

Determinants of Occupational Accidents in Inpatient Nurses: The Role of Implementation of Standard Operating Procedures, PPE Compliance, and Workload

Nabilatul Fanny^{1*}, Kelvin Elwis Sabrang Prayoga¹, Nurulshyha Md Yatim²

¹Hospital Administration Department, Faculty of Health Sciences, Universitas Duta Bangsa Surakarta, Indonesia

²Universiti Kuala Lumpur, Institute of Medical Science Technology, Malaysia

Email: nabilatul@udb.ac.id*

ABSTRACT

Background: nurses are health workers who have a high risk of experiencing occupational accidents due to exposure to biological, physical, ergonomic, and psychosocial hazards while providing health services. **Objective:** the purpose of this study was to determine the determinants of occupational accidents in inpatient nurses based on the implementation of SOPs, compliance with the use of PPE, and workload with incidents. **Methods:** this study is a quantitative study with a cross-sectional design conducted on 75 inpatient nurses at Hospital X, Surakarta City using a total sampling technique. Data analysis was performed univariately, bivariate using the Chi-square test, and multivariate using multiple logistic regression with a significance level of 5%. **Results:** Most respondents implemented SOPs well (84%), complied with the use of PPE (76%), and had a light workload (53.3%). A total of 20% of respondents had experienced occupational accidents. Bivariate analysis showed a relationship between the implementation of SOPs ($p=0.004$), compliance with the use of PPE ($p<0.001$), and workload ($p=0.002$) with the occurrence of occupational accidents. Logistic regression results show that the implementation of inappropriate SOPs can increase the risk of work accidents by 3.474 times, non-compliance with the use of PPE increases the risk by 4.796 times, and heavy workload increases the risk by 6.633 times. Workload is the most dominant factor influencing work accidents. **Conclusion:** The implementation of SOPs, compliance with the use of PPE, and workload are significantly related to the occurrence of work accidents in inpatient nurses. **Recommendation:** Workload is the most influential factor and therefore needs to be the main focus in efforts to prevent work accidents in hospitals

Keywords Work accidents; Nurses; SOP; PPE; Workload; Hospital Occupational Safety and Health

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INTRODUCTION

As a healthcare institution for the community, hospitals are workplaces that pose a high risk to the safety and health of hospital staff, patients, visitors, and the hospital environment (1). Hospital Occupational Safety and Health (OSH) is a crucial aspect that cannot be ignored. Implementing OSH in hospitals can create a safe, healthy, and productive work environment. The World Health Organization (2024) emphasized that protecting healthcare workers through an effective OSH system not only impacts worker safety but also contributes to service quality and patient safety. Similarly, the Ministry of Health of the Republic of Indonesia (2024) stated that implementing OSH in healthcare facilities is an obligation that must be implemented in an integrated manner within the hospital management system (2,3).

Based on data from the Employment Social Security Administration, the number of workplace accidents in Indonesia has continued to grow over the past five years. Workplace accidents increased by 21.28% to 221,740 cases in 2020 and increased by 5.65% to 234,270 cases in 2021. These accidents are caused by un-ergonomic positions and workers not using safe equipment (4). Globally, the WHO reports that approximately 1 in 10 health workers experience a work-related incident each year. Data from the International Labour Organization (ILO) shows that non-fatal work injuries in the health and social sectors range from 1,500–

3,000 cases per 100,000 workers in several countries (2). Research published in *Frontiers in Public Health* (2024) shows that injuries caused by sharp objects account for approximately 55.3% of all workplace accidents in hospitals. In addition, other risks such as exposure to chemicals, electric shock, stress due to high workloads, and violence from patients or hospital visitors also pose a threat to the safety of health workers (5).

