Assessment of healthcare professionals' knowledge regarding catheterization indications and prevention of catheter-associated urinary tract infections; a comprehensive study

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ARTICLE INFO

ABSTRACT

Introduction: The healthcare professionals' knowledge about catheter-associated urinary tract infections (CAUTIs) is crucial for effective CAUTI prevention which is a significant portion of the healthcare-associated infections that contributes to complications among hospitalized patients.

Objectives: This study aimed to assess the knowledge levels of healthcare professionals, specifically nurses and physicians, in the context of urinary catheterization indications and CAUTI prevention.

Materials and Methods: This cross-sectional study employed a structured questionnaire aligned with CDC guidelines in Jordanian hospitals that captured the physicians and Nurses knowledge of urinary catheterization and CAUTI prevention.

Results: The analysis of the data indicates that nurses possess slightly higher knowledge levels compared to physicians. Specifically, in the domain of "Appropriate Urinary Catheter Use," nurses demonstrated a statistically significant higher mean score than physicians (4.2 ± 0.7 versus 3.8 ± 0.5, $t = -2.14$, $P = 0.024$). Similarly, nurses attained a statistically higher mean scores than physicians in the domain of "catheter materials" (Mean $\pm$ SD=3.2 ± 0.4 versus 2.9 ± 0.3; $t=3.2$, $P = 0.002$). The domain of "proper techniques for urinary catheter maintenance," nurses exhibited a statistically non-significant higher mean score than physicians (Mean $\pm$ SD = 4.3 ± 0.5 versus 4.1 ± 0.4). Moreover, the domains of "appropriate urinary catheter use" and "proper techniques for urinary catheter maintenance" showed commendable understanding among both professions.

Conclusion: This study reveals that while differences exist in knowledge between nurses and physicians regarding urinary catheterization and CAUTI prevention, both professions demonstrate strong competency in key aspects. Collaboration between nurses and physicians, along with the integration of advanced techniques, is recommended for optimal patient outcomes.

Implication for health policy/practice/research/medical education:
This study assesses healthcare professionals' knowledge of urinary catheterization and the prevention of catheter-associated urinary tract infections in Jordanian hospitals. It reveals that nurses exhibit slightly higher knowledge levels than physicians, particularly in "appropriate catheter use" and "catheter materials," highlighting areas for collaborative improvement.

Please cite this paper as: Al-Rawashdeh S, Qaddumi B, Ayyad M, Ayaad O, Alkhatatbeh H, Abu Alhaijaa E, Shatnawi R, Ibrahim R, Majed M, AlDhahli SN. Assessment of healthcare professionals' knowledge regarding catheterization indications and prevention of catheter-associated urinary tract infections; a comprehensive study. J Renal Inj Prev. 2025; x(x): e38385. doi: 10.34172/jrip.2025.38385.

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Introduction

Catheter-associated urinary tract infections (CAUTIs) are a predominant concern in the realm of healthcare-associated infections. Epidemiologically, CAUTIs account for a significant chunk of complications among hospitalized patients. An estimated 15-25% of such patients are subjected to urinary catheters during their stay, and a concerning 3-7% of these individuals eventually develop CAUTI (1-3). Several risk factors accentuate the propensity for CAUTIs, with the duration of catheterization topping the list (4). Other factors, such as female gender, advanced age, an immunocompromised state, and improper catheter care, also exacerbate the risk (5). Patients with CAUTIs typically present symptoms like fever, lower abdominal discomfort, malodorous or discolored urine, and altered urination patterns (6). The ripple effects of these infections can be profound, occasionally spiraling into severe conditions like pyelonephritis, sepsis, or even bacteremia (7). The economic implications of CAUTIs are equally daunting (8). Extended hospitalizations, supplementary diagnostic and treatment regimens, and the looming threat of financial penalties for healthcare institutions underscore the economic strain. Moreover, the rampant use of antibiotics to counter these infections paves the way for drug-resistant strains, making subsequent infections more arduous and cost-intensive to treat (9).

