Assessment of Knowledge, Attitude and Practice on Chemical Exposure among Cleaners in a University Hospital

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ABSTRACT

Cleaning activities at healthcare facilities were conducted manually or mechanically using disinfectants or enzymatic products by healthcare cleaners. This may cause exposure to hazardous chemicals and lead to acute and chronic health effects among the cleaners. The study assessed cleaners' knowledge, attitude, and practice (KAP) regarding the use of harmful disinfectants. A total of 108 cleaners were randomly selected from a university hospital and a modified questionnaire assessing their KAP regarding chemical exposure was distributed. Results showed that 96% of respondents reported the presence of workplace safety signs, policies, and procedures. Although almost respondents (99.1%) had personal protective equipment (PPE) provided, there were clear gap in support; 64.9% mentioned a lack of regular training and 25.0% noted limited job rotation. Knowledge was moderate (mean 73.9%) whereas attitudes (81.3%) and practices (81.4%) were generally good. Knowledge was correlated positively with attitude ($p = 0.003$, $r = 0.283$). In conclusion, these findings suggest that providing PPE alone is not enough, it should be supported by regular training and planned job rotation to reduce risks effectively and in the long term.

Keywords: cleaners, knowledge, attitude, practice, chemical exposure

1 INTRODUCTION

Hospital cleaning is crucial in reducing healthcare-associated infections (HAIs) and mitigating environmental contamination. High-touch areas such as those frequented by patients, visitors, and healthcare workers serve as reservoirs for pathogen transmission [1]. Effective hospital cleaning is a critical component of infection prevention strategies, as inadequate cleaning practices can lead to the persistence of pathogens such as *Clostridium difficile*, *Staphylococcus aureus*, and multi-drug-resistant organisms (MDROs) on surfaces [2]. The cleaning process typically involves manual or mechanical removal of dirt, debris, and microorganisms using water with detergents or enzymatic cleaners. This process eliminates microorganisms and reduces organic bioburden, thus improving environmental hygiene [3].

Cleaners use various cleaning agents, including soaps, disinfectants, bleaching agents, and specialised cleaners for cleaning bathrooms, glass, and drains. However, prolonged or improper use of these cleaning agents is associated with acute and chronic health effects, particularly respiratory and dermatological health. For example, exposure to chlorine-based disinfectants and other volatile cleaning agents has been linked to occupational asthma, rhinitis, and chronic respiratory conditions [4,5]. Additionally, irritant contact dermatitis, eczema, and chemical burns are frequently reported among hospital cleaners, often due to insufficient use of personal protective equipment (PPE) or inappropriate handling of chemical agents [6].

Excessive exposure to these agents is known to harm cleaners' health. In a recent study, 53% of hospital cleaners reported experiencing symptoms of respiratory irritation [7,8], while 47% reported eye irritation during their work shifts [9]. These findings are consistent with earlier reports including studies from Denmark which have highlighted the high prevalence of hand dermatitis and other dermatological conditions among hospital cleaning staff, often attributed to frequent hand washing, contact with chemicals, and inadequate protective measures [10].

A significant challenge in hospital cleaning is that many cleaners have insufficient knowledge, training, tools, and access to safety information. This deficiency increases the risk of occupational diseases caused by chemical hazards and improper cleaning practices. A study in Eastern Ethiopia highlighted inadequate knowledge of risk management and safety practices among hospital

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cleaners. It emphasised the critical need for formal training programs to improve safety awareness and practices, aiming to reduce the prevalence of work-related injuries [11].

Assessing cleaners' knowledge, attitude, and practice (KAP) scores regarding chemical exposure is crucial for identifying gaps in awareness and promoting safer practices. Studies have shown that educational interventions and targeted training programs significantly improve KAP scores and reduce workplace hazards [12]. This study aims to determine the KAP scores among hospital cleaners, providing valuable insights into their understanding, perceptions, and behaviours regarding chemical exposure. The results will help raise awareness among responsible bodies and cleaners about workplace hazards, facilitating the implementation of effective control measures. Moreover, these findings can serve as a reference for improving occupational settings and guide the development of new standard operating procedures (SOPs) to ensure a safer work environment.

