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Article

Assessing Nursing Students' Awareness and Preventive Practices for Catheter-Associated Urinary Tract Infections

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ABSTRACT

Background: Catheter-associated urinary tract infections (CAUTIs) are among the most common hospital-acquired infections, accounting for nearly 40% of all nosocomial cases. Although preventable, they contribute to increased patient morbidity and healthcare burden. Nursing students, often involved in catheter care during clinical training, must possess adequate knowledge of CAUTI prevention. Despite existing guidelines, a gap persists in assessing awareness at the student level in low- and middle-income countries. **Objective**: To assess the level of knowledge regarding preventive practices for catheter-associated urinary tract infections among undergraduate nursing students and identify key areas of deficiency.

Methods: This quantitative cross-sectional study was conducted at Rashid Latif Nursing College, Lahore, from October 2024 to April 2025. A total of 96 BSN students were selected using simple random sampling. Data were collected using a validated online questionnaire with 15 knowledge-based items and analyzed using SPSS version 23.0. Descriptive statistics and a one-proportion Z-test were used to evaluate overall knowledge levels. **Results**: The mean correct response rate was 60.51% ($Z = 3.28$, $p = 0.0011$), indicating moderate to good knowledge among participants. High accuracy was noted for meatal cleaning before catheterization (83%) and aseptic urine aspiration (71%). However, deficits were evident in knowledge of post-catheter care and lubricant use, with 9.22% of responses marked "Don't know. **Conclusion**: While most nursing students demonstrated adequate understanding of CAUTI prevention, notable gaps remain. Strengthened clinical education and infection control training are essential to close these gaps and promote safe catheter practices.

Keywords: Catheter-Associated Urinary Tract Infections, CAUTI, Nursing Education, Infection Prevention, Urinary Catheterization, Patient Safety, Clinical Training

INTRODUCTION

Catheter-associated urinary tract infections (CAUTIs) remain one of the most prevalent healthcare-associated infections (HAIs), accounting for approximately 40% of all nosocomial infections globally, with more than 80% attributable to indwelling urethral catheters (1,2). Despite being largely preventable, CAUTIs contribute significantly to increased morbidity, prolonged hospital stays, and elevated healthcare costs. In low- and middle-income countries (LMICs), the burden of CAUTIs is likely underestimated due to gaps in surveillance systems, inadequate training, and limited adherence to evidence-based preventive practices (3). The Centers for Disease Control and Prevention (CDC) and the Association for Professionals in Infection Control and Epidemiology (APIC) have issued comprehensive guidelines for CAUTI prevention, including aseptic insertion techniques, use of antimicrobial-coated catheters, prompt catheter removal, and rigorous hand hygiene (4,5). However, the implementation of these guidelines often falls short, particularly in resource-constrained settings. Among healthcare professionals, nurses—and by extension, nursing students—play a pivotal role in the insertion, maintenance, and removal of urinary catheters. Their adherence to recommended infection control protocols is instrumental in preventing CAUTIs. Therefore, their level of knowledge and preparedness directly impacts patient outcomes. A study conducted in Ethiopia found that only 58.4% of nurses demonstrated good knowledge regarding CAUTI prevention, suggesting a critical gap in professional readiness (6). Another cross-sectional study in Nigeria revealed that 57.3% of nursing students had adequate knowledge, but significant misconceptions persisted, highlighting the need for targeted educational interventions (7). Similarly, research from Malaysia and Pakistan underscores the variation in CAUTI-related knowledge among nursing students, often influenced by clinical exposure and institutional training quality (8,9). These findings indicate that while some students acquire sufficient theoretical knowledge, gaps remain in translating this knowledge into effective preventive practice.

The population at risk—hospitalized patients requiring catheterization—relies on nurses and nursing students to prevent iatrogenic complications. Yet, educational institutions may not always provide comprehensive training on CAUTI prevention as part of clinical rotations or curriculum design. This disconnect between education and practice poses a major challenge to infection control in hospitals. Although previous studies have assessed CAUTI knowledge among practicing nurses, few have focused specifically on the awareness levels of undergraduate nursing students undergoing clinical training in Pakistan. Moreover, limited literature exists on their understanding of catheter hygiene, insertion protocols, and the care bundle approach recommended to prevent CAUTIs in real-world clinical settings (10,11).

