



ORIGINAL ARTICLE

Infection Prevention Insights into Knowledge Scores, Improved Hand Hygiene and Personal Protective Equipment Compliance Among Nurses at Tertiary Healthcare

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Received: 12 February, 2026

Revised: 27 February, 2026

Accepted: 06 March, 2026

Published: 10 March, 2026

ABSTRACT

Background: Infection prevention and control (IPC) is a vital program to minimize the risk of health care-associated infections (HAIs) and keep healthcare workers safe and healthy for patients. Nursing staff are in close and continuous contact with patients so present study was set to evaluate the knowledge and compliance of the nursing staff with IPC measures and to find the associated factors. **Methods:** A cross sectional study was conducted in 150 nursing staff of various clinical departments of tertiary care hospitals. A non-probability and convenience sampling techniques were used. Structured self-administered questionnaire data collected on socio-demographic characteristics, IPC knowledge, hand hygiene, PPE use, waste disposal and standard precautions. The total knowledge and compliance score were obtained and then divided into poor, moderate and good. Data was analyzed in SPSS version 26.0. Descriptive statistics, Chi square test, Pearson correlation and multiple linear regression were used and $p < 0.05$ set as statistically significant. **Result:** The mean knowledge score was 78.4 ± 11.2 and the mean compliance score was 74.6 ± 12.8 . The participants' knowledge about the topic was good in 58.0%, moderate in 32.0% and poor in 10.0%. The percentage of nurses that reported good compliance was 54.0% and 33.3% reported moderate compliance. There was significant association between knowledge level and compliance ($p < 0.001$); and there was positive correlation between compliance score and knowledge score ($r = 0.64$, $p < 0.001$). Knowledge and IPC training as well as professional experience, were significant predictors of compliance. **Conclusion:** Nursing staff had good knowledge and compliance with IPC. There was positive correlations between higher knowledge and IPC training and compliance. Recommendations include regular education and monitoring for strengthening IPC practices.

Keywords: Infection prevention and control, nursing staff, compliance, knowledge, healthcare-associated infections, patient safety.

Infection prevention and control (IPC) is a key element of safe and good quality health care¹. Despite the progress made in the prevention of HAIs, they continue to be significant preventable problems which affect the morbidity, hospitalization duration, antimicrobial use, cost of care and risk for healthcare workers². The minimum IPC measures are the ones that are used in all patient care activities, including hand hygiene, use of personal protective equipment, safe injection practices, respiratory hygiene, waste disposal and sharps safety³. Therefore, the implementation of these measures is crucial to safeguard patients, the nursing staff and the healthcare environment.

Nurses play a pivotal role in IPC because they are constantly at the patient's bedside and often have contact with blood, body fluids, invasive devices and contaminated surfaces, etc⁴. Recent research conducted on nurses and healthcare workers revealed that knowledge, education, preparedness and perceived risks are factors that affect the adherence to standard precautions⁵. But if the training, monitoring and institutional support is not adequate, adherence may be inconsistent⁶. Studies on the effectiveness of intervention have provided evidence that infection-control link nurse programs and audit and feedback may result in better hand hygiene and standard precaution practices⁷. Adherence might be impacted by multiple factors beyond these, including work-related stress, burnout, staffing pressure and specialty-specific risk, especially in high-demand clinical settings^{8,9}.

In spite of the importance of IPC in hospital policies, there is limited evidence locally to assess both the knowledge and compliance with IPC by nursing staff. The identification of this relationship is important to understand the gaps in practice and inform targeted departmental training, monitoring and resource allocation¹⁰.

The aim of this study was to evaluate the knowledge of nursing staff about IPC measures and to find out how compliant they are with the recommended IPC practices. The relationship of IPC knowledge, IPC training and professional experience or department to compliance was also analyzed.

