

Original Article

A Comparative Study of Hand Hygiene Compliance Among Nursing Staff in the Intensive Care Unit Versus General Ward at a Secondary Level Public Hospital, Bhakkar

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ABSTRACT

Background: Hand hygiene is essential for preventing healthcare-associated infections, yet adherence may differ across clinical settings. Evidence from secondary-level public hospitals in Pakistan remains limited. **Objective:** To compare self-reported hand hygiene compliance among nurses working in the intensive care unit (ICU) and General Ward of DHQ Hospital, Bhakkar. **Methods:** A comparative cross-sectional study recruited 80 nurses (ICU = 34; General Ward = 46) through purposive sampling. A structured questionnaire assessed self-reported hand hygiene frequency across the five World Health Organization moments using a five-point Likert scale. Total scores ranged from 5 to 25. Data were analyzed using Welch's t test, Mann-Whitney U test, and categorical association tests. **Results:** The questionnaire demonstrated good internal consistency (Cronbach's $\alpha = 0.87$). Complete-score analyses included 79 nurses. ICU nurses reported higher mean compliance scores than General Ward nurses (22.94 ± 2.32 versus 20.04 ± 5.06 ; mean difference = 2.90, 95% CI 1.20–4.59; $p = 0.001$; Cohen's $d = 0.70$). High self-reported compliance was identified in 84.8% of ICU nurses and 60.9% of General Ward nurses (Fisher-Freeman-Halton $p = 0.022$). **Conclusion:** ICU nurses reported significantly higher hand hygiene frequency scores than General Ward nurses. Findings indicate an association between clinical unit and self-reported practices but do not establish actual bedside adherence. **Keywords:** Hand Hygiene; Nursing Staff; Intensive Care Units; General Ward; Cross-Sectional Studies; Infection Prevention; Pakistan.

INTRODUCTION

Healthcare-associated infections (HCIs) remain a major public health concern and represent a significant threat to patient safety, healthcare quality, and clinical outcomes worldwide. These infections contribute to prolonged hospitalization, increased healthcare expenditures, antimicrobial resistance, preventable complications, and

mortality. The burden is particularly substantial in low- and middle-income countries, where inadequate infection prevention infrastructure, limited resources, high patient volumes, and inconsistent adherence to established infection control protocols create additional challenges for healthcare professionals. Patients admitted to intensive care units (ICUs) are especially vulnerable because of their critical conditions, compromised immunity, frequent exposure to invasive procedures, and prolonged contact with healthcare personnel. Evidence suggests that approximately 7–10% of hospitalized patients globally acquire at least one healthcare-associated infection, with disproportionately higher rates reported in resource-limited healthcare settings. Consequently, strengthening infection prevention and control practices remains essential for improving patient safety and reducing avoidable healthcare-related complications (1,2).

Hand hygiene is recognized as one of the most effective and economical strategies for preventing healthcare-associated infections and interrupting the transmission of pathogenic microorganisms within clinical environments. Healthcare workers frequently come into contact with patients, contaminated surfaces, medical devices, biological fluids, and potentially infectious materials, making their hands an important vehicle for microbial transmission. Failure to perform appropriate hand hygiene before and after clinical activities increases the risk of cross-contamination between healthcare workers, patients, and hospital environments. The World Health Organization (WHO) has therefore established hand hygiene as a fundamental component of infection prevention through the “Clean Care Is Safer Care” initiative and the WHO Guidelines on Hand Hygiene in Health Care. These guidelines emphasize the importance of performing hand hygiene at critical points during patient care to minimize microbial transmission and improve healthcare quality (1–3).

The WHO “My 5 Moments for Hand Hygiene” framework provides a standardized approach for identifying situations in which healthcare workers should perform hand hygiene. These moments include before touching a patient, before performing a clean or aseptic procedure, after exposure or potential exposure to body fluids, after touching a patient, and after touching the patient's immediate surroundings. The framework incorporates both patient-protective and healthcare worker-protective practices and is applicable across different hospital departments. Appropriate hand hygiene can be performed using alcohol-based hand rubs or soap and water, depending on clinical indications and the condition of the hands. Despite the availability of internationally recognized guidelines, consistent adherence remains a challenge across healthcare settings, indicating a continuing gap between recommended infection prevention practices and their implementation during routine patient care (3,4).

Nursing personnel play a particularly important role in preventing healthcare-associated infections because they maintain continuous and frequent contact with patients throughout hospitalization. Their responsibilities include medication administration, wound management, intravenous therapy, assistance with personal hygiene, monitoring of vital signs, and handling of equipment and contaminated materials. Each of these activities creates potential opportunities for microbial transmission when appropriate hand hygiene is omitted. Although nurses are generally aware of the importance of infection prevention, previous studies have demonstrated that knowledge does not always translate into consistent clinical practice. Differences in workload, institutional support, accessibility of hand hygiene products, skin irritation, professional experience, and perceived infection risks can influence adherence to recommended hand hygiene procedures. These findings suggest that improving hand hygiene requires attention not only to individual knowledge but also to the organizational and environmental circumstances in which nursing care is delivered (1,2,5,6).

The clinical environment may be an important determinant of hand hygiene behavior because nursing responsibilities and patient care demands differ across hospital units. Intensive care units typically accommodate critically ill patients requiring continuous monitoring, invasive procedures, mechanical ventilation, and complex therapeutic interventions. Consequently, ICU nurses encounter frequent hand hygiene indications and work in environments where infection prevention is particularly important. In contrast, general wards commonly accommodate larger and more heterogeneous patient populations, with nursing staff managing routine treatments, medication administration, patient admissions, discharges, and frequent patient interactions. High patient turnover, competing clinical responsibilities, and differences in the availability of infection prevention resources may influence opportunities to perform hand hygiene consistently. Therefore, comparing ICU and general ward nursing staff can provide useful insight into whether self-reported hand hygiene practices differ between these clinical environments (1,2,7).

Previous observational research has documented considerable variation in hand hygiene compliance across hospital departments and professional categories. Sharma et al. investigated hand hygiene practices in the intensive care units of a tertiary care hospital in India and reported overall compliance of 43.2% across 911 observed opportunities, with compliance among nurses recorded at 41.3%. The study also demonstrated differences in adherence according to the risk associated with clinical activities, suggesting that hand hygiene practices may become less consistent during certain high-risk care situations. Similarly, Umar et al. reported variations in compliance among healthcare professionals working in public hospitals in eastern Ethiopia, with compliance differing across intensive care and general medical wards. These findings indicate that hand hygiene adherence is not uniform across hospital environments and that departmental characteristics may contribute to differences in infection prevention behavior (2,7).

