

Research Article

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# Hand Hygiene Knowledge Assessment, a Proposal for Prevent Health Care Associated Infection: A Quasi-Experimental Study in a Tertiary Care Hospital



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## Abstract

**Background:** Healthcare workers' hands are a key route for the transmission of harmful microorganisms between patients in clinical settings. Hand hygiene, particularly the use of alcohol-based hand rub, is a proven and cost-effective method for infection prevention. Therefore, sufficient knowledge and proper execution of hand hygiene techniques are essential to minimize healthcare-associated infections (HCAIs). This study evaluates the knowledge and practices of alcohol-based hand rub (Hand Hygiene) among nursing staff directly involved in patient care.

**Objective:** To assess the knowledge and practices related to hand hygiene using alcohol-based hand rub among nursing staff providing direct patient care at Liaquat National Hospital, Institute for Postgraduate Medical Studies and Health Sciences.

**Methods:** A quasi-experimental study was conducted from April 17 to June 30, 2025, involving nursing staff from one of the clinical sections of Liaquat National Hospital. A modified World Health Organization (WHO) questionnaire was used to collect demographic data and assess knowledge and practice of hand hygiene (alcohol-based hand rub), with results expressed as the percentage of correctly identified steps. A modified WHO checklist was also used to observe and evaluate the performance of the hand rub technique.

**Result:** Two hundred nurses (mean age  $34.6 \pm 7.26$  years; experience  $7.15 \pm 7.10$  years) participated, most being male. Post-intervention, knowledge of hand hygiene improved from 84.5% to 100%, correct step alignment from 45.5% to 91% ( $p < 0.001$ ), and adherence to all seven steps from 78.5% to 97.5%. Sequencing accuracy rose from 42.5% to 75% ( $p < 0.001$ ). Significant improvements were noted across gender and major qualification groups, particularly General Nursing & Specialization and Post RN/BScN.

**Conclusion:** The intervention significantly enhanced nurses' knowledge, step alignment, and adherence to proper hand hygiene practices. These improvements were consistent across genders and qualifications, with the greatest impact on sequencing accuracy. Structured training programs are essential to sustain compliance and reduce infection risks in healthcare settings.

**Keywords:** Hand Hygiene; Nurses; Infection Control; Training Intervention; Knowledge Improvement; Compliance; Healthcare-Associated Infections; Sequencing; Alignment; Education Program

## Introduction

Healthcare-associated infections (HCAIs), also called nosocomial infections, are infections acquired during care in hospitals or clinics that were not present or incubating at the time of admission. These infections pose a serious threat to patient safety worldwide and contribute to longer hospital stays, increased antimicrobial resistance, higher healthcare costs, and elevated mortality rates [1,2]. Although comprehensive global estimates are limited, recent data suggest that HCAIs continue to

affect millions of patients annually in both high-income and low-and middle-income settings.

Studies show that hand hygiene (alcohol-based hand rub) the practice during patient care is the single most effective way to prevent HCAIs [3,4]. The World Health Organization's recommended **seven-step technique** has proven to be highly effective in removing transient microorganisms from the hands. These steps include: (1) rubbing palms together, (2) rubbing the

back of both hands, (3) interlacing fingers and rubbing hands together, (4) interlocking fingers and rubbing the back of fingers on opposing palms, (5) rotational rubbing of thumbs, (6) rubbing fingertips on palms, and (7) rubbing both wrists in a circular motion followed by air drying [5]. When performed properly, this sequence ensures full surface coverage of the hands and contributes significantly to infection control. However, studies have shown that healthcare workers, including nurses, often do not fully adhere to this technique, either due to lack of training or time constraints [6]. Ensuring proper knowledge, alignment, and practice of these seven steps is crucial for effective hand hygiene, especially in high-risk clinical settings.

In developed countries such as the United States, approximately 1.7 million cases of HCAs are reported annually, leading to nearly 99,000 deaths. In the European Union, nearly 2.6 million cases are estimated each year, with over 91,000 associated deaths [7]. In contrast, data from developing regions such as Africa and South Asia is limited but suggests significantly higher rates of infection. A pooled study reported the prevalence of HCAs in African hospitals to be around 12.76%, nearly twice that of high-income countries [8]. This disparity highlights the urgent need for effective infection prevention strategies in low- and middle-income settings. Among the various strategies for preventing HCAs, **hand hygiene** stands out as the most cost-effective and practical method. The World Health Organization (WHO) has recognized hand hygiene as the single most important measure in preventing the spread of infections in healthcare settings [9]. Proper hand hygiene, including the correct sequence and technique of hand Hygiene (alcohol-based hand Rub), can significantly reduce microbial transmission among patients and healthcare workers [10].

