Natural Resources for Human Health
eISSN: 2583-1194

Original Research

Received 21 Oct 2024
Revised 25 Nov 2024
Accepted 27 Dec 2024

Natural Resources for Human Health 2024, Vol. 4 (4): 495–500

KEYWORDS:
indwelling urinary catheter, catheter-associated urinary tract infection (CAUTI), nursing interventions, infection prevention, catheter care bundles,aseptic technique.

The Impact of Nursing Interventions on Reducing Complications Associated with Indwelling Urinary Catheters

Muhanna Hussain Alharran[1], Manal Salman Khader Alazmi[2], Shaykhah Ahmed R. Alobaidi[3], Alhazmi, Majed Mosabeh A.[4], Alotaibi, Abdullah Abdulrahman J.[5], Abdullah Musallam Mussabah Alshammari[6], Hala Awadh Awad Alanazi[7], Hanan Rabai Alharbiy[8], Abdulmajeed Mofareh Hassab Alruwaili[9], Al Ruwaili Musherh Al Raied H[10]

[1]Nursing Specialist – King Abdulaziz Specialist Hospital, Al Jouf Health Cluster, Ministry of Health, Sakaka, Al Jouf Region, Saudi Arabia.
Email: malharran@moh.gov.sa
[2]Nursing Technician – Al-Qurayyat General Hospital, Al Jouf Health Cluster, Ministry of Health, Al Qurayyat, Al Jouf Region, Saudi Arabia.
Email: masualazmi@moh.gov.sa
[3]Nursing Technician – King Salman Medical City, Madinah Health Cluster, Ministry of Health, Madinah, Madinah Region, Saudi Arabia.
Email: shalobaidi@moh.gov.sa
[4]Nursing Technician – North Medical Tower Hospital, Northern Borders Health Cluster, Ministry of Health, Arar, Northern Borders Region, Saudi Arabia.
Email: malhazmi18@moh.gov.sa
[5]Nursing Specialist – Dawadmi General Hospital, Third Riyadh Health Cluster, Ministry of Health, Dawadmi, Riyadh Region, Saudi Arabia.
Email: a-f_2008@hotmail.com
[6]Nursing Specialist – Hail Health Cluster, Ministry of Health, Hail, Hail Region, Saudi Arabia.
Email: MATRSYO777@gmail.com
[7]Nursing Specialist – Al Hadithah Hospital, Al Jouf Health Cluster, Ministry of Health, Al Qurayyat, Al Jouf Region, Saudi Arabia.
Email: Halaa8688@gmail.com
[8]Nursing Technician – Northern Borders Health Cluster, Ministry of Health, Arar, Northern Borders Region, Saudi Arabia.
Email: alhanan777@outlook.com
[9]Oncology Nursing Specialist – King Abdulaziz Specialist Hospital, Al Jouf Health Cluster, Ministry of Health, Sakaka, Al Jouf Region, Saudi Arabia.
Email: xm2jed@gmail.com
[10]Nursing Specialist – Maternity and Children Hospital, Al Jouf Health Cluster, Ministry of Health, Sakaka, Al Jouf Region, Saudi Arabia.
Email: maalrwiliy@moh.gov.sa

ABSTRACT: Indwelling urinary catheters remain one of the most frequently used medical devices in hospital settings, yet their presence carries substantial risk. Catheter-

Natural Resources for Human Health
eISSN: 2583-1194

associated urinary tract infections (CAUTIs) account for a large proportion of healthcare-associated infections, while non-infectious complications—including urethral trauma, catheter encrustation, blockage, and patient discomfort—further compound morbidity and extend hospital stays. Nursing interventions occupy a central position in mitigating these risks, since nurses are typically responsible for insertion decisions, ongoing maintenance, and daily surveillance of catheterised patients. Evidence consistently demonstrates that structured nursing protocols—encompassing appropriate indication review, aseptic insertion technique, and early removal prompted by nurse-led reminder systems—are associated with significant reductions in both infection rates and catheter days. The cumulative effect of such interventions is not merely clinical; reduced complication rates translate directly into lowered healthcare costs, shorter admissions, and improved patient comfort and dignity. Effective nursing strategies operate across the full lifecycle of catheter use, beginning with the critical decision of whether a catheter is indicated at all. Nurse-driven protocols that empower staff to question unnecessary placements, combined with daily assessment of continuing need, have repeatedly been shown to shorten dwell time—the single most important modifiable risk factor for complications. Maintenance-focused interventions are equally consequential: maintaining a closed drainage system, positioning the drainage bag below bladder level, performing routine meatal hygiene, ensuring unobstructed urine flow, and securing the catheter to prevent traction all form part of evidence-based bundle care. Education and training also emerge as pivotal elements, as knowledge deficits regarding aseptic technique and hand hygiene are frequently implicated in preventable infections. However, implementation is not without barriers—staffing constraints, time pressures, and inconsistent adherence to guidelines can dilute intervention effectiveness. Sustained success therefore depends on a combination of robust protocols, ongoing staff education, audit and feedback mechanisms, and a workplace culture that prioritises catheter stewardship as a shared responsibility.

