



Nurses' Knowledge and Perceived Compliance with Standard Precautions for Preventing Diphtheria Transmission at Murtala Muhammad Specialist Hospital, Kano, Nigeria

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Abstract

Background: Diphtheria is a contagious, vaccine-preventable disease that has re-emerged in Nigeria, particularly in Kano State, amid concerns about suboptimal vaccination coverage and gaps in infection prevention and control (IPC). This study aimed to assess the knowledge and compliance of nurses with standard precautions for preventing diphtheria transmission at Murtala Muhammad Specialist Hospital (MMSH), Kano. **Methods:** A descriptive cross-sectional study was conducted at MMSH with a sample of 125 consenting nurses through total population sampling using a structured questionnaire. The data were analysed using descriptive statistics and inferential tests, including chi-square and regression analysis. The significance level was set at $p \leq 0.05$. **Results:** The study found that 57.6% of nurses had good knowledge, 34.4% had moderate knowledge, and 8.0% had poor knowledge of diphtheria prevention. Compliance with standard precautions was high, 94.4% of nurses complied with hand hygiene, 98.4% complied with waste disposal, and 92.8% adhered to isolation protocols. However, perceived compliance with Personal Protective Equipment (PPE) usage was moderate, with only 48.0% consistently using appropriate PPE, reflecting moderate compliance. Inferential statistics revealed a statistically significant association in level of knowledge and work experience ($X^2=22.35$, $df=6$, $p<0.01$), with more experienced nurses having higher knowledge. Additionally, no significant relationship was found between nurses' knowledge and standard precaution compliance ($p=0.999$), and Factors influencing compliance were predicted using Multiple Linear Regression, where training ($p=0.000$), PPE availability ($p=0.014$), and institutional support ($p=0.003$) were statistically significant. **Conclusion:** While nurses at MMSH exhibit a high level of knowledge and compliance with standard precautions, further efforts are needed to improve PPE usage and address barriers like high workload and staff shortages. Strengthening training, enhancing resource availability, and reinforcing hospital policies are crucial for improving adherence to IPC measures.

Keywords: Compliance, Diphtheria, Infection Prevention, Knowledge, Nurses, Standard Precautions

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Introduction

Diphtheria is a highly contagious, vaccine-preventable infection caused by *Corynebacterium diphtheriae*, primarily affecting the upper respiratory tract and sometimes the skin (Sinumvayo *et al.*, 2024). Although global cases declined significantly following the introduction of routine immunisation, the disease has re-emerged in several low- and middle-income countries where vaccination coverage remains suboptimal, and health systems face multiple operational challenges (Osuagwu *et al.*, 2023).

In Nigeria, diphtheria outbreaks have intensified, with the Nigeria Centre for Disease Control and Prevention (NCDC) declaring a national outbreak in early 2023 after recording a rapid increase in suspected and confirmed cases across several states (NCDC, 2023). Between epidemiological week 19 of 2022 and week 3 of 2023, a recent diphtheria outbreak in Nigeria has resulted in 41,336 suspected cases and 1,262 deaths, with Kano State reporting the highest burden of 24,239 suspected and 18,108 confirmed cases, making it the epicentre of the outbreak (NCDC, 2025; Tolu Kolawole, 2026). Children aged 2–14 years accounted for more than 85% of confirmed cases, and most affected individuals were unvaccinated or incompletely vaccinated (World Health Organisation, 2023; Lawal *et al.*, 2023). The situation was further worsened by gaps in surveillance, limited access to Polymerase Chain Reaction (PCR) testing, inadequate diagnostic capacity, and delays in sample processing (Baptiste *et al.*, 2024).

Kano State remains the epicentre of the outbreak, contributing approximately 74% of all confirmed cases nationwide (NCDC, 2023). This places significant responsibility on secondary healthcare facilities such as Murtala Muhammad Specialist Hospital (MMSH), a high-volume referral centre that manages both suspected and confirmed

diphtheria cases. In such settings, nurses serve as frontline caregivers and are central to preventing nosocomial transmission. Their adherence to standard precautions, including hand hygiene, use of PPE, safe waste disposal, and isolation protocols, is essential for reducing the spread of infectious diseases (Verbeek *et al.*, 2020).

