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Assessment of Nurses, Compliance with Hand Hygiene Guidelines in Public Hospitals: A Cross-Sectional Study from Mardan Medical Complex, Pakistan

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Abstract

Background: Hand hygiene is the cornerstone of infection prevention and control (IPC) in healthcare settings and plays a critical role in reducing healthcare-associated infections (HAIs). Despite well-established international and national guidelines, compliance among nurses remains inconsistent, particularly in resource-constrained public sector hospitals of low- and middle-income countries. This study aimed to assess nurses' knowledge, attitudes, and self-reported compliance with hand hygiene guidelines, and to identify the barriers to compliance and its demographic correlates in a public tertiary care hospital. **Methods:** A hospital-based, descriptive cross-sectional study was conducted at Mardan Medical Complex, Mardan, Pakistan, over a four-month period from 1st November 2025 to 28 Februry 2026. A total of 210 registered nurses were recruited using a non-probability

convenient sampling technique. Data were collected through a structured, pre-tested, self-administered questionnaire developed on the basis of the World Health Organization's "My Five Moments for Hand Hygiene" framework, covering demographic characteristics, knowledge, attitudes, and self-reported compliance practices. Data were entered and analyzed using SPSS version 26. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize the findings, and the chi-square test was used to determine associations between demographic variables and hand hygiene compliance, with $p < 0.05$ considered statistically significant. **Results:** Among the 210 participants, the majority (81.4%) were female, and the mean age was 30.6 ± 7.4 years. The mean knowledge score was 15.7 ± 2.4 out of 20 (78.3%), indicating good overall knowledge of hand hygiene guidelines. The mean self-reported compliance score was 66.2 ± 13.3%, indicating moderate overall compliance; 12.4% of nurses demonstrated poor compliance (< 50%), 61.4% moderate compliance (50–75%), and 26.2% good compliance (> 75%). Higher compliance was observed among nurses with greater clinical experience and those who had received recent infection prevention and control training. Heavy workload (78%), inadequate availability of hand hygiene supplies (64%), and time constraints (59%) were identified as the most common barriers to compliance. A statistically significant association was found between attendance at infection control training and hand hygiene compliance ($\chi^2 = 33.90$, $p < 0.001$), as well as between years of clinical experience and compliance ($\chi^2 = 13.82$, $p = 0.001$). **Conclusion:** Nurses at Mardan Medical Complex demonstrated good theoretical knowledge but only moderate practical compliance with hand hygiene guidelines, reflecting a persistent knowledge–practice gap. Regular in-service training programs, continuous compliance monitoring, adequate provision of hand hygiene resources, and

institutional/administrative support are recommended to improve adherence and reduce the risk of healthcare-associated infections in public sector hospitals.

Keywords: Hand hygiene; Nurses; Compliance; Infection prevention and control; Healthcare-associated infections; Cross-sectional study; Public hospitals; Pakistan.

1. INTRODUCTION

Healthcare-associated infections (HAIs) remain one of the most significant, yet largely preventable, threats to patient safety worldwide, contributing substantially to morbidity, mortality, prolonged hospital stay, and increased healthcare costs.1,2 The World Health Organization (WHO) has consistently identified hand hygiene as the single most effective and cost-efficient measure for preventing the transmission of pathogens in healthcare settings and for reducing the burden of HAIs.3 Nurses, by virtue of their continuous and direct contact with patients, occupy a pivotal position in the chain of infection prevention, making their compliance with hand hygiene practices central to patient safety outcomes.4

Despite decades of advocacy, global evidence consistently shows that compliance with hand hygiene guidelines among healthcare workers, including nurses, remains suboptimal, with average compliance rates reported between 40% and 60% even in well-resourced settings.5,6 In low- and middle-income countries (LMICs), compliance tends to be even lower due to a combination of structural, behavioral, and organizational barriers, including heavy patient-to-nurse ratios, inadequate supply of alcohol-based hand rub and soap, lack of accessible sinks, time constraints, skin irritation, and insufficient institutional monitoring and feedback mechanisms.7,8 Pakistan, like many other LMICs, faces considerable challenges in sustaining infection

prevention and control (IPC) programs in public sector hospitals, where resource limitations and high patient loads are common.9