Given this context, the present study seeks to assess the level of awareness and preventive knowledge regarding CAUTIs among nursing students at Rashid Latif Nursing College, Lahore. By identifying specific knowledge gaps, this research aims to inform curriculum development and training enhancements that can reduce preventable infection rates. We hypothesize that nursing students possess a moderate level of knowledge about CAUTI preventive measures, with significant room for improvement in critical practice areas. The study's objective is to determine the proportion of nursing students demonstrating adequate knowledge of evidence-based CAUTI prevention strategies and to highlight opportunities for educational reform that align with global infection control standards.

MATERIALS AND METHODS

This quantitative cross-sectional study was conducted at Rashid Latif Nursing College (RLNC), part of the Rashid Latif Medical Complex in Lahore, Pakistan, to evaluate the knowledge levels of undergraduate nursing students regarding preventive measures for catheter-associated urinary tract infections (CAUTIs). The study was carried out over a span of 28 weeks, from October 2024 to April 2025, following a pre-specified GANTT chart schedule that structured phases of literature review, ethical approval, data collection, analysis, and manuscript preparation. The study population consisted of undergraduate Bachelor of Science in Nursing (BSN) students currently enrolled in RLNC who had commenced their clinical rotations.

A total of 184 students met the inclusion criteria, which required active enrollment in the BSN program and ongoing participation in clinical training at affiliated hospitals. Students who had not yet begun clinical placements or who declined consent were excluded. From this population, a sample of 96 students was selected using a simple random sampling method to minimize selection bias and ensure representativeness. Informed consent was obtained electronically, and participation was voluntary and anonymous, with assurances of data confidentiality and the right to withdraw without penalty. Data were collected using a structured, pre-validated questionnaire designed to assess demographic variables and knowledge related to CAUTI prevention. The questionnaire consisted of two sections: the first included demographic information such as age and gender, and the second comprised 15 dichotomous items assessing factual knowledge on CAUTI prevention practices. Response options for each knowledge item were coded as "True" (1), "False" (0), or "Don't know" (2). The instrument was adapted from existing validated tools and was pretested for reliability, achieving Cronbach's alpha of 0.79, indicating acceptable internal consistency. The questionnaire was distributed via Google Forms to facilitate efficient data collection and reduce nonresponse bias.

Operational definitions were used to quantify knowledge levels. A correct response (True) indicated appropriate knowledge, while incorrect or "Don't know" responses signaled knowledge deficits. Total scores were aggregated, and descriptive statistics were used to calculate proportions of correct responses per item and overall knowledge levels across participants. Data were analyzed using IBM SPSS version 23.0. Descriptive statistics, including means, frequencies, and percentages, were used to summarize demographics and item-level responses. A Z-test for one proportion was employed to determine whether the proportion of students demonstrating adequate knowledge significantly differed from the hypothesized value of 50%, which was considered the threshold for moderate awareness. A p-value < 0.05 was considered statistically significant. Ethical approval for the study was obtained from the Institutional Review Board of Rashid Latif Medical Complex. All ethical protocols, including voluntary informed consent, anonymity of participants, and data protection measures, were strictly adhered to throughout the research process. Data were securely stored, and only the principal investigator had access to the identifiable dataset. The study was designed and implemented to maintain transparency, reproducibility, and adherence to ethical standards in human research.

RESULTS

A total of 96 nursing students participated in the study, yielding a 100% response rate. Among these, 51 were female (53%) and 45 were male (47%). The majority of participants (n=76, 79%) were aged between 21 and 25 years, followed by 15 students (16%) under the age of 20, 4 students (4%) aged 26–30 years, and only 1 participant (1%) aged above 30. This demographic distribution indicates that the study sample predominantly consisted of young adult nursing students currently undergoing clinical training (Table 1).

Knowledge responses were analyzed for 15 statements related to CAUTI prevention. The overall proportion of correct responses across all items was 60.51%, indicating that the majority of students possessed a moderate-to-good level of knowledge. The item with the highest correct response rate (83%) was related to antiseptic meatal cleaning before catheter insertion. In contrast, items with lower accuracy included routine use of antiseptic lubricants (50% correct) and meatal cleansing post-catheterization (48% correct), highlighting persistent knowledge gaps in areas of catheter care maintenance. Students demonstrated strong understanding in several areas: 69% accurately recognized that alcohol-based hand sanitizers are effective in preventing CAUTIs, and 71% correctly identified aspirating urine from a disinfected needleless port as a standard preventive technique. Additionally, 70%

supported continuous bladder irrigation in cases where obstruction is anticipated. However, uncertainty remained, as some items had up to 18% of responses marked as "Don't know," suggesting the need for further instructional clarity.