Evidence from Pakistani healthcare settings has also highlighted important differences in hand hygiene practices between clinical departments. Masood et al. reported higher compliance among intensive care personnel than general ward staff, with corresponding rates of 71.1% and 60.3%. The same study identified variations across nursing shifts, with higher compliance during morning duties and lower compliance during night shifts. These findings suggest that clinical workload, institutional monitoring, staffing patterns, and the nature of patient care may influence hand hygiene practices across different working environments. However, evidence from other settings has demonstrated lower compliance in intensive care environments, indicating that the relationship between clinical unit and hand hygiene behavior may depend on local organizational circumstances. Such variations highlight the importance of investigating compliance within specific hospital settings rather than assuming that patterns observed in tertiary hospitals apply equally to secondary-level healthcare facilities (2,7,8).

Hand hygiene compliance also differs according to the specific clinical indication. Previous research indicates that healthcare workers frequently demonstrate greater adherence after exposure to potentially contaminated materials than before patient contact or aseptic procedures. Billock et al. examined indication-specific hand hygiene compliance and highlighted variations between different clinical moments. These findings are consistent with the possibility that healthcare workers may prioritize hand hygiene when they perceive an immediate risk of contamination to themselves. Erasmus et al. also identified behavioral and organizational influences on hand hygiene practices, including the importance of positive role models and healthcare workers' perceptions regarding infection transmission. Such evidence emphasizes the need to examine individual hand hygiene moments rather than relying exclusively on overall compliance scores, as different moments may reflect distinct behavioral priorities and clinical challenges (9,10).

In addition to clinical environment and behavioral influences, the method used to assess hand hygiene compliance is an important methodological consideration. Direct observation is commonly used to assess hand hygiene practices during actual patient care because it allows researchers to document whether hand hygiene is performed when a clinical opportunity occurs. However, observational assessments require trained personnel, adequate monitoring periods, and organizational resources. Furthermore, the presence of observers may influence healthcare workers' behavior. Self-administered questionnaires provide a practical alternative for evaluating healthcare workers' perceptions and reported frequency of hand hygiene practices, particularly in settings where continuous observation is difficult to implement. Nevertheless, self-reported compliance and directly observed compliance represent different measurements and should not be interpreted as equivalent indicators of actual clinical performance (11,12).

Al-Wazzan et al. investigated hand hygiene practices among nursing personnel in public secondary care hospitals and compared self-reported practices with directly observed behavior, demonstrating the importance of distinguishing reported adherence from actual clinical performance. Similarly, van Dijk et al. examined the validity of self-reported compliance and behavioral determinants of observed hand hygiene practices across Dutch hospitals. These investigations highlight the limitations of relying exclusively on questionnaire-based assessments, particularly because recall bias, social desirability, and awareness of recommended guidelines may influence responses. Nevertheless, self-report instruments remain useful for exploratory assessments of perceived routine practices, identifying potential differences between clinical groups, and informing future observation-based investigations when their limitations are explicitly acknowledged (11,12).

Several investigations have also identified factors that may contribute to inadequate hand hygiene practices among nurses. Khodadadi reported that workload, insufficient time, and skin-related concerns were perceived as barriers to consistent adherence among ICU nurses. De Wandel et al. further examined behavioral determinants of hand hygiene compliance in intensive care settings, emphasizing the relevance of individual perceptions and contextual influences. Other research has demonstrated that the accessibility of alcohol-based hand rubs and the implementation of institutional interventions can contribute to improvements in hand hygiene practices. Salama et al. investigated the impact of bedside alcohol-based hand rub availability on compliance in intensive care units, while Lydon et al. synthesized evidence concerning interventions intended to improve ICU hand hygiene adherence. Together, these studies suggest that hand hygiene behavior is influenced by multiple interacting factors and that findings may vary across healthcare organizations with different resources and infection prevention systems (6,13–15).

Despite the availability of international and regional research, evidence specifically comparing self-reported hand hygiene practices among nurses working in ICUs and general wards of secondary-level public hospitals remains relatively limited in the literature discussed above. Much of the existing evidence has originated from tertiary care institutions, specialized departments, or studies using direct observational methods. Secondary-level public hospitals may differ from tertiary institutions in staffing patterns, clinical workload, infection prevention resources, organizational supervision, and patient populations. Furthermore, findings from large urban healthcare centers may not fully represent the working conditions of hospitals serving peripheral districts. Therefore, locally conducted investigations are required to provide context-specific evidence that can guide future quality improvement initiatives and infection prevention assessments in secondary-level healthcare facilities (2,8,16).

District Headquarters (DHQ) Hospital, Bhakkar, is a secondary-level public healthcare institution serving patients with diverse clinical needs. Nursing personnel working in its intensive care unit and general ward perform distinct clinical responsibilities that may be associated with differences in routine hand hygiene practices. ICU nursing care involves critically ill patients and frequent high-risk procedures, whereas general ward nursing care involves a broader range of routine patient management activities. However, the extent to which nurses in these two departments differ in their self-reported adherence to the WHO Five Moments has not been established by the evidence presented in the current literature review. A comparative assessment may therefore identify differences in reported hand hygiene frequency and provide preliminary information for hospital administrators, nursing educators, and infection prevention personnel when considering future observational audits and targeted interventions.

The present study addresses this knowledge gap by employing a quantitative, analytical, comparative cross-sectional design to assess self-reported hand hygiene practices among registered nursing staff working in the ICU and General Ward of DHQ Hospital, Bhakkar. Self-reported adherence was assessed using a structured questionnaire based on the WHO Five Moments for Hand Hygiene, with each moment rated on a five-point frequency scale. Responses were combined into a total self-reported compliance score, and an Individual Compliance Rate was calculated as the percentage of the maximum possible questionnaire score. This approach permits comparison of reported hand hygiene frequency between clinical units while recognizing that the resulting measure does not represent directly observed hand hygiene opportunities or objectively verified compliance.