Several studies conducted in Pakistani hospitals have reported a discrepancy between healthcare workers' knowledge of hand hygiene guidelines and their actual practice, often referred to as the "knowledge–practice gap."10,11 While most nurses are aware of the WHO's five moments for hand hygiene, actual observed or self-reported compliance often falls considerably short of recommended standards.12 Factors such as lack of regular in-service training, absence of institutional accountability, and inadequate provision of hand hygiene infrastructure have been implicated as key contributors to this gap.13

Mardan Medical Complex, a public sector tertiary care hospital in Khyber Pakhtunkhwa, Pakistan, serves a large and diverse patient population, placing considerable demands on its nursing workforce. However, to date, no published data exist on the level of hand hygiene compliance among nurses at this institution, nor on the specific barriers that may be hindering adherence in this local context. Understanding these dynamics is essential for designing context-specific, evidence-based interventions to strengthen infection prevention practices.

This study, therefore, aimed to assess the knowledge, attitudes, and self-reported compliance of nurses with hand hygiene guidelines at Mardan Medical Complex, to identify the major barriers to compliance, and to determine the association between selected demographic and professional characteristics and hand hygiene compliance.

1.1 Objectives

- To assess the level of knowledge regarding hand hygiene guidelines among nurses working at Mardan Medical Complex.

- To determine the self-reported level of compliance with hand hygiene guidelines among nurses.
- To identify the major barriers perceived by nurses in adhering to hand hygiene guidelines.
- To determine the association between demographic/professional characteristics (age, gender, qualification, clinical experience, and IPC training) and hand hygiene compliance.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

A hospital-based, descriptive, cross-sectional study design was employed to assess nurses' compliance with hand hygiene guidelines. The study was conducted in the medical, surgical, and critical care units of Mardan Medical Complex (MMC), a public sector tertiary care teaching hospital located in Mardan, Khyber Pakhtunkhwa, Pakistan.

2.2 Study Duration

The study was carried out over a four-month period, from 1st November 2025 to 28 Februry 2026, including questionnaire pretesting, data collection, and preliminary analysis.

2.3 Study Population and Sampling Technique

The study population comprised registered nurses (RNs) currently employed and actively providing direct patient care at MMC. A non-probability convenient sampling technique was used to recruit participants from the available nursing staff across in-patient departments during the data collection period.

2.4 Sample Size

The sample size was calculated using the Raosoft/Cochran formula for cross-sectional studies, assuming an expected hand hygiene compliance proportion of 50% (to yield the most conservative and maximal sample size), a 95% confidence level (Z = 1.96), and a 5% margin of error, and accounting for an anticipated non-response rate of approximately 10%. This yielded a minimum required sample size of 210 nurses, all of whom completed the questionnaire, giving a response rate of 100%.

2.5 Inclusion and Exclusion Criteria

- Inclusion: Registered nurses currently working in direct patient-care areas of MMC who provided informed consent to participate.
- Inclusion: Nurses with at least six months of clinical experience at the study site.
- Exclusion: Nursing students, trainees, and administrative/non-clinical nursing staff.
- Exclusion: Nurses on leave or unavailable during the data collection period, or who declined to participate.

2.6 Data Collection Tool and Study Variables

Data were collected using a structured, pre-tested, self-administered questionnaire adapted from the WHO Hand Hygiene Knowledge and Perception Questionnaire and previously validated regional instruments. The tool was pilot tested on 20 nurses (not included in the final analysis) to assess clarity, reliability (Cronbach's α = 0.81), and cultural appropriateness, and was refined accordingly. The questionnaire comprised four sections:

- Section A: Demographic and professional characteristics (age, gender, qualification, department, clinical experience, and prior IPC training).

