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Knowledge and Compliance with Infection Prevention and Control Practices Among Nurses During Clinical Practice

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Abstract

Nurses represent a Susceptible population during Clinical Practice due to repeated exposure to infectious agents in healthcare settings. Adherence to infection prevention and control (IPC) practices is critical for patient safety and occupational health. However, gaps in knowledge and compliance among Nurses remain a significant problem. This study aimed to assess the level of knowledge and compliance with IPC practices among pre-registration Nurses (Bachelor of Science in Nursing program) in Central Punjab, Pakistan, during Clinical Practice, and to identify factors influencing compliance. A descriptive cross-sectional design was employed. A total of 150 pre-registration Nurses (BSN program) were engaged for a purpose sampling from a tertiary care teaching hospital in Lahore, Central Punjab. Data was collected using a questionnaire comprising sociodemographic characteristics, knowledge items, and compliance assessment. Data was analyzed using SPSS version 25; descriptive and logical statistics were applied. The mean knowledge score was 74.3% (SD = 9.1), indicating a moderate-to-good level of knowledge. However, compliance scores were notably lower, with a mean of 61.8% (SD = 11.4). The most frequently reported barriers to compliance were lack of time (68%), unavailability of supplies (54%), and high patient workload (49%). Knowledge score was significantly associated with compliance ($r = 0.612$, $p < 0.001$). Students with prior IPC training demonstrated significantly higher compliance ($p = 0.003$). While Nurses demonstrate adequate theoretical knowledge of IPC, compliance during clinical practice remains suboptimal. Structured IPC training programs, adequate supply of protective equipment, and supervisory support are recommended to bridge the knowledge-practice gap.

Keywords: *Infection Prevention and Control, Pre-Registration Nursing Students, Hand Hygiene, Clinical Practice, Standard Precautions, Healthcare-Associated Infections, Knowledge-Practice Gap*

Introduction

Healthcare-associated infections (HAIs) represent one of the most serious challenges facing modern healthcare systems worldwide. According to the World Health Organization (WHO), HAIs affect hundreds of millions of patients each year, contributing to increased morbidity,

prolonged hospitalization, excess mortality, and escalating healthcare costs (WHO, 2022). In low- and middle-income countries (LMICs), the burden of HAIs is estimated to be two to three times higher than in high-income countries, largely due to infrastructure deficits, insufficient training, and resource constraints (Allegranzi et al., 2011).

Infection prevention and control (IPC) encompass a range of evidence-based practices designed to prevent the transmission of infectious agents in healthcare settings. Core IPC measures include hand hygiene, use of personal protective equipment (PPE), adherence to standard precautions, proper waste disposal, and aseptic techniques. These measures are not only fundamental to patient safety but are also critical for protecting healthcare workers from occupational exposure to pathogens (CDC, 2023).

Nurses constitute a unique and particularly vulnerable segment of the healthcare workforce. During their clinical rotations, they are exposed to patients with infectious conditions while simultaneously developing clinical competencies and adapting to the demands of a complex healthcare environment. Inadequate IPC compliance among Nurses can lead to cross-transmission of pathogens, placing both patients and the students themselves at risk (Labrague et al., 2018).

Despite the recognized importance of IPC, several studies have reported significant gaps between theoretical knowledge of IPC principles and actual compliance in clinical settings among nursing students. A study conducted in Nigeria found that while 76% of Nurses demonstrated adequate knowledge of hand hygiene, only 48% were compliant with recommended protocols (Ogoina et al., 2019). Similar findings have been reported across South and Southeast Asia, where compliance with standard precautions among student nurses ranged from 41% to 65% (Bahrami et al., 2020; Efstathiou et al., 2011).

