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Preventing catheter-associated urinary tract infections: A position paper of the International Society for Infectious Diseases, 2024 update

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ABSTRACT

Objectives: This review, conducted by a panel of experts assembled by the International Society for Infectious Diseases, seeks to consolidate the latest recommendations for preventing catheter-associated urinary tract infections (CAUTIs). It offers insights into CAUTI rates and the associated extended hospital stays, costs, mortality, and risk factors across high- and low- to middle-income countries.

Methods: An in-depth review of current recommendations and evidence-based strategies for CAUTI prevention was undertaken. To develop practical preventive measures, the expert panel examined data on CAUTI incidence, related health care impacts, and risk factors across various economic contexts.

Results: The review highlights notable differences in CAUTI rates, health care costs, extended hospital stays, and mortality between high- and low- to middle-income countries. It emphasizes evidence-based strategies for CAUTI prevention, demonstrating their effectiveness across diverse health care environments.

Conclusions: This position paper offers recommendations and insights intended to assist health care professionals in effectively preventing CAUTIs. Implementing evidence-based preventive strategies has the potential to lower CAUTI rates, reduce related costs, and enhance patient outcomes in high- and low- to middle-income countries.

Introduction

This document comprehensively examines existing evidence and offers an international perspective with focused suggestions for addressing critical issues in high- and low- and middle-income countries (LMICs). It provides concise, actionable recommendations to aid in preventing catheter-associated urinary tract infections (CAUTIs). We acknowledge statements and recommendations from previous guidelines, including those from the Society for Healthcare Epidemiology of America, the Infectious Diseases Society of America, and the Association for Professionals in Infection Control and Epidemiology 2022 update. The quality of evidence (QOE) assessment is based on their criteria and scoring consensus, when available [1]. This expert guidance document is sponsored by the International Society of Infectious Diseases. The International Nosocomial Infection Control Consortium (INICC) observed consistently higher CAUTI rates in LMICs over the past two decades. The INICC report from 2002 to 2005 indicated a CAUTI rate of 8.9 per 1000 urinary catheter (UC)–days [2], gradually reducing to 2.91 in the report covering data from 2015 to 2020 [3]. As reported by the Centers for Disease Control and Prevention (CDC) National Healthcare Safety Network (NHSN), the median CAUTI rate in US medical-surgical intensive care units (ICUs) is 1.3 per 1000 UC-days [4]. The costs associated with each CAUTI in the United States were

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reported to be US $1006 per case [5]. Data were pooled from 630 ICUs in 45 LMICs from 2015 to 2020, covering Africa, Asia, Eastern Europe, Latin America, and the Middle East, including 204,770 patients, 1,480,620 patient-days, 637,850 UC-days, and 7635 CAUTIs. The length of stay (LOS) was 6.57 days for patients without health care–associated infections (HAIs) and 24.41 days for those with CAUTIs. The mortality rates were 14.06% for patients without HAI and 31.14% for those with CAUTIs. Overall, antimicrobial resistance has impacted the observed high LOS and mortality rate [3]. CAUTI is an independent mortality risk factor. In a multicenter, multinational, multicontinental study involving 786 ICUs across 312 hospitals in 147 cities spanning 37 countries between 1998 and 2022, 300,827 patients were followed up during 2,167,397 patient-days, resulting in 21,371 HAIs. Multiple logistic regression identified the following mortality risk factors: CAUTI (adjusted odds ratio [aOR] = 1.18; 95% CI = 1.10-1.28; P <0.0001). LOS (risk rises 1% per day) (aOR = 1.01; 95% CI = 1.01-1.02; P <0.0001), female gender (aOR = 1.09; 95% CI = 1.07-1.12; P <0.0001), and age (aOR = 1.012; 95% CI = 1.011-1.0124; P <0.0001) were slightly associated with mortality [6]. The duration of catheterization is the main contributing CAUTI risk factor [7]. Studies identified the following variables as risk factors for CAUTIs: female sex, age over 50 years, increased days of catheterization, longer ICU stays, urological surgical procedures, mobility issues, diabetes, hypertension, spinal cord lesions, cerebrovascular disease, and level of education [1]. In a prospective cohort study across 623 ICUs within 224 hospitals across 114 cities spanning January 1, 2014 to February 12, 2022, involving 169,036 patients and 1,166,593 patient-days, the primary aim was to elucidate the incidence and risk factors associated with CAUTI in LMICs. The investigation revealed a substantial CAUTI rate of 2.83 per 1000 UC-days. The multiple logistic regression analysis identified several risk factors, including pre-CAUTI LOS (aOR = 1.05; 95% CI = 1.05-1.06; P <0.0001), UC device utilization ratio (DUR) (aOR = 1.09; 95% CI = 1.07-1.12; P <0.0001), age (aOR = 1.01; 95% CI = 1.01-1.02; P <0.0001), female sex (aOR = 1.39; 95% CI = 1.26-1.51; P <0.0001), public facility status (aOR = 2.24; 95% CI = 1.66-3.01; P <0.0001), and admission to neurologic ICUs (aOR = 11.49; 95% CI = 6.92-19.11; P <0.0001). Increased LOS, female gender, and age were all risk factors very close to the unit, suggesting a slight association [8].