The primary objective of this study was to compare mean self-reported hand hygiene compliance scores between nurses working in the ICU and those working in the General Ward at DHQ Hospital, Bhakkar. The study also aimed to describe reported hand hygiene frequency across the five WHO moments and compare the distribution of nurses across study-defined high, moderate, and low compliance categories. The central research question was whether self-reported hand hygiene compliance differed significantly between ICU and General Ward nursing staff. It was hypothesized that a statistically significant difference would exist in mean self-reported hand hygiene compliance scores between the two clinical units.

MATERIAL AND METHODS

A quantitative, analytical, comparative cross-sectional study was conducted to assess and compare self-reported hand hygiene compliance among nursing staff working in the Intensive Care Unit (ICU) and General Ward of District Headquarters (DHQ) Hospital, Bhakkar, Punjab, Pakistan. DHQ Hospital is a secondary-level public healthcare facility providing inpatient, emergency, and critical care services to patients with diverse clinical conditions. The

comparative cross-sectional design was selected to evaluate differences in reported hand hygiene practices between two distinct clinical environments during a single study period without introducing an intervention or manipulating participants' clinical responsibilities. The primary grouping variable was the clinical unit of employment, categorized as ICU or General Ward, whereas the primary outcome was the total self-reported hand hygiene compliance score derived from a structured questionnaire based on the World Health Organization (WHO) Five Moments for Hand Hygiene framework (3).

The target population comprised registered nursing personnel actively engaged in direct bedside patient care at DHQ Hospital, Bhakkar. According to institutional staffing records, the hospital had 94 nursing personnel, including 11 head nurses, 81 charge nurses, and two male nurses. Nurses were eligible if they were assigned to the ICU or General Ward, regularly participated in direct patient care, had completed at least one month of continuous clinical service in their respective unit, and provided written informed consent. Nurses on extended leave during the data collection period and those who had attended a formal hand hygiene training seminar within the preceding month were excluded. These eligibility criteria were applied to recruit nurses with recent routine exposure to the clinical activities assessed by the questionnaire while reducing the potential influence of recent formal training on self-reported practices.

The sample size was estimated using the Rao soft sample-size calculator, based on Cochran's formula with finite population correction. Considering a finite population of 94 nursing personnel, a 95% confidence level, an assumed response distribution of 50%, and a 5% margin of error, the minimum estimated sample size was 76 participants. A 10% allowance for potential nonresponse or incomplete questionnaires was added, resulting in a recruitment target of 84 nurses. Ultimately, 80 completed questionnaires were obtained, comprising 34 ICU nurses and 46 General Ward nurses. The calculation was intended to support descriptive sample planning within the available nursing population rather than to establish statistical power for a specified between-group mean difference. Accordingly, the achieved sample represented the available recruited nursing personnel and was used for the planned comparative analysis.

Participants were selected using purposive nonprobability sampling. Registered nurses meeting the eligibility criteria were approached individually during appropriate periods of their clinical duties, including shift handovers and scheduled breaks, to minimize disruption to routine patient care. Recruitment and questionnaire distribution were conducted across morning, evening, and night shifts to provide opportunities for nurses working different duty schedules to participate. Before enrollment, eligible nurses received an explanation of the study objectives, questionnaire procedures, voluntary nature of participation, confidentiality measures, and right to withdraw without professional or administrative consequences. Written informed consent was obtained before questionnaire distribution. Each consenting nurse received a paper-based self-administered questionnaire and completed it independently without researcher assistance. Completed questionnaires were deposited in a designated collection box or returned directly to the research team.

Data were collected using a structured questionnaire adapted from the WHO "My 5 Moments for Hand Hygiene" framework and informed by established approaches to assessing self-reported hand hygiene behavior (3,12,17). The questionnaire consisted of three components. The first provided operational definitions and clinical examples of the five WHO hand hygiene moments to standardize respondents' understanding of the situations being assessed. The second collected professional and demographic information relevant to the study, including clinical unit of posting, professional designation, and total years of nursing experience. The third comprised five self-report items assessing the reported frequency of hand hygiene performance during routine clinical activities. The instrument was designed to capture nurses' perceived frequency of hand hygiene practices rather than directly observed adherence or the proportion of actual clinical opportunities during which hand hygiene was performed.

The five questionnaire items corresponded to the WHO-recommended hand hygiene indications: Moment 1, before touching a patient; Moment 2, before performing a clean or aseptic procedure; Moment 3, after potential exposure to body fluids; Moment 4, after touching a patient; and Moment 5, after touching the patient's immediate surroundings (3). Clinical examples were included to improve the interpretation of each indication. These examples included assisting patients with movement or measuring vital signs, performing wound care or intravenous procedures, handling contaminated dressings or biological materials, completing direct patient contact, and touching bedside equipment or surrounding surfaces. Respondents indicated how frequently they performed hand

hygiene with soap and water or an alcohol-based hand rub during these situations. Each item was rated using a five-point ordinal frequency scale: never (1), rarely (2), sometimes (3), often (4), and always (5).

The primary outcome was the total self-reported hand hygiene compliance score, calculated by summing responses to the five questionnaire items. The possible total score ranged from 5 to 25, with higher scores indicating greater reported frequency of hand hygiene performance across the WHO Five Moments. For descriptive interpretation, the total score was converted into an Individual Compliance Rate (ICR), calculated as the total score divided by the maximum possible score of 25 and multiplied by 100. This derived measure represented the percentage of the maximum attainable questionnaire score and ranged from 20% to 100%. It was not treated as an objectively observed hand hygiene opportunity-based compliance rate. Participants were further classified using predefined, Bloom-derived scoring thresholds into high or good self-reported compliance (ICR $\geq 80\%$; total score 20–25), moderate or average compliance (ICR 60–79%; total score 15–19), and low or poor compliance (ICR $< 60\%$; total score ≤ 14). These categories were applied consistently across both clinical units and were interpreted as study-defined descriptive classifications rather than independently validated clinical compliance thresholds (18,19).