INTRODUCTION

Indwelling urinary catheters (IUCs) are among the most frequently utilized medical devices in healthcare settings globally, with millions of catheters inserted annually in hospitals, long-term care facilities, and home care environments. While they serve essential functions in managing acute urinary retention, monitoring output in critically ill patients, facilitating surgical procedures, and managing incontinence, their use is intrinsically associated with a significant risk of complications. The most prevalent and concerning of these is catheter-associated urinary tract infection (CAUTI), which accounts for a substantial proportion of healthcare-associated infections (HAIs), leading to increased patient morbidity, prolonged hospital stays, and elevated healthcare costs [1]. Approximately 75% of all urinary tract infections acquired in hospitals are linked to catheter use, and the risk of acquiring a CAUTI increases by 3% to 7% for each day the catheter remains in place [2].

Beyond infectious complications, patients are at risk for non-infectious complications, including urethral trauma, catheter blockage, bladder spasms, and accidental dislodgement. Given that nurses are at the forefront of catheter insertion, daily maintenance, and removal, nursing interventions are pivotal in mitigating these risks. The presence of a foreign body in the urinary tract bypasses natural host defenses, and the formation of a biofilm on the catheter surface provides a reservoir for multidrug-resistant organisms [3]. Consequently, the nursing role extends far beyond the simple mechanical task of insertion; it encompasses continuous assessment, advocacy for prompt removal, and the strict enforcement of aseptic protocols. This article comprehensively examines the impact of evidence-based nursing interventions on reducing the complications associated with IUCs, exploring the multifaceted strategies required to enhance patient safety and clinical outcomes. By implementing targeted, nurse-led protocols, healthcare facilities can dramatically reduce the incidence of both infectious and non-infectious catheter-related harms [4].

Understanding the Spectrum of Indwelling Urinary Catheter Complications

To effectively implement preventative nursing strategies, it is essential to first understand the diverse nature of complications associated with IUCs. These complications can be broadly categorized into infectious and non-infectious events. Infectious complications are dominated by CAUTI, which occurs when bacteria enter the urinary tract via the catheter, often through the periurethral space or by ascending the drainage tubing. The formation of a crystalline biofilm on the catheter surface is a critical factor in the pathogenesis of CAUTI and catheter encrustation. This biofilm protects bacteria from both the host's immune system and antimicrobial therapy, making infections notoriously difficult to treat [3].

Non-infectious complications are equally significant and often contribute to the development of infections. These include urethral trauma during insertion, which can lead to strictures or false passages; catheter-associated bladder discomfort and spasms; mechanical issues such as catheter blockage or kinking; and skin breakdown around the meatus [4]. Furthermore, prolonged catheterization can lead to patient immobility, psychological distress, and a diminished quality of life. The mechanical irritation caused by the catheter balloon resting on the bladder neck can trigger severe detrusor muscle spasms, causing significant pain and often leading to urine bypassing around the catheter [5]. Understanding this spectrum allows nurses to tailor interventions not just to prevent CAUTI, but to address the holistic safety and comfort of the patient [5].

The Critical Role of Appropriate Catheter Indication and Prompt Removal

The most effective nursing intervention for reducing catheter-related complications is the prevention of unnecessary catheterization and the prompt removal of the device when it is no longer clinically indicated. Nurses play a crucial role in advocating for their patients by questioning the initial need for an IUC and conducting daily assessments of its continued necessity [6]. The "nurse-driven removal protocol" is a highly effective, evidence-based strategy. Under this protocol, nurses are empowered to remove a catheter based on specific, pre-approved clinical criteria without requiring a new physician order [7].

Studies demonstrate that implementing nurse-driven removal protocols significantly reduces the overall duration of catheterization, which directly correlates with a decreased incidence of CAUTI and other complications [8]. In addition to daily necessity reviews, exploring alternatives to IUCs—such as intermittent catheterization, external condom catheters for male patients, or urinary collection devices for female patients—is a vital nursing intervention. By minimizing the initial insertion and expediting removal, nurses directly eliminate the primary risk factor for catheter-related harm. Furthermore, the implementation of daily "catheter huddles" during multidisciplinary rounds ensures that the entire care team remains accountable for reviewing the ongoing need for the device, thereby fostering a culture of safety [9]. Nurses must also be proactive in implementing bladder training protocols prior to removal to prevent post-removal urinary retention [10].