Prevention, as they say, is better than cure. The cornerstone of CAUTI prevention lies in circumscribed catheter use (10). Healthcare professionals must ensure catheters are used judiciously and removed promptly once their necessity wanes. Adhering to impeccable hygiene standards during insertion and routine care, and opting for antimicrobial catheters where appropriate, can further slash the risk (5).

Additionally, barrier methods, such as sterile drapes and gloves during insertion, can be instrumental (2). The importance of knowledge among health providers cannot be emphasized enough in this context (1). Regular hands-on training sessions elucidating the correct techniques for catheter care can be a game-changer (9). It's imperative for healthcare staff to be cognizant of the risks tethered to prolonged catheter use (2).

Familiarity with institutional guidelines on catheter care, coupled with regular updates on CAUTI rates and practices, can foster a culture of continuous improvement. Furthermore, equipping health providers with the tools to enlighten patients about CAUTIs can be immensely beneficial, as well-informed patients can play an active role in infection prevention (4). In essence, the battle against CAUTIs demands a multifaceted approach, with the knowledge and proactive involvement of health providers playing a pivotal role (8).

Despite the prevalence of standardized protocols and the recognized importance of catheterization in patient care, there persists a marked variability in its application and associated outcomes (10,11). One critical factor influencing this scenario is the depth, consistency, and applicability of healthcare professionals' knowledge regarding the indications for catheterization and the best practices for CAUTI prevention (11). Anecdotal evidence and isolated studies have hinted at gaps in understanding and adherence to recommended guidelines among medical professionals (12).

There is an emergent need to comprehensively assess the knowledge levels of healthcare providers in relation to catheterization and CAUTI prevention (13). A failure to address this knowledge gap not only jeopardizes patient safety and well-being but also escalates the economic burden on healthcare systems through prolonged treatments and potential litigations (8-10). This study aims to provide a holistic understanding of the current state of knowledge among healthcare professionals, identify potential areas of improvement, and lay the groundwork for targeted educational interventions.

The significance of assessing healthcare professionals' knowledge regarding catheterization indications and the prevention of CAUTIs cannot be understated. At its heart, this study embodies the very essence of healthcare—a steadfast commitment to patient safety (14). Unearthing gaps in knowledge and practice provides a pathway to tailor interventions that enhance patient safety, ensuring an elevated standard of care (15).

Moreover, the economic ramifications of CAUTIs, from extended hospitalizations to potential litigation costs, make the insights from this study crucial for healthcare institutions eyeing both clinical excellence and financial sustainability. On a broader scale, CAUTIs and their associated antibiotic treatments potentially lead to the rise of antibiotic-resistant pathogens. By honing in on optimal catheterization practices and prevention strategies, this research plays a pivotal role in the global movement toward antibiotic stewardship. It further empowers healthcare providers by pinpointing areas for professional development and training, fostering an environment of continuous learning (14).

Beyond individual practitioners, the findings stand to reshape institutional practices. The study's insights can catalyze the formulation of standardized practices, ensuring consistency in patient care across the board. Such standardizations, in turn, could influence policy decisions at higher administrative levels, weaving the study's findings into the very fabric of healthcare policy and practice. For patients, the ripple effects of this study manifest as increased trust in their healthcare providers, knowing that they are informed and adhere to the best practices. Additionally, this research, by meticulously mapping the current state of affairs, provides a robust foundation for future explorations in the domain, guiding subsequent research endeavors (15-18). In its entirety, this study not only addresses the immediate challenges linked with catheterization and CAUTIs but also threads its significance into the broader tapestry of healthcare

advancement, policy formulation, and patient-provider trust.

Objectives

The aim of this study was to meticulously analyze and comprehend the current level of awareness, understanding, and application of knowledge by healthcare professionals concerning catheterization indications and CAUTI prevention.

Materials and Methods

Study design and participants

A descriptive, cross-sectional and comparative study design was adopted to fulfill the objectives of this study over a three-month period, from January 2024 to March 2024. This approach, often used in health research, offered insights into the prevalence of specific practices, knowledge levels, or conditions at a particular point in time. It was an effective way to gauge the perspectives and understanding of a defined group, in this instance, healthcare professionals.