The questionnaire underwent content-oriented expert review before its administration. Senior nursing faculty, academic research supervisors, and hospital infection prevention personnel evaluated the instrument for language clarity, clinical relevance, contextual suitability, and correspondence with the WHO Five Moments framework. Feedback from the reviewers was incorporated to improve item wording and applicability to routine nursing practice in the study setting. A preliminary pilot assessment involving approximately 8–9 nurses was undertaken at the same hospital to examine questionnaire clarity and internal consistency. Nurses participating in the pilot assessment were excluded from the final analytical sample. Cronbach's alpha was used to assess internal consistency, with a coefficient of at least 0.70 considered acceptable. Internal consistency was subsequently reassessed using complete compliance responses from the main study sample. Corrected item–total correlations and changes in Cronbach's alpha following item deletion were also examined. The expert review, pilot assessment, and reliability analysis were used to evaluate the adapted instrument's suitability for the present exploratory study without assuming equivalence to directly observed hand hygiene behavior.

Several procedural measures were incorporated to improve data quality and reduce avoidable measurement and selection errors. All participants received the same structured questionnaire, standardized WHO-moment descriptions, response categories, and scoring instructions. Independent questionnaire completion was encouraged to reduce researcher influence on participants' answers. Recruitment across different nursing shifts was undertaken to improve access to eligible staff working varying duty schedules. Unique questionnaire identification codes were used for data entry and checking, and responses were screened for missing values and scores outside the permitted range of 1–5. Confidential data collection procedures were used to reduce concerns about professional evaluation, although social desirability and recall bias could not be eliminated because hand hygiene practices were assessed exclusively through self-report. The study did not include direct observation, infection surveillance, microbiological assessment, or independent verification of the participants' reported practices.

The main explanatory variable was clinical unit, coded as ICU or General Ward. The principal dependent variable was the summed five-item self-reported hand hygiene compliance score. Secondary descriptive outcomes included the score for each WHO hand hygiene moment, the derived ICR, and the proportions of nurses classified within the three study-defined compliance categories. Total years of nursing experience was collected as a professional characteristic and used to describe and compare the two groups. Workload, staffing ratios, availability of hand hygiene products, shift-specific compliance, supervision, and other potential determinants of hand hygiene behavior were not measured as analytical covariates. Consequently, comparisons between units were unadjusted and were not intended to establish an independent causal effect of clinical setting on compliance. Each participant completed the questionnaire once, and no repeated outcome assessments or follow-up measurements were undertaken.

Data were coded, entered, cleaned, and analyzed using IBM SPSS Statistics version 26.0. Descriptive statistics were used to summarize participants' professional characteristics and self-reported hand hygiene scores. Categorical variables were presented as frequencies and percentages, whereas continuous and summed-score variables were summarized using means and standard deviations. Medians and ranges were also calculated for nursing experience.

The internal consistency of the five-item compliance scale was evaluated using Cronbach's alpha and corrected item-total correlations. The primary comparison examined differences in mean total compliance scores between ICU and General Ward nurses. Before inferential analysis, the distribution of total scores within each group was assessed using the Shapiro–Wilk normality test, together with examination of skewness and score distributions. Equality of group variances was evaluated using Levene's test.

An independent-samples *t* test was initially specified for the comparison of mean total compliance scores between the two clinical units. Because Levene's test indicated unequal variances, Welch's independent-samples *t* test was selected as the primary inferential procedure. The mean difference between groups was reported with its 95% confidence interval, and Cohen's *d* was calculated using the pooled standard deviation to quantify the standardized magnitude of the difference. Student's independent-samples *t* test, assuming equal variances, was additionally reported as a sensitivity analysis. Given the bounded nature of the total score and evidence of non-normal score distributions, the Mann–Whitney *U* test was also performed as a nonparametric sensitivity analysis. The associated standardized test statistic, mean ranks, and effect size *r* were used to supplement interpretation of the between-group comparison. These sensitivity analyses were intended to examine the consistency of the overall group comparison under different statistical assumptions.

Associations between clinical unit and the three self-reported compliance categories were evaluated using Pearson's chi-square test of independence. Cramér's *V* was calculated to describe the strength of the association. Because more than 20% of the expected cell frequencies were below five, the Fisher–Freeman–Halton exact test was additionally applied to evaluate the association without relying exclusively on the asymptotic chi-square approximation. For a supplementary binary comparison, compliance categories were collapsed into high compliance and non-high compliance, the latter comprising moderate and low categories. The association between unit and this binary classification was examined using a chi-square test, and an unadjusted odds ratio with a 95% confidence interval was calculated to quantify the relative odds of being classified in the high self-reported compliance category. Nursing experience was compared between ICU and General Ward nurses using Welch's independent-samples *t* test and the Mann–Whitney *U* test. No multivariable adjustment or inferential subgroup analysis of individual WHO moments was undertaken. All statistical tests were two-sided, and a *p*-value below 0.05 was considered statistically significant. Missing-data handling was specified before the total-score comparison. Questionnaires were examined for incomplete compliance responses and invalid numerical entries. All recorded item responses were within the permitted 1–5 range; however, one ICU participant had not answered the item relating to Moment 3, after potential exposure to body fluids. Because calculation of the total score required complete responses across all five moments, this participant was excluded from total-score analyses using complete-case analysis. Consequently, the principal analytical sample consisted of 79 nurses, including 33 ICU nurses and 46 General Ward nurses. The participant's available responses to the remaining four moments were retained for the corresponding item-level descriptive analyses. Therefore, item-level analyses included 80 participants for Moments 1, 2, 4, and 5, whereas Moment 3, total compliance scores, ICR classification, and related inferential analyses were based on 79 complete records. No missing-value imputation was performed.

Ethical approval was obtained through Alhamd College of Nursing and Allied Health Sciences, Bhakkar, and formal administrative permission to conduct the research was obtained from DHQ Hospital, Bhakkar. The research was conducted in accordance with established principles of voluntary participation, respect for participants, confidentiality, beneficence, and responsible handling of research information. Written informed consent was obtained from all enrolled nurses before questionnaire administration. Participation was voluntary, and nurses were informed that refusal or withdrawal would not affect their employment or professional standing. No personal names or identification numbers were collected on the questionnaires. Instead, unique identification codes were assigned for data management, and completed questionnaires were securely stored with access restricted to the research team. The collected information was used exclusively for research purposes, and findings were analyzed and reported at the aggregate level to protect individual participants from identification or professional consequences.