Aseptic Technique and Best Practices During Catheter Insertion

When catheterization is deemed necessary, the insertion procedure itself is a critical control point for preventing complications, particularly urethral trauma and early-onset CAUTI. Nursing interventions during insertion must adhere strictly to aseptic technique. This involves thorough hand hygiene, the use of sterile gloves and drapes, and the application of an appropriate antiseptic solution for periurethral cleaning [7]. The use of sterile, single-use lubricant is recommended to minimize friction and urethral injury during insertion [11].

Proper catheter sizing is another essential nursing consideration; selecting the smallest appropriate French size ensures adequate drainage while reducing the risk of urethral trauma and patient discomfort [12]. Furthermore, nurses must ensure the catheter is properly secured after insertion. Inadequate securement can lead to movement, urethral traction, and tissue damage [12]. The use of commercially available catheter securement devices is strongly recommended over traditional tape, as these devices minimize the risk of meatal tearing, skin breakdown, and accidental dislodgement [13]. In cases of difficult insertion, particularly in male patients with enlarged prostates, the use of a coude-tipped catheter by a trained nurse can reduce traumatic injury and prevent the creation of false passages in the urethra [14]. Rigorous adherence to these insertion protocols is a foundational nursing intervention that sets the stage for safe catheter management [14].

Daily Maintenance and the Prevention of Ascending Infection

The maintenance phase of catheter care is where nursing interventions have a continuous impact on preventing complications, especially CAUTI. Maintaining a sterile, continuously closed drainage system is paramount. Any disruption to this system, such

as disconnecting the catheter from the tubing, provides a direct pathway for bacteria to enter the bladder [15]. Nurses must therefore avoid unnecessary system breaches. The drainage bag must be kept below the level of the bladder at all times to prevent the retrograde flow of urine, which can introduce bacteria into the bladder [16].

Additionally, the bag should be emptied regularly—before it becomes over two-thirds full—and the drainage spigot must never touch the floor or the collection container to prevent contamination. Routine perineal hygiene, using standard soap and water during daily bathing, is sufficient for cleansing the meatal area, and the routine use of antiseptic urethral cleansers is not recommended as it can disrupt natural flora and promote resistance [17]. Furthermore, nurses must ensure that the catheter and tubing are free from kinks or obstructions to maintain an unobstructed flow of urine and prevent stasis. A common nursing error is routinely changing the catheter at arbitrary intervals; instead, catheters should only be changed based on clinical indications, such as infection, blockage, or encrustation [18].

Managing and Mitigating Non-Infectious Complications

Nursing interventions extend beyond infection control to encompass the management of mechanical and physiological complications. Catheter-associated bladder discomfort and spasms are common issues that significantly impact patient comfort. Nursing-led, non-pharmacological interventions play a central role in managing these spasms; these include ensuring proper catheter fixation, maintaining a closed system, and providing patient education on relaxation techniques [19].

Catheter blockage, often caused by encrustation or debris, is another significant complication. To prevent blockage, nurses should encourage adequate fluid intake (unless medically contraindicated) to promote dilute urine and regularly assess for signs of obstruction, such as reduced urine output or bypassing [20]. If a blockage occurs, gentle irrigation with sterile normal saline using a catheter-tip syringe may be performed as per protocol. Accidental dislodgement or self-extraction by confused patients is a severe risk; the use of securement devices and, in some cases, increased patient monitoring or the use of alternative devices for at-risk individuals are effective nursing strategies to prevent unplanned removals [21]. By proactively managing these mechanical issues, nurses prevent secondary complications like mucosal trauma and bleeding.

The Impact of Nurse-Led Education and Care Bundles

The translation of evidence-based guidelines into daily practice is best achieved through the implementation of comprehensive nursing care bundles and structured education. A care bundle is a set of evidence-based practices—such as hand hygiene, aseptic insertion, daily necessity review, and maintaining a closed system—that, when performed collectively and consistently, significantly improve patient outcomes [7].