The research backdrop was the diverse landscape of public Jordanian Hospitals. Five public Jordanian hospitals were chosen conveniently to conduct this study. These hospitals, with their varied patient demographics and healthcare practices, provided a rich environment for understanding how universally accepted guidelines, such as those from the Centers for Disease Control and Prevention (CDC), are translated into real-world clinical settings.

The study targeted healthcare professionals, specifically physicians and nurses working in these hospitals during the designated period.

Inclusion and exclusion criteria

Participants were included if they met the following criteria: (1) they were either physicians or nurses, (2) they had at least three months of continuous work experience in the same hospital, and (3) they consented to participate in the study. Exclusion criteria included healthcare professionals from other disciplines, those with less than three months of experience in their current unit, or individuals who declined participation.

Sample size

The total population of eligible healthcare professionals across the selected hospitals was 2965. Using a standard sample size calculation for cross-sectional studies with a 95% confidence level and a 5% margin of error, the minimum required sample size was approximately 340 participants. We increased the sample size to enhance representativeness and statistical power. The sample was selected using the convenience sampling approach, this technique, while not strictly random, was chosen for its practicality and efficiency in reaching our target audience in the chosen setting.

Data collection

Data were collected using a structured, self-administered questionnaire composed of two main sections. The first section captured demographic characteristics of the participants, including their profession (physician or nurse), age group (20–30, 30–40, or 40–50 years), gender (male or female), educational level (diploma, bachelor's, or master's degree), years of professional experience (1–5, 6–10, 11–15, or more than 15 years), and marital status (single, married, divorced, or widowed). These variables provided essential context for understanding the background and diversity of the study population.

The second section of the questionnaire focused on assessing participants' knowledge regarding CAUTI prevention and best practices in urinary catheterization (16,17). Developed in alignment with the CDC guidelines, this section was divided into six key domains; appropriate urinary catheter use, proper techniques for urinary catheter insertion, proper techniques for urinary catheter maintenance, catheter materials, management of obstruction, and specimen collection. Each domain comprised items that explored specific aspects of clinical practice, with responses captured on a five-point Likert scale ranging from "strongly disagree" to "strongly agree" (16,17).

The second section of the questionnaire was designed to evaluate participants' knowledge related to CA-UTI prevention and best practices in urinary catheterization. This instrument was developed in alignment with the CDC guidelines, which provided a robust, evidence-based framework to ensure the questionnaire content reflected global best practices in infection control and patient safety (17,18). The tool comprehensively assessed various dimensions of clinical knowledge, divided into six core domains; appropriate urinary catheter use, proper techniques for urinary catheter insertion, proper techniques for urinary catheter maintenance, catheter materials, management of obstruction, and specimen collection (16,17).

Participants were prompted to respond to each statement on a scale ranging from one to five, where one represented "Strongly Disagree" and five signified "Strongly Agree". The first domain, titled "appropriate urinary catheter use", comprised five items that concentrated on the proper circumstances and durations for urinary catheter utilization. This section also addressed the precautions essential for distinct patient demographics, such as the elderly, women, and those with weakened immune systems (16,17).

Following this, the "proper techniques for urinary catheter insertion" domain had five items. These items delved into the essential practices and hygienic measures during the catheter insertion process. Subsequently, the "proper techniques for urinary catheter maintenance" domain contained 10 items. These items highlighted the importance of maintaining both the sterility and

functionality of the catheter after its insertion. Topics ranged from the emphasis on a closed drainage system to guidelines on when catheters should be replaced (16,17).

The fourth domain, "Catheter Materials", consisted of three items. This section investigated the various types of catheter materials available and assessed their suitability for diverse patient needs and situations. The "Management of Obstruction" domain, which had just one item, outlined the appropriate course of action in instances where a catheter-related obstruction was suspected. Lastly, the "Specimen Collection" section, with its three items, delineated the sterile methods necessary when procuring urine samples for a variety of tests (16,17).