Standard Operating Procedures (SOPs) are guidelines or references for carrying out work tasks in accordance with the functions and tools for assessing hospital performance based on technical, administrative, and procedural indicators in accordance with the relevant work procedures. The purpose of SOPs is to create commitment regarding hospital work units to realize good governance. SOPs function as a service control tool that provides systematic guidance for medical personnel in carrying out work procedures correctly and consistently. Meanwhile, Personal Protective Equipment (PPE) acts as the last physical defense in preventing injury and exposure to hazardous agents. PPE is a tool that has the ability to protect a person and functions to isolate part or all of the body from potential hazards in the workplace. PPE includes gloves, respiratory protection, eye protection, head coverings, protective clothing, and protective shoes (6,7).

In the last five years (2020–2024), needlestick injuries (NSIs) remain the most frequently reported form of occupational accident among hospital nurses in Indonesia. The incidence of needlestick injuries (NSIs) among nurses shows a very concerning proportion, ranging from 38% to 73%, with 70 cases specifically reported (8,9). In Central Java, a recent study of nurses at a hospital in Central Java showed that NSI incidents are still found among inpatient nurses and are related to individual and work environment factors. As many as 40 of 156 nurses experienced NSI incidents (25.6%). Meanwhile, ICU nurses have a risk of NSI of 43.6% with the risky cause being the needle recapping procedure (10). Nurses as health workers with the largest number (around 47.08%) and are on the front line of service and have the highest risk of exposure to hazards. Nurses' intensive interaction with patients, medical equipment, and biological materials places them at real risk of occupational accidents (11). These data indicate that occupational safety risks remain a serious problem that requires systematic attention.

Nurses have several service roles, including caregivers, educators, client advocates, counselors, change agents, leaders, managers, researchers, and practice developers. As a result of these various roles, nurses must be accountable for, resulting in various difficulties in service delivery, such as excessive workload (12). Workload is something that arises from the interaction between task demands, the work environment, skills, behaviors, and perceptions of workers. Workload is one factor that can lead to fatigue. Nursing fatigue is a symptom associated with decreased work efficiency, skills, and boredom in nurses. Research conducted by Gumelar et al. (2021) found that more than half of respondents (with a sample of 58 nurses) experienced a heavy workload of 56.9%. The majority of respondents experienced high fatigue, namely 67.2%. Excessive workload causes nurses to become fatigued, which has an impact on decreased alertness and reaction time (13).

Hospital X is one of the public hospitals in Surakarta City, which has obtained full accreditation and has the status of a type C hospital. The results of a preliminary study indicate that nurses are a group of health workers who have a high risk of experiencing work accidents due to the intensity of direct contact with patients, the use of sharp medical instruments, exposure to bodily fluids, and the demands of work that lasts 24 hours. Based on Hospital X Needle Injury data in 2025, the forms of work accidents that are still frequently found are nurses being pricked by needles on the palm, nurses slipping on the floor while taking medication resulting in back injuries and musculoskeletal pain due to lifting and moving patients, and exposure to infectious materials during nursing procedures. Based on the results of preliminary

interviews with 10 nurses, it was found that all nurses stated that they understood the SOPs applicable in the hospital. However, in daily implementation, there are still discrepancies between established procedures and work practices in the field. This condition generally occurs in service situations that require a quick response or when the number of patients being treated increases. Some nurses admitted that they sometimes skip certain stages in the SOP to speed up service, potentially increasing the risk of work accidents. In terms of PPE use, observations indicate that most nurses used basic PPE, such as masks and gloves, as needed for the procedure. However, compliance with complete PPE use remains suboptimal. Some nurses were found not to use PPE according to standards for certain procedures, citing discomfort, time constraints, or the perception that the procedure was low-risk. This situation can increase the risk of biological exposure and injury due to contact with hazardous materials. Furthermore, workload was a significant factor, according to interviews. Most nurses stated that the high number of patients, the complexity of cases, the need for extensive documentation, and the rotating work system caused physical and mental fatigue. Nurses working night shifts or during periods of increased patient numbers reported experiencing decreased concentration, potentially leading to errors and increasing the risk of workplace accidents. These preliminary findings indicate the need for further research to analyze the relationship and influence of each factor on the incidence of workplace accidents, thus providing a basis for developing more effective prevention strategies in the hospital environment.