However, despite the proven effectiveness of hand hygiene, studies show that compliance rates among healthcare workers remain suboptimal, especially in low-resource settings [11]. In lower-resource contexts, such gaps are common. A survey in eastern Ethiopia found nurses' compliance at 37.4% on average, with wide variation depending on the department [12]. Beyond these quantitative measures, qualitative research from Saudi Arabia's ICU settings has identified barriers such as workloads, lack of time, role-modeling, and environmental constraints that reduce adherence to hand hygiene [13]. Additionally, a study in Malaysia reported that gender, educational background, and cultural factors also influenced nurses' self-reported compliance and performance scores [14]. Nurses play a critical role in delivering patient care and have frequent contact with patients, making them key players in infection prevention. Their adherence to hand hygiene practices is essential to reducing infection rates in hospitals [15]. Unfortunately, research shows that many nurses have insufficient knowledge or fail to follow the proper steps and alignment of hand hygiene procedures [16]. This lack of compliance is influenced by several factors including limited training, workload, time pressure, and lack of resources [17].

Given these challenges, regular and structured training programs are necessary to reinforce hand hygiene knowledge and improve practice. Training interventions that focus on both theoretical knowledge and practical demonstration of correct hand Hygiene (alcohol-based hand Rub) techniques have been shown to increase compliance and improve outcomes. However, in many healthcare institutions, such programs are either lacking or inconsistently implemented.

This study seeks to assess the effectiveness of hand hygiene training on the knowledge, procedural alignment, and practical implementation of hand hygiene steps among nursing staff at Liaquat National Hospital, Institute for Postgraduate Medical Studies and Health Sciences. By analyzing pre- and post-intervention responses, the research aims to generate meaningful insights into the role of structured educational interventions in enhancing infection control practices and minimizing the incidence of healthcare-associated infections (HCAs).

## Objective

To assess the knowledge and practices related to hand hygiene using alcohol-based hand rub among nursing staff providing direct patient care at Liaquat National Hospital, Institute for Postgraduate Medical Studies and Health Sciences.

## Material/Methodology

This quasi-experimental pre-post study was conducted at Liaquat National Hospital, Institute for Postgraduate Medical Studies and Health Sciences, between April 17 and June 30, 2025, to evaluate the impact of training on hand hygiene compliance. A non-probability consecutive sampling technique was employed, and 200 nursing employees were recruited from an initial pool of 210 eligible participants, achieving a 95.2% response rate. Sample size calculated by taking prevalence of hand hygiene practice among nursing, P1=26% before educational intervention and P2=42% after educational intervention using power of text (B)=90%. The total calculated sample size is 186 nursing employees with the help of online sample size calculator (<http://wnarfin.github.io/ssc/ssmcnemar.html>) taking 95% confidence level, then 200 were included to enhance validity.

Data collection involved a structured knowledge questionnaire adapted from WHO's "Hand Hygiene Knowledge Questionnaire for Health Care Workers" and direct observation using a WHO-based seven-step hand hygiene checklist for alcohol-based hand rub (ABHR). Observations were conducted shift-wise to align with work schedules, and in cases where both assessments could not be performed on the same day, alternate arrangements were made. The questionnaire comprised 10 questions, including seven short-answer questions and three sequencing items, assessing knowledge of ABHR use, infection transmission routes, and key moments for hand hygiene, while the observation form documented compliance with individual steps and correct sequencing.

**Inclusion criteria:** Nurses working at the wards, critical areas, and other areas provided they make contact with patients, were eligible to participate.

**Exclusion criteria:** Nurses in administrative positions and who do not attend to patients were excluded.

**Statistical analysis:** Data was compiled and analyzed using IBM SPSS version 27. Mean and standard deviations was presented for the quantitative. Frequencies and percentages was presented for the qualitative variables. McNemar test was used for paired comparison of categorical data. P-value  $\leq 0.05$  was considered as statistically significant.

## Results

A total of 200 nurses participated in the study, the average age of the nurses was  $34.6 \pm 7.26$  years. Their average years' of work experience was  $7.15 \pm 7.10$ . Majority of the nurses were male. The distribution of the qualification was noted as General Nursing & Specialization 73(36.5), Post RN/BScN 73(36.5), BSN holders 21(10.5%), Nurse Aids 17(8.5%), General Nurses 8(4%), Midwives 6(3%), and Technicians 2(1%). All the details were

presented in (Table 1).