Although international studies have documented the health risks of cleaning agents among hospital workers, evidence from Malaysia remains scarce. Most local research has focused on healthcare professionals [13], laboratory staff [14,15], or industrial workers [16] with limited attention given to hospital cleaners, a group frequently exposed to chemical hazards yet often overlooked in occupational health studies. The present study is novel in that it specifically addresses the KAP of hospital cleaners in a Malaysian university hospital, thereby providing context-specific data that are essential for guiding preventive strategies, policy development and targeted intervention in the vulnerable workforce.

2 MATERIALS AND METHODS

A cross-sectional study was conducted involving 108 randomly selected cleaners from a university hospital to assess their KAP regarding chemical exposure. A simple random sampling method was utilised to recruit participants. This approach was chosen to ensure that the sample was representative of the broader population within the university hospital, reducing the risk of selection bias and enhancing the generalizability of the study findings. This sampling process process ensured that the results are valid and reliable. Data collection began in April 2021 and used a structured process to increase participation and reduce bias.

2.1 Sample Size

The sample size for this study was calculated using G*Power software to ensure adequate statistical power. Key parameters for the calculation included an alpha level of 0.05, a desired statistical power of 0.80, an effect size of 0.15, and the inclusion of 10 predictors. Based on these parameters, the calculation determined that a minimum of 108 participants would be required to achieve sufficient power for the study's analyses. To allow for possible dropouts or non-responses, a 10% was added to the minimum sample size, resulting in a final target of 116 participants.

2.2 Data Collection

Consent letters and information sheets were given to participants to explain the study's purpose, procedures, and confidentiality. These were provided with the questionnaires to ensure transparency and voluntary participation. Data were collected through face-to-face sessions and by distributing questionnaires via a supervisor, allowing flexibility and easier access for all respondents.

The face-to-face sessions lasted about two weeks in a selected lecture hall, where participants received clear instructions and support from trained facilitators. This allowed for immediate feedback and improved accuracy. For those unable to attend, questionnaires were distributed by supervisors, with extra support provided via WhatsApp. The questionnaire took about 15–20 minutes to complete. Afterward, responses were checked, collected, and stored securely. All data were entered into a database and analysed using statistical methods. This approach ensured high participation, minimal missing data, and reliable results to guide safety and health improvements for hospital cleaners.

2.2.1 Questionnaire

A modified questionnaire, adapted from a previous KAP study by Waras [17] was used to collect data. The questionnaire consisted of 44 questions divided into five sections:

Section I: This section gathered respondents' background information, including age, gender, years of employment, education level, frequency of directly handling chemicals outside of work, and details of the job rotation system.

Section II: This section focused on occupational factors at the workplace, querying safety signs, safety policies and procedures, safety data sheet (SDS) information, continuous training, and the availability of PPE.

Section III: Consisting of 12 questions on general knowledge of chemical exposure to cleaning agents during work, this section covered the exposure pathways of chemicals, PPE used, safe operation procedures when handling chemicals, chemical information based on the SDS, and the effects of chemicals. Correct answers were awarded one (1) mark, while incorrect answers received zero (0) marks.

Section IV: This section contained nine questions assessing attitudes toward chemical exposure at the workplace, including opinions on SDS, training, and the use of personal protective equipment. Responses were recorded using a 5-point Likert scale with negative and positive statements.

Section V: This section explored safe practices in chemical handling at work. It included ten questions covering safety precautions, safe operation procedures, training, PPE, and chemical labelling and storage. This section was also scored using a Likert scale.

The questionnaire was validated through pilot studies to evaluate the feasibility of crucial components of the full-scale survey, including processes, resources, and management. Reliability testing yielded an overall Cronbach's Alpha of 0.766, with reliability scores for the Knowledge, Attitude, and Practice sections being 0.79, 0.72, and 0.75, respectively. The total scores for KAP were classified as follows: scores greater than 80% were considered "Good," scores between 79% and 50% were categorised as "Moderate," and scores 50% or less were classified as "Poor." This classification is adapted from [17].

2.4 Data Analysis

Data were entered and analysed using IBM SPSS Statistics 25. Descriptive statistics (frequencies and percentages) were used to summarise the data. Inferential tests included Pearson correlation to measure the strength and direction of relationships, and multiple linear regression (MLR) to examine relationship between sociodemographic factors (age, gender, years of employment, education) and occupational factors (safety signs, policies and procedures, safety data sheets, training, PPE) with KAP scores on chemical exposure.