In Pakistan, IPC practices in healthcare settings have received growing attention in recent years, particularly following the COVID-19 pandemic, which exposed critical weaknesses in infection control infrastructure across public sector hospitals. Punjab, the most populous province, bears a disproportionate share of this burden: its tertiary care hospitals in cities such as Lahore (Central Punjab), Rawalpindi (Northern Punjab), and Multan (Southern Punjab) serve vast patient catchment areas under chronic resource constraints. The Pakistan Nursing Council (PNC) mandates IPC content within BSN curricula; however, the translation of this mandated content into consistent clinical practice among pre-registration students remains largely uninvestigated. The data published on the knowledge and compliance of Nurses specifically with IPC practices during Clinical Practice remain limited. Understanding the existing knowledge base, identifying compliance gaps, and exploring associated factors are essential steps toward developing targeted educational interventions.

This study was therefore designed to assess the level of knowledge and compliance with IPC practices among final-year pre-registration Nurses (BSN program) during Clinical Practice at a tertiary care teaching hospital in Lahore, Central Punjab, Pakistan, and to identify demographic and educational factors associated with compliance.

Research Objectives

1. To assess the level of knowledge regarding IPC practices among final-year pre-registration Nurses (BSN program) at a tertiary care teaching hospital in Lahore, Central Punjab.
2. To evaluate compliance with IPC practices during Clinical Practice.
3. To identify barriers to IPC compliance.
4. To determine the association between knowledge and compliance and identify influencing factors.

Research Hypotheses

H_1: There is a significant positive correlation between IPC knowledge scores and compliance scores among nursing students.

H_2: Nurses who have received prior formal IPC training demonstrate significantly higher compliance than those who have not.

Literature Review

A robust body of literature documents the critical role of IPC knowledge and compliance in reducing HAIs. WHO (2009) introduced the Five Moments for Hand Hygiene framework, which has since become the global standard for hand hygiene training. Studies consistently demonstrate that hand hygiene is the single most effective measure for preventing HAIs, yet compliance rates among healthcare workers — including Nurses — remain suboptimal (Pittet et al., 2017).

A systematic review by Huis et al. (2012) involving 41 studies found that the mean hand hygiene compliance rate among healthcare workers was approximately 40%, with rates among Nurses being particularly variable depending on training and supervision. The authors identified knowledge deficits, workload, and lack of role modeling by senior staff as key barriers.

Efstathiou et al. (2011) conducted a multi-country study among Nurses in Greece, Cyprus, and Hong Kong, finding that while most students (78-85%) had adequate theoretical knowledge about standard precautions, actual compliance was observed to be considerably lower, particularly in areas of PPE donning and doffing and sharps disposal. The study underscored the disconnect between classroom learning and clinical application.

In Asia, research by Bahrami et al. (2020) in Iran found that final-year Nurses scored significantly higher on IPC knowledge tests compared to junior students, yet compliance disparities persisted across both groups. The authors attributed this to the absence of direct clinical supervision and insufficient reinforcement of IPC protocols during rotations.

Labrague et al. (2018) explored compliance with standard precautions in the Philippines, revealing that availability of supplies, perception of risk, and attitude toward infection prevention were the most significant predictors of compliance. Students who perceived HAIs as a serious risk to patients were significantly more complaints, suggesting that attitude-focused educational interventions may be effective.

In the South Asian context, a study from India (Tripathi & Negi, 2019) found that 71% of Nurses had good knowledge of IPC but only 56% demonstrated satisfactory compliance during clinical observations. Multivariable logistic regression identified prior IPC training (OR = 2.4, 95% CI: 1.3–4.5) and positive supervisor attitude (OR = 1.9, 95% CI: 1.1–3.3) as significant predictors of compliance.

From Pakistan, limited but emerging data highlight significant gaps in IPC infrastructure and practice. A study by Akhtar et al. (2020) in tertiary care hospitals of Lahore found that healthcare workers — including nurses — frequently cited lack of gloves, hand sanitizer, and PPE as primary barriers to compliance, suggesting that structural and systemic factors are as important as knowledge in determining practice.

The literature collectively supports three key conclusions: (1) Nurses generally possess reasonable theoretical IPC knowledge; (2) clinical compliance consistently falls below recommended standards; and (3) this gap is influenced by factors including prior training, supervisor support, availability of resources, and perceived risk. This study adds to this evidence base by focusing specifically on a Pakistani nursing student population during Clinical Practice.