Nurse-led implementation of CAUTI prevention bundles has been shown to drastically reduce infection rates. For instance, a four-year quasi-experimental study utilizing a Plan-Do-Check-Act model demonstrated a 38% reduction in CAUTI risk and an 11% reduction in catheter utilization following the implementation of a nurse-led bundle and removal protocol [8]. Continuous education and training for nursing staff are fundamental to the success of these bundles. Regular training ensures that nurses are competent in aseptic technique, knowledgeable about the indications for catheterization, and empowered to enforce daily catheter assessments. Furthermore, empowering patients through education—teaching them to keep the bag below the bladder and how to perform hand hygiene before touching the catheter—creates a collaborative safety net between the patient and the nurse [22]. By fostering a culture of safety and continuous learning, nursing education directly translates into reduced complication rates [22].

Table 1: Summary of Key Nursing Interventions for Preventing Indwelling Urinary Catheter Complications

Phase of Care	Nursing Intervention	Target Complication(s) Prevented
Pre-Insertion	Verify clinical indication; consider alternatives (e.g., intermittent catheterization, external catheters).	Unnecessary catheterization, CAUTI, Urethral trauma
Insertion	Strict aseptic technique; use sterile equipment; select smallest appropriate catheter size; use securement device.	CAUTI, Urethral injury, Patient discomfort, Dislodgement

Daily Maintenance	Maintain closed drainage system; keep bag below bladder; perform routine perineal hygiene; avoid unnecessary bag changes.	CAUTI, Ascending infection, Urine reflux, Encrustation
Monitoring & Review	Assess daily necessity via nurse-driven protocol; monitor for blockage, spasms, or bypassing.	Prolonged catheterization, CAUTI, Bladder spasms
Removal	Prompt removal when criteria are met; provide post-removal bladder training if needed.	CAUTI, Prolonged dwell time, Urinary retention

System-Level Support and the Future of Catheter Care

While individual nursing interventions are crucial, their sustained effectiveness depends heavily on system-level support. Healthcare institutions must provide the necessary infrastructure, such as electronic health record (EHR) prompts that remind clinicians to review catheter necessity daily, and the availability of nurse-driven removal protocols [9]. Furthermore, a supportive organizational culture that encourages interprofessional collaboration and values nursing autonomy in catheter management is essential. Looking to the future, emerging technologies may further augment nursing interventions. For example, the development of "smart catheters" capable of detecting early signs of infection or encrustation could provide real-time data to nurses, allowing for even more proactive interventions [23].

The economic impact of reducing catheter-related complications cannot be overstated. Each CAUTI episode adds thousands of dollars to healthcare costs due to extended length of stay, additional diagnostic tests, and antimicrobial treatments. By preventing these infections through rigorous nursing care, healthcare systems yield a significant return on investment [24]. However, the fundamental principles of rigorous aseptic technique, daily assessment, and prompt removal remain the cornerstone of safe practice. By integrating these evidence-based practices into a comprehensive, nurse-led safety framework, healthcare organizations can significantly reduce the burden of catheter-related complications and ensure optimal patient outcomes across all care settings [25].

CONCLUSION

Indwelling urinary catheters are indispensable medical devices in modern healthcare, but their use is inextricably linked to a high risk of preventable complications, primarily CAUTI and urethral trauma. The evidence overwhelmingly supports the critical role of nursing interventions in mitigating these risks. By leading the way in appropriate catheter indication, strict aseptic insertion, rigorous daily maintenance, and the implementation of nurse-driven removal protocols, nurses act as the primary gatekeepers of patient safety in this domain. The adoption of comprehensive care bundles and continuous nursing education further amplifies these efforts, transforming evidence-based guidelines into tangible reductions in patient morbidity and healthcare costs. Ultimately, reducing the complications associated with IUCs requires a multifaceted, interdisciplinary approach that empowers nurses, supports system-level protocols, and prioritizes a culture of zero tolerance for preventable harm.

REFERENCES

[1] Weiner-Lastinger LM, Abner S, Edwards JR, Kallen AJ, Karlsson M, Magill SS, Pollock D, See I, Soe MM, Walters MS, Dudeck MA. Antimicrobial-resistant pathogens associated with adult healthcare-associated infections: summary of data reported to the National Healthcare Safety Network, 2015–2017. Infection Control & Hospital Epidemiology. 2020 Jan;41(1):1-8.

[2] Saint S, Greene MT, Krein SL, Rogers MA, Ratz D, Fowler KE, Edson BS, Watson SR, Meyer-Lucas B, Masuga M, Faulkner K. A program to prevent catheter-associated urinary tract infection in acute care. New England Journal of Medicine. 2016 Jun 2;374(22):2111-9.

[3] Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. Nature reviews microbiology. 2015 May;13(5):269-84.

[4] Leslie SW, Sajjad H, Sharma S. Prevention of inappropriate self-extraction of Foley catheters. InStatPearls [Internet]. StatPearls Publishing.