METHODOLOGY

The design of the study was cross sectional analytical design (January to May 2023) to assess the knowledge and compliance of nursing personnel in infection prevention and control (IPC) measures of tertiary hospitals. The target group consisted of registered nurses (RNs) who have a role to provide direct patient care and who often have an interaction with practices related to infection prevention and control in their job activities. In the present study which was non-probability convenience sampling, total 150 nursing staffs were included. The inclusion criteria were: RN with at least 6 months clinical experience and who actively participated in patient care activities in patient care areas. Extended leave nurses, administrative nurses not involved with patient care, student nurses and those who declined participation in the study were excluded.

A structured self-administered questionnaire, which was based on existing infection prevention and control guidelines, was used to gather data. The questionnaire was segmented into 3 parts – Socio-demographic and professional characteristics, knowledge of IPC measures and compliance with IPC practices. The knowledge items assessed knowledge of hand hygiene, PPE, waste segregation, standard precautions and handling of needle stick injuries. Compliance items were designed to measure compliance with hand hygiene, use of PPE, safe injection practices, waste disposal practices and patient care infection control. Summing the answers to the relevant items of the questionnaire gave Knowledge and Compliance scores. The participants were grouped according to their level of knowledge and compliance and into the categories of poor, moderate and good knowledge and compliance as defined by the scoring criteria.

IBM SPSS version 26.0 was used to enter and analyze the data. The descriptive statistics were used to summarize the data on the study variables which included mean, standard deviation, frequency and percentage. The chi-square test was used for categorical variables to see if there was any association between the variables. Pearson correlation was conducted to examine the correlation between knowledge, experience, training attendance and compliance scores. The independent predictors of compliance with the infection prevention and control measures were determined by multiple linear regression analysis. Statistically significant was defined as a p-value < 0.05. Departmental Head of the respective institution approved all studies and participants gave informed consent. The information collected was kept confidential throughout the research process. The participants and their responses were guaranteed confidentiality and used for academic or research purposes only.

RESULTS

There were 150 nursing staff who took part in the study. The mean age of the participants was 31.8 ± 7.4 years and most were women (68.0%). The majority of respondents had over five years of experience in their profession, and had taken at least one IPC training session in the last two years. Overall, IPC knowledge and compliance scores showed good compliance with recommended IPC practices. This table shows the demographical and professional characteristics of the engaged nursing staff. Most participants were female and in the age range 25-34 years. The majority of nurses possessed a BS Nursing qualification, and 5 to 10 years of working as a nurse. A significant fraction had taken infection prevention and control (IPC) trainings in the past two years (Table I).

Table I: Socio-Demographic and Professional Characteristics of Nursing Staff (n = 150)

Variable	Category	n	%
Age (years)	<25	28	18.7
	25–34	72	48.0
	35–44	34	22.7
	≥45	16	10.6
Gender	Male	48	32.0
	Female	102	68.0
Education	Diploma Nursing	46	30.7
	BS Nursing	82	54.7
	Postgraduate	22	14.6
	<5 years	58	38.7
Professional Experience	5–10 years	61	40.7
	>10 years	31	20.6
	Yes	104	69.3
IPC Training in Last 2 Years	No	46	30.7

The Table II shows that the knowledge of the IPC principles by the nursing staff is summarized. The majority of the participants exhibited good knowledge and only a few participants had poor knowledge scores. There was a high level of correct responses found for hand hygiene, use of PPE, waste segregation and needle stick injury management. Overall, there was good knowledge of infection control guidelines.

Table II: Knowledge Regarding Infection Prevention and Control Measures (n = 150)

Variable	Category	n (%)
Knowledge Score	Mean ± SD	78.4 ± 11.2
	Poor (<60%)	15 (10.0)
Knowledge Level	Moderate (60–79%)	48 (32.0)
	Good (≥80%)	87 (58.0)

Hand Hygiene Knowledge	Correct Response	132 (88.0)
PPE Usage Knowledge	Correct Response	126 (84.0)
Waste Segregation Knowledge	Correct Response	121 (80.7)
Needle Stick Injury Protocol	Correct Response	118 (78.7)

The **Table III** shows the extent of respect for the recommended IPC practices among nursing staff. The level of compliance was good, with over half of participants observing hand hygiene, and high levels of using PPE and disposing of waste. A lower percentage of compliance was observed, however, indicating that there are still areas that need to be monitored and reinforced.