Suggested practice

Necessary prerequisites

The cornerstone of CAUTI prevention is avoiding unnecessary indwelling UC (IUC) insertion. Conduct a risk assessment for CAUTI and establish a program across the organization to identify and discontinue all catheters that are no longer required. Establish and enforce an institutional policy mandating regular, typically daily, evaluations of the ongoing necessity for catheterization [1] (QOE: moderate). Instances could involve implementing automatic stop orders, which prompt a review of current indications and necessitate the renewal of orders to continue IUC.

In addition, standardized reminders can highlight persistent catheters alongside their current indications, tailored to physicians or nurses. Nursing and medical personnel should conduct daily assessments during patient rounds to determine the ongoing necessity of catheter use [1]. Ensure the availability of suitable infrastructure to prevent CAUTI [9] (QOE: low). Guarantee that each unit has the necessary supplies to adhere to best practices in managing urinary issues. This includes ensuring the availability of bladder scanners, supplies for non-catheter incontinence management (e.g. urinals, garments, bed pads, and skin products), and IUCs catheters. It is imperative to make non-catheter urinary management supplies easily accessible for bedside use, such as IUCs.

In addition, ensure that the physical environment allows the proper positioning of IUCs with attached tubes on beds, wheelchairs, and at appropriate heights without risk of kinking for patients in their rooms and during transport. Offer and execute evidence-based protocols designed to manage various stages of the IUC life cycle, including assessing catheter appropriateness, ensuring proper insertion technique, providing maintenance care, and promptly removing catheters when they are no longer necessary (QOE: low). Customize and integrate evidence-based criteria for appropriate indications for IUC use, potentially incorporating them as standardized clinical decision support tools within electronic medical record ordering systems [1]. Only adequately trained health care professionals (HCPs) should perform IUC insertions, with an ongoing evaluation of their competence [1]. Supervision by an experienced HCP should be mandated when trainees are involved in catheter insertions and removals to mitigate the risk of infectious and traumatic complications linked to urinary catheterization [1]. Given the notably elevated rates of CAUTIs associated with catheter insertions by trainees, educational programs may need to reconsider the stage of medical training and the specific trainees involved in IUC insertions in patients, as opposed to relying solely on simulation-based training models [10] (QOE: low). Guarantee the availability and convenient placement of supplies essential for maintaining the aseptic technique during IUC insertion [1] (QOE: low).