METHODS

This research is a quantitative study with an associative method and a cross-sectional approach. This approach was chosen to identify the relationship between independent variables and variables at the same time (14). The study population was all inpatient nurses at RSU X in Surakarta City in 2025, totaling 75 nurses. The sampling technique used total sampling, so that the number of samples was the same as the population, namely 75 respondents, with the aim of obtaining a comprehensive picture of the conditions of the implementation of Standard Operating Procedures, PPE Compliance, and Workload on nurses at the research location. The independent variables in this study were the implementation of SOPs, PPE compliance, and workload. While the dependent variable was work accidents. All variables were categorized on an ordinal scale with objective criteria based on scores.

Data collection used primary and secondary data. Primary data were obtained through observation and questionnaires by respondents, while secondary data were obtained from relevant documents/archives in the hospital and literature studies. The instruments used were a structured questionnaire and observation sheets. Before use, the instrument had undergone validity and reliability testing at Bung Karno Regional Hospital in Surakarta with 30 trial respondents. The results of the validity test showed that all questions were valid ($r_{\text{count}} > r_{\text{table}} 0.361$). The reliability test was conducted using the Cronbach's Alpha method to assess the level of internal consistency of the instrument. The test results showed that the SOP implementation variable obtained a Cronbach's Alpha value of 0.842, the PPE compliance variable was 0.865, the workload variable was 0.801, and the work accident variable was 0.798. All Cronbach's Alpha values were above the minimum limit of 0.60 so that the research instrument was declared reliable.

Data processing was performed through editing, coding, scoring, tabulating, and data entry using SPSS software. Data analysis was performed using univariate, bivariate, and multivariate methods. Univariate analysis was used to describe the frequency distribution of respondent characteristics and research variables, while bivariate analysis used the chi-square test to determine the relationship between the independent and dependent variables (the significance level used was $\alpha = 0.05$). Multivariate analysis used multiple logistic regression

to determine the factors most influential on the occurrence of work accidents. The research stages can be briefly seen in the research flowchart below (15,16).