Participation in the study was entirely voluntary. Written informed consent was secured through a cover letter attached to the questionnaire, wherein participants were asked to indicate their agreement to participate by selecting either "Yes" or "No" in response to a clearly stated consent question.

Validity of the questionnaire used
The questionnaire demonstrated strong psychometric properties. Content validity was established through expert review and alignment with CDC standards. Reliability was confirmed through internal consistency metrics, with Cronbach's alpha values ranging from 0.831 to 0.884 across all domains. Confirmatory factor analysis (CFA) showed that all items had factor loadings above 0.60, supporting item-construct relationships. Model fit indices indicated an excellent fit (comparative fit index [CFI] = 0.962, Tucker-Lewis index [TLI] = 0.957, root mean square error of approximation [RMSEA] = 0.042, standardized root mean square residual [SRMR] = 0.035, χ^2/df = 1.87, P = 0.062). Convergent validity was confirmed with average variance extracted (AVE) values between 0.58 and 0.64.

Outcomes
The outcomes include the comparison of total score and scores of all domains between nurses and physicians.

Statistical analysis
Statistical analysis was conducted using IBM SPSS Statistics version 29. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize participants' demographic characteristics and knowledge scores. Chi-square tests were applied to compare categorical demographic variables such as age, gender, educational level, years of experience, and marital status between physicians and nurses, identifying statistically significant differences that could act as potential confounders. Independent samples T-tests were used to compare knowledge scores between physicians and nurses across each urinary catheterization knowledge domain. To examine differences in total knowledge scores across demographic subgroups, independent t-tests were

employed for binary variables (e.g., gender), while one-way analysis of variance (ANOVA) was employed for variables with more than two categories (e.g., age group, education level, experience, and marital status). Where applicable, test values (t or F) and p-values were reported to determine statistical significance, which was set at $P < 0.05$.

Internal consistency was assessed using Cronbach's alpha. Construct validity was examined via CFA, and item loadings were calculated. Model fit was evaluated using indices including the CFI, TLI, RMSEA, SRMR, and the chi-square to degrees of freedom ratio (χ^2/df). Convergent validity was assessed through the AVE.

Results
The study included a balanced number of physicians and nurses. A comparison of demographic characteristics between the two professional groups revealed several statistically significant differences. In terms of age, nurses tended to be younger than physicians, with most nurses in the early career age group, while physicians were more concentrated in older age brackets. This age difference was statistically significant, suggesting that age may influence the knowledge or experience levels assessed in subsequent analyses. Although both male and female participants were evenly represented in the overall sample, no significant difference was observed in gender distribution between physicians and nurses, indicating gender parity across both professional groups.

Educational attainment differed markedly between the two groups. Physicians were more likely to hold advanced degrees, whereas a substantial proportion of nurses had diploma-level education. These differences in academic background reached statistical significance and could potentially impact clinical knowledge and practices. Regarding years of experience, physicians generally had more extended professional exposure, with a notable portion having worked for over a decade. Nurses, on the other hand, were more frequently found in the lower experience categories. This variation in clinical experience was statistically significant.

Lastly, marital status also showed a significant difference between the groups. A higher proportion of physicians were married, while nurses were more commonly single. This may reflect underlying differences in age, lifestyle, or work-life balance considerations between the professions. In summary, age, educational level, experience, and marital status significantly differed between physicians and nurses and should be considered as potential confounding variables in further analyses. Gender, however, did not differ significantly between the two groups (Table 1).

Table 2 presents a comparative analysis of urinary catheterization knowledge between physicians and nurses across various key domains. The results reveal several notable trends in domain-specific knowledge, with some differences reaching statistical significance.

When considering the overall knowledge scores across all domains, nurses appeared to have slightly higher mean scores than physicians. However, this difference did not reach statistical significance, suggesting that the general level of knowledge was relatively comparable between the two groups. A significant difference emerged in the domain of appropriate urinary catheter use, where nurses demonstrated a stronger understanding of correct indications and usage practices compared to their physician counterparts. This may reflect differences in the frequency of catheter-related tasks encountered in daily practice between the two professions.

