use PPE appropriate to the level of occupational risk, including heavy-duty gloves or puncture-resistant gloves, face masks, protective clothing, and safety footwear. The use of latex examination gloves does not meet the requirements for primary PPE because they are not specifically designed to protect workers against sharps injuries. Based on observational findings, Hospital X, Lampung Province, has provided PPE for its personnel; however, the gloves currently used are limited to latex examination gloves rather than heavy-duty or puncture-resistant gloves, as required by the applicable regulations. These findings indicate that although PPE is available in sufficient quantity, the appropriateness of the PPE type for the level of occupational risk remains suboptimal, thereby limiting its effectiveness in preventing needle stick injuries.

The findings of this study are consistent with those reported by Oga et al. (2025), who found that PPE use was not significantly associated with the occurrence of Needle Stick Injury among healthcare workers. Their study suggested that needle stick injuries are more strongly influenced by unsafe work practices, individual worker characteristics, compliance with safety box utilization, and the waste management systems implemented within healthcare facilities.

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Based on these findings, although PPE compliance was not significantly associated with the occurrence of NSI in the present study, PPE remains an essential component of occupational safety. Hospitals should ensure not only the availability of PPE in adequate quantities but also the provision of PPE that is appropriate for the specific occupational hazards encountered by medical waste management personnel, particularly heavy-duty or puncture-resistant gloves for handling sharp medical waste. Continuous supervision, routine monitoring, and periodic evaluation of PPE compliance are also necessary to ensure that protective equipment is used correctly and consistently. Strengthening these measures is expected to further reduce the risk of Needle Stick Injury among solid medical waste management personnel.

3. **Association Between Compliance with Standard Operating Procedures (SOPs) and the Risk of Needle Stick Injury (NSI) Among Solid Medical Waste Management Personnel at Hospital X, Lampung Province**

The statistical analysis yielded a p-value of 0.118 ($p > 0.05$), indicating that there was no statistically significant association between adherence to Standard Operating Procedures (SOPs) and the occurrence of Needle Stick Injury (NSI) among solid medical waste management personnel at Hospital X, Lampung Province. Nevertheless, respondents with good compliance with SOPs were more frequently found in the group that had not experienced NSI (80.6%), whereas respondents with poor adherence to SOPs were more commonly observed among those who had experienced NSI (55.6%). This difference in proportions suggests a tendency for adherence to SOPs to reduce the risk of NSI, although the association was not statistically significant.

Standard Operating Procedures (SOPs) are established guidelines designed to ensure that every stage of medical waste management is carried out safely, effectively, and in accordance with applicable standards. These procedures encompass waste segregation, collection, transportation, temporary storage, the proper use of Personal Protective Equipment (PPE), and the disposal of sharp medical waste into designated safety boxes. The Regulation of the Minister of Health No. 7 of 2019 and the Regulation of the Minister of Health No. 8 of 2021 stipulate that all medical waste management activities must be conducted in compliance with established SOPs as part of efforts to protect workers and promote a strong culture of occupational safety within healthcare facilities.

The findings of this study are consistent with those reported by Nuramalah et al. (2023), who identified non-compliance with work procedures as one of the factors associated with the occurrence of Needle Stick Injury among healthcare workers. Similarly, Sungkawa et al. (2020) reported that most NSI incidents resulted from work practices that did not comply with occupational safety procedures, while accident investigations identified procedural violations as one of the primary causes of sharps injuries. However, unlike these previous studies, the present study did not identify a statistically significant association between SOP compliance and NSI occurrence. This discrepancy may be attributed to differences in respondent characteristics, job responsibilities, the overall level of SOP compliance, and the occupational safety systems implemented across different hospitals. Furthermore, the majority of respondents in the present study demonstrated good adherence to SOPs, resulting in relatively limited variability among participants.

These findings are further supported by Wilburn and Eijkemans (2004), who emphasized that compliance with safety procedures is a fundamental strategy for preventing Needle Stick Injury. Elseviers et al. (2014) also reported that the implementation of safe work procedures, combined with continuous supervision and ongoing training, effectively reduced the incidence of needle stick injuries. Likewise, Motaarefi et al. (2016), in a systematic review, concluded that non-compliance with established work procedures is one of the principal determinants of NSI in healthcare settings. Therefore, although adherence to SOPs was not significantly associated with NSI in the present study, consistent implementation of SOPs should continue to be strengthened through regular dissemination of procedures, routine supervision, compliance monitoring, and continuous professional development. These efforts are essential to fostering a sustainable culture of occupational safety and reducing the risk of Needle Stick Injury among solid medical waste management personnel at Hospital X, Lampung Province.