2.5 Ethical Clearance

The study was approved by the Human Research Ethics Committee (HREC) of Universiti Sains Malaysia (USM) (protocol code USM/JEPeM/21010092, dated March 5, 2021). Before data collection, participants received an information sheet explaining the study's purpose, procedures, benefits, and risks. Informed consent was obtained to ensure voluntary participation. Confidentiality and anonymity were guaranteed, with data stored securely and accessed only by the research team. The study followed the Declaration of Helsinki to protect participants' rights and well-being.

3 RESULTS

3.1 Sociodemographic Characteristics of Respondents

The study involved 108 cleaners from a university hospital in Kelantan, with a 90% response rate. Table 1 shows the respondents' sociodemographic background. Most were female (78.7%), while 21.3% were male. The mean age was 39.34 ± 11.93 years, with 26.9% aged 19–29, 24.1% aged 30–39, 23.1% aged 40–49, 22.2% aged 50–59, and 3.7% aged 60–69. The mean employment duration was 3.94 ± 4.12 years. Most (72.2%) had worked 1–5 years, followed by 23.1% (6–10 years), 2.8% (11–15 years), and 0.9% each for 16–20 years and 26–30 years. In terms of education, 85.2% had secondary school education, 12.0% primary school, and 2.8% had no formal education.

Table 1: Sociodemographic Characteristics of Respondents

Variables	Data
Age (years)	39.34 ± 11.93
19-29	29 (26.9)
30-39	26 (24.1)
40-49	25 (23.1)
50-59	24 (22.2)
60-69	4 (3.7)
Gender	
Male	23 (21.3)
Female	85 (78.7)
Duration of employment (years)	3.94 ± 4.12
1-5	78 (72.2)
6-10	25 (23.1)
11-15	3 (2.8)
16-20	1 (0.9)
21-25	0 (0.0)
26-30	1 (0.9)
Education level (years)	10.09 ± 2.366
Does not go to school (0)	3 (2.8)
Primary school (6)	13 (12.0)
Secondary school (11)	92 (85.20

Data were presented as frequency (percentage) or mean ± standard deviation.

3.2 Implementation of Workplace Safety Measures at the Workplace

Figure 1 shows that over 95% of respondents reported having safety signs, policies, and procedures at work. Most (99.1%) said they were provided with PPE, and 77% noted the availability of SDS for chemicals. However, 64.9% felt regular training was lacking, and 25.0% reported limited job rotation. This highlights a clear gap between safety provisions and daily practice.

3.3 Knowledge, Attitude, and Practice on Chemical Exposure

Table 2 shows that the respondents had a mean knowledge score of 73.9% ± 13.1. The mean attitude score was 81.3% ± 9.3, while the mean practice score was 81.4% ± 8.9. Overall, the findings indicate that respondents demonstrated moderate knowledge, positive attitudes, and effective practices toward chemical exposure.

3.4 Correlation of Knowledge, Attitude, and Practice Scores on Chemical Exposure

Table 3 shows a significant but weak positive correlation between knowledge and attitude scores (p

Table 2: Knowledge, Attitude, and Practice on Chemical Exposure

Domain	Mean±S.D.	Min-Max	Level
Knowledge	73.9±13.1	41.67-91.67	Moderate
Attitude	81.3±9.3	52.78-97.22	Good
Practice	81.4±8.9	55-100	Good

Data were presented as mean ± standard deviation.

Table 3: Correlation of Knowledge, Attitude, and Practice on the exposure to chemical cleaning agents

Domain	r value	p-value
Knowledge & Attitude	0.283	0.003*
Knowledge & Practice	0.117	0.229
Attitude & Practice	-0.026	0.772

*Pearson correlation *Significant at p <0.01

= 0.003, r = 0.283), suggesting that targeted training could help translate knowledge into improved safety culture. No significant correlation was observed between practice scores and either knowledge or attitude (p > 0.05).

3.5 Predictors of Knowledge, Attitude, and Practice Scores on Chemical Exposure

Table 4 shows that knowledge scores were significantly associated with job rotation (β = 0.716, CI: 0.034–1.398), the presence of an SDS (β = 0.768, CI: 0.070–1.467), and training (Adj β = 1.690, CI: 1.123–2.257). No significant associations were found between attitude or practice scores and the examined factors (p > 0.05). After adjusting for confounders in multiple linear regression, job rotation (Adj β = 0.673, CI: 0.014–1.331) and training (Adj β = 1.689, CI: 1.101–2.277) remained significant predictors of knowledge scores, while attitude scores were significantly influenced by the presence of an SDS (Adj β = 2.100, CI: 0.401–3.798).