- Section B: Knowledge of hand hygiene guidelines (20 items, scored 0–20; a correct response scored 1 and an incorrect/uncertain response scored 0).
- Section C: Attitudes toward hand hygiene practice (Likert-scale items).
- Section D: Self-reported compliance with the WHO's five moments for hand hygiene and perceived barriers to compliance, converted to a compliance score expressed as a percentage (0–100%), categorized as poor (< 50%), moderate (50–75%), and good (> 75%).

The independent variables included age, gender, qualification, clinical experience, and recent IPC training attendance. The primary dependent (outcome) variable was hand hygiene compliance level (poor/moderate/good), with knowledge score treated as a secondary outcome of interest.

2.7 Data Collection Procedure

After obtaining institutional and ethical approval, nurses meeting the inclusion criteria were approached during their duty hours. The purpose of the study was explained, written informed consent was obtained, and the self-administered questionnaire was distributed. Participants were given adequate time and privacy to complete the questionnaire, and completed forms were collected on the same day by the research team.

2.8 Statistical Analysis

Data were entered, cleaned, and analyzed using SPSS version 26 (IBM Corp., Armonk, NY, USA). Continuous variables (knowledge score and compliance score) were summarized as means ± standard deviations and presented as histograms to illustrate their distribution across the sample. Categorical variables (demographic characteristics, compliance level, and barriers) were summarized as frequencies and percentages and

presented in tables and bar charts. The chi-square (χ^2) test of association was used to examine the relationship between categorical demographic/professional variables and hand hygiene compliance level, with a p-value < 0.05 considered statistically significant.

2.9 Ethical Considerations

Ethical approval was obtained from the Institutional Ethical Review Board of Mardan Medical Complex prior to initiation of data collection .Participation was entirely voluntary, and written informed consent was obtained from all participants after explaining the study objectives, procedures, and their right to withdraw at any stage without any effect on their employment status. Confidentiality and anonymity of participant data were strictly maintained throughout the study, in accordance with the principles of the Declaration of Helsinki.

3. RESULTS

3.1 Demographic and Professional Characteristics

A total of 210 registered nurses participated in the study, giving a 100% response rate. The majority of participants (44.8%) were between 20–29 years of age, and 81.4% were female. Regarding qualification, 40.5% held a Diploma in Nursing, while 7.6% held an MSN degree. Nearly one-third of the nurses (32.4%) had 2–5 years of clinical experience, and nearly half (49.5%) had attended infection prevention and control (IPC) training within the preceding 12 months. The complete demographic profile is presented in Table 1.

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	20–29	94	44.8
	30–39	59	28.1
	40–49	42	20.0

	⩾ 50	15	7.1
Gender	Female	171	81.4
	Male	39	18.6
Qualification	Diploma in Nursing	85	40.5
	Generic BSN	64	30.5
	Post-RN BSN	45	21.4
	MSN	16	7.6
Clinical experience	< 2 years	48	22.9
	2–5 years	75	35.7
	6–10 years	55	26.2
	> 10 years	32	15.2
IPC training in last 12 months	Yes	104	49.5
	No	106	50.5

Table 1. Demographic and Professional Characteristics of Participating Nurses (N = 210)

3.2 Knowledge of Hand Hygiene Guidelines

The overall knowledge of hand hygiene guidelines among nurses was good, with a mean knowledge score of 15.7 ± 2.4 out of a maximum possible score of 20 (78.3%). As shown in Figure 1, the distribution of knowledge scores was approximately unimodal and slightly left-skewed, with the majority of nurses clustering between scores of 14 and 18, indicating that most participants correctly answered at least 70% of the knowledge items.