RESULTS

A total of 80 registered nurses participated in the study, including 34 (42.5%) from the intensive care unit (ICU) and 46 (57.5%) from the General Ward. All participants were recorded as BSN-qualified nursing personnel. The overall mean nursing experience was 6.04 ± 5.63 years. ICU nurses had a mean experience of 6.69 ± 5.73 years compared

with 5.57 ± 5.56 years among General Ward nurses. The difference between-group in nursing experience was not statistically significant (Welch's $t = 0.88$, $p = 0.382$). Similarly, the Mann-Whitney U test showed no statistically significant difference in the distributions of nursing experience ($U = 669.5$, $p = 0.270$). Participant characteristics are summarized in Table 1.

The five-item self-reported hand hygiene scale demonstrated good internal consistency, with a Cronbach's alpha coefficient of 0.87 among 79 complete cases. Corrected item-total correlations ranged from 0.62 to 0.80, and removal of an individual item did not improve the overall reliability coefficient. Across the five WHO hand hygiene moments, the highest overall mean score was recorded for Moment 3, after body fluid exposure risk (4.42 ± 0.97), whereas the lowest was observed for Moment 5, after touching patient surroundings (4.19 ± 1.17). ICU nurses recorded numerically higher mean scores than General Ward nurses across all five moments. The largest descriptive differences were observed for Moment 4, after touching a patient (4.62 ± 0.74 versus 3.89 ± 1.25), and Moment 1, before touching a patient (4.59 ± 0.61 versus 3.91 ± 1.23). Item-level findings are presented in Table 2.

Table 1. Professional Characteristics of Nursing Staff by Clinical Unit (N = 80)

Characteristic	ICU (n = 34)	General Ward (n = 46)	Total (N = 80)	p-value
BSN-qualified nurses, n (%)	34 (100.0)	46 (100.0)	80 (100.0)	—
Nursing experience, years, mean $\pm$ SD	6.69 ± 5.73	5.57 ± 5.56	6.04 ± 5.63	0.382
Nursing experience, years, median (range)	4 (1–21)	3 (1–22)	4 (1–22)	0.270

ICU, intensive care unit; BSN, Bachelor of Science in Nursing; SD, standard deviation. The mean comparison uses Welch's independent-samples t test; the distributional comparison uses the Mann-Whitney U test. Median (range) is retained because quartiles are not reported in the source manuscript.

Table 2. Self-Reported Hand Hygiene Scores Across the Five WHO Moments

WHO hand hygiene moment	ICU, mean $\pm$ SD	General Ward, mean $\pm$ SD	Overall, mean $\pm$ SD
Moment 1: Before touching a patient	4.59 ± 0.61	3.91 ± 1.23	4.20 ± 1.06
Moment 2: Before a clean/aseptic procedure	4.53 ± 0.61	4.09 ± 1.24	4.28 ± 1.04
Moment 3: After body fluid exposure risk	4.73 ± 0.63	4.20 ± 1.11	4.42 ± 0.97
Moment 4: After touching a patient	4.62 ± 0.74	3.89 ± 1.25	4.20 ± 1.12
Moment 5: After touching patient surroundings	4.50 ± 0.96	3.96 ± 1.26	4.19 ± 1.17

WHO, World Health Organization; SD, standard deviation. Scores range from 1 (never) to 5 (always). ICU denominators are 34 for Moments 1, 2, 4, and 5, and 33 for Moment 3. General Ward n = 46 for all items. Overall N = 80 except Moment 3 (N = 79).

Table 3. Overall Self-Reported Hand Hygiene Compliance by Clinical Unit (N = 79)

Outcome	ICU (n = 33)	General Ward (n = 46)	Overall (N = 79)
Total compliance score (5–25), mean $\pm$ SD	22.94 ± 2.32	20.04 ± 5.06	21.25 ± 4.37
Individual Compliance Rate (%), mean $\pm$ SD	91.76 ± 9.27	80.17 ± 20.26	85.01 ± 17.46
Total compliance score, median	24	22	—

ICU, intensive care unit; SD, standard deviation. Individual Compliance Rate = total score/25 $\times$ 100; it represents the percentage of the maximum possible questionnaire score. Medians are taken from Figure 5 of the manuscript.

Table 4. Between-Group Comparison of Total Self-Reported Hand Hygiene Scores

Statistical analysis	Test statistic	df	Mean difference (95% CI)	p-value	Effect size
Welch's independent-samples t test	3.41	67.07	2.90 (1.20–4.59)	0.001	0.70
Student's independent-samples t test	3.06	77	2.90 (1.01–4.78)	0.003	0.70
Mann-Whitney U test	506.5	—	—	0.011	0.29

CI, confidence interval; df, degrees of freedom. Mean difference is ICU minus General Ward. Effect sizes are pooled-standard-deviation Cohen's d for t tests and r for Mann-Whitney U. Reported 95% CI for Cohen's d: 0.24–1.16. The Welch test is the primary comparison; the remaining tests are sensitivity analyses.

Table 5. Distribution of Self-Reported Hand Hygiene Compliance Categories by Clinical Unit (N = 79)

Compliance category	ICU (n = 33), n (%)	General Ward (n = 46), n (%)	Total (N = 79), n (%)
Low (score ≤ 14)	0 (0.0)	7 (15.2)	7 (8.9)
Moderate (score 15–19)	5 (15.2)	11 (23.9)	16 (20.3)
High (score 20–25)	28 (84.8)	28 (60.9)	56 (70.9)

Values are column percentages. Categories use the study-defined Bloom-derived thresholds. Pearson $\chi^2(2) = 7.31$, $p = 0.026$; Cramér's $V = 0.30$. Fisher–Freeman–Halton exact $p = 0.022$. The exact test is preferred because two of six expected cell counts are below five.

Table 6. Association Between Clinical Unit and High Self-Reported Hand Hygiene Compliance

Clinical unit	High, n (%)	Moderate/low, n (%)	Crude OR (95% CI)	p-value
General Ward (n = 46)	28 (60.9)	18 (39.1)	1.00 (reference)	—
ICU (n = 33)	28 (84.8)	5 (15.2)	3.60 (1.17–11.04)	0.021

OR, odds ratio; CI, confidence interval; ICU, intensive care unit. OR is unadjusted. The p-value is from the reported Pearson chi-square test after collapsing categories into high and moderate/low. No adjusted regression model was reported.