Methodology

Study Design

A descriptive cross-sectional study design was employed to assess knowledge and compliance with IPC practices. Cross-sectional designs are appropriate for determining prevalence, measuring associations between variables at a single point in time, and are widely used in nursing education research (Polit & Beck, 2021).

Study Setting

The study was conducted at a public sector tertiary care teaching hospital affiliated with a nursing institution in Lahore, Central Punjab, Pakistan. Lahore, the provincial capital of Punjab and one of Pakistan's principal centers of medical and nursing education, hosts multiple BSN-degree-awarding institutions regulated by the Pakistan Nursing Council (PNC). The hospital was selected due to its active pre-registration nursing (BSN) Clinical Practice program and the availability of a representative sample of final-year Nurses across multiple clinical wards including medicine, surgery, pediatrics, gynecology, and the intensive care unit (ICU). The findings are therefore most directly applicable to the urban tertiary care Clinical Practice context of Central Punjab, with potential relevance to comparable institutions in Northern Punjab (e.g., Rawalpindi, Gujranwala) and Southern Punjab (e.g., Multan, Bahawalpur), where similar BSN training structures operate under PNC accreditation.

Study Population and Sampling

The target population comprised final-year pre-registration Nurses enrolled in the four-year Bachelor of Science in Nursing (BSN) degree program — the standard entry-level nursing qualification regulated by the Pakistan Nursing Council — and actively engaged in clinical rotations at the study hospital. Final-year students were selected because they have completed the majority of their academic coursework in IPC and have had substantial clinical exposure, making them an ideal group for assessing knowledge-practice gaps.

Inclusion Criteria:

Final-year pre-registration Nurses (BSN program) actively enrolled and present during clinical rotations at the designated study hospital in Lahore; willing to participate and provide written informed consent; available during the data collection period.

Exclusion Criteria:

Students on academic leave or medical leave; students who had not yet completed at least two clinical rotation blocks.

A purposive sampling technique was used to recruit all eligible final-year pre-registration Nurses present at the study hospital during the data collection period. Based on a prior study (Bahrami et al., 2020) reporting a compliance rate of 61%, using a 5% margin of error and 95% confidence level, the calculated minimum sample size was 131. A total of 150 students were recruited to account for potential incomplete responses and to increase statistical power. It is acknowledged that purposive sampling from a single institution in Central Punjab limits external generalizability; future multi-site studies across Northern Punjab (Rawalpindi/Gujranwala) and Southern Punjab (Multan/Bahawalpur) are warranted to establish provincial-level estimates.

Data Collection Instrument

A structured, self-administered questionnaire was developed and used for data collection. The questionnaire comprised four sections:

5. Section A: Sociodemographic and background information (age, gender, prior IPC training, clinical rotation duration).
6. Section B: IPC Knowledge Assessment — 20 multiple-choice questions covering hand hygiene, PPE use, standard precautions, waste disposal, and aseptic techniques. Each correct answer scored 1 point (total = 20). Scores were categorized as: Poor (<50%), Moderate (50–74%), Good (75–100%).
7. Section C: IPC Compliance Self-Report — 15 Likert-scale items (Always/Often/Sometimes/Rarely/Never) assessing frequency of IPC practice during clinical rotations. Scored 1–5; maximum score = 75. Compliance categorized as: Low (<60%), Moderate (60–79%), High (80–100%).
8. Section D: Perceived barriers to IPC compliance — 10 items (Yes/No) exploring factors such as workload, supply availability, time constraints, and supervisory support.

Content validity was established by review from three nursing faculty experts with expertise in IPC. A pilot test was conducted with 15 students (not included in the main sample) to assess clarity and reliability. The Cronbach's alpha for the knowledge scale was 0.78 and for the compliance scale was 0.82, indicating acceptable internal consistency.

Data Collection Procedure

Data was collected over a period of six weeks. Questionnaires were distributed to eligible students during a scheduled non-clinical session to minimize interruption to clinical duties. Participation was voluntary, and anonymity was assured. Completed questionnaires were collected in sealed envelopes.