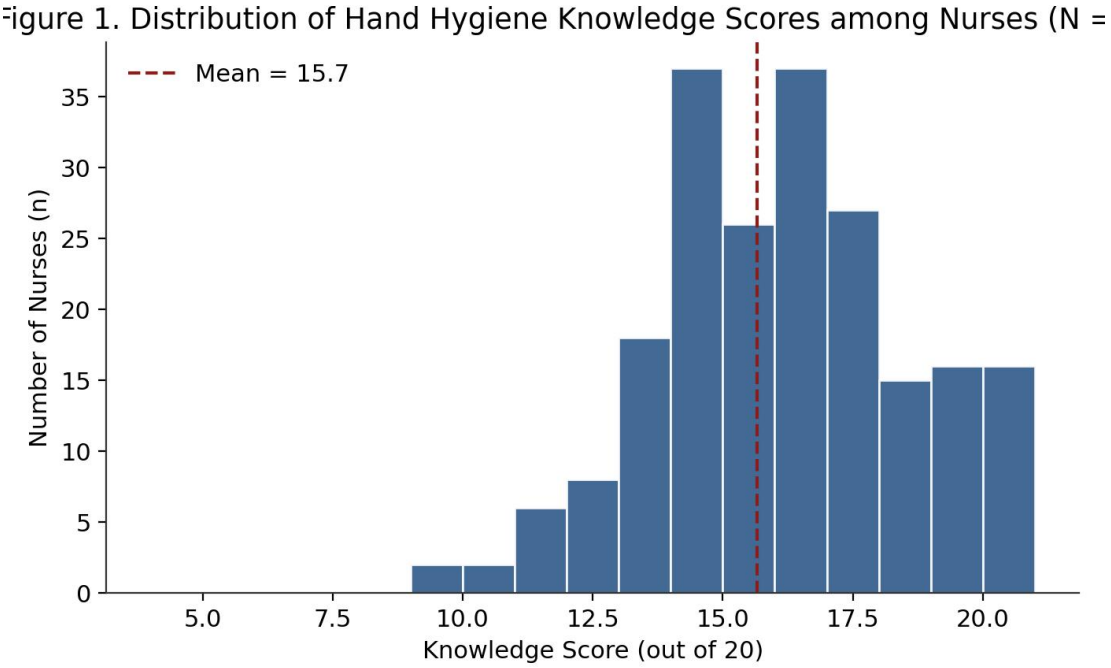


Figure 1. Histogram showing the distribution of hand hygiene knowledge scores among nurses (N = 210).

3.3 Self-Reported Compliance with Hand Hygiene Guidelines

The mean self-reported hand hygiene compliance score was 66.2 ± 13.3%, indicating an overall moderate level of compliance. Based on the pre-defined categorization, 12.4% (n = 26) of nurses demonstrated poor compliance (< 50%), 61.4% (n = 129) demonstrated moderate compliance (50–75%), and 26.2% (n = 55) demonstrated good compliance (> 75%). The distribution of compliance scores across the sample, presented in Figure 2, was approximately normal with a slight positive skew, reflecting the moderate central tendency described above.