However, studies from Nigeria indicate that nurses' compliance with IPC practices is often inconsistent due to inadequate training, PPE shortages, high workload, and insufficient supervision (Iliyasu *et al.*, 2016; Houghton *et al.*, 2020; Aliyu *et al.*, 2020). Iliyasu *et al.* (2016) reported that fewer than 50% of nurses in some tertiary facilities adhered to recommended PPE protocols during outbreaks. Although non-compliance with infection prevention practices has previously been reported at MMSH (Hussein, 2017), such evidence is outdated and not specific to diphtheria outbreaks or nurses' perceived compliance. Given the high patient load and heightened exposure risk at MMSH, current disease-specific data are essential to understand nurses' knowledge, perceived compliance, and influencing factors. This study is therefore necessary to inform targeted and effective infection control interventions during the ongoing diphtheria outbreak.

Despite recurrent diphtheria outbreaks in Kano State, there is a notable absence of facility-specific evidence on nurses' knowledge and perceived compliance with standard precautions at Murtala Muhammad Specialist Hospital (MMSH). Infection prevention and control guidelines assume that nurses understand and consistently adhere to standard precautions; however, the persistence of diphtheria transmission suggests that nurses' perceived compliance may not align with recommended practices. Without empirical data capturing nurses' own perceptions of compliance and the factors

influencing them during an active outbreak, hospital managers lack the evidence needed to design targeted training, supervision, and infection control strategies. This study, therefore, seeks to fill this gap by assessing nurses' knowledge, perceived compliance, and influencing factors related to standard precautions for preventing diphtheria transmission at MMSH.

Materials and Methods

A descriptive cross-sectional research design was used to conduct the study at MMSH Kano. MMSH is one of the largest government-owned tertiary healthcare facilities in Kano State, providing comprehensive inpatient and outpatient services across multiple clinical departments. The hospital has an official bed capacity of approximately 826–930, with around 30 wards and units covering major specialities such as medicine, surgery, paediatrics, obstetrics and gynaecology, and emergency care, as well as 9 operating theatres and numerous diagnostic and support units, serving a high patient volume from Kano and neighbouring regions. It has a staff strength of 508, including clinical and administrative staff. The target population for the study was all nurses working at the hospital, with a total population of one hundred and thirty-four (134) staff nurses as of September, 2025. Since the population was small and manageable, total population sampling (census) was used, including all nurses. Therefore, the sample size was 134, equal to the total.

Data for this study were collected using a self-administered structured questionnaire adapted from previously validated instruments on nurses' knowledge and compliance with standard precautions (Hussein, 2017; WHO, 2016). The questionnaire comprised five sections: socio-demographics, knowledge of standard precautions, perceived compliance with standard precautions, factors influencing compliance, and strategies to improve knowledge and compliance. Perceived

Compliance data were obtained by asking nurses to indicate the frequency with which they adhered to specific standard precaution practices in their daily routine, using a 5-point Likert scale ranging from “strongly disagree” to “strongly agree.” Knowledge was assessed through a series of multiple-choice and true/false items, with scores categorised into poor, moderate, and good knowledge levels based on percentage thresholds adapted from previous studies.

The instrument's reliability was established through a pilot study involving 10% of the target population in a similar hospital setting, yielding a Cronbach's alpha of 0.82, indicating good internal consistency. Face and content validity were ensured through expert review by infection control specialists and nursing educators; items were revised according to their recommendations. Data were analysed using the Statistical Package for Social Sciences (SPSS) version 25, and results were presented in frequencies, percentages, means, and standard deviations. Inferential statistics, including chi-square and regression analysis, were carried out to test hypotheses. The level of significance was set at $p \leq 0.05$.

Ethical approval was sought from the Kano State Health Research Ethics Committee of the Ministry of Health, with reference number NHREC/17/03/2018/SHREC/2025/6607.

Anonymity was ensured by not collecting names or personal identifiers, and each questionnaire was coded. Confidentiality was maintained by storing data securely and reporting results in aggregate form, accessible only to the research team.