4. **Association Between Occupational Health and Safety (OHS) Training and the Risk of Needle Stick Injury (NSI) Among Solid Medical Waste Management Personnel at Hospital X, Lampung Province**

The statistical analysis yielded a p-value of 0.048 ($p < 0.05$), indicating a statistically significant association between Occupational Health and Safety (OHS) training and the occurrence of Needle Stick Injury (NSI) among solid medical waste management personnel at Hospital X, Lampung Province. The distribution of the data showed that respondents who had received

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adequate OHS training were more frequently found in the group that had not experienced NSI (75.0%), whereas respondents with inadequate OHS training were more commonly observed among those who had experienced NSI (66.7%). These findings suggest that insufficient OHS training may increase the risk of Needle Stick Injury among solid medical waste management personnel.

Occupational Health and Safety (OHS) training is designed to enhance workers' knowledge, skills, and competencies in identifying workplace hazards and implementing safe work practices, including the proper use of Personal Protective Equipment (PPE), safe medical waste handling, appropriate use of safety boxes, and effective management of occupational accidents. According to Green and Kreuter (2005), training constitutes an enabling factor that facilitates the development of positive health-related behaviors. Likewise, Notoatmodjo (2014) emphasized that education and training transform knowledge into practical actions, thereby enabling workers to consistently maintain safe work practices.

The findings of the present study demonstrate that OHS training plays an important role in preventing NSI because personnel who receive regular training tend to have a better understanding of medical waste management procedures, the appropriate use of PPE, the proper function and utilization of safety boxes, and compliance with Standard Operating Procedures (SOPs). Based on observational findings, solid medical waste management personnel at Hospital X, Lampung Province, generally had not received structured and professionally organized OHS training. Instead, they primarily received brief instructions or informal briefings from their supervisors, which did not provide comprehensive education regarding hazard identification, proper PPE use, safe handling of sharp medical waste, emergency response procedures, or the management of Needle Stick Injury incidents. This condition may explain the significant association observed between OHS training and NSI occurrence in the present study. Given the high occupational risks associated with medical waste management, all personnel involved in handling medical waste—including non-healthcare workers—should possess adequate competencies acquired through structured training programs. This finding is also consistent with the policies of the Ministry of Health of the Republic of Indonesia, which has implemented Healthcare Facility Waste Management Training Programs and Hazardous and Toxic Waste (B3) Management Training Programs to improve personnel competency in the safe management of medical waste.

The findings of this study are consistent with those reported by Dion et al. (2022), who found that participation in occupational training was significantly associated with the occurrence of needle stick injuries among hospital solid waste management personnel. Workers who had never received training were at a higher risk of sustaining needle stick injuries than those who had participated in regular training programs. Similar findings were reported by Toybah et al. (2025), who demonstrated that improving workers' competencies through occupational safety training contributed to a reduced risk of Needle Stick Injury among healthcare workers. Furthermore, Wilburn and Eijkemans (2004) identified education and training as one of the primary NSI prevention strategies recommended by the World Health Organization (WHO). Likewise, the World Health Organization (2020) emphasized the importance of continuous education and training in strengthening occupational safety, while Motaarefi et al. (2016), through a systematic review, concluded that inadequate training is one of the key determinants contributing to Needle Stick Injury in healthcare facilities.

Based on these findings, Occupational Health and Safety (OHS) training represents an important factor in reducing the risk of Needle Stick Injury among solid medical waste management personnel. Therefore, hospitals should implement more structured, regularly scheduled, and competency-based OHS training programs covering the proper use of PPE, safe management of sharp medical waste, compliance with Standard Operating Procedures (SOPs), prevention of biological exposure, and appropriate management of Needle Stick Injury incidents. Periodic evaluation of these training programs is also essential to ensure that the knowledge and skills acquired are effectively translated into daily work practices. Such efforts are expected to strengthen the culture of occupational safety and contribute to reducing the incidence of Needle Stick Injury among solid medical waste management personnel.

CONCLUSION

Based on the findings of this study, Needle Stick Injury (NSI) remains an important occupational safety issue among solid medical waste management personnel at Hospital X, Lampung Province. This study found that compliance with the use of Personal Protective Equipment (PPE), implementation of safety boxes, and adherence to Standard Operating Procedures (SOPs) were not significantly associated with the occurrence of NSI, although these factors remain essential components of strategies to prevent

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sharps-related injuries. In contrast, Occupational Health and Safety (OHS) training was found to be significantly associated with NSI, indicating that improving workers' competencies through structured and continuous training is a key factor in reducing the risk of injury. Therefore, hospitals should prioritize strengthening OHS training programs, supported by the provision of appropriate PPE that complies with established standards, optimization of safety box utilization, enhanced adherence to SOPs, and continuous supervision. These measures are essential for fostering a strong culture of occupational safety and minimizing the occurrence of Needle Stick Injury among solid medical waste management personnel.

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