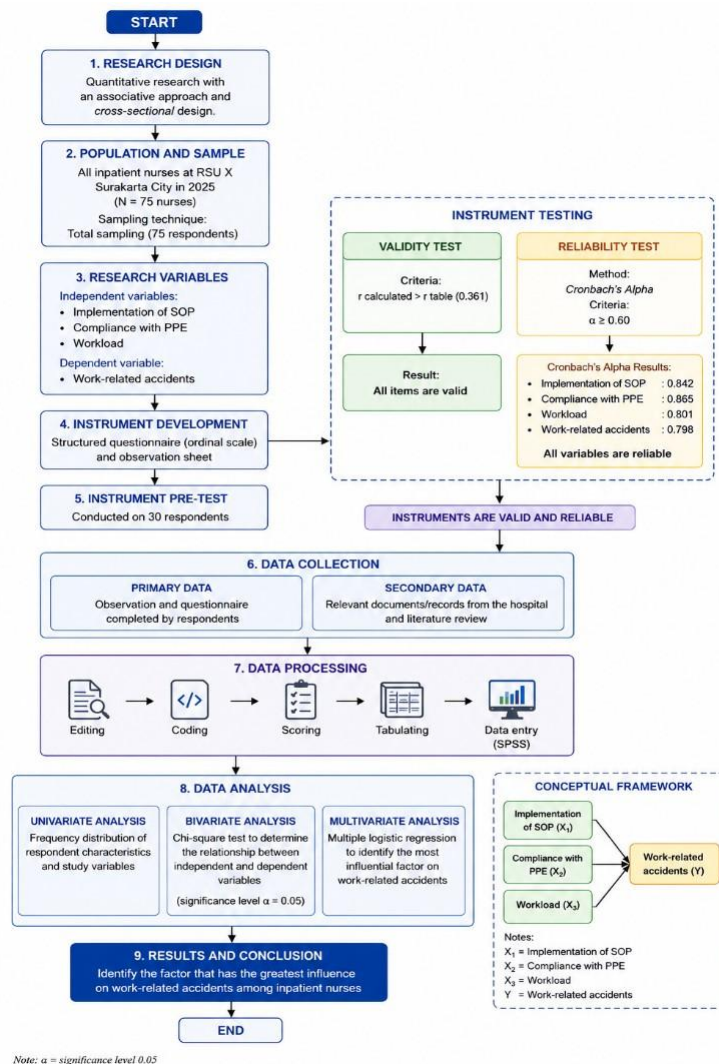


Figure 1. Research Stage Flowchart

RESULTS

This research was conducted at Hospital X, a type C private hospital located in Surakarta City, Central Java. Hospital X provides a variety of healthcare services, including outpatient care, inpatient care, emergency care, intensive care, and various specialist services supported by professional healthcare professionals. As a hospital that provides 24-hour services, nurses play a crucial role in providing nursing care while facing various occupational risks, making this hospital a relevant location to examine factors related to workplace accidents among inpatient nurses. This hospital has a formalized guideline for the use of PPE and a policy on Hospital Occupational Safety and Health, which serves as a reference for all staff in providing safe services.

Univariate Analysis

Based on the results of distributing questionnaires to inpatient ward nurses at Anggrek Aster, Bakung, Bougenville, Cattleya, Cempaka wards with a total of 75 nurses. So a description of the characteristics of the respondents was obtained based on gender, age, education and length of work of the respondents with the following details.

Table 1. Respondent Characteristics (n=75)

Respondent Characteristics	Frequency	Percentage (%)
Age		
20-29	20	26,7
30-39	38	50,7
40-49	13	17,3
50-59	4	5,3
Gender		
Male	22	29,3
Female	53	70,7
Last education		
D3 Keperawatan	65	86,7
S1 Keperawatan	7	9,3
S1 + Profesi Ners	3	4
Length of working		
<1 year	2	2,6
1-5 years	12	16
6-10 years	26	34,7
>10 years	35	46,7

Based on Table 1, it can be seen that the majority of respondents are in the 30-39 years age range (50.7%), the most dominant respondent characteristics based on gender are female (70.7%). In terms of the most recent education, the majority have a D3 nursing educational background (86.7%), some respondents have a work period of more than 10 years (46.7%).

The description of the implementation of standard operating procedures, compliance with the use of personal protective equipment, workload, and work accidents among nurses in inpatient units is shown in table 2 below.

Table 2. Frequency Distribution of Research Variables (n=75)

Category	Frequency	Percentage (%)
SOP Implementation		
Appropriate	63	84
Not appropriate	12	16
PPE Compliance		
Compliant	57	76
Not Compliant	18	24
Workload		
Heavy	35	46,7
Light	40	53,3
Workplace Accidents		
Accidents	15	20
No Accidents	60	80

The results of the univariate analysis showed that almost all respondents had implemented the SOP properly/appropriately (84%). Meanwhile, regarding the compliance variable for PPE use, 57 respondents (76%) were compliant. Respondents with a light workload were 53.3% and those with a heavy workload were 46.7%. The distribution of the work accident variable showed that 20% of respondents had experienced a work accident and 80% of respondents had not experienced a work accident.

Bivariate Analysis

Testing the relationship between variables using the chi-square test yielded the following data.

Table 3. Relationship between SOP Implementation and Workplace Accidents (n=75)

SOP	Workplace Accidents				Total		ρ -value
	Accidents		No Accidents				
	n	%	n	%	n	%	
Appropriate	5	8,8	52	91,2	57	100	0,004
Not appropriate	10	55,6	8	44,4	18	100	
Total	15	20	60	80	75	100	

Based on Table 3, it shows that the proportion of respondents who experienced work accidents was higher among respondents who were less appropriate in implementing standard operating procedures with a percentage of 55.6%, compared to respondents who implemented standard operating procedures appropriately with a percentage of 8.8%. Based on the results of statistical tests using chi square, the ρ -value was obtained = 0.004 ($\rho < 0.05$), so statistically it can be said that there is a relationship between the implementation of SOPs and the occurrence of work accidents.

