INFECTIONS ASSOCIATED WITH BLADDER CATHETER IN INTENSIVE CARE: A SYSTEMATIC REVIEW

Infeções associadas ao cateter vesical em cuidados intensivos: revisão sistemática da literatura

Infecciones asociadas a sondas vesicales en cuidados intensivos: revisión sistemática de la literatura

Bárbara Pauseiro*, Beatriz Vilar**, Marta Matos***, João Simões****

ABSTRACT

Background: the risk of healthcare associated infections is significantly increased when associated with the use of invasive devices. It is estimated that around 80% of urinary tract infections are associated with bladder catheterization, representing up to 40% of the healthcare associated infections. **Objectives**: to identify the risk factors for catheter-associated urinary tract infections, their incidence and the preventive and corrective nursing interventions in intensive care. **Methodology**: systematic review, organized according to the steps recommended by the Joanna Briggs Institute, and developed according to the PRISMA flowchart. **Results**: 10 studies were analysed, allowing to identify the risk factors such as age, gender, comorbidities and the length of time the bladder catheter has been in the patient, and an incidence between 2,7% and 19,3%. Nursing interventions included the implementation of general healthcare associated infections control measures and those specific to bladder catheters. **Conclusion**: patients who are older, female, have Diabetes Mellitus, are immunocompromised and have been with longer permanence of the bladder catheter have a higher probability of contracting a catheter-associated urinary tract infection.

Keywords: urinary catheter; urinary tract infection; intensive care unit; nursing

*RN., Diaverum, Hemo Atlântico Gaia – Hemodialysis Center, Vila Nova de Gaia, Portugal – https://orcid.org/0009-0005-3180-5754

**RN., Northern Rehabilitation Center, Spinal Cord Injury Inpatient Unit, Valadares, Vila Nova de Gaia, Portugal - https://orcid.org/0009-0009-6586-7311

***RN., Casa de Saúde da Boavista, Obstetrics and Gynecology Inpatient Unit, Central Operating Room Complex, Porto, Portugal - https://orcid.org/0009-0008-2811-3783

****PhD., University of Aveiro, School of Health (ESSUA) and Institute of Biomedicine (iBiMED), Aveiro, Portugal - https://orcid.org/0000-0002-4989-2252

Corresponding Author:
João Simões
jflindo@ua.pt

How to cite:
Pauseiro, B., Vilar, B., Matos, M., & Simões, J. (2025). Infeções associadas ao cateter vesical em cuidados intensivos: revisão sistemática da literatura. *Revista de Investigação & Inovação em Saúde, 8*(2), 1-11.
https://doi.org/10.37914/riis.v8i2.438

Received: 07/12/2024
Accepted: 10/04/2025

RESUMO

Enquadramento: o risco de Infeções Associadas aos Cuidados de Saúde eleva-se significativamente quando associado ao uso de dispositivos invasivos. Estima-se que cerca de 80% das Infeções do Trato Urinário estão associadas à cateterização vesical representando até 40% das Infeções Associadas aos Cuidados de Saúde. **Objetivos**: identificar os fatores de risco de Infeções do Trato Urinário associadas ao Cateter Vesical, a incidência das mesmas e as intervenções de Enfermagem preventivas e corretivas em Cuidados Intensivos. **Metodologia**: revisão sistemática da literatura, organizada de acordo com as etapas preconizadas pelo Joanna Briggs Institute, e desenvolvida de acordo com a declaração de Principais Itens para Relatar Revisões Sistemáticas e Meta-análises (PRISMA). **Resultados**: analisados 10 estudos permitindo identificar fatores de risco como a idade, sexo, comorbilidades e o tempo de permanência do cateter vesical, e uma taxa de incidência entre 2,7% e 19,3%. Identificaram-se como intervenções de Enfermagem a implementação de medidas gerais de controlo de Infeções Associadas aos Cuidados de Saúde e específicas do cateter vesical. **Conclusão**: doentes mais velhos, do sexo feminino, com Diabetes Mellitus, imunocomprometidos e com mais tempo de permanência do cateter vesical têm maior probabilidade de desenvolvimento de uma Infeção do Trato Urinário associada ao Cateter Vesical.