Data Analysis

Data was entered and analyzed using SPSS version 25.0. Descriptive statistics (frequencies, means, standard deviations) were used to summarize sociodemographic characteristics, knowledge scores, and compliance scores. Pearson's correlation coefficient was used to assess the relationship between knowledge and compliance scores. Independent samples t-test and one-way ANOVA were used to compare mean compliance scores across subgroups. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of the affiliated institution (Reference No: UHS-IRB-2023/NUR-114). Written informed consent was obtained from all participants prior to data collection. Participation was entirely voluntary, and students were informed of their right to withdraw at any time without consequences. All data were kept strictly confidential and used solely for research purposes.

Results

Sociodemographic Characteristics

A total of 150 questionnaires were distributed, and 147 were returned completed, yielding a response rate of 98%. Table 1 presents the sociodemographic profile of the participants.

Table 1: Sociodemographic Characteristics of Participants (n = 147)

Variable	Frequency (n)	Percentage (%)
Gender		
Female	118	80.3%
Male	29	19.7%
Age Group		
20–22 years	62	42.2%
23–25 years	73	49.7%
>25 years	12	8.2%
Prior IPC Training (Formal)		
Yes	89	60.5%
No	58	39.5%
Duration of Clinical Exposure		
<12 months	34	23.1%
12–24 months	81	55.1%
>24 months	32	21.8%

Most participants were female (80.3%), with a mean age of 22.6 years (SD = 1.7). Approximately 60.5% reported having received at least one formal IPC training session during their academic program. More than half (55.1%) had 12–24 months of cumulative clinical exposure.

Knowledge of IPC Practices

The mean knowledge score was 14.86 out of 20 (74.3%, SD = 9.1). Table 2 presents the distribution of knowledge levels among participants.

Table 2: Distribution of IPC Knowledge Scores (n = 147)

Knowledge Level	Frequency (n)	Percentage (%)
Poor (<50%)	14	9.5%
Moderate (50–74%)	58	39.5%
Good (75–100%)	75	51.0%
Total	147	100%

Most students (51%) demonstrated good knowledge of IPC practices, while 39.5% had moderate knowledge. Only 9.5% scored in the poor category. The highest knowledge scores were recorded for questions on hand hygiene indications (88.4% correct) and use of gloves (84.2% correct).

Knowledge was lowest for questions on waste segregation (58.5% correct) and management of sharps injuries (61.2% correct).

Compliance with IPC Practices

The mean compliance score was 46.4 out of 75 (61.8%, SD = 11.4), reflecting moderate overall compliance. Table 3 details compliance levels.

Table 3: Distribution of IPC Compliance Scores (n = 147)

Compliance Level	Frequency (n)	Percentage (%)
Low (<60%)	51	34.7%
Moderate (60–79%)	76	51.7%
High (80–100%)	20	13.6%
Total	147	100%

The most consistently performed IPC practices were hand hygiene before and after patient contact (reported as 'always' by 72.1%) and wearing gloves during invasive procedures (69.4%). The least complied-with practices were proper disposal of sharps (reported as 'always' by 38.1%), changing PPE between patients (34.0%), and performing full-body PPE donning/doffing procedures correctly (29.9%).

Barriers to IPC Compliance

Table 4 summarizes the self-reported barriers to IPC compliance.

Table 4: Self-Reported Barriers to IPC Compliance (n = 147)

Barrier	Yes (n)	Yes (%)
Lack of time during clinical duties	100	68.0%
Unavailability of IPC supplies (gloves, sanitizer)	79	53.7%
High patient workload	72	49.0%
Forgetfulness	65	44.2%
Lack of role modeling by senior staff	59	40.1%
Inadequate training/education on IPC	53	36.1%
Skin irritation from hand hygiene products	41	27.9%
Perception that risk is low for a given patient	38	25.9%
Inconvenience of wearing PPE	33	22.4%
Lack of supervisory monitoring	29	19.7%

The three most cited barriers were lack of time (68%), unavailability of IPC supplies (53.7%), and high patient workload (49%). Lack of role modeling by senior clinical staff was also a notable barrier, reported by 40.1% of participants.