Table 4. The Relationship between Compliance with the Use of PPE and Work Accidents (n=75)

PPE Compliance	Workplace Accidents		No Accidents		Total		ρ -value
	Accidents		No Accidents				
	n	%	n	%	n	%	
Compliant	6	9,4	58	90,6	64	100	0,000
Not Compliant	9	81,8	2	18,2	11	100	
Total	15	20	60	80	75	100	

Based on Table 4, it shows that respondents who experienced work accidents were more likely to be respondents who did not comply with the use of personal protective equipment with a percentage of 81.8%, compared to respondents who complied with the use of personal protective equipment with a percentage of 9.4%. Based on the results of statistical tests using chi square, the ρ -value was obtained = 0.000 ($\rho < 0.05$), so statistically it can be said that there is a relationship between compliance with the use of personal protective equipment and the occurrence of work accidents.

Table 5. Relationship between Workload and Work Accidents (n=75)

Workload	Workplace Accidents				Total		ρ -value
	Accidents		No Accidents		n	%	
	n	%	n	%			
Heavy	8	42,1	11	57,9	19	100	0,002
Light	7	12,5	49	87,5	56	100	
Total	15	20	60	80	75	100	

Based on Table 5, it shows that respondents who experienced work accidents were more likely to have heavy workloads with a percentage of 42.1%, compared to respondents who had light workloads with a percentage of 12.5%. Based on the results of statistical tests using chi square, the p -value was obtained = 0.002 ($p < 0.05$), so statistically it can be said that there is a relationship between workload and the occurrence of work accidents.

Multivariate Analysis

All significant variables in the bivariate analysis were entered into multiple logistic regression. Multivariate analysis was conducted to determine the most dominant variable and to analyze the influence between the research variables. Logistic regression analysis is a mathematical modeling approach used to analyze the relationship between several independent variables and a dichotomous or binary dependent variable.

Table 6. Results of Multiple Logistic Regression Analysis of Factors Associated with Workplace Accidents in Inpatient Nurses (n=75)

Variable	B	S.E	Wald	p - value	OR (Exp(B))	95% C.I For Exp (B)	
						Lower	Upper
Implementation of SOPs	1,245	0,485	6,590	0,010*	3,474	1,343	8,987
Compliance with PPE use	1,568	0,529	8,787	0,003*	4,796	1,699	13,537
Workload	1,892	0,601	9,909	0,002*	6,633	2,043	21,534
Constant	-4,125	1,124	13,460	0,000	0,016		

Information:

Dependent: Workplace Accident (0 = Not experienced, 1 = Experienced)

* $p < 0.05$ (significant)

Table 7. Model Feasibility

Parameters	Value
-2 Log Likelihood	82,347
Nagelkerke R Square	0,486
Hosmer and Lemeshow Test (p-value)	0,621
Overall Percentage Correct	78,4%

Based on the results of multiple logistic regression analysis, it was found that the three independent variables were significantly related to the incidence of work accidents in inpatient nurses ($p < 0.05$). The variable of inappropriate implementation of SOPs increased the risk of work accidents by 3.474 times compared to the implementation of appropriate SOPs (OR = 3.474; $p = 0.010$). Nurses who did not comply with the use of PPE had a risk of experiencing work accidents 4.796 times compared to nurses who complied (OR = 4.796; $p = 0.003$). Meanwhile, high workload was the most dominant factor because it had the largest OR value, namely 6.633 ($p = 0.002$), which indicated that nurses with high workloads had a risk of experiencing work accidents 6.633 times greater than nurses with low workloads. Thus, workload was the most influential factor on the incidence of work accidents in inpatient nurses.

The Nagelkerke R Square value of 0.486 indicates that the variables of SOP implementation, PPE compliance, and workload are able to explain 48.6% of the variation in occupational accident incidence. The Hosmer-Lemeshow test results show a p -value of 0.621 (> 0.05), so the regression model is deemed fit and suitable for use in analysis.