Establish a structured method for documenting various aspects of the patient record, such as the physician's directive for IUC placement, reasons for insertion, insertion details (including date, time, and personnel), nursing placement records, daily maintenance tasks, and removal specifics. Also, document removal criteria and reasons for continued use. Ensure standardized documentation for efficient data collection and quality enhancement, including accessible records of IUC insertion and removal. Utilize electronic systems with search capabilities whenever feasible. Consider implementing nurse-driven protocols for IUC removal once the need for placement is resolved, integrating them into routine orders or as reminders during physician rounds. These protocols should outline exceptions, such as for postoperative urology patients or cases requiring urology consultation before removal, necessitating a physician's authorization [1] (QOE: low). Ensure that there are enough well-trained HCPs and technological resources available to support the monitoring of IUC use and its outcomes [1] (QOE: low). Perform surveillance for CAUTI [1] (QOE: low). Create a standardized method for urine culturing by implementing an institutional protocol that outlines suitable indications for catheterized and non-catheterized patients [11]. Investigate incorporating these criteria into the electronic medical record and periodically review the reasons for requesting urine cultures as part of the CAUTI risk evaluation process [12] (QOE: low).

Implementation of CAUTI prevention strategies

Multidimensional approach

Numerous national, multinational, and multicontinental studies using a multidimensional approach have been conducted, achieving a significant reduction in rates of CAUTIs and mortality. All of them include six components: (a) bundle, (b) education, (c) surveillance of CAUTI, (d) monitoring adherence with recommendations to prevent CAUTI, (e) internal reports of CAUTI rates, and (f) performance feedback [13–20].

Bundles

Care "bundles" are simple sets of evidence-based practices that, when implemented collectively, improve the reliability of their de-

Table 1
Impact of a multidimensional approach on CAUTI rates in LMICs.

Setting	Number of ICUs	Study period	ICU type	Baseline CAUTI rate[a]	Intervention CAUTI rate[a]	RR; 95% CI; *P*-value	Ref
32 LMICs	299	1998-2022	AICU	14.89	1.71	RR = 0.11; 95% CI = 0.09-0.13; *P* <0.001	[14]
15 LMICs	57	1999-2011	AICU	7.86	4.95	RR 0.63, 95% CI = 0.55-0.72; *P* = 0.0001	[15]
Six LMICs	10	2003-2010	PICUs	5.9	2.6	RR= 0.43, 95% CI = 0.21-1.02; *P* = 0.0344	[16]
Turkey	13	2003-2011	AICU	10.63	5.65	RR = 0.53; 95% CI = 0.4-0.7; *P* = 0.0001	[17]
Philippines	4	2005-2010	AICU	11.0	2.66	RR = 0.24; 95% CI = 0.11-0.53; *P* = 0.0001	[18]
Argentina	2	2000-2002	AICU	21.3	12.39	RR = 0.58; 95 CI% = 0.39-0.86; *P* = 0.006	[19]
Lebanon	1	2007-2012	AICU	13.07	2.21	RR = 0.17; 95% CI = 0.06-0.5; *P* = 0.0002	[20]

AICU = adult ICU; CAUTI = catheter-associated urinary tract infection; CI = confidence interval; ICU = intensive care unit; LMICs = low- and middle-income country; PICU = pediatric ICU; Ref = reference; RR = relative risk.
[a] CAUTIs per 1000 urinary catheter–days.

livery and improve patient outcomes [21]. The INICC utilizes a bundle as part of its approach to reducing CAUTI rates, demonstrating effectiveness in Africa, Asia, Latin America, Eastern Europe, and the Middle East. A comprehensive strategy was implemented across 299 ICUs spanning 32 LMICs. The approach involved a nine-element bundle, coupled with educational initiatives, continuous surveillance of CAUTI rates and clinical outcomes, monitoring of adherence to bundle components, and regular feedback on performance. The primary metric, CAUTI rate per 1000 UC-days, exhibited a substantial decrease from 14.89 during the baseline period to 1.71 in the 28-39 months phase. Over the duration of 978,364 patient-days, involving 150,258 patients and 652,053 UC-days, the intervention achieved an 89% reduction in CAUTI incidence (Table 1) [13–20].