Association Between Knowledge, Demographics, and Compliance

Pearson's correlation analysis revealed a moderate, significant positive correlation between IPC knowledge scores and compliance scores ($r = 0.612$, $p < 0.001$), supporting Hypothesis 1. Table 5 presents comparisons of mean compliance scores across key subgroups.

Table 5: Mean Compliance Scores by Subgroup

Variable	Mean Score	SD	p-value
Prior IPC Training			
Yes	50.2	9.8	0.003*
No	41.3	11.9	
Gender			
Female	47.1	10.9	0.271
Male	44.6	12.4	
Clinical Exposure			
<12 months	40.8	12.2	0.018*
12–24 months	47.6	10.4	
>24 months	51.3	9.1	

** Statistically significant at $p < 0.05$*

Students who had received prior formal IPC training demonstrated significantly higher mean compliance scores (50.2 vs. 41.3, $p = 0.003$), supporting Hypothesis 2. Gender did not significantly influence compliance ($p = 0.271$). Duration of clinical exposure was significantly associated with compliance ($p = 0.018$), with students having >24 months of exposure demonstrating the highest compliance.

Discussion

This study assessed IPC knowledge and compliance among final-year pre-registration Nurses (BSN program) at a tertiary care teaching hospital in Lahore, Central Punjab, Pakistan, and found a meaningful gap between theoretical understanding and clinical practice. The mean knowledge score of 74.3% indicates a moderately good level of IPC awareness, consistent with findings reported in comparable populations in Iran (Bahrami et al., 2020), the Philippines (Labrague et al., 2018), and India (Tripathi & Negi, 2019).

The compliance means of 61.8% is notably lower than knowledge scores, confirming the widely documented knowledge-practice gap in nursing IPC research. This finding aligns with Efstathiou et al. (2011), who observed that theoretical knowledge alone is insufficient to ensure behavioral compliance, and that clinical context — including supervision, role modeling, and resource availability — plays a decisive role.

The finding that hand hygiene compliance was among the highest reported practices (72.1% always) is encouraging, as hand hygiene remains the single most effective IPC measure according to the WHO (2009). However, the substantially lower compliance with sharps disposal (38.1%) and PPE management between patients (34.0%) represents a critical safety gap that warrants urgent attention. Inadequate sharps disposal practices in particular pose significant risks for needle stick injuries and bloodborne pathogen transmission, a concern that has been prominently documented in LMICs (Pruss-Ustun et al., 2005).

The identification of time constraints (68%), supply unavailability (53.7%), and workload (49%) as the leading barriers to compliance reinforces the systemic nature of IPC non-adherence. These structural factors were similarly reported by Akhtar et al. (2020) in Pakistani hospitals and highlight that individual motivation and knowledge alone cannot overcome environmental barriers. As recommended by the WHO multimodal IPC improvement strategy, institution-level changes — including reliable supply chains, adequate staffing, and physical reminders at point of care — are essential complements to educational initiatives (WHO, 2009).

The significant positive correlation between knowledge and compliance ($r = 0.612$, $p < 0.001$) indicates that enhancing IPC knowledge is an important, though not sufficient, step toward improving practice. Interventions that combine didactic IPC education with simulation-based practical training may be most effective in translating knowledge into consistent clinical behavior, as demonstrated by randomized controlled trials in nursing education (Luo et al., 2019).

The finding that students with prior formal IPC training had significantly higher compliance ($p = 0.003$) underscores the value of structured, repeated IPC training throughout the nursing curriculum. This is consistent with the recommendation of the WHO that IPC education should be ongoing and embedded in healthcare professional training rather than delivered as a single-episode intervention. The association between longer clinical exposure and higher compliance ($p = 0.018$) further suggests that practical experience, when guided by adequate supervision, fosters internalization of IPC principles.