DISCUSSION

The Relationship between SOP Implementation and Work Accidents

The results of the study showed a significant relationship between the implementation of SOPs and the incidence of work accidents among inpatient nurses ($p=0.004$). Nurses who did not comply with SOPs had a higher proportion of work accidents than nurses who implemented SOPs according to standards. Logistic regression results showed that the implementation of SOPs that did not comply increased the risk of work accidents by 3.474 times. This finding is in line with research conducted by Saharudin (2026), which showed that compliance with SOPs contributes to reducing the incidence of needlestick injuries, exposure to infectious materials, and other work safety incidents among healthcare workers ⁽¹⁷⁾. However, this study also showed that there were respondents (5 nurses) who implemented SOPs according to standards still experienced accidents. This indicates that the existence of SOPs as documents does not automatically result in safe work behavior if access to SOPs is uneven, internalization of SOPs is not optimal, and implementation supervision is not consistent.

SOPs are work guidelines that serve to direct healthcare workers to carry out actions safely, effectively, and consistently. Non-compliance with SOPs can lead to procedural errors, increased exposure to hazards, and the risk of work-related injuries ⁽⁶⁾. Consistent implementation of SOPs also contributes to building a safety culture in hospitals. When all healthcare workers are committed to working according to procedures, the work environment becomes safer, the risk of accidents decreases, and the quality of healthcare services improves. Conversely, non-compliance in the implementation of SOPs can lead to unsafe actions, which are one of the main causes of workplace accidents in healthcare facilities ⁽²⁵⁾. In the hospital context, SOP implementation is influenced not only by nurses' knowledge, but also by working conditions such as high patient volumes, time constraints, and service pressure. Therefore, SOPs will be more effective if supported by control/supervision mechanisms such as routine supervision, compliance audits, incident-based SOP updates, periodic training, performance feedback, and a strengthened work safety culture to improve compliance with SOPs.

The Relationship between Compliance with the Use of PPE and Work Accidents

This study found a significant relationship between compliance with PPE use and the incidence of work-related accidents ($p<0.000$). Nurses who did not comply with PPE use had a 4.796 times greater risk of work-related accidents than nurses who did. PPE is the final layer of protection that functions to reduce the risk of exposure to biological, chemical, and physical hazards in the hospital environment. The use of gloves, masks, face shields, and other PPE has been shown to reduce the risk of needlestick injuries, contact with bodily fluids, and the transmission of infectious diseases ⁽¹⁸⁾. The results of this study support WHO recommendations that compliance with PPE use is an important component of a health worker safety system ⁽²⁾.

However, some respondents who adhered to the use of PPE still experienced work-related accidents, albeit in small numbers. This suggests that PPE alone is insufficient if other safety practices are inconsistent, such as the sequence of donning and doffing PPE, hand hygiene, medical waste management, and adherence to safe work procedures under workload pressure. This also points to the need for strengthened standard precautions training, supervision by ward heads, and the availability of adequate PPE to ensure continued safe behavior ⁽¹⁹⁾. This statement is supported by the results of research conducted by Latarissa et al. (2022) that knowledge, attitudes, availability of personal protective equipment (PPE), and motivation are factors associated with the use of PPE among nurses ⁽²⁰⁾. Furthermore, non-compliance with PPE use is often caused by discomfort, low risk perception, time constraints,

or inadequate PPE availability. Therefore, hospitals need to ensure the availability of adequate PPE and increase supervision and education regarding the importance of consistent PPE use.

Relationship between Workload and Work Accidents

The results of the study showed that workload had a significant relationship with occupational accidents ($p=0.002$). Nurses with heavy workloads had a higher proportion of occupational accidents than nurses with light workloads. Multivariate analysis showed that workload was the most dominant factor with an OR value of 6.633. The heavier the workload, the shorter the working time a person can work without fatigue and significant physiological disorders, or vice versa, so that workers who experience work fatigue can also experience occupational accidents. According to Hidayat (2020), workload is something that arises from the interaction between task demands, the work environment where it is used as a workplace, skills, behaviors, and perceptions of workers. Workload can sometimes also be defined operationally by various factors such as task demands or efforts made to perform the work ⁽²¹⁾.