Results

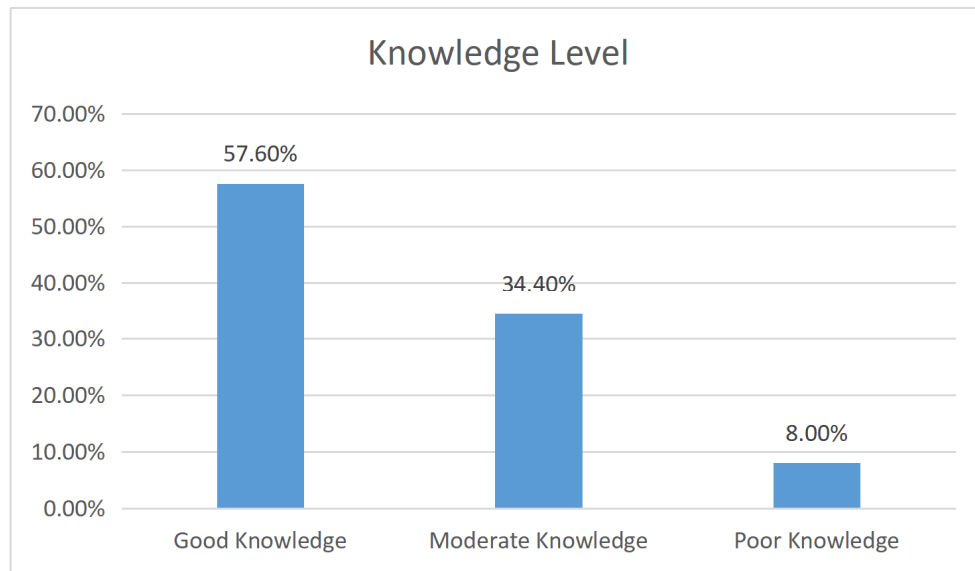
A total of 134 questionnaires were administered, of which 125 were successfully retrieved and analysed. Nine (9) questionnaires were not retrieved as a result of non-response, with a response rate of 93.3 %.

Table 1: Socio-Demographic Characteristics of Respondents (N = 125)

Variable	Category	Frequency	Percent (%)
Age	21–30	23	18.4
	31–40	49	39.2
	41–50	43	34.4
	51yrs and above	10	8.0
Gender	Male	42	33.6
	Female	83	66.4
Highest Educational Qualification	ND/PD	31	24.8
	HND/B.Sc.	92	73.6
	M.Sc.	2	1.6
Years of Work Experience	Below 5 years	16	12.8
	5–15 years	69	55.2
	15–25 years	21	16.8
	25–35 years	19	15.2
Total		125	100.0

Table 1 reveals the socio-demographic data of the respondents. The age distribution of respondents shows that almost two-fifths were within the 31–40 years category (39.2%), two-thirds (66.4%) were females compared to 33.6% males. Educational qualifications

indicate that the majority of respondents had HND/B.Sc. (73.6%), while 24.8% held ND/PD and only 1.6% had M.Sc. Finally, work experience data shows that more than half (55.2%) had 5–15 years of experience.

**Figure 1:** Level of Nurses' Knowledge on Standard Precautions for Diphtheria Prevention

The majority of nurses (57.6%) have good knowledge of diphtheria prevention, while 34.4% have moderate knowledge. However,

8.0% show poor understanding, particularly regarding the use of personal protective equipment (PPE).

Table 2: Respondents' Level of Knowledge among Nurses on Standard Precautions for Diphtheria Prevention (n= 125)

S/N	Statement	Yes (F, %)	No (F, %)
1.	Diphtheria is transmitted from person to person through respiratory droplets, direct contact with infected, or contaminated objects.	91 (72.8%)	34 (27.2%)
2.	Diphtheria primarily affects the mucous membranes of the respiratory tract and occasionally the skin.	67 (53.6%)	58 (46.4%)
3.	I am aware that diphtheria is transmitted through respiratory droplets and direct contact.	100 (80.0%)	25 (20.0%)
4.	Hand hygiene is a critical component of preventing diphtheria transmission.	101 (80.8%)	24 (19.2%)
5.	Gloves must be worn when in contact with a diphtheria-infected patient's bodily fluids.	23 (18.4%)	102 (81.6%)
6.	Masks and eye protection are necessary when there is a risk of exposure to respiratory secretions.	50 (40.0%)	75 (60.0%)
7.	A gown is not necessary when providing care to a diphtheria patient.	61 (48.8%)	64 (51.2%)
8.	Patients with suspected diphtheria should be placed under droplet and contact precautions.	93 (74.4%)	32 (25.6%)
9.	Equipment used for diphtheria patients should be properly disinfected before reuse.	82 (65.6%)	43 (34.4%)
10.	Diphtheria can be easily prevented by a vaccine.	100 (80.0%)	25 (20.0%)

Table 2 shows that most nurses at MMSH have good knowledge of diphtheria prevention, with high awareness of its transmission modes (80%) and the importance of hand hygiene (80.8%) and vaccination (80%). However, there are gaps in knowledge

regarding the use of personal protective equipment (PPE), with only 18.4% of nurses aware that gloves should be worn when handling infected bodily fluids, and 40% recognizing the need for masks and eye protection.