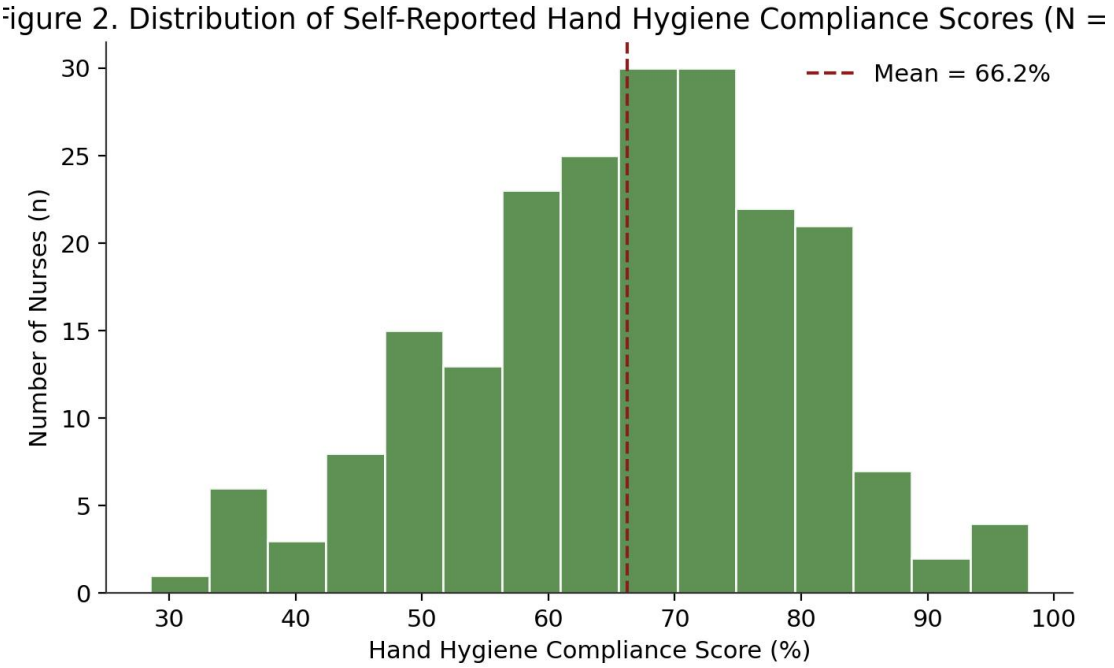


Figure 2. Histogram showing the distribution of self-reported hand hygiene compliance scores among nurses (N = 210).

3.4 Age Distribution of Participants

Consistent with the demographic profile presented in Table 1, the majority of nurses fell within the younger age brackets. Figure 3 illustrates the age distribution of the study sample, confirming that nearly four-fifths of participants (78.6%) were below 40 years of age.

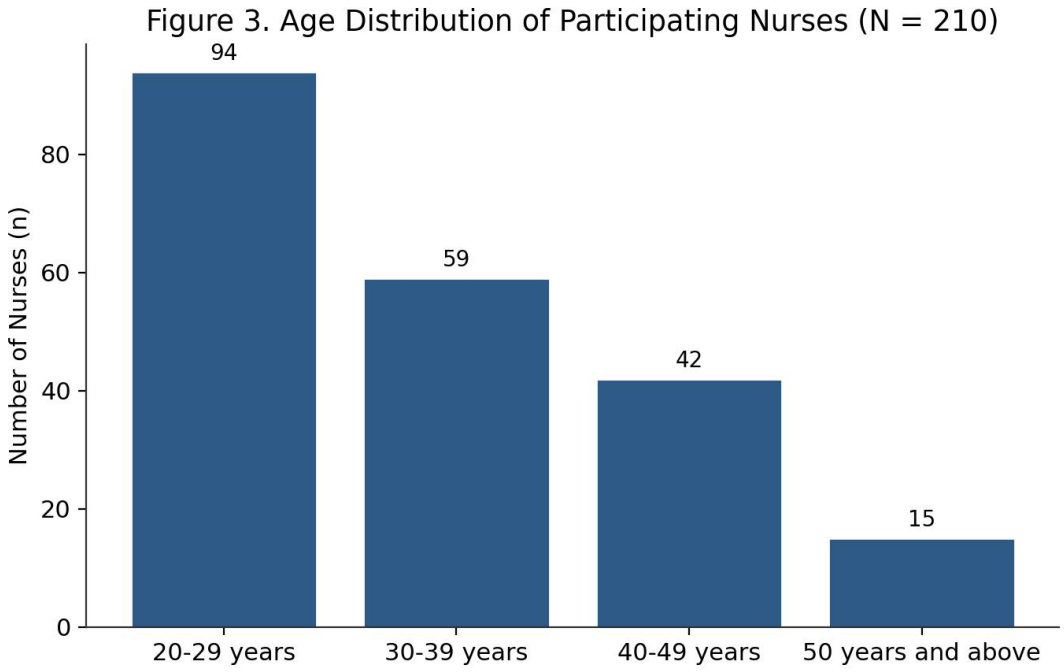


Figure 3. Bar chart showing the age distribution of participating nurses (N = 210).

