RESEARCH PAPER

Assessment of Knowledge, Attitude, and Practices Regarding Prevention of Catheter-Associated Urinary Tract Infections Among Nursing Staff: A Cross-Sectional Study

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Abstract

Background

Catheter-associated urinary tract infections (CAUTIs) are among the most common healthcare- associated infections (HAIs), contributing to increased patient morbidity, prolonged hospitalization, and healthcare costs. Nursing staff play a critical role in preventing CAUTIs through appropriate catheter insertion, maintenance, and adherence to aseptic techniques. Their knowledge, attitude, and practice (KAP) directly influence the quality of catheter care and infection prevention outcomes. However, existing literature suggests gaps in KAP among nursing professionals, particularly in resource-limited settings. The aim of this study was to assess the knowledge, attitude, and practice of nursing staff regarding catheter care and infection prevention.

Methodology

A cross-sectional questionnaire-based study was conducted at tertiary care hospital involving 197 nursing staff. After obtaining informed consent, data were collected using a validated structured questionnaire for nursing staff to assess their knowledge, attitude, and practice regarding catheter care and infection prevention. Data were analyzed using SPSS v27.

Results

Descriptive analysis revealed that among nursing staff, 77 (39.1%) had adequate knowledge, 67 (34.0%) had moderately adequate knowledge; 74 (37.6%) had a favourable attitude, and 35 (17.8%) showed a moderately favourable attitude; 93 (47.2%) reported adequate practice, while 40 (20.3%) demonstrated moderately adequate practice. The overall KAP was found to be moderate among the majority of participants.

Conclusion

The study concludes that although the nursing staff demonstrated a moderate level of KAP, there remains a need for structured and continuous professional education to improve their competency in catheter care. Addressing knowledge gaps and fostering a more positive attitude are crucial to ensuring better patient outcomes.

Keywords: attitude, catheter-associated urinary tract infection (cauti), healthcare-associated infection, infection prevention, knowledge, nurse, practice

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Introduction

Catheter-associated urinary tract infections (CAUTIs) are widely acknowledged as one of the most prevalent types of healthcare-associated infections [1].Hospital-acquired infections (HAIs) are a critical concern for patient safety, as they can lead to longer hospital stays, increased rates of complications and death, overuse of antibiotics, and significant economic pressure on healthcare services [2- 4].Urinary tract infections that develop 48 hours after the urinary catheter is inserted or removed are known as catheter-associated UTIs [5].A urinary tract infection (UTI) arises when an infection affects any component of the urinary system, including the kidneys, ureters, bladder, or urethra.In more serious instances, the condition can lead to both localized and widespread complications, such as kidney infections (pyelonephritis), bloodstream infections, the formation of urinary stones, an increased risk ofbladder cancer, and in extreme cases, may even result in death. Among hospital- acquired infections, catheter-associated urinary tract infections (CAUTIs) are particularly common. According to the National Healthcare Safety Network (NHSN), CAUTIs rank among the most frequently reported infections in healthcare settings [6-8].In pediatric healthcare settings, catheter- associated urinary tract infections (CAUTIs) are considered among the two or three most common healthcare-associated infections [9].Pediatric patients with CAUTIs spend an average of 2.4 more days in the hospital and incur seven thousand dollars in excess charges [10].HAIs not only worsen patient outcomes by increasing illness and the risk of death, but they also add to the financial stress and emotional toll experienced by the patient's family [1 1-13].According to findings reported in the Journal of Hospital Infection, around 12% to 16% of adult patients admitted to hospitals receive an indwelling urinary catheter during their stay, with the risk of developing a catheter-associated urinary tract infection (CAUTI) rising by 3% to 7% for each additional day the catheter is in place [14].Catheter-associated urinary tract infection (CAUTI) is characterized by the presence of a significant bacterial load in the urine of a patient with an indwelling urinary catheter. These infections occur when microorganisms-commonly Gram-negative and Gram-positive bacteria, as well as fungi- invade the urinary tract through the catheter. CAUTIs are associated with increased patient morbidity and mortality, extended hospital stays, and elevated healthcare costs [15].Prevention is the cornerstone in combating catheter-associated urinary tract infections (CAUTIs), with estimates suggesting that between 17% and 69% of these infections-amounting to approximately 380,000 cases and 9,000 deaths each year-could be avoided through effective infection control measures [16]. The estimated incidence rates of catheter-associated urinary tract infections (CAUTIs) in various hospital settings across India, expressed per 1000 catheter-days. The highest incidence was observed in ICU settings (10.4/1000 catheter-days), followed by tertiary hospitals (9.2/1000) and surgical wards (8.5/1000). The lowest rates were noted in general wards (6.0/1000) [17-18]. The Knowledge-Attitude-Practice (KAP) model, introduced by Mayo in the 1960s, outlines a sequential process where individuals acquire knowledge, develop attitudes, and adopt practices related to health behaviors. In this framework, "knowledge" refers to the understanding of relevant information, "attitude" encompasses beliefs and feelings towards that information, and "practice" denotes the actions taken. The model suggests that knowledge acts as the basis for behavioral transformation, whereas attitudes function as the motivational element that encourages the implementation of new practices [19]. Nursing staff hold a central role in catheter management and infection prevention. Their ability to maintain aseptic technique, adhere to protocols, and apply best practices directly impacts patient safety and clinical outcomes. However,there is a lack of comprehensive research exploring how nursing staff's understanding, mindset, and clinical practices collectively influence CAI prevention in routine care. This study addresses that gap by evaluating both the role of patient sociodemographic characteristics and the KAP of nursing staff in relation to catheter care, by identifying highlighting areas where nursing practice may be improved, This study aims to support the advancement of infection control practices with the goal of ultimately enhancing patient outcomes.