One ICU participant had an incomplete response for Moment 3 and was excluded from analyses requiring a complete five-item score, resulting in a primary analytical sample of 79 participants (ICU n = 33; General Ward n = 46). The overall mean total self-reported compliance score was 21.25 ± 4.37 out of 25, equivalent to a mean Individual Compliance Rate (ICR) of $85.01 \pm 17.46\%$ of the maximum possible questionnaire score. ICU nurses had a mean total score of 22.94 ± 2.32 , compared with 20.04 ± 5.06 among General Ward nurses. Corresponding mean ICR values were $91.76 \pm 9.27\%$ and $80.17 \pm 20.26\%$, respectively. The median total scores were 24 in the ICU and 22 in the General Ward (Table 3).

Assessment of statistical assumptions demonstrated departures from normality in both groups, with Shapiro–Wilk statistics of 0.82 for ICU nurses and 0.85 for General Ward nurses (both $p < 0.001$). Levene's test indicated unequal variances ($F = 27.23$, $p < 0.001$). Consequently, Welch's independent-samples t test was used as the primary comparison. ICU nurses had a statistically higher mean self-reported compliance score than General Ward nurses, with a mean difference of 2.90 points (95% CI 1.20–4.59; $t[67.07] = 3.41$, $p = 0.001$). The standardized mean difference was Cohen's $d = 0.70$ (95% CI 0.24–1.16). The corresponding difference in mean ICR was 11.59 percentage points based on the displayed rounded means. Sensitivity analyses were consistent with the primary result, including Student's t test ($p = 0.003$) and the Mann–Whitney U test ($U = 506.5$, $p = 0.011$; $r = 0.29$). The principal comparative results are presented in Table 4.

Among the 79 participants with complete compliance scores, 56 (70.9%) were classified in the study-defined high compliance category, 16 (20.3%) in the moderate category, and seven (8.9%) in the low category. The distribution differed between clinical units. High compliance was reported by 28 of 33 ICU nurses (84.8%) and 28 of 46 General Ward nurses (60.9%). All seven participants classified in the low compliance category were from the General Ward. The association between clinical unit and compliance category was statistically significant using Pearson's chi-square test ($\chi^2[2] = 7.31$, $p = 0.026$; Cramér's $V = 0.30$). Because two expected cell counts were below five, the Fisher–Freeman–Halton exact test was also applied and supported the association ($p = 0.022$). The categorical distribution is summarized in Table 5.

When the compliance categories were combined into high versus moderate/low, ICU nurses had greater unadjusted odds of reporting high compliance than General Ward nurses (OR = 3.60, 95% CI 1.17–11.04; $p = 0.021$). The relatively wide confidence interval indicated uncertainty regarding the magnitude of this association. These findings represent differences in study-defined self-reported hand hygiene categories rather than objectively observed clinical adherence (Table 6).

Overall, the primary analysis demonstrated a statistically significant difference in self-reported hand hygiene scores between the two nursing groups. The direction of the difference was consistent across the continuous-score comparison, nonparametric sensitivity analysis, and categorical comparisons. The General Ward also demonstrated greater variability in total reported scores, whereas ICU responses were more concentrated toward the maximum possible score. The results establish an unadjusted association between clinical unit and reported hand hygiene frequency within the sampled hospital population.

DISCUSSION

The present study examined differences in self-reported hand hygiene compliance among nursing staff working in the intensive care unit (ICU) and General Ward of DHQ Hospital, Bhakkar. The findings demonstrated that ICU nurses

reported significantly higher overall hand hygiene compliance scores than General Ward nurses, with a moderate standardized between-group difference. Higher mean scores were observed among ICU nurses across all five World Health Organization (WHO) hand hygiene moments, although these individual differences were evaluated descriptively rather than through separate inferential tests. The distribution of study-defined compliance categories also differed between the two clinical units, with a greater proportion of ICU nurses classified in the high-compliance category and all participants classified in the low-compliance category belonging to the General Ward. These findings suggest an association between clinical unit and self-reported hand hygiene practices within the selected hospital, while emphasizing the importance of distinguishing reported behavior from directly observed clinical adherence.

The overall mean Individual Compliance Rate (ICR) was 85.01%, suggesting that participants generally selected responses toward the upper end of the five-point frequency scale. However, this value represents the percentage of the maximum possible self-report questionnaire score rather than the proportion of observed opportunities during which hand hygiene was performed. Previous observational investigations have reported substantially lower compliance levels among healthcare professionals. Sharma et al. documented overall hand hygiene compliance of 43.2% across 911 observed opportunities in intensive care units, with nursing personnel demonstrating compliance of 41.3% (7). Similarly, Umar et al. reported considerable variation in hand hygiene compliance among nurses employed in public hospitals in eastern Ethiopia, with adherence differing across clinical departments (2). The higher numerical values observed in the present study should therefore not be interpreted as evidence of superior infection prevention practices at DHQ Hospital, because the methods used to measure compliance differed substantially between studies.

Differences between self-reported and directly observed compliance have been documented in previous research. Al-Wazzan et al. compared self-reported hand hygiene practices with direct observation among nursing staff in secondary care hospitals and demonstrated the importance of distinguishing perceived adherence from actual clinical performance (11). Similarly, van Dijk et al. examined the validity of self-reported hand hygiene compliance and its relationship with observed behavior, emphasizing that questionnaire responses and observational measures are not interchangeable (12). Self-report questionnaires may be influenced by recall bias, social desirability, and participants' familiarity with recommended infection prevention practices. Nurses may report their intended or customary behavior rather than accurately recalling every clinical opportunity in which hand hygiene was indicated. These mechanisms provide plausible explanations for the high self-reported scores observed in the present study. Nevertheless, the magnitude of any discrepancy between reported and actual compliance at DHQ Hospital cannot be established without direct observational assessment.

The principal comparative finding was that ICU nurses reported higher mean hand hygiene scores than General Ward nurses, with a between-group difference of 2.90 points on the 25-point questionnaire scale and a corresponding standardized mean difference of 0.70. This finding is directionally consistent with the study by Masood et al., who reported higher hand hygiene compliance among critical care personnel than General Ward staff, with rates of 71.1% and 60.3%, respectively (8). Both investigations identified a relative advantage among personnel working in intensive care settings. However, the absolute compliance values and the magnitudes of the differences should be interpreted cautiously because of potential differences in study populations, institutional characteristics, and measurement procedures. The agreement in the direction of the findings may indicate that certain features of critical care environments are associated with stronger reported hand hygiene practices, but it does not establish that ICU placement itself produces better compliance.