In the domain of proper techniques for urinary catheter insertion, nurses again scored higher on average than physicians, although the difference was not statistically significant. This trend could point to nurses' more hands-on involvement in direct catheter insertion and procedural adherence. A similar pattern was observed in the maintenance of urinary catheters, with nurses outperforming physicians slightly. While the difference was marginally above the threshold for statistical significance, it suggests a potential clinical gap worth further exploration, particularly in the context of maintaining catheter sterility and functionality.

The most marked difference was observed in the knowledge of catheter materials, where nurses demonstrated significantly greater familiarity. This finding may be attributed to nurses' routine involvement in selecting and handling catheter types during clinical procedures, which likely enhances their practical knowledge in this area. In contrast, knowledge related to the management of catheter obstruction did not differ significantly between the two groups, indicating a comparable level of understanding of how to handle such complications.

Overall, the findings suggest that nurses generally exhibited stronger knowledge in several domains of urinary catheterization, particularly in appropriate use and catheter materials. These distinctions highlight the need for interdisciplinary reinforcement of knowledge through targeted education and collaboration (Table 2).

Table 3 presents a comparative analysis of total

Table 1. Demographic characteristics and comparison between physicians and nurses

Variable	Category	Total (n = 950)	Physicians (n = 475)	Nurses (n = 475)	*P* value
Age	20–30 years	475 (50.0%)	130 (27.4%)	345 (72.6%)	**<0.001**
	30–40 years	425 (44.7%)	290 (61.1%)	135 (28.4%)	
	40–50 years	50 (5.3%)	55 (11.6%)	15 (3.2%)	
Gender	Male	475 (50.0%)	240 (50.5%)	235 (49.5%)	0.795
	Female	475 (50.0%)	235 (49.5%)	240 (50.5%)	
Educational Level	Diploma	95 (10.0%)	0 (0.0%)	95 (20.0%)	**<0.001**
	Bachelor	712 (74.9%)	378 (79.6%)	334 (70.3%)	
	Master	143 (15.1%)	97 (20.4%)	46 (9.7%)	
Years of Experience	1–5 years	190 (20.0%)	70 (14.7%)	120 (25.3%)	0.003
	6–10 years	275 (28.9%)	155 (32.6%)	120 (25.3%)	
	11–15 years	100 (10.5%)	70 (14.7%)	30 (6.3%)	
	More than 15 years	85 (8.9%)	55 (11.6%)	30 (6.3%)	
Marital Status	Single	475 (50.0%)	180 (37.9%)	295 (62.1%)	**<0.001**
	Married	363 (38.2%)	250 (52.6%)	113 (23.8%)	
	Divorced	59 (6.2%)	25 (5.3%)	34 (7.2%)	
	Widowed	53 (5.6%)	20 (4.2%)	33 (6.9%)	

P values were calculated using chi-square tests. *P* values less than 0.05 are highlighted in bold to indicate statistically significant differences

Table 2. The comparison of urinary catheterization knowledge between physician and nurse participants

Domains	Total (Mean ± SD)	Physicians (Mean ± SD)	Nurses (Mean ± SD)	t-test (*P* value)
Appropriate urinary catheter use	4.0 ± 0.6	3.8 ± 0.5	4.2 ± 0.7	-2.14 (0.024)
Proper techniques for urinary catheter insertion	3.8 ± 0.7	3.6 ± 0.8	4.0 ± 0.6	-1.68 (0.120)
Proper techniques for urinary catheter maintenance	4.2 ± 0.5	4.1 ± 0.4	4.3 ± 0.5	-1.98 (0.051)
Catheter materials	3.05 ± 0.35	2.9 ± 0.3	3.2 ± 0.4	-3.21 (0.002)
Management of obstruction	3.8 ± 0.55	3.7 ± 0.6	3.9 ± 0.5	-1.23 (0.190)
Total (Mean ± SD)	4.05 ± 0.5	4.0 ± 0.4	4.1 ± 0.6	-1.54 (0.078)