Table III: Compliance with Infection Prevention and Control Practices (n = 150)

Variable	Category	n (%)
Compliance Score	Mean $\pm$ SD	74.6 $\pm$ 12.8
Compliance Level	Poor	19 (12.7)
	Moderate	50 (33.3)
	Good	81 (54.0)
Regular Hand Hygiene	Yes	129 (86.0)
Consistent PPE Use	Yes	123 (82.0)
Proper Waste Disposal	Yes	127 (84.7)
Safe Needle Handling	Yes	119 (79.3)

The **Table IV** explores the IPC knowledge and compliance among nursing staff. For participants with good knowledge, good compliance was significantly more likely than moderate or poor knowledge. The association was statistically significant ($p < 0.001$), indicating that increased knowledge is associated with better compliance with IHP.

Table IV: Association between Knowledge Level and Compliance Level

Knowledge Level	Poor Compliance n (%)	Moderate Compliance n (%)	Good Compliance n (%)	p-value
Poor	9 (60.0)	5 (33.3)	1 (6.7)	<0.001
Moderate	8 (16.7)	25 (52.1)	15 (31.2)	
Good	2 (2.3)	20 (23.0)	65 (74.7)	

The **Table V** shows the correlation of the compliance scores with some specific professional characteristics. Attendance in IPC training programs and years of professional experience were the next strongest positive associations with compliance, followed by knowledge score. The age was statistically significantly positively correlated with compliance levels, but in a smaller degree.

Table V: Correlation between Knowledge, Experience, and Compliance Scores

Variable	Correlation with Compliance Score (r)	p-value
Knowledge Score	0.64	<0.001
Years of Experience	0.35	<0.001
Age	0.21	0.011
Number of IPC Trainings Attended	0.48	<0.001

Table VI lists the independent predictors of compliance to the infection prevention and control measures. Knowledge score was the most powerful predictor, followed by IPC training and professional experience. After adjusting for the other variables, neither educational level nor age was significant. The regression model explained 57% of the variation in compliance scores.

Table VI: Multiple Linear Regression Analysis for Predictors of Compliance

Predictor	β Coefficient	p-value
Knowledge Score	0.41	<0.001
IPC Training Attendance	0.36	<0.001
Professional Experience	0.24	0.008
Education Level	0.12	0.094
Age	0.09	0.168

The **Table VII** shows compliance scores in various hospital departments. The scores of the nurses working in intensive care units were the highest and those of the nurses working in outpatient departments were comparatively low. There were significant differences between departments, which suggests that work environment and clinical roles could have an impact on adherence to infection prevention and control measures.

Table VII: Department-Wise Compliance with IPC Measures

Department	Mean Compliance Score $\pm$ SD
Intensive Care Unit (ICU)	81.2 $\pm$ 10.1
Emergency Department	77.6 $\pm$ 11.4
Medical Ward	73.8 $\pm$ 12.6
Surgical Ward	72.9 $\pm$ 13.2
Outpatient Department	69.5 $\pm$ 12.8

There were significant differences between departments, which suggests that work environment and clinical roles could have an impact on adherence to infection prevention and control measures.

DISCUSSION

This study aimed to assess the knowledge and compliance of nursing personnel about IPC measures in tertiary health-care facilities. Findings indicated that most nurses had good knowledge of IPC principles and over half reported good adherence to recommended IPC practices. Awareness and adherence to hand hygiene, use of personal protective equipment (PPE), waste segregation, and needle-stick injury management were relatively high. A strong correlation was found between knowledge and compliance; that is, the more nurses knew about IPC, the more likely they were to recommend infection control measures. The findings are consistent with recent studies, which also showed that increased IPC knowledge was highly correlated with adherence with standard precautions and safe clinical care among nurses and healthcare practitioners ^{11,12}. This highlights the importance of continuing to enhance education programs to maintain high levels of patient safety and prevent HAIs.