Table 1: Demographic Characteristics of Participants (n = 96)

Variable	Category	Frequency	Percentage
Gender	Male	45	47%
	Female	51	53%
Age (in years)	<20	15	16%
	21–25	76	79%
	26–30	4	4%
	>30	1	1%

Table 2: Knowledge of Preventive Measures Related to CAUTI Among Nursing Students (n = 96)

No.	Item	False (%)	True (%)	Don't Know (%)
1	Antiseptic lubricants reduce CAUTI more than non-antiseptic ones	25%	68%	7%
2	Silver-coated catheters increase urethral irritation/resistance	26%	64%	10%
3	Routine use of antiseptic lubricants is necessary	43%	50%	7%
4	Bladder irrigation with antiseptics prevents CAUTI	30%	60%	10%
5	Alcohol hand sanitizer equals handwashing in preventing CAUTI	31%	69%	0%
6	Adding microbial solutions to drainage bags reduces infections	38%	51%	11%
7	Meatal cleansing with post-catheterization with antiseptics is beneficial	36%	48%	16%
8	Silicone preferred to Teflon/latex in long-term use	23%	64%	13%
9	Aspirate urine from disinfected needleless port for small volumes	16%	71%	13%
10	Antiseptic meatal cleaning before insertion reduces CAUTI	12%	83%	5%
11	Continuous irrigation prevents obstruction	20%	70%	10%
12	Routine catheter/bag changes are recommended	32%	55%	13%
13	Obtain urine aseptically from drainage bag for large volumes	36%	52%	12%
14	No benefit of clamping before removal on bacteriuria	28%	55%	17%
15	Antimicrobial prophylaxis is effective for long-term catheter use	23%	59%	18%

The findings were statistically analyzed using a one-proportion Z-test to determine whether the observed correct response rate differed significantly from a hypothesized threshold of 50%. The observed mean correct response rate of 60.51% was statistically significant ($Z = 3.28$, $p = 0.0011$), indicating that students' knowledge exceeded the baseline threshold with a high degree of confidence. Collectively, the results affirm that nursing students at Rashid Latif Nursing College possess moderate knowledge of CAUTI preventive measures, with statistically significant awareness levels across key practice areas. However, approximately 30% of participants provided incorrect answers and 9% admitted to lacking knowledge, suggesting that curricular enhancements are needed to reinforce critical prevention competencies.

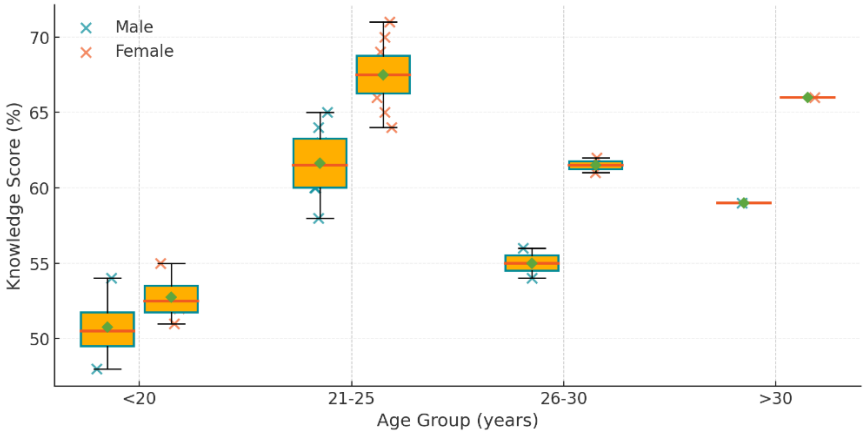

Figure 1 Knowledge Score Distribution by Age Group and Gender

Knowledge scores are higher in the 21–25 year age group, with median values exceeding 65% for both genders and noticeably tighter interquartile ranges compared to other age groups. In the youngest and oldest categories, knowledge scores are more dispersed and modest in both male and female students. The gender comparison across age brackets demonstrates minimal difference, as box medians and means are closely aligned; however, females in the 21–25 group achieve the highest individual scores. Distribution patterns highlight that middle age groups—those with the greatest clinical exposure—consistently outperform others, while extreme age groups exhibit both lower medians and greater variability in knowledge. These findings suggest that optimal knowledge

acquisition regarding catheter-associated urinary tract infection prevention coincides with the primary years of undergraduate training and clinical immersion.