Materials And Methods

Aim

To evaluate the impact of knowledge, Attitude, and practices (KAP) on catheter care and infection prevention healthcare settings.

Study design and setting

This study was a cross-sectional questionnaire-based study conducted among nursing staff to assess their knowledge, attitude, and practices regarding catheter care and prevention of catheter-associated urinary tract infections (CAUTI). The study was carried out at tertiary care hospital. A semi structured questionnaire was adapted from the validated tool developed by Balu et al., 2021, used to assess the Knowledge, Attitude and Practice levels on prevention of CAUTI among nursing staffworking in a tertiary care hospital. The duration of the study was six months. Ethical approval was

obtained from the Institutional Research Ethics Committee, ensuring adherence to ethical research standards.

Ethical approval

The study received ethical clearance from the Research Ethics Committee of JNUIMSRC (Approval No. JNUIMSRC/IEC/2025/04) and was carried out in compliance with institutional policies and established ethical standards.

Sample size and sampling technique

The sample size was calculated using Cochran's formula, with a 95% confidence level and a 5% margin of error, assuming a population proportion of 0.5 to ensure maximum variability. The initial estimated population size was 400, from which a sample size of 197 was calculated. Participants were recruited using a convenience sampling method.

Inclusion and exclusion criteria

The study included nursing staffwho were currently employed and actively engaged in patient care at the selected healthcare institution during the study period, and who provided informed consent to participate. Interns, nursing students, staff not working in direct patient care, those on leave during data collection, and individuals who declined or withdrew consent were excluded from the study.

Data Collection Tools

A validated structured questionnaire on knowledge and modified Likert scaled attitude, and practice questionnaire were given to the participants for assessment. It was framed by following the review of literatures, national, and international CDC guidelines. The questionnaire was validated by following face validity method. The validity and reliability of the tool were tested by conducting a pilot study in different group of participants working in tertiary care hospital. The participants involved in the pilot study were not included in the present study.

Methods of measurement

The questionnaire consisted of four sections. The demographic data section, it consists of details of the participants such as age, gender, education, profession, and professional experience. This was followed by a set of 14, yes or no questions to assess the level of knowledge. Score of "1" was awarded to the correct response and "0" was awarded to the incorrect response accordingly. The possible total knowledge score could range from 0 to 14. Based on the mean score, the level of knowledge was classified into inadequate, moderately adequate, and adequate knowledge, if the score was below, equal and more than the mean score.The section to assess attitude comprised of 8 statements which was scaled by using 5 points Likert scale.