4 DISCUSSION

4.1 Knowledge, Attitude, and Practice on Chemical Exposure

The respondents demonstrated moderate knowledge of chemical exposure, with an average score of 73.9%. A key finding is the imbalance between structural provision and implementation: while PPE was almost universally available (99.1%), regular training (64.9% inadequate) and job rotation (25.0% insufficient) were lacking. This suggests that safety measures remain incomplete when equipment provision is not supported by capacity-building and work organisation. These results differ from a previous study in which most factory workers showed good knowledge of chemical exposure [18]. The difference may reflect variations in personal experience, environmental conditions, and socio-cultural influences that shape knowledge, perceptions, and behaviours. Prior research has highlighted the role of educational interventions and workplace environments in influencing knowledge levels [19]. Most respondents showed a good attitude toward chemical exposure, with scores above 80%. This is consistent with previous studies reporting positive attitudes toward chemical use and workplace safety [20]. Contributing factors may include personal experience, guidance from key individuals, mass media influence, and regular reminders from supervisors or safety officers [21]. These results support earlier findings that continuous education and awareness programs play a vital role in promoting and sustaining positive attitudes toward chemical safety [22]. Such initiatives strengthen the importance of safety measures and encourage proactive behaviour among workers.

In terms of practice, most respondents reported good chemical safety practices, with scores above 80%. This contrasts slightly with a study in Kashan, Iran, where workers in small and medium industries showed only adequate practices [23]. Such differences may be explained by variations in awareness, perceptions of workplace hazards, and access to training or equipment across sectors and countries. Recent evidence highlights that regular training and proper safety equipment are key to strengthening safety practices [24]. These measures help ensure workers understand chemical hazards and are prepared to manage risks effectively.