The role of role modeling by senior staff — cited as a barrier by 40.1% of students — deserves particular emphasis. Nurses look to experienced clinicians for behavioral cues, and non-adherent senior staff can inadvertently normalize IPC violations (Borg et al., 2014). A culture of IPC compliance must therefore be cultivated at all levels of the clinical hierarchy, with senior nurses and physicians held to the same standards as students.

These findings carry particular significance within the Punjab context. Public sector tertiary care hospitals across Central Punjab (Lahore), Northern Punjab (Rawalpindi, Gujranwala), and Southern Punjab (Multan, Bahawalpur) share broadly similar structural challenges: high patient-to-nurse ratios, intermittent supply of PPE and hand hygiene consumables, and limited dedicated IPC nurse educators. The Pakistan Nursing Council's BSN curriculum mandates IPC content, yet no standardized competency-based IPC assessment framework exists at the provincial level for pre-registration students. Policymakers at the Punjab Healthcare Commission and the Higher Education Commission should consider developing region-specific IPC competency benchmarks and mandating direct observational assessment of IPC skills as a prerequisite for clinical graduation clearance.

Implications for Nursing Education and Practice

- Nursing curricula should incorporate simulation-based IPC training, with repeated practice and feedback, to bridge the gap between theoretical knowledge and clinical application.
- Hospital administrations should ensure consistent availability of IPC supplies, including gloves, hand sanitizers, and PPE, particularly in high-risk clinical areas.

- Clinical mentors and preceptors should be trained and held accountable as IPC role models to positively influence student behavior.
- IPC refresher training should be mandated at the start of every clinical rotation cycle.
- Observational compliance audits, in addition to self-report measures, should be incorporated into future IPC research.

Limitations

This study has several limitations that should be considered when interpreting the findings. First, compliance was assessed via self-report, which is subject to social desirability bias; students may have overestimated their compliance. Future studies should supplement self-report with structured direct observational audits using validated tools such as the WHO Hand Hygiene Observation Form. Second, the study was conducted at a single tertiary care teaching hospital in Lahore, Central Punjab, limiting generalizability to primary and secondary care settings and to other regions of Punjab, including Northern Punjab (e.g., Rawalpindi, Gujranwala) and Southern Punjab (e.g., Multan, Bahawalpur), where infrastructure, supervision quality, and resource availability may differ substantially. Third, the cross-sectional design precludes causal inference; longitudinal cohort studies are needed to examine how IPC compliance evolves across all years of the BSN program and into early registered nursing practice. Fourth, while a validated questionnaire was used, the compliance instrument relied on student self-perception rather than objective behavioral measurement. Fifth, the study did not assess ward-level or supervisor-level factors that may independently influence student compliance, representing an important gap for future multilevel modelling approaches.

Conclusion

This study demonstrated that while final-year pre-registration Nurses (BSN program) in Lahore, Central Punjab, Pakistan, possess moderate-to-good knowledge of IPC practices, their compliance during Clinical Practice remains suboptimal. A significant knowledge-practice gap was identified, particularly in areas of sharps disposal, PPE management, and respiratory hygiene. Key barriers included time constraints, supply unavailability, and lack of role modeling by senior staff.

Prior formal IPC training and longer clinical exposure were positively associated with compliance, highlighting the importance of structured, repeated educational interventions across the nursing program. A positive and significant correlation between knowledge and compliance further confirms that improving IPC knowledge is a necessary, though not standalone, component of improving practice.

Addressing IPC compliance among Nurses requires a multi-pronged approach encompassing curriculum reform, institutional supply management, clinical supervision, and a culture of accountability at all levels of the healthcare team. These findings provide evidence-based recommendations for nursing educators, hospital administrators, and policymakers working to strengthen IPC systems in Pakistan and similar resource-limited settings.

Future research should employ mixed-methods designs, direct observational techniques, and multi-institutional sampling across diverse regions of Punjab — including Northern Punjab (Rawalpindi, Gujranwala), Central Punjab (Lahore, Faisalabad), and Southern Punjab (Multan, Bahawalpur) — to capture regional variations in IPC training quality, resource availability, and compliance culture, and to provide a more comprehensive and generalizable picture of IPC practice among pre-registration Nurses in Pakistan.

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