Options for the provided positive statements were "Strongly Agree," "Agree," "Neither agree nor disagree," "Disagree," and "Strongly disagree" and was given score from 1to 5, respectively. The scores were reversely coded as 5, 4, 3, 2, and 1, for negatively phrased questions. Then, the overall attitude score was calculated, which could range from 8 to 40. Attitude scores 'below the mean' was assigned for unfavourable attitude section, 'above the mean score' were assigned for favourable attitude section, and 'equal to the mean score'were classified under moderately favourable attitude section. The final sections for practice assessment had a set of 10 statements which were scaled by 3 point scale. Options for the provided positive statements were "Agree," "Neither agree nor disagree," and "Disagree," scored from 1 to 3, as stated. The scores were reversely coded as three, two, one, for negatively phrased questions. Then, total overall score calculated, ranged from 10 to 30. Practice scores were categorized into three sections - inadequate practice, moderately adequate practice, and adequate practice. The below mean score was categorized into inadequate practice, above mean score was categorized into adequate practice, and equal to mean score was assigned for moderately adequate practice section. The data collection tool was adapted from a previously published and validated questionnaire on CAUTI prevention Balu et al. (22).

Statistical analysis

Data were entered and analysed using IBM SPSS Statistics for Windows, Version 27 (IBM Corp). The Shapiro-Wilk test indicated that the data were not normally distributed; therefore, non-parametric tests were applied. Descriptive statistics such as frequencies, percentages, means, and standard deviations were used to summarize the responses in each domain of nursing staff demography. The validated questionnaire was adapted from Balu et al. (2021) to assess the knowledge, attitude, and practices of nursing staff regarding catheter care and CAUTI prevention, divided separately into three components: Knowledge, Attitude, Practice.

Results

In descriptive statistics was used and the majority being male 157(79.7%), aged between 20-29 years (143). In terms of designation, 176 (89.3%) of the participants were staff nurses, the majority were posted in the medicine unit (46; 23.4%), and 131 (66.5%) had 1-5 years of experience. Educational qualifications showed that 1 10 (55.8%) held a diploma, and a majority of the nursing staff 129 (65.5%) had received training.In Descriptive statistical analysis was performed to evaluate the knowledge, attitude, and practices (KAP) of nursing staff regarding catheter care and CAUTI prevention. The mean knowledge score was 9.95 ± 2.07, with 39.1% exhibiting adequate knowledge (score 1 1-14) , 34% showing moderately adequate knowledge (score 9-10), and 26.9% of participants demonstrating inadequate knowledge (score 0-8). The mean attitude score was 28.32 ± 4.25, where 37.6% showed a favorable attitude (score 30-40), 17.8% had a moderately favorable

attitude (score 28-29), and 44.7% had an unfavorable attitude (score 8-27). The mean practice score was 25.83 ± 2.89, with 47.2% reporting adequate practices (score 27-30), 20.3% having moderately adequate practices (score 25-26), and32.5% demonstrating inadequate practices (score 10-24). A correlation analysis revealed there was no significant correlation was found between KAP and demography of nursing staff.

Knowledge of nursing staff

The descriptive analysis reveals that while a majority of nursing staff exhibited good knowledge on CAUTI prevention, notable gaps still exist. Specifically, 62.9% (n = 124) correctly identified the role of catheter duration in CAUTI, yet 37.1% (n = 73) failed to recognize this risk. 58.9% (n = 1 16) were aware that catheters should be removed within 24 hours postoperative, whereas 41.1% (n = 81) were not.Similarly, 61.9% (n = 122) linked prolonged hospital stay with increased CAUTI risk,but 38.1% (n = 75) did not. Regarding catheter care practices, 55.3% (n = 109) knew that frequent use of antiseptic lubricants is unnecessary, while 44.7% (n = 88) answered incorrectly. Finally, 68.0% (n = 134) acknowledged the benefit of daily cleaning of the meatus and catheter, yet 32.0% (n = 63) were unaware.

TABLE 1: Knowledge of nursing staff

Q.No.	Knowledge variable	Yes n (%)	No n (%)
Q1	Is the most common hospital-acquired infection CAUTI?	157 (79.7%)	40 (20.3%)
Q2	Is the risk factor of CAUTI not directly related to the duration of catheterization?	124	73
Q3	Do high-risk groups for CAUTI include female gender and elderly patients?	148 (75.1%)	49 (24.9%)
Q4	Is acute urinary retention and bladder obstruction the indication for catheterization?	145 (73.6%)	52 (26.4%)
Q5	Are strict aseptic precautions to be followed for urinary catheterization?	156 (79.2%)	41 (20.8%)
Q6	Should catheters be removed as soon as possible or within 24 hours for catheterized postoperative patients?	116 (58.9%)	81 (41.1%)
Q7	Is cleaning the peri-urethral region with antiseptics mandatory to prevent CAUTI?	154 (78.2%)	43 (21.8%)
Q8	Should the urinary catheter be secured properly after insertion to prevent displacement or injury to the bladder?	156 (79.2%)	41 (20.8%)
Q9	Does CAUTI increase with the duration of the patient's stay in the hospital?	122 (61.9%)	75 (38.1%)
Q10	If the urinary catheter remains indwelling for a month, is the risk of bacteriuria high?	152 (77.2%)	45 (22.8%)
Q11	May silicone-alloy-coated indwelling urinary catheters benefit patients for long-term care?	140 (71.1%)	57 (28.9%)
Q12	Is the frequent use of lubricants with antiseptics not necessary?	109 (55.3%)	88 (44.7%)
Q13	Does daily cleaning of the meatus and catheter with soap and water reduce the possibility of CAUTI?	134 (68.0%)	63 (32.0%)
Q14	Is CAUTI most often caused by Escherichia coli?	142 (72.1%)	55(27.9%)