Education

Train HCPs responsible for catheter insertion on proper CAUTI indication criteria [1]. Educate HCPs overseeing IUC insertion, care, and maintenance on CAUTI prevention. This training should encompass alternatives to IUCs and insertion, management, and removal procedures [1] (QOE: low). Assess HCPs' proficiency in catheter use, care, and maintenance [22] (QOE: low). Educate HCPs on the importance of urine culture stewardship (to distinguish colonization from infection) and guide when to perform urine cultures. Consider mandating clinicians to specify a justified indication when ordering a urine culture. These indications should be evidence-based and tailored to the patient population, even in LMICs, using automatic orders and continuing education activities [23]. Incorporate guideline-based reminders that are tailored to specific situations. Although the CDC website offers a general example of suitable and unsuitable reasons for urine culture, literature provides various lists customized for specific clinical settings, such as the ICU, emergency department, nursing home, and patients with or without catheters [24]. Host training sessions focusing on the proper technique for urine specimen collection, stressing the importance of promptly delivering samples to the microbiology laboratory, ideally within an hour. In cases where transportation to the laboratory might be delayed, it is recommended to refrigerate samples (for up to 24 hours) or use preservative urine transport tubes [1] (QOE: low). Before resorting to IUC placement, clinicians should be educated to explore alternative bladder management methods, such as intermittent catheterization for males and females, where appropriate [1] (QOE: low). Ensure prompt sharing of data and timely delivery of reports to relevant stakeholders [1] (QOE: low).

Surveillance of CAUTI

Utilize consistent surveillance methods and definitions to enable data comparison with benchmark standards, such as those published by the CDC/NHSN [25] (QOE: low).

Numerator: The count of CAUTIs.

Denominator: The total number of UC-days for all patients.

CAUTI rate calculation: Divide the number of CAUTIs in each unit by the total number of UC-days, then multiply the result by 1000 to express the measure as the number of CAUTIs per 1000 UC-days [25].

Monitor CAUTI rates over a period to evaluate the ongoing effectiveness of prevention strategies.

Risk adjustment: Stratify CAUTI rates according to risk factors such as ward or clinical service line. Compare CAUTI rates across different patient care units using historical, CDC/NHSN [4], and the INICC international data [3]. Monitor the DUR over time to detect any fluctuations, enabling comparisons at hospital and unit levels. This serves as a proxy for assessing patient exposure risk. The DUR, a CDC/NHSN [4] and INICC measure [3], is calculated as the observed UC-days divided by observed patient-days.

Internal reporting of CAUTI rates

These performance measures are intended for internal hospital quality improvement efforts and may not directly meet external reporting obligations. They encompass process and outcome measures suitable for communication to senior hospital leadership, nursing leadership, and clinicians overseeing patients susceptible to CAUTIs [26]. For future improvement, internal reporting can be strengthened by creating and honing metrics that emphasize the rate of urine culturing and adherence to urine collection techniques in catheterized and non-catheterized patients. When offering internal reports as a benchmark, compare the CAUTI rates of the hospital against data from the CDC/NHSN [4] and the INICC international data [3] (QOE: low).

Monitoring adherence to recommendations to prevent catheter-associated urinary tract infection

Assessing and documenting adherence to IUC insertion and maintenance guidelines using a checklist ensures adherence to proper procedural steps and identifies and addresses any gaps. Calculate adherence by dividing the adherence of each recommendation by the total number of IUC, then multiply by 100 for a percentage expression [27].

Performance feedback

In performance feedback sessions, infection prevention specialists present charts illustrating the monthly adherence levels of HCPs with infection prevention practices [13]. The infection control tool is essential for HCPs to identify areas for improvement when adherence with infection prevention practices is lacking. Utilizing the "observer effect" on HCPs' behavior, this approach effectively influences their practices to enhance efficiency [28]. This approach was designed to influence behaviors to achieve more effective implementation [13].