Table 3: Perceived Compliance of Nurses to standard precautions in the management of diphtheria cases (N = 125)

Statement	Strongly disagree F(%)	Disagree F (%)	Neutral F (%)	Agree F (%)	Strongly agree F(%)	Mean	Std.Dev	Perceived Compliance rate
Wear appropriate PPE	0 (0.0)	0 (0.0)	5 (4.0)	60 (48.0)	60 (48.0)	3.4480	1.1249	Moderate Compliant
Perform hand hygiene before and after contact	2 (1.6)	0 (0.0)	6 (4.1)	58 (46.4)	59 (47.2)	3.6480	1.1163	High Compliant
Properly dispose of contaminated materials	0 (0.0)	0 (0.0)	3 (2.4)	55 (44.0)	67 (53.6)	3.6160	1.1555	High Compliant

Adhere to isolation protocols for diphtheria cases	0 (0.0)	0 (0.0)	0 (0.0)	65 (52.0)	60 (48.0)	3.7600	0.8926	High perceived Compliant
Receive regular infection prevention training	0 (0.0)	1 (0.8)	3 (2.4)	67 (53.6)	54 (43.2)	3.5360	1.2798	High perceived Compliant
Report breaches in infection control	0 (0.0)	0 (0.0)	1 (0.8)	39 (31.2)	85 (68.0)	3.8400	1.4335	High perceived Compliant
Feel supported by hospital management for compliance	0 (0.0)	0 (0.0)	0 (0.0)	66 (52.8)	59 (47.2)	3.6160	1.0300	High perceived Compliant

Decision Rule: Compliant: Mean score of 3.5 or higher, **moderate -Compliant:** Mean score below 3.5

Table 3 shows that the findings indicate that nurses at MMSH generally demonstrate high perceived compliance with standard precautions. Most participants selected “Strongly Agree” (SA) or “Agree” for the perceived compliance statements, with mean scores ranging from 3.448 to 3.840 on a 5-point scale. The highest adherence was observed in reporting breaches in infection control, where 68% of respondents strongly agreed, and 31.2% agreed (mean = 3.840, SD = 1.434), and in adhering to isolation protocols for diphtheria cases, with 48% strongly agreeing and 52% agreeing (mean = 3.760, SD = 0.893). Other areas of high compliance included proper disposal of

contaminated materials, performing hand hygiene before and after patient contact, and receiving regular infection prevention training, all showing over 90% of respondents in the SA and Agree categories.

The only area identified for improvement was wearing appropriate personal protective equipment (PPE), where only 48% strongly agreed, and 48% agreed (mean = 3.448, SD = 1.125), indicating moderate compliance. Overall, the results suggest that perceived compliance among nurses is high, particularly for reporting, isolation adherence, and hand hygiene, but targeted interventions may be needed to enhance consistent PPE usage.

Table 4: Chi-Square for Level of Nurses’ Knowledge and Level of Experience.

Level of experience	Poor knowledge	Moderate knowledge	Good knowledge	Total
0-5	5	15	10	30
6-15	3	15	22	40
16-25	2	8	20	30
26-35	0	5	20	25
Total	10	43	72	125

$X^2=22.35$, $df=6$, $p\text{-value} < 0.01$

A Chi-Square test of independence was conducted to examine the relationship between nurses’ years of experience and their categorised knowledge levels (low, moderate,

high). The results indicated a statistically significant association ($\chi^2 = 22.35$, $df = 6$, $p < 0.01$), suggesting that nurses’ knowledge of standard precautions varies significantly with

years of experience. Specifically, nurses with more years of experience demonstrated higher knowledge scores compared to those with fewer years of experience, supporting the

conclusion that experience positively influences knowledge of diphtheria prevention. We reject the null hypothesis.