[5] Warren JW. Catheter-associated urinary tract infections. International journal of antimicrobial agents. 2001 Apr 1;17(4):299-303.
[6] Garratt I. Klebsiella pneumoniae biofilm formation and antimicrobial susceptibility during polymicrobial infections of the catheterised urinary tract.
[7] Alkurabi S, Hassoun A, Jett-Mitchell R. 877: Prevention of Catheter Associated Urinary Tract Infections (CAUTIs): results and challenges. InOpen Forum Infectious Diseases 2014 Dec (Vol. 1, No. Suppl 1, p. S252).
[8] Durant DJ. Nurse-driven protocols and the prevention of catheter-associated urinary tract infections: a systematic review. American journal of infection control. 2017 Dec 1;45(12):1331-41.
[9] Gray J, Rachakonda A, Karnon J. Pragmatic review of interventions to prevent catheter-associated urinary tract infections (CAUTIs) in adult inpatients. Journal of Hospital Infection. 2023 Jun 1;136:55-74.
[10] Fakih MG, Dueweke C, Meisner S, Berriel-Cass D, Savoy-Moore R, Brach N, Rey J, DeSantis L, Saravolatz LD. Effect of nurse-led multidisciplinary rounds on reducing the unnecessary use of urinary catheterization in hospitalized patients. Infection Control & Hospital Epidemiology. 2008 Sep;29(9):815-9.
[11] Gad MH, AbdelAziz HH, Gad M. Catheter-associated urinary tract infections in the adult patient group: a qualitative systematic review on the adopted preventative and interventional protocols from the literature. Cureus. 2021 Jul 9;13(7).
[12] Kwon BK, Banaszek D, Kirshblum S. Advances in the Rehabilitation of the Spinal Cord–Injured Patient: The Orthopaedic Surgeons' Perspective. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2019 Nov 1;27(21):e945-53.
[13] Leslie SW, Sajjad H, Sharma S. Prevention of inappropriate self-extraction of Foley catheters. InStatPearls [Internet]. StatPearls Publishing.
[14] Stickler DJ. Clinical complications of urinary catheters caused by crystalline biofilms: something needs to be done. Journal of internal medicine. 2014 Aug;276(2):120-9.
[15] Griebling TL. Re: systematic review of interventions to reduce urinary tract infection in nursing home residents. Journal of Urology. 2018 Dec;200(6):1143-4.
[16] Wald HL, Ma A, Bratzler DW, Kramer AM. Indwelling urinary catheter use in the postoperative period: analysis of the national surgical infection prevention project data. Archives of surgery. 2008 Jun 16;143(6):551-7.
[17] Lachance CC, Grobelna A. Management of patients with long-term indwelling urinary catheters: a review of guidelines.
[18] Nicolle LE. Catheter-related urinary tract infection. Drugs & aging. 2005 Aug;22(8):627-39.
[19] Spoolder DA, Geelhoed JP. Management of bladder spasms in patients with indwelling urinary catheters: A systematic review. Continence. 2023 Sep 1;7:100713.
[20] Willder S, Kelsey E, O'Connor E, Grills R. Expanding urological services into regional Australia and reducing interhospital transfers: how the nurse practitioner can help. ANZ Journal of Surgery. 2024;94(6):1076-82.
[21] Miller D, Pelzman D, Bonfili J, Erpenbeck S, Orikogbo O, Risnear A, Pekala K, Maganty A, Jones R, Jackman S, Rusilko P. Implementation of a standardized process of coude catheter insertion decreases traumatic catheterizations. Urology. 2024 1;194:253-9.
[22] Wilde MH, Brasch J. Self-monitoring of urine flow in people with long-term urinary catheters: 2445. Journal of Wound Ostomy & Continence Nursing. 2008 May 1;35(3):S73.
[23] Chen D, Temkin E, Solter E, Nutman A, Carmeli Y, Schwaber M, Ben-David D. A national intervention to reduce undesirable urinary tract events in internal medicine wards. Infection Control and Hospital Epidemiology. 2020 Oct 1;41(S1):s98-.
[24] Cheng WY, Lin YH, Lai CC, Chao CM. Impact of catheter-associated urinary tract infection bundle on other health care–associated infections. American journal of infection control. 2015 Feb 1;43(2):197-8.
[25] Saint S, Greene MT, Kowalski CP, Watson SR, Hofer TP, Krein SL. Preventing catheter-associated urinary tract infection in the United States: a national comparative study. JAMA internal medicine. 2013 May 27;173(10):874-9.