Main approaches

Insertion of indwelling urinary catheters

Only insert IUCs when essential for patient care and keep them in place only for as long as the indications persist (QOE: moderate). Appropriate indications include the following:

(1) Specific surgical procedures, such as urologic surgery or those involving contiguous structures of the genitourinary tract, during prolonged surgeries, in cases of large-volume infusions or diuretics during surgery, or when intraoperative monitoring of urine output is necessary. However, it is crucial to remove catheters placed solely due to the duration of surgery (e.g. >3 hours) or for decompression for a specific surgical approach after the surgical case.
(2) Patients in the ICU where hourly assessment of urine output is essential when clinically adjusting therapies frequently, such as volume resuscitation, diuresis, and vasopressors. However, the mere presence of ICU care does not warrant IUC placement; a specific clinical indication is still required.
(3) Management of acute urinary retention, indicated by newly developed retention of urine with a postvoid residual bladder volume >500 cm^3, as detected by a bladder scanner; treatment is recommended if asymptomatic or >300 cm^3 if symptomatic. Symptoms may include bladder pain or fullness, persistent urge to void, new incontinence or leaking, or being only able to have frequent small voids.
(4) Aiding in the healing process of open pressure ulcers or skin grafts for certain patients with urinary incontinence when alternative supplies for protective wounds or incontinence management are not feasible.
(5) Facilities may permit exceptions as part of palliative and/or comfort care if catheter use aligns with specific patient goals, such as reducing the need for frequent bed or garment changes or managing uncontrolled pain [29].

Consider exploring alternative methods for bladder management, such as intermittent catheterization for males or females, when appropriate [1] (QOE: low).

Use the appropriate technique for IUC insertion [1] (QOE: moderate).

Consider collaborating to assist with patient positioning and to monitor for potential contamination during IUC placement [30] (QOE: low).

Adhere to hand hygiene practices (following CDC or World Health Organization guidelines) immediately before inserting the IUC and before and after any manipulation of the IUC site or equipment [1] (QOE: low).

Use an aseptic technique and sterile equipment when IUC [1] (QOE: low).

Use sterile gloves, drapes, sponges, and a sterile antiseptic solution to cleanse the urethral meatus and utilize a single-use sterile packet of lubricant jelly for insertion [1] (QOE: low).

Choose an IUC with the smallest possible diameter that ensures adequate drainage to minimize urethral trauma. However, when needed, explore alternative catheter types and sizes, especially for patients expected to have challenging catheterization, to lessen the chances of multiple potentially traumatic catheterization attempts [1] (QOE: LOW).

Management of indwelling urinary catheters

Adhere to routine hygiene practices. Although the issue of cleaning the meatal area with antiseptic solutions remains unresolved, emerging literature suggests the use of chlorhexidine before catheter insertion [31]. It is recommended to avoid alcohol-based products due to concerns about the alcohol causing drying of the mucosal tissues [32] (QOE: low). After insertion, ensure IUCs are adequately secured to prevent movement and reduce urethral traction [33] (QOE: low) Ensure the continuous maintenance of a sterile, closed drainage system [32] (QOE: low). When breaks in the aseptic technique, disconnection, or leakage occur, replace the catheter and the collection system using the aseptic technique [1] (QOE: low). To examine fresh urine, obtain a small sample by aspirating urine from the needleless sampling port using a sterile syringe or cannula adapter after cleansing the port with disinfectant [1] (QOE: low). Ensure prompt transportation of urine samples to the laboratory. If immediate transport is not possible, contemplate refrigerating urine samples or utilizing sample collection cups with preservatives. Collect larger volumes of urine, such as for special analyses such as 24-hour urine, aseptically from the drainage bag [1] (QOE: low). Maintain unobstructed urine flow (QOE: low). Encourage bedside caregivers, patients, and transport personnel to consistently keep the collecting bag positioned below the bladder level, avoiding placement on the floor. Ensure the catheter and collecting tube remain free from kinks to maintain proper urinary flow and reduce the risk of bladder stasis and infection. Empty the collecting bag regularly using individual containers for each patient and refrain from touching the draining spigot to the collecting container [1].