**Table 1:** Demographic details of the nurses under study.

Characteristics	n(%)
Age	$34.6 \pm 7.26$
Experience	$7.15 \pm 7.10$
Gender	
Male	135(67.5)
Female	65(32.5)
Qualification	
General Nursing & Specialization	73(36.5)
Post RN/ BScN	73(36.5)
BSN	21(10.5)
Nurse Aid	17(8.5)
General Nurse	8(4)
Midwife	6(3)
Technician	2(1)

**Table 2:** Comparison of nurse's pre versus post responses regarding knowledge, alignment and practice of hand hygiene steps.

Hand Hygiene Steps	Pre	Post	P-value
Knowledge of steps	169(84.5)	200(100)	<0.001*
Alignment of steps	91(45.5)	182(91)	<0.001*
Practice of steps (All)	157 (78.5)	195 (97.5)	<0.001*
Practice (Correct in Sequence)	85 (42.5)	150 (75)	<0.001*

McNemar test was applied

\*Significant at  $p < 0.05$

A comparison of nurse's pre versus post responses regarding knowledge, alignment and practice of hand hygiene steps presented in Table 2. Nurses' knowledge of proper hand hygiene procedures increased from 169 (84.5%) before the intervention to 200 (100%) after the training. Additionally, there was a considerable improvement in the correct alignment of these steps rising from 91 (45.5%) pre-intervention to 182 (91%) post-intervention ( $p < 0.001$ ). In terms of practice, overall performance of all seven steps of alcohol-based hand hygiene increased from 157 (78.5%) pre-intervention to 195 (97.5%) post-intervention. However, the proportion of nursing employees who followed correct sequencing was achieved by 85 (42.5%) to 150 (75%) ( $p < 0.001$ ) (Figure 1 & Table 2).

Knowledge reached 100% post-intervention among both genders (males: 82.2%→100%, females: 89.2%→100%) and all qualification groups. Alignment improved significantly for males (44.4%→91.1%) and females (47.7%→90.8%) ( $p < 0.001$ ). By qualification, the greatest gains were in General Nursing & Specialization (46.6%→95.9%) and Post RN/BScN (43.8%→97.3%) (Table 3).

Significant improvements were observed in adherence to all seven ABHR steps (78.5%→97.5%) and sequencing (42.5%→75%) post-training ( $p < 0.001$ ). Male nurses improved from 81.4% to 97.7% and females from 72.3% to 96.9%, with major gains among General Nursing & Specialization (78.0%→97.2%) and Post RN/BScN (84.9%→98.6%) (Table 4).

**Table 3:** Pre-post comparison of nurse's responses regarding knowledge and alignment of hand hygiene steps with respect to gender and qualification.

Hand Hygiene Steps	Knowledge		P-value	Alignment			P-value
	Pre	Post		Pre	Post		
Gender							
Male	111(82.2)	135(100)	-	60(44.4)	123(91.1)		<0.001*
Female	58(89.2)	65(100)	-	31(47.7)	59(90.8)		<0.001*
Qualification							
General Nursing & Specialization	60(82.2)	73(100)	-	34(46.6)	70(95.9)	<0.001*	
Post RN/ BScN	67(91.8)	73(100)	-	32(43.8)	71(97.3)	<0.001*	
Nurse Aid	13(76.5)	17(100)	-	6(35.3)	10(58.8)	0.344	
BSN	13(61.9)	21(100)	-	11(52.4)	18(85.7)	0.039*	
General Nurse	8(100)	8(100)	-	5(62.5)	8(100)	-	
Midwife	6(100)	6(100)	-	3(50)	4(66.7)	1	
Technician	2(100)	2(100)	-	2(100)	1(50)	-	

McNemar test was applied

\*Significant at  $p < 0.05$

**Table 4:** Pre-post comparison of nurse's responses regarding Practice All Steps and Practice Correct in Sequence of hand hygiene steps with respect to gender and qualification.

Hand Hygiene Steps	Practice All Steps		P-value	Practice Correct in Sequence		P-value
	Pre	Post		Pre	Post	
Gender						
Male	110 (81.4)	132 (97.7)	<0.001	52 (38.5)	105 (77.7)	<0.001
Female	47 (72.3)	63 (96.9)	0.001	33 (50.8)	45 (69.2)	0.030*
Qualification						
General Nursing & Specialization	57(78)	71 (97.2)	0.001	34 (46.5)	59 (80.8)	0.002*
Post RN/ BScN	62 (84.9)	72 (98.6)	0.0045	33 (45.2)	57 (78.0)	<0.001
Nurse Aid	12 (70.5)	15 (88.2)	0.3983	5 (29.4)	11 (64.7)	0.020*
BSN	15 (71.4)	21(100)	0.0207	8 (38.0)	12 (57.1)	0.32
General Nurse	6 (75)	8(100)	0.4667	3 (37.5)	6 (75)	0.35
Midwife	4 (66.6)	6 (100)	0.4545	2 (33.3)	4 (66.6)	0.5
Technician	1 (50)	2 (100)	1	0 (0)	1 (50)	1