Table 3. Total knowledge score by demographics

Variable	Category	n	Mean ± SD	Test value	*P* value
Age	20–30 years	475	4.11 ± 0.49	F = 5.46	**0.004**
	30–40 years	425	4.00 ± 0.50		
	40–50 years	50	4.05 ± 0.45		
Gender	Male	475	4.04 ± 0.49	t = -1.37	0.170
	Female	475	4.09 ± 0.53		
Educational level	Diploma	95	3.96 ± 0.54	F = 7.39	**<0.001**
	Bachelor	712	4.06 ± 0.50		
	Master	143	4.17 ± 0.44		
Years of experience	1–5 years	190	4.00 ± 0.50	F = 3.12	**0.026**
	6–10 years	275	4.06 ± 0.48		
	11–15 years	100	4.12 ± 0.47		
	More than 15 years	85	4.09 ± 0.51		
Marital status	Single	475	4.01 ± 0.53	F = 3.87	**0.009**
	Married	363	4.12 ± 0.48		
	Divorced	59	4.05 ± 0.47		
	Widowed	53	4.00 ± 0.45		

Note: ANOVA was used for variables with more than two groups. Independent T-test was used for gender. Bold *P* values indicate statistically significant differences (*P* < 0.05).

knowledge scores related to urinary catheterization across various demographic characteristics. The aim was to explore whether knowledge levels significantly varied based on age, gender, educational background, years of experience, or marital status. A statistically significant difference in knowledge scores was observed across age groups, with younger participants demonstrating higher levels of knowledge. This finding suggests that more recent graduates or early-career professionals may be more attuned to current clinical guidelines and practices. Gender did not show a statistically significant difference in total knowledge scores. Both male and female participants had similar levels of knowledge, indicating that gender was not a contributing factor to variance in understanding catheter-related procedures. In contrast, educational level was significantly associated with knowledge. Participants with postgraduate qualifications scored notably higher than those with only a diploma or a bachelor's degree. This trend underscores the value of advanced academic training in enhancing clinical competence and adherence to evidence-based practices. Years of professional experience also influenced knowledge scores, with participants who had been in practice longer tending to perform slightly better. Although the difference was modest, it was statistically significant, reflecting the potential cumulative impact of clinical exposure and ongoing professional learning.

Finally, marital status was found to be a significant factor, with married individuals achieving higher knowledge scores compared to their single, divorced, or widowed counterparts. This may indirectly reflect variables such as age, stability, or professional seniority, which could influence access to training or clinical responsibility (Table 3).

Discussion

The exploration of urinary catheterization practices and the associated knowledge among healthcare professionals has been a subject of extensive scrutiny in the medical literature. This examination, as highlighted in Table 2 and its subsequent summary, brings to light an intriguing trend: nurses exhibit a slightly heightened comprehension across various domains compared to their physician counterparts (1). These findings are consistent with the research conducted by Mong et al, which delved deep into the realm of knowledge, attitudes, and practices concerning the prevention of CAUTIs, revealing discernible differences among healthcare professionals. This slight edge in knowledge that nurses possess can often be attributed to their frequent hands-on experience with catheter insertion, maintenance, and management when compared to physicians. This experiential learning aspect becomes particularly significant (2,4).

Abubakar et al emphasized the importance of gauging the knowledge of healthcare workers in the context of CAUTI prevention, underscoring its critical role in managing and curbing infection rates. The observed disparities in the knowledge domains, especially the realm of "catheter materials" as presented in Table 3, find resonance in the discoveries of Balu et al (3). Their comprehensive assessment of knowledge, attitudes, and practices regarding CAUTI prevention among healthcare professionals accentuated the value of being well-versed in various catheter types. This holistic understanding

contributes to the mitigation of potential complications like infections and obstructions (3).