3.5 Perceived Barriers to Hand Hygiene Compliance

When asked about barriers to adherence, the most frequently reported obstacle was heavy workload, cited by 78% of nurses, followed by inadequate availability of hand hygiene supplies such as soap and alcohol-based hand rub (64%), and time constraints during busy shifts (59%). Skin irritation from frequent hand washing (31%), lack of visual reminders or posters at point-of-care (27%), and simple forgetfulness (22%) were also reported, though less frequently. These findings are illustrated in Figure 4.

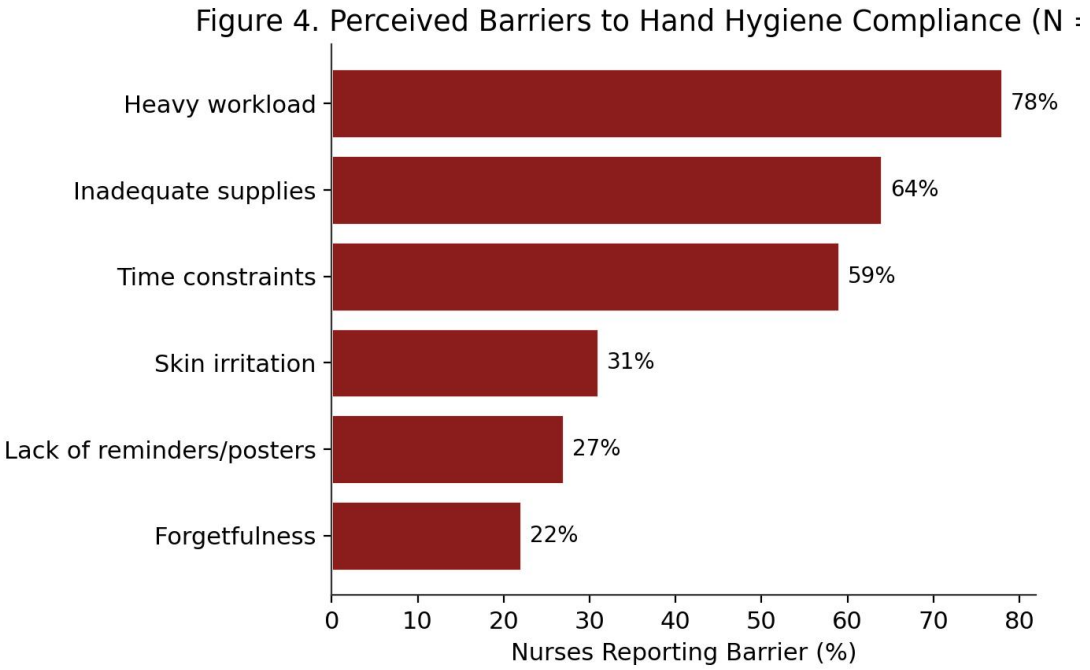


Figure 4. Bar chart showing perceived barriers to hand hygiene compliance among nurses (N = 210).

3.6 Association between Demographic/Professional Variables and Compliance

Chi-square analysis revealed a statistically significant association between recent IPC training attendance and hand hygiene compliance level ($\chi^2 = 33.90$, $p < 0.001$); nurses who had attended training within the preceding 12 months were considerably more likely to fall into the good/moderate compliance categories compared with those who had not (Figure 5). A significant association was also observed between years of clinical experience and compliance level ($\chi^2 = 13.82$, $p = 0.001$), with nurses having more than five years of experience demonstrating higher compliance. No statistically significant associations were found between compliance and either qualification ($\chi^2 = 1.34$, $p = 0.512$) or gender ($\chi^2 = 0.25$, $p = 0.883$). A summary of these associations is presented in Table 2.