Palavras-chave: cateteres urinários; infeções do trato urinário; unidades de cuidados intensivos; enfermagem

RESUMEN

Marco contextual: el riesgo de infecciones asociadas a la asistencia sanitaria aumenta significativamente cuando se asocia al uso de dispositivos invasivos. Se estima que alrededor del 80% de las infecciones del tracto urinario están asociadas con el sondaje vesical, lo que representa hasta el 40% de las infecciones asociadas a la asistencia sanitaria. **Objetivos**: identificar los factores de riesgo de las infecciones del tracto urinario asociadas al sondaje vesical, su incidencia y las intervenciones de enfermería preventivas y correctoras en cuidados intensivos. **Metodología**: revisión sistemática de la literatura, organizada según los pasos recomendados por el Instituto Joanna Briggs, y desarrollada según el diagrama de flujo PRISMA. **Resultados:** se analizaron 10 estudios, que permitieron identificar factores de riesgo como la edad, el sexo, las comorbilidades y el tiempo de permanencia de la sonda vesical, y una tasa de incidencia entre el 2,7% y el 19,3%. Las intervenciones de enfermería incluyeron la aplicación de medidas generales de control de las infecciones asociadas a la asistencia sanitaria y otras específicas para las sondas vesicales. **Conclusión**: los pacientes de más edad, de sexo femenino, con diabetes mellitus, inmunodeprimidos y que llevan más tiempo con la sonda vesical tienen más probabilidades de desarrollar una infeccione del tracto urinario asociada al sondaje vesical.

Palabras clave: catéteres urinarios; infecciones urinarias; unidades de cuidados intensivos; enfermería

INTRODUCTION

Healthcare-Associated Infections (HAIs) are infections acquired after a patient's admission to a healthcare facility. They represent a significant epidemiological challenge worldwide and are the fourth leading cause of complications in developed countries, with a notable impact on mortality, morbidity, and healthcare costs (Barbosa et al., 2019; Mota, 2019).

The risk of developing HAIs increases considerably when invasive medical devices are used, particularly indwelling urinary catheters. In this context, Urinary Tract Infections (UTIs) are of particular concern, with approximately 80% of UTIs linked to catheterization, accounting for up to 40% of all HAIs (Mota, 2019; Rodrigues, 2023).

There is a growing body of clinical guidelines addressing Catheter-Associated Urinary Tract Infections (CAUTIs), issued by leading organizations such as the Infectious Diseases Society of America (IDSA), the Centers for Disease Control and Prevention (CDC), and the European Centre for Disease Prevention and Control (ECDC). These guidelines clearly differentiate CAUTIs from asymptomatic bacteriuria (Nicolle et al., 2019). According to the Centers for Disease Control and Prevention (2025), symptomatic UTIs are diagnosed when a patient presents with at least one of the following symptoms: fever, suprapubic tenderness, costovertebral angle pain or tenderness, increased urinary frequency, urinary urgency, or dysuria. In addition to these clinical signs, a urine culture must identify no more than two species of microorganisms, with at least one showing a colony count $\geq 10^5$ CFU/mL.

UTIs may also be diagnosed based on criteria for asymptomatic bacteriuria, which include: the presence or absence of a urinary catheter, no symptoms of symptomatic UTI, and a urine culture with similar parameters to those mentioned above; or identification of at least one matching microorganism in both blood and urine cultures, with colony counts $\geq 10^5$ CFU/mL (Centers for Disease Control and Prevention, 2025).

A CAUTI is specifically defined as a symptomatic UTI occurring in a patient with an indwelling urinary catheter in place for at least two consecutive days on the date of the event, or removed within the two days prior (Centers for Disease Control and Prevention, 2025).