It's pertinent to acknowledge, as posited by Antwi, that the practical training regimen in nursing, particularly in intricate procedures such as catheterization, is rigorous (4). This intensity in training potentially places nurses at an advantage in specific contexts. Such a robust knowledge foundation plays a constructive role in elevating the quality of patient care. This was further corroborated by Abdelmoaty et al, whose research showcased measurable enhancements in the knowledge of intensive care unit nurses regarding the prevention of catheter-acquired urinary tract infections (5).

However, while the disparities between physicians and nurses in certain knowledge domains are noticeable, it is paramount to recognize that statistically significant differences were not observed across all domains. This observation underscores the commendably high and comparable levels of understanding that both professions maintain in certain aspects of catheterization. This notion finds harmony with the findings of Teshager et al (6), who meticulously explored the knowledge and practices of nurses in intensive care unit settings.

To optimize patient outcomes, a collaborative approach that harnesses the strengths and expertise of both physicians and nurses is strongly recommended (7,13,18). Park et al put forth the notion of leveraging advanced techniques such as machine learning to further amplify the comprehension and prevention of hospital-acquired CAUTIs, underlining the potential of technology in healthcare enhancement.

Demographic characteristics such as age, education, and experience significantly influence the level and depth of clinical knowledge among healthcare professionals. These variables operate both independently and interactively to shape cognitive readiness, awareness of current guidelines, and responsiveness to clinical demands.

Age often reflects generational differences in training exposure and access to contemporary evidence-based practices. Younger professionals, especially those in their early careers, are more likely to have been trained under updated national or institutional standards. Their education may include modules on healthcare-associated infection prevention, simulation labs focused on catheter insertion, and digital learning platforms that reinforce guideline adherence. This creates a knowledge advantage that compensates for their lack of clinical years. Additionally, younger clinicians may be more adaptive in using electronic health systems that integrate catheter reminders and order sets, further reinforcing good practices (1-5).

In contrast, older healthcare workers may possess rich experiential knowledge gained from managing diverse patient populations. However, unless they engage in regular professional development, their practices may become shaped by routine and clinical intuition rather than evolving guidelines. Continuous education is thus essential for maintaining best-practice alignment over time, particularly as catheter-associated infections and device safety protocols are areas with frequent updates (1,3).

Educational background is a particularly powerful determinant of knowledge in technical domains such as urinary catheterization. Individuals with higher academic qualifications—such as master's degrees—often undergo more comprehensive training that includes exposure to clinical research, critical appraisal skills, and deeper theoretical discussions of infection prevention and patient safety. This advanced learning fosters a mindset of inquiry and accountability, enabling them to not only follow procedures but also understand the rationale behind them. Diploma-level practitioners, while competent in foundational skills, may not have received the same depth or breadth of training, which can limit their ability to apply guidelines across complex scenarios or critically evaluate their actions (1,2,5).

Clinical experience also plays a vital role. Repeated exposure to similar clinical situations enhances familiarity and procedural fluency. Experienced professionals often develop intuitive recognition of risks or complications and are better equipped to handle challenging cases. That said, experience must be coupled with lifelong learning; without it, clinicians risk clinging to outdated practices. The value of experience is therefore best realized when it is enriched by formal knowledge updates, workshops, and evidence-based refreshers (1-3).

The association between marital status and knowledge—though not causal—can reflect broader patterns linked to age, stability, or career progression. Married professionals may have more structured lifestyles that facilitate career planning, professional development, or advanced study. They might also be more likely to hold senior roles, participate in institutional committees, or have access to formal training programs. While marital status itself does not determine competence, it may correlate with other variables that influence access to learning and leadership opportunities (1,3).

These insights emphasize the need for differentiated educational strategies. Younger and less experienced staff may benefit from hands-on mentorship and procedural reinforcement, while older or more experienced professionals may require tailored updates to prevent skill stagnation. Moreover, supporting diploma holders with pathways to academic progression can elevate baseline competencies across the workforce. Healthcare organizations that recognize and address these demographic influences can cultivate a more resilient, competent, and cohesive clinical team capable of delivering safer and more effective care.