n = number of participants (n = 197)

Attitude of nursing staff

The descriptive analysis shows a large proportion-85.7% (n = 169)-agreed that renewal reminders for catheter replacement help prevent CAUTI, and 74.6% (n = 148) recognized the importance of education in catheter care. However, 66.0% (n = 130) expressed agreement or neutrality with the notion that CAUTI development is unavoidable among catheterized patients, reflecting a passive attitude toward prevention. Similarly, 50.3% (n = 99) did not consider CAUTI a serious illness, and 54.8% (n = 108) agreed or remained neutral on the belief that catheters can be removed at the convenience of healthcare workers-both attitudes contrary to safe clinical practice. Furthermore, 46.7% (n = 92) questioned the necessity of aseptic precautions during catheter removal, and 42.7% (n = 84) held incorrect beliefs regarding routine screening for asymptomatic bacteriuria.

TABLE 2: Attitude of nursing staff

Q.No.	Variables	Strongly agree n (%)	Agree n (%)	Neither agree nor disagree n (%)	Disagree n(%)	Strongly disagree n(%)
Q15	Renewal reminders for catheter prevents CAUTI	85 (43.1%)	84 (42.6%)	24 (12.2%)	04 (2.0%)	00 (0%)
Q16	Development of CAUTI cannot be avoided among catheterized patients	23 (11.7%)	107 (54.3%)	43 (21.8%)	18 (9.1%)	06 (3.0%)
Q17	CAUTI is not a very serious illness	34 (17.3%)	65 (33.0%)	56 (28.4%)	35 (17.8%)	07 (3.6%)
Q18	Education regarding basic catheter care helps to prevent CAUTI	52 (26.4%)	96 (48.7%)	35 (17.8%)	13 (6.6%)	01 (0.5%)
Q19	Health care workers can remove the catheter whenever they are convenient	25 (12.7%)	83 (42.1%)	55 (27.9%)	23 (11.7%)	11 (5.6%)
Q20	Prevention of CAUTI is a frequent problem and impossible to attain it	18 (9.1%)	78 (39.6%)	42 (21.3%)	49 (24.9%)	10 (5.1%)
Q21	Aseptic precautions may not be needed for removing the Foley's catheter	33 (16.8%)	59 (29.9%)	38 (19.3%)	52 (26.4%)	15 (7.6%)
Q22	Routine screening for asymptomatic bacteriuria (ASB) is recommended in catheterized patients, which has now not advised by the CDC prior to catheter insertion.	22 (11.2%)	62 (31.5%)	51 (25.9%)	41 (20.8%)	21 (10.7%)

n = number of participants (n = 197)

Practice of nursing staff

A large majority followed key protocols such as hand hygiene before and after catheter handling (87.8%) and catheterization only when indicated (74.6%). Most also recognized the importance of proper catheter size (71.6%) and regular training (73.6%). However, adherence dropped for critical practices like maintaining a closed drainage system (61.9%) and correct positioning of the urine bag below bladder level (67.0%). Additionally, 55.8% still believed in routine bladder irrigation contradicting current guidelines- and 27.4% supported patient isolation for UTI, revealing outdated practices. Neutral responses were high in areas such as urine drainage maintenance (27.9%) and urine bag emptying (27.4%), suggesting uncertainty.These findings underline the need for uniform, evidence- based clinical training to bridge practice gaps and standardize catheter care protocols.