In contrast, Umar et al. reported lower compliance in intensive care settings than in general medical wards, with departmental rates of 23.1% and 46.8%, respectively (2). Sharma et al. also demonstrated that compliance in intensive care units could remain inadequate despite the increased infection risks associated with critically ill patients and invasive procedures (7). These discrepancies indicate that the relationship between clinical setting and hand hygiene adherence is not uniform across healthcare institutions. Differences in staffing patterns, patient acuity, infection prevention infrastructure, managerial supervision, clinical workload, and institutional safety culture may contribute to variation between hospitals. Moreover, the use of direct observation in some studies and self-report questionnaires in others introduces additional measurement differences. Therefore, the higher reported compliance among ICU nurses in the present study should be interpreted as a context-specific finding rather than a universally applicable pattern.

Several clinical and organizational mechanisms may plausibly contribute to the observed difference between ICU and General Ward nurses. Intensive care nursing frequently involves patients receiving invasive treatments, intravenous therapy, continuous physiological monitoring, and other procedures requiring strict infection prevention precautions. Repeated exposure to these clinical situations may reinforce awareness of hand hygiene indications and integrate infection prevention practices into routine nursing activities. Furthermore, the immediate consequences of healthcare-associated infections may be more apparent when caring for critically ill patients. Arai et al. highlighted the importance of infection prevention awareness and clinical factors influencing nursing adherence in intensive care environments (1). However, increased procedural complexity and workload may also create barriers to consistent performance. De Wandel et al. identified behavioral determinants associated with hand hygiene compliance in intensive care units, illustrating that knowledge, attitudes, and contextual influences may interact in shaping clinical behavior (13). Consequently, the relationship between clinical acuity and hand hygiene practice is likely multifactorial rather than attributable to patient severity alone.

Differences in working conditions may also help explain the lower mean scores and greater variability observed among General Ward nurses. General wards may involve frequent patient admissions and discharges, multiple simultaneous nursing responsibilities, and repeated transitions between patient care activities. These circumstances can increase the number of hand hygiene indications occurring during a clinical shift and may create competing demands on nursing staff. Khodadadi identified heavy workload, insufficient time, and skin-related discomfort as perceived barriers to hand hygiene compliance among nurses working in intensive care settings (6). Similarly, previous research has emphasized the importance of institutional resources and organizational conditions in supporting infection prevention practices (2,13). In the present study, General Ward scores demonstrated considerably greater dispersion than ICU scores, suggesting heterogeneity in reported practices within the ward. Nevertheless, workload, staffing levels, availability of hygiene products, and clinical supervision were not measured directly. Their possible contribution to the observed differences therefore remains explanatory rather than established.

The analysis of individual WHO hand hygiene moments provided additional insight into reported nursing practices. Across the complete sample, the highest mean frequency was observed for Moment 3, following potential exposure to body fluids, whereas comparatively lower mean scores were recorded for Moment 5, after touching patient surroundings, and Moment 1, before touching a patient. This pattern is broadly consistent with previous literature suggesting that healthcare workers may prioritize hand hygiene at moments associated with perceived personal contamination risks. Billock et al. examined indication-specific hand hygiene compliance and identified differences in adherence across clinical situations (9). Erasmus et al. further explored behavioral reasons for inadequate hand hygiene and highlighted the importance of healthcare workers' beliefs, social influences, and perceptions of infection prevention (10). Together, these findings suggest that perceived risk may influence healthcare professionals consider hand hygiene most necessary.

A potential explanation for the relatively high Moment 3 scores is that exposure to blood, secretions, excretions, or contaminated materials produces an immediate and recognizable perception of infection risk. In contrast, activities occurring before routine patient contact or after touching environmental surfaces may not always produce the same perception of urgency. Hand hygiene following contact with patient surroundings is nevertheless essential because environmental surfaces and medical equipment can contribute to indirect microbial transmission (3). The observed ordering of mean scores therefore suggests a possible difference between self-protective and patient-protective perceptions. However, this interpretation requires caution because the variation among overall item means was relatively small, individual-moment comparisons were not statistically tested, and the lowest-rated moment within the General Ward was Moment 4, after touching a patient. The findings do not establish a uniform behavioral pattern across both clinical units.

ICU nurses reported numerically higher scores for each of the five WHO moments, with the largest descriptive difference observed after touching a patient, followed by before touching a patient. These patterns may reflect differences in the organization of nursing activities, perceived infection risks, institutional routines, or the availability of hand hygiene facilities. Previous research has demonstrated that access to hand hygiene materials and the implementation of structured infection prevention interventions can influence adherence. Salama et al. investigated the relationship between bedside availability of alcohol-based hand rub and hand hygiene compliance in intensive care units, while Lydon et al. synthesized evidence concerning interventions designed to improve

adherence in critical care environments (14,15). Such findings support the importance of organizational conditions and structured infection prevention strategies. Nevertheless, the present study did not assess the availability of alcohol-based hand rub, water, soap, or other supplies, and therefore cannot determine whether resource accessibility contributed to the differences between units.

The distribution of compliance categories further illustrated differences in reported practices between the clinical groups. Although most participants were classified in the high self-reported compliance category, the proportion was greater among ICU nurses than General Ward nurses. The significant association was supported by both the conventional chi-square test and the Fisher–Freeman–Halton exact test, which was particularly relevant because some expected cell frequencies were small. ICU nurses had 3.60 times the unadjusted odds of being classified in the high-compliance category compared with General Ward nurses. However, the confidence interval was relatively wide, indicating uncertainty in the estimated magnitude of this association. Furthermore, the categories were based on Bloom-derived thresholds originally associated with educational assessment rather than clinically validated thresholds for observed hand hygiene performance (18,19). Consequently, the classification findings are useful for describing differences within the study sample but should not be interpreted as definitive evidence that individual nurses achieved internationally accepted clinical compliance standards.