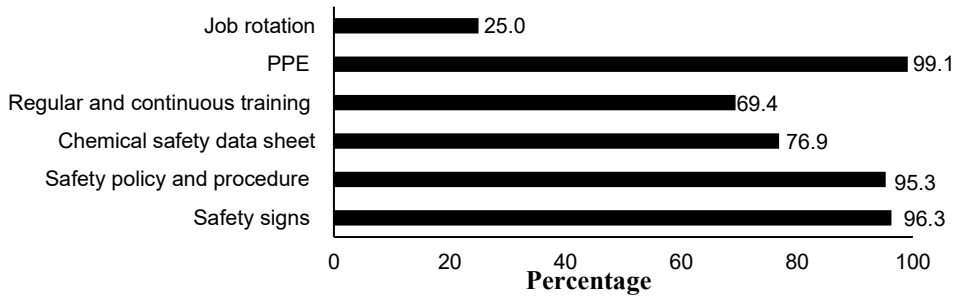

Figure 1: Implementation of workplace safety measures at the workplace

Table 4: Predictors of knowledge, attitude and practice on chemical exposure

	SLR[a]		MLR[b]		
	β (95% CI)	**p-value**	**Adj β(95% CI)**	**t-stat**	**p-value**
Knowledge (R^2 = 0.003)					
Constant			7.311 (3.96, 11.03)		
Age	0.009 (-0.017, 0.034)	0.506	0.0010 (-0.028,0.028)	0.006	0.995
Gender	0.553(-0.175,1.281)	0.135	0.184(-0.554,0.922)	0.494	0.623
Duration of Employment	0.014(-0.059,0.088)	0.699	-0.013(-0.087,0.061)	-0.337	0.737
Education (years)	0.051(-0.077, 0.178)	0.433	0.055(-0.066,0.175)	0.900	0.371
Job rotation	0.716(0.034, 1.398)	0.040*	0.673(0.014,1.331)	2.028	0.045*
Safety Signs	0.904(-0.681,2.489)	0.261	0.581(-0.876,2.038)	0.792	0.431
Safety Policy & Procedures	0.283(-1.149,1.716)	0.696	-0.666(-2.004,0.672)	-0.988	0.326
SDS	0.768(0.070,1.467)	0.031*	0.526(-0.170,1.222)	1.499	0.137
Training	1.690(1.123,2.257)	<0.001*	1.689(1.101,2277)	5.702	<0.001*
PPE	0.879(-.261,4.018)	0.580	-0.427(-3.213,2.359)	-0.304	0.762
Attitude (R^2 = 0.121)					
Constant			37.45 (28.60, 46.73)		
Age	-0.053 (-0.106, 0)	0.052	-0.058 (-0.125,0.009)	-1.706	0.0091
Gender	0.132(-1.435,1.699)	0.868	0.572(-1.228. 2.373)	0.631	0530
Duration of Employment	-0.083(-0.238,0.073)	0.295	-0.022 (-0.203, 0.158)	-0.243	0.809
Education (years)	0.136(-0.136,0.407)	0.324	0.018(-0.276,0.312)	0.123	0.903
Job rotation	-0.716(-2.192.0.760)	0.338	-0.665(-2.272,0.941)	-0.822	0.413
Safety Signs	-0.231 (-3.629,3.167)	0.893	-1.430 (-4.984,2.124)	-0.797	0.427
Safety Policy & Procedures	-0.338 (-3.392,2.716)	0.827	-1.311 (-4.576,1.954)	2.454	0.427
SDS	1.298 (-0.203,2.799)	0.089	2.100 (0.401,3.798)	2.454	0.016*
Training	-0.124 (-1.517,1.269)	0.861	0.002(-1.432,1.437)	0.003	0.997
PPE	-4.766 (-11.044,1.871)	0.157	-5.534(-12.331,1.262)	-1.616	0.109
Practice (R^2 = 0.076)					
Constant			28.52 (18.64,38.40)		
Age	0.006 (-0.052,0.063)	0.850	-0.026 (-0.099,0.048)	-0.697	0.488
Gender	-0.024 (-1.691, 1.643)	0.977	0.185 (-1.778,2.147)	0.187	0.852
Duration of Employment	0.102 (-0.063,0.268)	0.222	0.142 (-0.054,0.339)	1.437	0.154
Education (years)	-0.093 (-0.382.0.197)	0.527	-0.016(-0.336,0.305)	-0.098	0.922
Job rotation	-0.235 (-1.810,1.341)	0.768	-0.286(-2.037,1.465)	-0.325	0.746
Safety Signs	-2.288 (-5.876, 1.299)	0.209	-2.828 (-6.702,1.047)	-1.449	0.151
Safety Policy & Procedures	2.041 (-1.184,5.2625)	0.212	2.900 (-0.659,6.459)	1.617	0.109
SDS	-0.070 (-1.688.1.548)	0.932	-0.488 (-2.339,1.363)	-0.524	0.602
Training	0.176 (-1.306,1.657)	0.814	-0.177 (-1.741,1.386)	-0.225	0.823
PPE	4.589 (-2.482, 11.660)	0.201	5.066(-2.343,12.474)	1.357	0.178

[a]Simple Linear Regression, [b]Multiple Linear Regression
SDS; Safety Data Sheet. PPE: Personal Protective Equipment
*Significant at p <0.05

The results highlight a clear gap between structural provisions and practical implementation. While PPE was widely available, regular training and job rotation were insufficient. This imbalance indicates that safety measures are incomplete without continuous capacity-building efforts. Addressing these gaps through targeted interventions, improved resource allocation, and ongoing education could strengthen workplace safety and reduce risks from chemical exposure

4.2 Correlation of Knowledge with Attitude and Practice

The study found a significant positive correlation between knowledge and attitude scores, consistent with earlier findings [25]. In contrast, no significant correlation was observed between practice and either knowledge or attitude. The positive link between knowledge and attitude supports the view that structured and ongoing training can reinforce safety beliefs and norms. However, the absence of a link with practice suggests that knowledge and resources (e.g., PPE, SDS) must be supported by supervisory monitoring, audits, and job rotation to drive lasting behavioural change. Behavioural theories also indicate that knowledge is closely related to attitudes toward safety, as seen among farmers handling hazardous chemicals [26]. The Health Belief Model (HBM) further explains that awareness of health risks and benefits strongly shapes health-related attitudes and behaviours [27]. When individuals recognise the risks of chemical exposure, they are more likely to handle chemicals with caution and adopt safer practices. Hatami and Kakavand [28] showed that educational interventions can significantly improve attitudes toward safe behaviours, while recent studies highlight the importance of tailored safety education in strengthening risk perception and fostering positive safety attitudes across different occupational groups [29].