TABLE 3: Practice of nursing staff

Q.No.	Variables	Agree n (%)	Neither agree nor disagree n (%)	Disagree n (%)
Q23	Before and after handling the catheter site, hands must be washed with antiseptics.	173 (87.8%)	23 (11.7%)	01 (0.5%)
Q24	Appropriate catheter size should be used to minimize urethral trauma	141 (71.6%)	52 (26.4%)	04 (2.0%)
Q25	Urinary Catheterization must be done whenever there is an appropriate indication.	147 (74.6%)	43 (21.8%)	07 (3.6%)
Q26	Twisting and kinking of the catheter must be prevented for an unobstructed flow of urine	122 (61.9%)	48 (24.4%)	27 (13.7%)

Q27	At least once daily, the bladder must be irrigated with antimicrobial solutions/iodine solution.	110 (55.8%)	60 (30.5%)	27 (13.7%)
Q28	Urine collection bag should be emptied regularly	129 (65.5%)	54 (27.4%)	14 (7.1%)
Q29	Urine collection bag must be positioned and fixed below the level of the bladder	132 (67.0%)	48 (24.4%)	17 (8.6%)
Q30	Isolation must be done for a patient with UTI, from other non- infected patients	101 (51.3%)	42 (21.3%)	54 (27.4%)
Q31	Maintaining close drainage system prevents CAUTI	122 (61.9%)	55 (27.9%)	20 (10.2%)
Q32	Regular educational training to be given on basic urinary catheter care	145 (73.6%)	38 (19.3%)	14 (7.1%)

n = number of participants (n = 197)

Correlation analysis of KAP (knowledge, attitude, practice)

A correlation analysis revealed a significant positive relationship between knowledge and practice (ρ = 0.152, p = 0.032), indicating that nursing staff with higher knowledge levels tend to perform better in practical catheter care. However, no significant correlation was observed between knowledge and attitude (ρ= 0.019, p = 0.789) or between attitude and practice (ρ = 0.007, p = 0.920), suggesting that attitude alone does not strongly influence practice and may require additional support through training and institutional reinforcement.

TABLE 4: Correlation Analysis of KAP

Relationship	Correlation Coefficient (ρ)	p-value (Sig. 2-tailed)
Knowledge ↔ Practice	0.152**	0.032**
Knowledge ↔ Attitude	0.019	0.789
Attitude ↔ Practice	0.007	0.920

**Significant at p<0.05 (2-tailed test)
*Spearman Correlation

Discussion

The present study assessed the knowledge, attitude, and practices (KAP) of nursing staff regarding catheter care and prevention of catheter-associated urinary tract infections (CAUTI). A total of 197 nursing staff participated in the study. The majority were female, predominantly within the 20-29 years age group, and held diploma or bachelor's qualifications with 1-5 years of clinical experience. This demographic profile reflects a relatively young and early-career nursing workforce. Similar characteristics have been reported in studies involving nursing staff in healthcare settings [20].

The mean knowledge score in the present study was 9.95 ± 2.07, with 39.1% of participants demonstrating adequate knowledge, 34% moderately adequate knowledge, and 26.9% inadequate knowledge. These findings indicate a moderate level of awareness regarding CAUTI prevention among nursing staff. Comparable results were observed by Balu et al. [21], who reported that 71.6% of participants had adequate knowledge of CAUTI prevention practices. Although knowledge levels appear satisfactory, the proportion of inadequately informed staff suggests a need for continuous educational reinforcement and periodic competency assessments.

Regarding attitude, the mean score was 28.32 ± 4.25, reflecting a generally moderate attitude toward CAUTI prevention. However, a notable proportion (44.7%) demonstrated an unfavorable attitude, while only 37.6%exhibited a favorable attitude. These findings suggest that, despite awareness of infection control measures, negative attitudes may persist among healthcare professionals. Mong et al. [22] emphasized that attitude plays a central role in translating knowledge into clinical practice, influencing compliance with infection prevention protocols.

The mean practice score was 25.83 ± 2.89, with 47.2% of participants reporting adequate practices, while 20.3% and 32.5% demonstrated moderately adequate and inadequate practices, respectively. These findings indicate a gap between knowledge and its translation into clinical practice. Such discrepancies are often associated with systemic factors, including high workload, inadequate supervision, limited institutional support, and insufficient monitoring mechanisms [23-24]. Similarly, previous studies have reported that adherence to catheter care protocols improves with structured supervision, regular audits, and performance feedback.