The distribution of total scores also warrants consideration. ICU nurses demonstrated relatively concentrated scores near the upper limit of the scale, whereas General Ward nurses showed greater variability, including several substantially lower values. This pattern was consistent with the significant Levene's test and the larger standard deviation recorded in the General Ward. The concentration of responses near the maximum score suggests a ceiling effect, particularly among ICU participants, which may reduce the ability of the instrument to distinguish between nurses who report frequent and very frequent hand hygiene practices. Ceiling effects and non-normal score distributions may also influence estimates of variability and standardized mean differences. The use of Welch's *t* test was appropriate for addressing unequal variances in the principal comparison, while the Mann–Whitney *U* test provided a complementary assessment less dependent on normality assumptions. The agreement between these analyses supports the presence of a group difference in the measured self-report scores, although it does not resolve concerns regarding reporting bias or measurement validity.

Nursing experience was examined as a professional characteristic that might differ between the two clinical groups. Although ICU nurses had a slightly greater mean duration of experience than General Ward nurses, the between-group comparison was not statistically significant. Previous studies have suggested that professional experience may influence hand hygiene knowledge, attitudes, and practices. For example, Baseer et al. reported associations between nursing characteristics and compliance with WHO-recommended hand hygiene moments (20). Greater clinical experience may contribute to familiarity with infection prevention procedures, although routine familiarity alone does not necessarily ensure consistent adherence. In the present study, the absence of a statistically significant difference in average experience between clinical units does not establish that experience was unrelated to compliance. The relationship between individual nursing experience and total compliance score was not directly analyzed, and the comparison between units was not adjusted for experience. Therefore, residual confounding cannot be excluded.

The findings have practical implications for nursing management and infection prevention activities in secondary-level public hospitals. The lower average self-reported compliance and wider score distribution among General Ward nurses suggest that this clinical area may benefit from further assessment of hand hygiene practices and potential barriers. However, because the study relied on self-report, the results should be regarded as preliminary information for quality improvement planning rather than a direct audit of bedside adherence. The WHO Five Moments framework provides a standardized basis for evaluating hand hygiene opportunities and identifying clinical situations in which adherence requires attention (3). Combining questionnaire findings with subsequent direct observational assessment could help distinguish perceived practices from actual performance and identify the circumstances contributing to differences between clinical units.

Evidence from previous research also supports the importance of multimodal approaches to improving hand hygiene. Interventions combining education, accessibility of hand hygiene products, institutional monitoring, feedback, and organizational support may address several barriers simultaneously. Lydon et al. reviewed interventions intended to improve hand hygiene compliance in intensive care settings, highlighting the relevance

of structured improvement strategies (15). Salama et al. demonstrated the importance of bedside alcohol-based hand rub availability as a potential component of infection prevention practice (14). At the institutional level, regular education and direct observation may therefore complement assessments of staffing, workflow, and material resources. Nevertheless, no intervention was implemented or evaluated in the present study, and the findings do not establish the effectiveness of any particular improvement strategy at DHQ Hospital.

An important strength of the present investigation is its focus on registered nurses working in two distinct clinical environments within a secondary-level public hospital. By concentrating on ICU and General Ward personnel within the same institution, the study provided a direct comparison under a shared broader organizational setting. The use of the WHO Five Moments framework also ensured that the questionnaire addressed internationally recognized hand hygiene indications rather than relying exclusively on a single general question about compliance (3). Additionally, the study evaluated both continuous self-report scores and predefined compliance categories, allowing different descriptive perspectives on the distribution of responses. The five-item scale demonstrated good internal consistency, and the statistical analysis incorporated assumption checking, Welch's *t* test, nonparametric sensitivity testing, effect sizes, and exact categorical inference when conventional chi-square assumptions were not fully satisfied.

Despite these strengths, several limitations affect interpretation. First, self-reported hand hygiene frequency was not verified through direct clinical observation, introducing possible social desirability and recall bias. Second, the adapted questionnaire was informed by the WHO framework and previous self-report approaches, but evidence of its broader construct validity, criterion validity, and measurement equivalence between the two units was limited. A high Cronbach's alpha coefficient supports internal consistency but does not establish that the instrument accurately measures actual hand hygiene performance. Third, the ICR was derived from the maximum attainable Likert score and therefore should not be interpreted as the percentage of clinical hand hygiene opportunities completed. Fourth, the use of study-defined compliance categories may have simplified the score distribution and introduced classification uncertainty, particularly near the selected cutoffs.

Further limitations relate to sampling and the analytical design. The investigation was conducted in a single hospital using purposive nonprobability sampling, restricting the generalizability of its findings to other institutions and geographic settings. Although the sample exceeded the minimum calculated using a finite-population proportion-based approach, that calculation did not specifically establish statistical power for the primary comparison of group means. The modest analytical sample also limited the precision of some categorical effect estimates. One ICU participant was excluded from total-score analyses because of a missing item, although the available item responses were retained for descriptive reporting. In addition, the cross-sectional design precluded examination of temporal changes, and the absence of measured workload, staffing, supervision, resource availability, and individual-level adjustment prevented assessment of potential explanatory factors. Consequently, the observed association between clinical unit and reported hand hygiene frequency should not be interpreted as evidence of a causal relationship.

Taken together, the findings indicate that self-reported hand hygiene practices differed between ICU and General Ward nurses at DHQ Hospital, Bhakkar, with ICU personnel reporting more frequent performance across the WHO hand hygiene indications and greater representation in the study-defined high-score category. The agreement between the primary and sensitivity analyses strengthens the statistical evidence for a difference in questionnaire scores, while the limitations of self-report, possible confounding, ceiling effects, and single-center sampling constrain its clinical interpretation. The study contributes context-specific descriptive evidence that may inform subsequent observational assessments and investigations of organizational and behavioral determinants of hand hygiene practices in secondary-level public healthcare facilities.

CONCLUSION

The study demonstrated a statistically significant difference in self-reported hand hygiene compliance between nurses working in the intensive care unit and General Ward of DHQ Hospital, Bhakkar. ICU nurses reported higher total compliance scores, numerically higher scores across all five WHO hand hygiene moments, and a greater proportion of participants in the study-defined high-compliance category, while lower and more variable scores were observed among General Ward nurses. These findings indicate an association between clinical unit and reported hand hygiene frequency within the selected hospital. However, because adherence was measured using a

self-administered questionnaire rather than direct observation, the findings represent perceived routine practices and cannot establish actual bedside compliance or causal differences between clinical environments.

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