Table 5: Chi-Square Test Table for Knowledge and Compliance with PPE Usage

Variable	Test	Value	df	Asymptotic Significance (p-value)
Knowledge of Diphtheria Prevention vs. PPE Compliance	Pearson Chi-Square	0.429	8	0.999
	Likelihood Ratio	0.438	8	0.998
	Linear-by-Linear Association	0.002	1	0.965
	N of Valid Cases			125

The Chi-Square test results showed no significant relationship between nurses' knowledge of diphtheria prevention and their compliance with PPE usage at the MMSH. The Pearson Chi-Square value was 0.429, with a p-value of 0.999, which is well above the 0.05 significance threshold, indicating that the two variables are independent. Similarly,

the Likelihood Ratio and Linear-by-Linear Association tests also returned high p-values (0.998 and 0.965, respectively), reinforcing the conclusion. Therefore, we fail to reject the null hypothesis and conclude that there is no significant relationship between knowledge of diphtheria prevention and PPE compliance among nurses at MMSH.

Table 6: Multiple Linear Regressions for Influencing Nurses' Perceived Compliance with Standard Precautions

Independent Variables	Unstandardized Coefficients (B)	Standardised Coefficients (β)	t-Value	p-Value
Adequate availability of PPE	0.23	0.25	2.52	0.014
Training and education on diphtheria and infection control	0.35	0.38	4.12	0.000
High workload and staff shortages	-0.18	-0.16	-1.92	0.058
Support and supervision from management	0.26	0.29	3.01	0.003
Fear of contracting diphtheria	0.15	0.14	2.05	0.042
Presence of clear hospital policies and guidelines	0.32	0.33	3.45	0.001
Peer behaviour and attitudes towards infection control	0.18	0.20	2.38	0.018
Model Summary:				
R	R²	Adjusted R²	Standard Error of the Estimate	
0.874	0.765	0.746	0.412	

The multiple linear regression analysis revealed that several factors significantly influence nurses' compliance with standard precautions in preventing diphtheria transmission in MMSH. Training and education on diphtheria and infection control emerged as the most significant factor ($p = 0.000$), followed by the presence of clear hospital policies and guidelines ($p = 0.001$) and support and supervision from management ($p = 0.003$). Additionally, fear of contracting diphtheria ($p = 0.042$) and peer

behaviour and attitudes towards infection control ($p = 0.018$) were also significant contributors. The model explained 76.5% of the variance in compliance, suggesting that these factors play a crucial role in influencing nurses' adherence to standard precautions. Based on these findings, the null hypothesis is rejected that no significant factors influence compliance, as these key elements are clearly linked to better compliance with infection control practices.

Table 7: Strategies can be Implemented to Improve Nurses' Knowledge and Compliance with Standard Precautions (N = 125)

Statement	Strongly Disagree F (%)	Disagree F (%)	Neutral F (%)	Agree F (%)	Strongly Agree F (%)	Mean	SD
• Providing easy access to up-to-date guidelines and protocols.	0 (0.0)	1 (0.8)	2 (1.6)	53 (42.4)	69 (55.2)	4.0240	1.0508
• Regular in-service training sessions improve nurses' knowledge of standard precautions.	0 (0.0)	0 (0.0)	0 (0.0)	50 (40.0)	75 (60.0)	4.0720	1.0486
• Positive reinforcement and feedback from supervisors.	0 (0.0)	0 (0.0)	7 (5.6)	53 (42.4)	65 (52.0)	3.9760	1.0959
• Access to hand hygiene facilities (e.g., sinks, hand sanitisers) is essential for effective compliance.	0 (0.0)	0 (0.0)	6 (4.8)	59 (47.2)	60 (48.0)	3.9040	1.0808
• Interactive workshops and simulations help nurses retain knowledge about infection prevention strategies.	0 (0.0)	2 (1.6)	9 (7.2)	35 (28.0)	79 (63.2)	3.3120	1.1174
• Incorporating infection control education into nursing curricula strengthens foundational knowledge and attitudes.	0 (0.0)	0 (0.0)	3 (2.4)	35 (28.0)	87 (69.6)	3.4880	1.1820