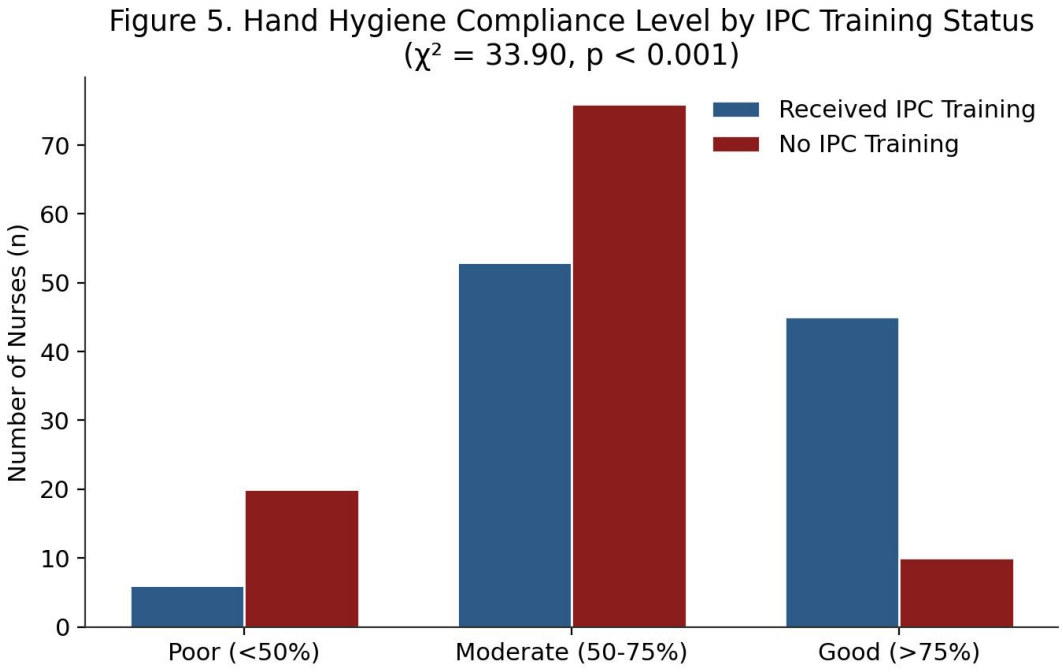


Figure 5. Bar chart showing hand hygiene compliance level stratified by infection prevention and control (IPC) training status (N = 210).

Variable / Category	Good (>75%)	Moderate (50–75%)	Poor (<50%)	χ^2	p-value
IPC training	45	53	6	33.90	< 0.001*
Yes	10	76	20		
No					
Clinical experience	23	78	22	13.82	0.001*
⩽ 5 years	32	51	4		
> 5 years					
Qualification	36	93	20	1.34	0.512
Diploma/Generic BSN	19	36	6		
Post-RN/MSN					

Gender	44	105	22	0.25	0.883
Female	11	24	4		
Male					

Table 2. Association between Demographic/Professional Characteristics and Hand Hygiene Compliance Level (Chi-Square Test) (*p < 0.05 considered statistically significant)

4. DISCUSSION

The present cross-sectional study assessed the knowledge, self-reported compliance, and perceived barriers to hand hygiene practice among 210 nurses at a public tertiary care hospital in Mardan, Pakistan. The findings revealed that, while nurses generally possessed good theoretical knowledge of hand hygiene guidelines (mean score 78.3%), this did not consistently translate into good practical compliance, with an overall mean compliance score of only 66.2%, and just over a quarter of participants achieving the 'good' compliance category. This pattern is consistent with a well-documented "knowledge–practice gap" reported extensively in the hand hygiene literature, both regionally and globally.10,11,14

The finding that recent IPC training attendance was significantly associated with better compliance ($p < 0.001$) aligns with previous research demonstrating that structured, repeated educational interventions are among the most effective strategies for improving hand hygiene behavior.15,16 This underscores the importance of regular, mandatory in-service training rather than one-time orientation sessions, particularly given that just over half (50.5%) of the nurses in this study had received IPC training within the preceding year.