DISCUSSION

The findings of this study reveal that nursing students at Rashid Latif Nursing College demonstrate a moderate-to-good level of knowledge regarding catheter-associated urinary tract infection (CAUTI) prevention, with 60.51% of all responses accurately identifying evidence-based preventive practices. This level of awareness aligns closely with previously reported results in regional and international literature. For instance, a similar study in Karachi reported 61.7% of nursing students had adequate knowledge of CAUTI prevention, suggesting comparable educational standards and clinical exposure across institutions in Pakistan (1). Moreover, this proportion is marginally higher than the 57.3% reported among Nigerian nursing students (2) and the 58.4% observed among practicing nurses in Ethiopia (3), reinforcing the notion that structured theoretical training and early clinical exposure can positively influence students' preparedness to engage in infection control practices.

Several knowledge items in this study yielded particularly high accuracy, including recognition of the importance of antiseptic meatal cleaning prior to catheter insertion (83%), and understanding the aseptic technique for aspirating urine from disinfected ports (71%). These findings indicate a strong theoretical foundation in critical catheter care domains. However, there were areas where misconceptions and uncertainty persisted—particularly around the necessity of routine antiseptic lubricant use, post-catheterization cleansing, and adding microbial solutions to drainage bags. These mixed results mirror those reported by Mong et al. in Malaysia, where 68.7% of nurses demonstrated overall good knowledge, but discrepancies emerged in practice-specific details (4). Such findings underscore the need to differentiate between general awareness and detailed procedural competency in CAUTI prevention. Interestingly, the gender distribution in this study was nearly balanced, with 53% females and 47% males, a noteworthy distinction from other studies that either lacked gender data or were skewed heavily toward female participants (5,6). This relative gender parity enhances the external validity and generalizability of the results, making the observed knowledge levels reflective of a more demographically representative student population. Compared to studies such as Jelly et al. (2022), which exclusively included female participants, this broader sampling frame offers more inclusive insights into the educational preparedness of nursing cohorts (7).

While this study confirms the presence of foundational knowledge among nursing students, the observed 9.22% of "Don't know" responses and 30.27% incorrect answers highlight existing knowledge deficits. These gaps may arise from inconsistent emphasis in classroom instruction, limited clinical mentorship, or insufficient reinforcement of infection control protocols during rotations. Evidence from Mota and Oliveira (2019) supports this interpretation, noting that gaps in practice adherence often stem from insufficient alignment between didactic education and real-world clinical expectations (8). This calls for a reevaluation of curriculum design to incorporate simulation-based training, skills checklists, and care bundle implementation that reinforce theoretical content with hands-on application.

The results are also consistent with findings by Teshager et al. (2022), who reported that 67.4% of ICU nurses in Ethiopia possessed good knowledge of CAUTI prevention—an expected outcome given their extended professional experience (9). However, the marginal difference between students (60.51%) and professionals (67.4%) in these studies points to the positive effect of clinical training even at undergraduate levels. Furthermore, these findings highlight the necessity of introducing quality improvement education and CDC-guided infection prevention protocols early in nursing education to ensure safe transition from student to practitioner (10).

Despite the strengths of this study—including a clearly defined population, validated tool, and structured methodology—several limitations warrant acknowledgment. The study was conducted at a single institution, which limits the generalizability of the findings to other educational or healthcare settings. Moreover, the use of self-reported knowledge measures may introduce bias, as students might overestimate their understanding due to social desirability. The cross-sectional design also restricts the ability to infer causality between clinical exposure and knowledge levels. Finally, the study did not assess behavioral adherence or practical performance, leaving open questions about the translation of knowledge into action—a gap similarly noted in the work of Davran and Karaca (2021) (11). Given these findings, future research should consider longitudinal or multi-institutional designs to evaluate how repeated clinical exposure, simulation training, and institutional policies influence knowledge retention and procedural accuracy in CAUTI prevention. Interventions could also explore the impact of digital learning modules, infection control workshops, or interprofessional collaborations on improving nursing competencies.

CONCLUSION

This study concludes that nursing students at Rashid Latif Nursing College possess a moderate-to-good level of knowledge regarding the prevention of catheter-associated urinary tract infections, with 60.51% of responses indicating accurate understanding of recommended preventive practices. While this reflects a promising foundation of awareness, substantial gaps remain in specific procedural areas critical to effective CAUTI prevention. The findings reinforce the need for enhanced infection control training within nursing curricula, integrating theoretical education with clinical application through simulations, care bundles, and evidence-based guidelines. Strengthening such educational strategies will ensure that future nurses are adequately prepared to reduce CAUTI incidence, improve patient safety, and support broader public health goals within hospital environments.

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