Supplementary interventions

These additional approaches are advised for implementation in hospital locations and/or populations where CAUTI rates remain unacceptably high, even after the adoption of the essential CAUTI prevention strategies mentioned earlier. Create a protocol to standardize the diagnosis and management of postoperative urinary retention. This protocol should include guidelines for nurse-directed intermittent catheterization and the utilization of bladder scanners as suitable alternatives to IUC, when appropriate [34] (QOE: moderate). If bladder scanners are utilized, they should clearly define their indications, provide training to nursing staff on their operation, and ensure disinfection between patients following the manufacturer's instructions [1]. Set up a system for analyzing and reporting data on catheter use and any adverse events resulting from catheter use (QOE: low). Use to identify high-risk units or hospitals. Evaluate process and outcome measures, such as standardized utilization ratio (a summary measure used to track device use over time) and standardized infection ratio (a statistic used to track HAIs over time). Define and monitor catheter harm beyond CAUTI, including issues such as catheter obstruction, unintended removal, catheter trauma, or reinsertion within 24 hours of removal [35].

Not advisable interventions to prevent catheter-associated urinary tract infection

Regular utilization of catheters impregnated with antimicrobial or antiseptic agents [1] (QOE: high). Introducing an opening into a closed system [1] (QOE: low). Conducting screening for asymptomatic bacteriuria in catheterized patients, except pregnant women and patients undergoing endoscopic urologic procedures associated with mucosal trauma [1] (QOE: high). Using catheter irrigation as a preventive measure against infection [1] (QOE: moderate). When using continuous irrigation to prevent obstruction, ensure the maintenance of a closed system. Regular administration of systemic antimicrobials as prophylaxis [1] (QOE: low). Regularly changing catheters as a preventive measure against infection (QOE: low). However, for patients with long-term catheters in place for more than 7 days, the replacement of the catheter may be considered at the time of specimen collection for urine testing to obtain

a fresh sample [36]. Application of alcohol-based products to the genital mucosa [1] (QOE: low).

Interventions pending resolution

Choosing between an antiseptic solution and sterile saline for meatal and perineal cleaning before catheter insertion [31]. Utilizing urinary antiseptics, such as methenamine, for the prevention of UTIs [1]. Separating patients with IUCs in place spatially to prevent the transmission of pathogens that could colonize urinary drainage systems [1]. The standard of care for the routine replacement of IUCs in place for more than 30 days as a measure for infection prevention [1]. Optimal practices for customizing and enhancing the implementation of CAUTI prevention and urine culture stewardship from the adult acute care setting to the pediatric acute care setting [1]. Use of silver alloy hydrogel-coated (SAH) catheter. In their study titled "Prevention of CAUTI using a SAH catheter in critically ill patients: A single-center prospective randomized controlled study," Zhao et al. [37] examined the efficacy of a SAH catheter in preventing CAUTI among 132 critically ill patients in the ICU. Patients were randomly assigned to SAH catheter or conventional catheter groups. The results showed significant differences: on day 7, the positivity rate for urinary white blood cells was higher in the conventional catheter group (33.8% vs 15.6%, $P = 0.016$). On day 10, the rates of positive urine cultures (27.9% vs 10.9%, $P = 0.014$) and CAUTIs (22.1% vs 7.8%, $P = 0.023$) were higher in the conventional catheter group. On day 14, viable bacteria counts were significantly higher in the conventional catheter group at catheter tip ($[3.21 \pm 1.91] \times 10^6$ cfu/ml vs $[7.44 \pm 2.22] \times 10^4$ cfu/ml, $P < 0.001$), balloon segment ($[7.30 \pm 1.99] \times 10^7$ cfu/ml vs $[3.48 \pm 2.38] \times 10^5$ cfu/ml, $P < 0.001$), and tail section ($[6.41 \pm 2.07] \times 10^5$ cfu/ml vs $[8.50 \pm 1.46] \times 10^3$ cfu/ml, $P < 0.001$). Despite a limited population sample from a single recruiting center in China, the authors concluded that SAH catheters effectively reduce CAUTIs in critically ill patients, likely impacting the reduced microbiologically confirmed infections [37].