To complement the interpretation of knowledge variation and professional competencies, it is important to contextualize these findings within broader quality

Study Highlights

What is the current knowledge?
• Knowledge of urinary catheterization and CAUTI prevention varies between nurses and physicians.
• Nurses generally have higher knowledge levels in areas like "Appropriate Urinary Catheter Use" and "Catheter Materials

What is new here?
• Differences in knowledge highlight the need for targeted education, especially for physicians in specific domains.
• Collaboration between nurses and physicians can enhance knowledge sharing and improve patient outcomes in CAUTI prevention.

management initiatives in oncology and acute care settings. A growing body of evidence underscores the value of structured interventions and leadership-driven reforms in enhancing nursing practice and patient care outcomes. For instance, shared governance frameworks supported by emotional intelligence have been shown to strengthen decision-making and operational efficiency which can enhance the work environment to prevent and handle the negative patient outcome such as infection (17,18). Similarly, qualitative evaluations of patient-centered care have illuminated gaps and strengths in both frontline and managerial perceptions, advocating for more inclusive models of care delivery (17,18).

Regarding measurable outcomes, the implementation of oncology acuity tools and structured leader rounds has been associated with improvements in patient satisfaction and outcomes including hospital acquired infection (10,18). Collectively, these studies reinforce the argument that demographic and professional variations in knowledge should not be viewed in isolation but rather addressed through systemic quality improvement frameworks that promote interdisciplinary education, leadership cultivation, and patient-centered innovation (13,18).

Lastly, it's imperative to acknowledge that while the data presented offers insightful trends, it's vital to account for the potential limitations and biases inherent in the study. Factors like the sampling methodology, regional medical practices, and varying educational curricula can wield influence over the generalizability of these findings. Zewdie et al's conclusion, drawn from their study on knowledge and practices for preventing catheter-related infections, further underscores the importance of conducting research in diverse settings to attain a comprehensive and well-rounded understanding of the subject matter (8).

Conclusion
In conclusion, the analysis of urinary catheterization practices and the associated knowledge among healthcare professionals reveals that nurses tend to exhibit a slightly stronger understanding across various domains compared to physicians. This variance could stem from nurses' hands-on experience in catheter-related procedures. However, both nurses and physicians maintain a commendably high and comparable level of knowledge in certain aspects of catheterization. While differences exist, collaboration between these two professions remains crucial for optimal patient care, and the integration of advanced techniques like machine learning holds potential for further enhancing CAUTI prevention. It's important to consider study limitations and diverse healthcare contexts to attain a holistic perspective on the topic.

Limitations of the study
This study has several limitations that may affect the interpretation of the findings. The cross-sectional design restricts the ability to establish causal relationships and limits insights into changes over time. The convenience sampling approach introduces potential selection bias, limiting generalizability to other regions or healthcare systems. The reliance on self-reported data through structured questionnaires may lead to response bias, and the structured format could overlook nuanced aspects of experiences. Furthermore, the focus on nurses and physicians excludes other healthcare professionals involved in CAUTI prevention, limiting the comprehensiveness of the findings.

Authors' contribution
Conceptualization: Samer Al-Rawashdeh, Malik Ayyad.
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Conflicts of interest
The authors declare that they have no competing interests.

Ethical issues
The research adhered to the principles outlined in the Declaration of Helsinki. All ethical considerations— including plagiarism, data fabrication, and duplicate publication—were fully observed by the authors. Prior to

data collection, ethical approval was obtained from the Institutional Review Board (IRB). Also, the institutional ethical committee at Mutah University of Medical Sciences approved all study protocols. Written informed consent was obtained from all participants before any study procedures commenced. Ensuring the confidentiality of data was a promise, we were committed to upholding; hence no responses were directly linked to participant identifiers. Each potential participant was approached individually in a private setting, where the objectives of the study were clearly elucidated. Only upon obtaining informed consent was any data collected. It was important to note that participation was entirely voluntary, with no adverse implications for withdrawal or non-participation.

Funding/Support

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