This current study further showed that the level of compliance was generally low compared with level of knowledge, implying that knowledge may not necessarily lead to consistent clinical practice. The overall knowledge of participants was good (58.0%) while the compliance was good (54.0%). The relative lack of compliance with some routine IPC activities and safe needle handling could be due to practical barriers associated with busy clinical shifts, and these findings are similar to those of previous investigations that have documented organizational barriers, workload, limited resources, staffing shortages and workplace culture influencing compliance with IPC measures despite a high level of theoretical knowledge ^{13,14}. The need for continuous reinforcement, environmental (supply) and organizational (institutional policies) support systems were also raised in earlier studies ¹⁵, which underscores the importance of institutional supports to help achieve compliance with the IPC guidelines.

One finding of this study is that there is a high positive correlation between knowledge scores and compliance scores. Both IPC training attendance and professional experience were independent predictors of compliance, but knowledge was the strongest predictor. Regular training updates could help increase the awareness of new infection risks, remind nurses of the infection control guidelines, and help nurses feel confident in dealing with occupational exposure incidents, as shown in previous literature ^{16,17}. Therefore, continuing professional development programs shall be an integral part of hospital infection prevention programs ¹⁸. In addition, hospitals with structured programs to prevent infection, regular audits, and ongoing competency training have seen much higher rates of compliance with standard precautions and hand hygiene among nurses ¹⁹. Furthermore, institutional support in terms of resources available, supervision, and reinforcement of adherence to institutional infection prevention policies has been found to be a critical factor in maintaining long-term adherence to infection prevention policies and practices and lowering HAI rates ²⁰.

There was also a significant positive correlation between professional experience and compliance. The more experienced nurses had higher compliance scores than less experienced nurses. Furthermore, department-wise analysis showed that compliance was better for nurses in intensive care units (ICUs) than for nurses in other departments, such as outpatient departments. This may be explained by the increased risk of infection ²¹, the more rigorous safety monitoring and safety culture that are often found in critical care settings ²². In practice, the findings of previous studies indicate that compliance with standard precautions increases in high-risk clinical environments where greatest institutional attention is placed on infection prevention, so that these methods could be used to enhance compliance in the lower-performing clinical departments ^{23,24}. Improving the IPC programs in all hospital departments is key to decreasing HAIs, safeguarding healthcare personnel and enhancing patient outcomes ²⁵.

These results must be interpreted with a few considerations. However, the cross-sectional study design does not allow us to conclude causal relationships between knowledge, training, experience and compliance. Furthermore, due to the use of convenience sampling and self-reported questionnaires, there may be selection and reporting biases that could impact the generalizability and accuracy of the findings. A multicenter study with larger and more diverse nursing population is recommended in order to confirm these results. Future research on real-world IPC practices, intervention trials for assessing training efficacy, and longitudinal studies to determine the long-term effects of compliance would yield more robust evidence to enhance IPC programs in health facilities.

CONCLUSION

The study revealed satisfactory knowledge of nurses, and compliance was slightly lower than knowledge, in regards to the infection prevention and control measures. There was a significant relationship observed between higher knowledge and compliance; and between IPC training and compliance with nursing practice, which meant that education and clinical exposure facilitate safer nursing practices. The findings of this study underscore the need to further bolster the implementation of IPC practices in reducing HAI and patient safety. To increase future research, larger multicenter samples should be used, as should be the long-term effect of structured IPC training, monitoring and feedback.

Acknowledgement

None

Conflict of Interest

None

Grant Support & Funding Source

None

Use of Artificial Intelligence

The corresponding author declared that no artificial intelligence or AI-assisted tools were used in this manuscript.

Authors' Contribution:

FJ: Conception and design, Collection and assembly of data, Analysis and interpretation of the data, drafting of the article, Critical revision of the article for important intellectual content; RA: Collection and assembly of data, Drafting of the article, Critical revision of the article for important intellectual content; ZQ: Statistical expertise, Analysis and interpretation, All Authors gave the final approval of the article.

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