Table 7 revealed the strategies that can be implemented to improve nurses' knowledge, attitude, and access to resources for better compliance with standard precautions. The majority (97.6%) agreed that providing up-to-date guidelines and protocols enhances compliance, with only a marginal 2.4% neutral or disagreeing. Similarly, 100% of

respondents supported regular in-service training sessions. Supervisor support was also highly valued: 94.4% endorsed positive reinforcement and feedback from supervisors, while only 5.6% remained neutral, highlighting the role of managerial encouragement in shaping attitudes. Access to infrastructure was another crucial factor, with

95.2% acknowledging that hand hygiene facilities are essential, though 4.8% were neutral, likely due to variability in facility availability. Innovative learning methods also attracted strong support: 91.2% agreed that interactive workshops and simulations aid knowledge retention, while a minority (8.8%) remained indifferent or disagreed. Furthermore, 97.6% strongly supported integrating infection control into nursing curricula, emphasising the importance of early training in building lifelong competence.

Discussion

The findings from this study revealed a generally high level of knowledge among nurses regarding the standard precautions necessary for the prevention of diphtheria transmission. Most nurses correctly identified the primary modes of transmission, such as respiratory droplets and direct contact, and recognised the importance of hand hygiene as a preventive measure. However, some notable gaps in knowledge were observed, particularly concerning the use of personal protective equipment (PPE), such as gloves, masks, and eye protection. This mirrors findings from previous studies, where similar gaps in PPE knowledge were reported among healthcare workers, particularly in settings with inconsistent training or insufficient resources (Olalekan *et al.*, 2021). Despite these knowledge gaps, the overall compliance with standard precautions was notably high, with almost all nurses adhering to practices like hand hygiene and proper waste disposal. This compliance suggests that the nurses in this study are generally committed to following infection control protocols, which could be attributed to recent outbreaks and heightened awareness regarding infection control measures (Ogoina *et al.*, 2020).

Comparing these findings to those in the literature, the high compliance levels found in this study contrast with some reports indicating gaps in compliance in other settings (McKay *et al.*, 2021; Uchenna *et al.*, 2019). In

these studies, significant lapses in infection control practices, such as improper disposal of sharps and failure to perform hand hygiene, were noted. The differences in findings could be attributed to various contextual factors, including the level of institutional support, the healthcare setting, and the frequency of training, all of which contribute to the overall effectiveness of infection control measures. Additionally, the relatively low incidence of non-compliance in this study may be reflective of better management practices and more consistent training at MMSH compared to other facilities.

In terms of the factors influencing compliance, the study highlighted the critical role of institutional support, availability of resources like PPE, and regular training in enhancing adherence to standard precautions. These findings align with existing literature that highlights the importance of these factors in ensuring high compliance levels. Research by Alhumaid *et al.* (2021) has shown that well-resourced healthcare environments and continuous education contribute significantly to improved infection control practices. On the other hand, the study also identified high workload and staff shortages as barriers to full adherence, which is consistent with observations by Ogoina *et al.* (2020), who found that understaffing and time constraints often hinder effective infection control practices.

The significant role of hospital policies, peer behaviour, and managerial support in fostering a culture of compliance was another key finding. Most nurses in this study agreed that having clear hospital guidelines, adequate management support, and peer reinforcement were essential to ensuring adherence to standard precautions. These findings echo the conclusions of several studies (Bouchoucha and Moore, 2019; Gammon *et al.*, 2020), which highlighted the influence of workplace culture, supportive supervision, and

collaborative attitudes on the overall compliance with infection control measures.

Additionally, the study pointed to areas where improvements could be made, such as the integration of infection control education into nursing curricula and more interactive training workshops. Previous research by Badu *et al.* (2021) and Adebimpe *et al.* (2024) has suggested that such educational strategies, particularly those that are interactive and engaging, can lead to sustained improvements in infection control compliance. Furthermore, regular in-service training sessions and the provision of up-to-date guidelines were highly supported by nurses in this study, reinforcing the need for ongoing professional development and access to the latest infection control knowledge.

Conclusion

While nurses at MMSH exhibit a high level of knowledge and compliance with standard precautions, further efforts are needed to improve PPE usage and address barriers like high workload and staff shortages. Strengthening training, enhancing resource availability, and reinforcing hospital policies are crucial for improving adherence to IPC measures.

Conflict of Interest

There is no conflict of interest in this study.

Human Ethics and Consent to Participate Declarations:

The study was conducted in accordance with ethical standards, and informed consent was obtained from all participants.

Availability of Data and Material

The datasets generated and/or analysed during the current study are available from the corresponding author on request.

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