Similar results have been reported among healthcare workers, teachers, and laboratory technicians, showing that practice does not always depend on knowledge or attitude [30, 31]. This may be influenced by factors such as habits, workplace culture, and resource availability. For instance, even knowledgeable workers with positive attitudes may neglect safety practices due to ingrained behaviours or limited reinforcement at work. These findings highlight the need to address both behavioural and environmental factors that shape safety practices. While enhancing knowledge and attitudes is important, interventions should also promote a supportive safety culture, ensure adequate resources, and include regular training and supervision. Evidence further suggests that strengthening safety culture and providing consistent training can help close the gap between knowledge, attitudes, and actual practices [32].

4.3 Relationship of Knowledge, Attitude and Practice with Associated Factors

Job rotation and training were found to significantly influence knowledge scores. These results are consistent with earlier studies highlighting the importance of diverse training programs in improving awareness of workplace hazards [33]. Continuous and varied training enables workers to better understand chemical risks and adopt safer practices. For example, workers who received regular training showed significant improvements in hazard knowledge [34]. Scenario-based and hands-on methods have also been shown to strengthen understanding of safety protocols and encourage stronger commitment to prevention [35]. In addition, the use of visual aids and accessible safety information can further improve workers' attitudes and compliance with safety measures [36, 37].

The provision of SDS was found to significantly influence attitude scores. Respondents who received detailed information on chemical hazards and safe handling through SDS demonstrated more positive attitudes toward chemical safety. This supports earlier findings that comprehensive safety information encourages adherence to safety protocols [38]. In contrast, practice scores were not significantly influenced by the factors studied ($p > 0.05$). This differs slightly from studies showing that practice may be affected by age, work experience, education, and PPE use [21, 34]. Such differences may be explained by individual determination and long-standing habits. Since practice reflects behavioural responses shaped by physical, psychosocial, and cognitive factors, it often requires more than knowledge or attitude alone to change [39].

A recent study highlighted that workplace culture and strict enforcement of safety policies are key drivers of safe practices, even when knowledge and attitudes are adequate [40]. This suggests that applying safety measures requires a supportive environment and continuous reinforcement. Factors such as management commitment, peer support, and regular supervision have been shown to help bridge the gap between knowledge, attitudes, and actual practices [41]. Addressing these contextual factors is essential for the effective implementation of workplace safety. In practice, the findings support shifting from an equipment-focused approach to an implementation-focused programme. This should include mandatory induction and quarterly refresher training tailored to specific hazards, structured job-rotation plans to reduce cumulative exposures, and routine advisory audits that integrate SDS use and PPE checks into standard procedures. Such measures would help close the implementation gap and ensure more sustainable safety improvements.

4.4 Study Limitations

This study has several limitations that should be noted. First, time constraints limited the depth of data collection and analysis. The sample size was also small and may not adequately represent all cleaners on the university campus, reducing the generalizability of the findings. In addition, the use of Likert scale questionnaires carries potential biases, as respondents may have given socially desirable answers or misinterpreted questions, which could affect data accuracy and reliability.

Future research should employ larger and more diverse samples to improve representativeness and extend the scope to multiple hospitals or workplaces for broader comparisons. A more detailed cross-sectional survey focusing on cleaners' knowledge, attitudes, and practices (KAP) regarding chemical exposure would provide stronger evidence. Research should also identify knowledge gaps, attitudes, and behaviours that need targeted interventions. Developing and implementing evidence-based strategies tailored to cleaners' needs can enhance workplace safety and reduce chemical exposure risks. Such efforts would support safer work environments and better occupational health outcomes

5 CONCLUSION

This study provides one of the few Malaysian-based examinations of hospital cleaners' knowledge, attitudes, and practices regarding chemical exposure. While attitudes and practices were generally good, knowledge was moderate, and gaps were observed between equipment provision and implementation, particularly in training and job rotation. These findings highlight that PPE alone is insufficient without systematic training and organisational support. Practical measures such as structured induction, regular refresher training, integration of SDS into supervision, and job-rotation plans are recommended to strengthen safety culture and promote consistent safe behaviours. Future studies should adopt multi-centre and longitudinal designs, complemented by implementation-effectiveness evaluations, to generate more robust and policy-relevant evidence.

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CONFLICT OF INTEREST

All authors declared no conflict of interest.

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