McNemar test was applied

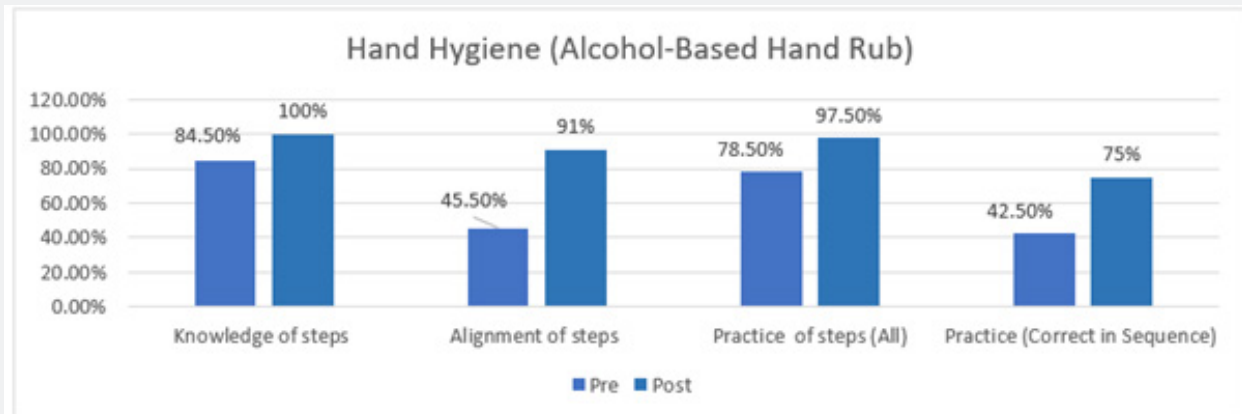
\*Significant at  $p < 0.05$

## Discussion

This quasi-experimental study demonstrated that structured training interventions can significantly enhance the knowledge and practices of hand hygiene among nursing employees using alcohol-based hand rub (ABHR). The findings revealed that while 98.3% of participants demonstrated knowledge of hand hygiene, only 58.7% achieved a good or moderately good level in practical application, indicating a knowledge-practice gap consistent with

previous research [1].

Despite high self-reported awareness and formal training among most participants, actual compliance with proper hand hygiene techniques based on the seven-step WHO recommended protocol remained suboptimal. Similar trends have been observed in other settings, including hospitals in Malaysia, Ethiopia, and Saudi Arabia, where barriers such as time constraints, workload, and lack of monitoring contributed to poor adherence [2,3].



**Figure 1:** Hand Hygiene (Alcohol-Based Hand Rub).

The high percentage (87.3%) of nurses receiving formal hand hygiene training suggests a strong institutional effort toward infection prevention. However, the finding that only 0.5% of participants achieved “good” knowledge levels raises concerns about the quality, frequency, and reinforcement of these training programs. These results align with observations from Alhassan [2], who highlighted that occasional and unstructured training often fails to translate into improved clinical practice.

Several studies have stressed that while knowledge is essential, behavioral and environmental factors significantly influence actual practice [5]. For example, Pittet et al. [3] found that role modeling by senior staff and institutional culture had a stronger influence on compliance than knowledge alone. Additionally, qualitative insights from intensive care units suggest that environmental factors such as the availability of ABHR dispensers and visual reminders affect consistent hand hygiene behavior [6].

The regression analysis from this study underscores that variables such as duration of service, prior training, and department placement may predict knowledge and practice alignment, similar to findings by Asadollahi et al. [12] and Seman et al. [15]. The use of a WHO-adapted observation checklist enhanced objectivity in evaluating hand hygiene steps, further validating the utility of standardized monitoring tools in quality improvement efforts.

Moreover, the observed high usage rate of soap and water hand washing among participants (96.8%) supports the idea that availability and familiarity influence preference, as noted by Salemi et al. [16]. Nevertheless, ABHR remains the gold standard for routine hand hygiene unless hands are visibly soiled, due to its rapid action and broad-spectrum efficacy [5].

This study adds to growing evidence that ongoing, structured, and department-specific hand hygiene training paired with

behavioral reinforcement strategies is essential for sustainable improvement. Visual tools, UV demonstrations (e.g., Glo Germ gel), real-time feedback, and departmental audits may further bridge the gap between knowledge and behavior.

### Limitations

The study was limited to a single tertiary care hospital and focused solely on nursing Employees, which may affect generalizability. Moreover, the quasi-experimental design without a control group limits causality inference. Future research should include multi-center randomized trials and explore longitudinal effects of repeated training.

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