No statistically significant association was observed between demographic variables, including age, gender,education, designation, years of experience, and prior CAUTI training, and the knowledge, attitude, or practice levels of nursing staff ($p > 0.05$). Comparable observations have been noted in other studies, suggesting that demographic factors may not consistently influence KAP outcomes among healthcare
professionals. which also reported that demographic characteristics did not significantly influence infection prevention behaviors. These results suggest that CAUTI-related practices may be more strongly shaped by institutional protocols, workplace culture, and standardized training programs rather than individual demographic factors. Furthermore, Singh et al. [25]. underscored the influence of healthcare professionals'perceptions and institutional support systems on the quality of patient care. They highlighted that continuous professional development and supportive organizational culture enhance compliance with infection prevention practices, particularly in high-risk populations such as the elderly. Overall, while the present study demonstrates moderate knowledge and generally acceptable practice levels among nursing staff, the presence of unfavorable attitudes and inconsistent adherence underscores the need for structured training programs, continuous monitoring, and reinforcement of evidence-based guidelines to strengthen CAUTI prevention strategies.

Conclusions

The present study aimed to assess the knowledge, attitude, and practices (KAP) of nursing staff regarding catheter care and the prevention of catheter-associated urinary tract infections (CAUTIs), The findings revealed that the overall level of KAP among nursing staffwas moderate, indicating a foundational understanding of catheter care but also highlighting areas that require strengthening through targeted educational initiatives. This study also revealed a statistically significant positive correlation between knowledge and practice among nursing staff ($\rho = 0.152$, $p = 0.032$), suggesting that enhanced knowledge modestly contributes to improved catheter care practices. However, the lack of significant associations between knowledge and attitude, and between attitude and practice, indicates that knowledge alone may not drive attitudinal shifts or consistent behavioral outcomes. These findings emphasize the need for integrated educational and institutional strategies that foster both understanding and adherence to infection prevention protocols.

Additional Information

Author Contributions

All authors contributed to the manuscript, reviewed the final version, and approved it for publication.

Concept and Design: Hari Shankar, Rajveer Singh

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Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. ESR/905/Inst/RAJ/2017/RR-20 issued approval JNUIMSRC/IEC/2025/04. Ethical approval for this study was obtained from the Institutional Ethics Committee of Jaipur National University Institute for Medical Sciences and Research Centre (JNUIMSRC), Jaipur, India. The study was approved under approval number JNUIMSRC/IEC/2025/04 dated 15 January 2025. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work.
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References

1. Meddings J, Rogers MA, Krein SL, Fakih MG, Olmsted RN, Saint S: Reducing unnecessary urinary catheter use and other strategies to prevent catheter-associated urinary tract infection: an integrative review. BMJ Qual Saf. 2014, 23:277-289. 10.1136/bmjqs-2012-001774
2. Burke JP: Infection control - a problem for patient safety . N Engl J Med. 2003, 348:651-656. 10.1056/NEJMhpr020557
3. Allegranzi B, Bagheri Nejad S, Combescure C, et al.: Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. Lancet. 2011, 377:228-241. 10.1016/S0140- 6736(10)61458-4
4. Umscheid CA, Mitchell MD, Doshi JA, Agarwal R, Williams K, Brennan PJ: Estimating the proportion of healthcare-associated infections that are reasonably preventable and the related mortality and costs. Infect Control Hosp Epidemiol. 2011, 32:101-114. 10.1086/657912
5. Saint S, Greene MT, Krein SL, et al.: A Program to Prevent Catheter-Associated Urinary Tract Infection in Acute Care. N Engl J Med. 2016, 374:2111-2119. 10.1056/NEJMoa1504906

6. Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA: Guideline for Prevention of Catheter-Associated Urinary Tract Infections 2009. Infection Control & Hospital Epidemiology. 2010, 31:319-326. 10.1086/651091
7. Majeed A, Sagar F, Latif A, et al.: Does antimicrobial coating and impregnation of urinary catheters prevent catheter-associated urinary tract infection? A review of clinical and preclinical studies. Expert Rev Med Devices. 2019, 16:809-820. 10.1080/17434440.2019.1661774
8. Mala R, Annie Aglin A, Ruby Celsia AS, et al.: Foley catheters functionalised with a synergistic combination of antibiotics and silver nanoparticles resist biofilm formation. IET Nanobiotechnol. 2017, 11:612-620. 10.1049/iet-nbt.2016.0148
9. Lyren A, Brilli RJ, Zieker K, Marino M, Muething S, Sharek PJ: Children's Hospitals' Solutions for Patient Safety Collaborative Impact on Hospital-Acquired Harm. Pediatrics. 2017, 140:20163494. 10.1542/peds.2016-3494
10. GoudieA, Dynan L, Brady PW, Fieldston E, Brilli RJ, Walsh KE: Costs of Venous Thromboembolism, Catheter-Associated Urinary Tract Infection, and Pressure Ulcer. Pediatrics. 2015, 136:432-439. 10.1542/peds.2015-1386
11. Klevens RM, Edwards JR, Richards CLJr, et al.: Estimating health care-associated infections and deaths in U.S. hospitals, 2002. Public Health Rep. 2007, 122:160-166. 10.1177/003335490712200205
12. Stone PW, Kunches L, Hirschhorn L: Cost of hospital-associated infections in Massachusetts. Am J Infect Control. 2009, 37:210- 214. 10.1016/j.ajic.2008.07.011
13. Zhan C, Miller MR: Excess length of stay, charges, and mortality attributable to medical injuries during hospitalization. JAMA. 2003, 290:1868-1874. 10.1001/jama.290.14.1868
14. Whitaker A, Colgrove G, Scheutzow M, Ramic M, Monaco K, Hill JLJr: Decreasing Catheter-Associated Urinary Tract Infection (CAUTI) at a community academic medical center using a multidisciplinary team employing a multi-pronged approach during the COVID-19 pandemic. Am J Infect Control. 2023, 51:319-323. 10.1016/j.ajic.2022.08.006
15. Nicolle LE: Catheter associated urinary tract infections . Antimicrob Resist Infect Control. 20143, 23-2014. 10.1186/2047-2994-3-23
16. Rebmann T, Greene LR: Preventing catheter-associated urinary tract infections: An executive summary of the. Association for Professionals in Infection Control and Epidemiology, Inc, Elimination Guide. Am J Infect Control. 2010, 38:644-646. 10.1016/j.ajic.2010.08.003
17. Mehta A, Rosenthal VD, Mehta Y, et al.: Device-associated nosocomial infection rates in intensive care units of seven Indian cities. Findings of the International Nosocomial Infection Control Consortium (INICC). J Hosp Infect. 2007, 67:168-174. 10.1016/j.jhin.2007.07.008
18. Guidelines for Prevention and Control of Catheter-Associated Urinary Tract Infections in Healthcare Settings (2019). ICMR.:
19. Huang A, Hong W, Zhao B, Lin J, Xi R, Wang Y: Knowledge, attitudes and practices concerning catheter- associated urinary tract infection amongst healthcare workers: a mixed methods systematic review. Nurs Open. 2023, 10:1281-1304. 10.1002/nop2.1384
20. Balu P, Ravikumar D, Somasunder VM, et al.: Assessment of Knowledge, Attitude and Practice on Prevention of Catheter- associated Urinary Tract Infection (CAUTI) among Health Care Professionals Working in a Tertiary Care Teaching Hospital. J Pure Appl Microbiol. 2021, 15:335-345. 10.22207/JPAM.15.1.28
21. Mody L, Meddings J, Edson BS, et al.: Enhancing Resident Safety by Preventing Healthcare-Associated Infection: A National Initiative to Reduce Catheter-Associated Urinary Tract Infections in Nursing Homes. Clin Infect Dis. 2015, 61:86-94. 10.1093/cid/civ236
22. Mong I, Ramoo V, Ponnampalavanar S, Chong MC, Wan Nawawi WNF: Knowledge, attitude and practice in relation to catheter- associated urinary tract infection (CAUTI) prevention: A cross-sectional study. J Clin Nurs. 2022, 31:209-219. 10.1111/jocn.15899
23. Bawaqneh KA, Ayed A, Salameh B: Nurses' Knowledge, Attitude, Practice, and Perceived Barriers of Infection Control Measures in the Intensive Care Units at Northwest Bank Hospitals. Crit Care Nurs Q. 2025, 48:160-171. 10.1097/CNQ.0000000000000538
24. Lee MH, Jun SH: Factors Affecting the Infection Control Practices of Nurses at University Hospitals . Healthcare (Basel. 2022:1517-2022. 10.3390/healthcare10081517
25. Singh S, Gupta R, Gill S, et al. (August 20, 2024) Perception and Attitude of Dental Students Towards Geriatric Care: A Questionnaire-Based Survey. Cureus 16(8): e67297. doi:10.7759/cureus.67297