These findings align with ergonomics and occupational safety theory, which states that increased work demands that are not balanced with worker capacity will increase the risk of work accidents ⁽²²⁾. For inpatient nurses, the high number of patients, the complexity of nursing procedures, extensive documentation, and shift work systems are factors that contribute to the high workload. Some nurses also have managerial duties, thus increasing the likelihood of work errors, injuries resulting from the use of medical equipment, and accidents resulting from physical activity during work.

As the most dominant factor, workload management needs to be a priority in hospital Occupational Safety and Health programs. Efforts to prevent workload on nurses can be implemented by adjusting the number of nursing staff to meet service needs, scheduling work that takes into account adequate rest periods, redistributing tasks proportionally, and utilizing technology to reduce administrative burdens. Furthermore, organizational support in the form of stress management programs, psychological counseling, and improving the culture of occupational safety needs to be implemented continuously. These strategies are expected to reduce work fatigue, increase productivity, and reduce the risk of workplace accidents among nurses ^(23, 24).

Implications of Findings and Other Factors Outside the Model

The Hosmer-Lemeshow test was used to assess the suitability between the values predicted by the model and the actual observed data. A significance value greater than 0.05 indicates no significant difference between the model prediction results and the observed data, so the logistic regression model is declared fit for use in explaining the relationship between variables (26, 27). Based on the results of the model fit test, the Hosmer-Lemeshow value was obtained of 0.621 ($p > 0.05$), indicating that the logistic regression model has a good fit with the research data, so it is suitable for use to analyze factors related to work accidents in inpatient nurses. The Nagelkerke R Square value of 0.486 indicates that the variables of SOP implementation, compliance with PPE use, and workload together are able to explain 48.6% of the variation in work accident incidence, while the remaining 51.4% is influenced by other factors outside the model (which were not studied) that have the potential to influence the occurrence of work accidents and therefore need to be studied further in subsequent research.

CONCLUSION

Based on the results of a study of 75 inpatient nurses at Hospital X, Surakarta City, using bivariate analysis, it can be concluded that the implementation of Standard Operating Procedures, compliance with the use of Personal Protective Equipment, and workload have a

significant relationship with the occurrence of work accidents in nurses. Likewise, the results of multiple logistic regression analysis show that all three variables have a significant effect on the occurrence of work accidents, with workload as the most dominant factor (OR = 6.633; $p = 0.002$), followed by non-compliance with the use of PPE (OR = 4.796; $p = 0.003$) and the implementation of inappropriate SOPs (OR = 3.474; $p = 0.010$). These findings indicate that increasing compliance with SOPs and the use of PPE as well as optimal workload management need to be a priority in efforts to prevent work accidents in inpatient nurses in order to create a safer, healthier, and more productive work environment.

Acknowledgments: The author would like to express his deepest gratitude to all parties who have provided support and contributions in the implementation of this research. Thanks are extended to the management and all staff of Hospital X, Surakarta City, who have provided permission, assistance, and data access during the research process. The author also thanks all inpatient nurses who have agreed to be respondents and actively participated in this research. Thank you to colleagues, and all parties who have provided direction, input, and support so that the research entitled "Determining Factors of Occupational Accidents in Inpatient Nurses: The Role of Implementation of Standard Operating Procedures, PPE Compliance, and Workload" can be completed well. Hopefully, the results of this research can provide benefits for the development of science and be used as consideration in efforts to improve occupational safety and health in the hospital environment.

Conflicts of Interest: The author declares that during the research, manuscript preparation, data analysis, and publication of this article, there were no conflicts of interest whatsoever, either financial or non-financial. The entire research process was conducted independently and objectively, based on scientific principles, to produce valid and accountable findings.

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