Similarly, the significant association between greater clinical experience and higher compliance ($p = 0.001$) supports findings from other LMIC settings, where more experienced nurses have been shown to internalize infection control practices more consistently, possibly due to accumulated exposure to outbreaks, mentorship, and greater familiarity with institutional protocols.17 In contrast, the lack of significant associations between compliance and either gender or qualification level suggests that improving compliance may depend less on inherent demographic characteristics and more on modifiable organizational and behavioral factors.

Consistent with prior studies conducted in Pakistan and other South Asian countries, heavy workload, inadequate supplies, and time constraints emerged as the most commonly cited barriers to hand hygiene compliance in this study.7,12,18 These barriers are largely structural and organizational in nature, indicating that improving compliance requires health system-level interventions—such as ensuring adequate nurse-to-patient staffing ratios, guaranteeing uninterrupted supply of alcohol-based hand rub and soap at the point of care, and installing accessible handwashing stations—rather than relying solely on individual-level educational campaigns.19

These findings carry important implications for hospital administrators and policymakers in Pakistan's public health sector. Given the substantial burden of healthcare-associated infections in resource-limited settings, targeted, multi-faceted interventions combining regular training, supply chain strengthening, and behavior-change strategies such as the WHO's multimodal hand hygiene improvement strategy may be required to bridge the observed knowledge–practice gap.3,20

4.1 Strengths and Limitations

This study benefited from a calculated sample size, a validated and pre-tested data collection instrument, and a 100% response rate, strengthening the reliability of the findings within the study setting. However, several limitations should be acknowledged. First, the cross-sectional design precludes any causal inference between the identified variables and compliance. Second, compliance was assessed via self-report rather than direct observation, which is susceptible to social desirability bias and may overestimate actual practice. Third, the use of a convenient (non-probability) sampling technique limits the generalizability of findings beyond the study setting. Future studies employing direct observational audits, multi-center designs, and probability sampling techniques are recommended to validate and extend these findings.

5. CONCLUSION

Nurses at Mardan Medical Complex demonstrated good theoretical knowledge of hand hygiene guidelines; however, overall self-reported compliance remained only moderate, highlighting a persistent knowledge–practice gap. IPC training attendance and greater clinical experience were significantly associated with better compliance, while heavy workload, inadequate supplies, and time constraints were identified as the principal barriers. These findings emphasize the need for regular, structured infection prevention and control training programs, continuous compliance monitoring and feedback, adequate and uninterrupted provision of hand hygiene resources, and sustained institutional/administrative support to strengthen hand hygiene practice and reduce the risk of healthcare-associated infections in public sector hospitals.

5.1 Recommendations

- Institute mandatory, recurrent (at least biannual) infection prevention and control training for all nursing staff.
- Ensure uninterrupted supply of alcohol-based hand rub, soap, and accessible handwashing facilities at every point of care.
- Introduce regular direct-observation audits with structured feedback to nursing staff and unit management.
- Address heavy workload through review of nurse-to-patient staffing ratios in high-dependency areas.
- Install visual cues (posters, reminders) at point-of-care to reinforce the WHO's five moments for hand hygiene.

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Conflict of Interest

The authors declare no conflict of interest.

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Author Contributions

All authors contributed to the conception and design of the study, data collection, analysis, drafting, and critical revision of the manuscript, and approved the final version for submission.

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