Suggested practice in under-resourced settings

Education

In LMICs, there is a critical need to intensify educational initiatives, as evidenced by the following research studies (QOE: low). Al-Sayaghi et al. [38] conducted an observational study in Yemen. The research aimed to evaluate HCPs' adherence to CAUTI prevention guidelines during IUC insertion. Utilizing a descriptive cross-sectional design, the study took place in hospitals across Sana'a City, Yemen from March to December 2020. Eligible participants included nurses and physicians from government, teaching, and private hospitals. Data collection used convenience sampling and a structured observational checklist tailored for the study. The findings revealed that nurses predominantly conducted IUC insertions, with a lack of written policies or procedures and in-service education departments in most hospitals.

The overall adherence mean score was 7.31 of 10, indicating 71% of HCPs exhibited high or acceptable adherence levels, whereas 29% demonstrated unsafe adherence levels. Particularly low adherence areas included maintaining an aseptic technique throughout insertion, using single-use lubricant jelly packets, hand hygiene before insertion, and securing the catheter post-insertion. Gender, HCPs' working ward/unit, availability of written policies/procedures, and in-service education departments influenced adherence levels. The study concluded that although Yemeni HCPs demonstrated acceptable overall adherence, critical measures exhibited unsafe adherence. Urgent actions are warranted, including developing, implementing, and monitoring national guidelines and institutional policies for CAUTI prevention.

In addition, regular in-service education, training programs, and ensuring access to necessary materials and supplies are deemed essential [38]. The study conducted by Zegeye et al. [39] aimed to assess the knowledge, practice, and associated factors of CAUTI prevention among nurses at the University of Gondar Comprehensive Specialized Hospital in northwest Ethiopia in 2021. Despite a significant burden, there was a lack of published scientific research on the subject in Ethiopia before this study. A total of 423 nurses were included in the institutional-based cross-sectional study, which utilized simple random sampling. Data were collected using self-administered questionnaires, analyzed using descriptive statistics, and further assessed through multivariable regression analysis. The results revealed that 37.7% of nurses had good knowledge of CAUTI prevention, whereas 51.8% demonstrated good practice. Factors associated with good knowledge included sex, work experience, working unit, training, and access to guidelines. Similarly, factors associated with good practice included sex, work experience, attitude, and knowledge of CAUTI prevention. It was concluded that efforts should be made to enhance knowledge and practice among nurses to improve patient outcomes [39].

Bundle approach

According to seven research studies implemented by INICC, a package with the following nine components effectively reduced the rates of CAUTI in LMICs (Table 1) [14–20].

1. Follow appropriate indications for IUC use;
2. Perform hand hygiene immediately before and after insertion or any manipulation of the catheter device or site;
3. Use an aseptic technique and a single-use packet of lubricant jelly for insertion;
4. Properly secure IUCs after insertion to prevent movement and urethral traction;
5. Maintain the IUC and collecting bag as a closed drainage system;
6. Maintain unobstructed urine flow;
7. Keep the collecting bag below the level of the bladder at all times, and do not rest the bag on the floor;
8. Empty the collecting bag regularly, and avoid reaching 75% of the volume of the bag;
9. Minimize IUC use and duration of use in all patients.

Multidimensional approach

Numerous national, multinational, and multicontinental studies using a multidimensional approach have been conducted in LMICs, achieving a significant reduction in rates of CAUTI and mortality. All of them included six components: (a) bundle, (b) education, (c) surveillance, (d) monitoring adherence with recommendations, (e) internal reports of CAUTI rates, and (f) performance feedback (Table 1) [14–20].

Summary

The empirical evidence delineated in this review incontrovertibly establishes that CAUTI rates in LMICs persist at a magnitude exceeding threefold of that observed in high-income countries. The review systematically presents scientific insights regarding the efficacy of diverse interventions across all settings, even in bundle and multidimensional approaches, distinguishing between proven effective measures, those demonstrated to be ineffective, and the prescription of supplementary measures specifically advocated for adoption in LMICs.

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Ethical approval

Done.

Author contributions

All authors contributed equally to this scientific review paper. They jointly undertook the tasks of conceptualization, literature review, data analysis and interpretation, drafting of the initial manuscript, critical review and editing, supervision, and final approval of the manuscript.

Declarations of competing interest

The authors have no competing interests to declare.

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