CAUTIs account for 20–50% of HAIs in Intensive Care Units (ICUs), occurring two to five times more frequently than in other inpatient units (Mota, 2019; Barbosa et al., 2019). This higher incidence is associated with the profile of ICU patients, who typically require multiple invasive devices, immunosuppressive therapies—leading to compromised immunity—and prolonged hospitalization (Mota, 2019). Due to the critical condition of these patients, urinary catheterization is often necessary for accurate fluid balance monitoring and continuous observation, increasing the risk of CAUTI (Cunha, 2020).

CAUTIs significantly prolong hospital stays and worsen patient outcomes, making it essential to monitor their incidence and prevalence to guide effective intervention strategies. Implementing evidence-based prevention measures—such as minimizing unnecessary catheter use and limiting catheter duration—can substantially reduce infection rates and associated healthcare costs. Consequently, it is crucial that nurses are able to identify patients who truly benefit from catheterization, recognize risk factors,

and apply preventive strategies effectively (Giles et al., 2019).

Given this context, the present review aims to synthesize current evidence on intrinsic and extrinsic risk factors associated with CAUTIs in adult and elderly ICU patients, report incidence rates, and identify preventive and corrective nursing interventions that may contribute to reducing CAUTI incidence.

Using the PCC (Population, Concept, Context) framework (Araújo, 2020), the following research questions were formulated: [1] What are the intrinsic and extrinsic risk factors associated with CAUTIs in adult or elderly ICU patients? [2] What is the incidence of CAUTIs in adult or elderly ICU patients? [3] What preventive or corrective nursing interventions can be applied to reduce the incidence of CAUTIs in adult or elderly ICU patients?

METHODOLOGICAL REVIEW PROCEDURES

A systematic literature review was conducted, following the stages recommended by the Joanna Briggs Institute (JBI) for systematic reviews (Aromataris & Munn, 2017). The study was also developed in alignment with international guidelines from the EQUATOR Network (Enhancing the QUAlity and Transparency Of Health Research), particularly the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The review protocol was registered on the PROSPERO platform of the National Institute for Health and Care Research, under the ID 654638.

For the selection of articles, the inclusion and exclusion criteria were defined according to the PCC mnemonic: [1] Population (P) – adult patients (≥18 years old) and elderly individuals, regardless of gender, race, social status, or clinical condition; [2] Concept (C) – studies addressing intrinsic and extrinsic risk factors; studies reporting incidence rates; and studies including preventive or corrective nursing interventions that could be applied to reduce incidence rates; [3] Context (C) – studies conducted in Intensive Care Units (ICUs), regardless of country or study period.

Additionally, the studies considered were limited to a 10-year publication window (2014 to 2023) and had to be original research articles published in Portuguese, English, or Spanish. Only articles that achieved a quality appraisal score of 75% or higher, according to JBI criteria, were included.

Data collection was performed in January 2024 across the following databases: Scopus**,** PubMed**,** Scientific Electronic Library Online (SciELO), and Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS)**.**

To identify appropriate search descriptors, an initial exploratory search was conducted in the aforementioned databases. The search strategy was adapted using terms from Health Sciences Descriptors (DeCS) and Medical Subject Headings (MeSH). The search keys, shown in Table 1, were constructed using a combination of the descriptors: *"urinary catheter"*, *"urinary tract infection"*, *"critical care"*, *"intensive care unit"*, *"adult"*, *"elderly"*, and *"aged"*, with Boolean operators *"OR"* and *"AND"*.

Table 1

Search strategy used for the Scopus, PubMed, SciELO, and LILACS databases, and corresponding results

Databases	Search strategy	Results
Scopus	(TITLE-ABS-KEY ("urinary catheter*") **AND** TITLE-ABS-KEY ("urinary tract infection*") **AND** TITLE-ABS-KEY ("critical care" **OR** "intensive care unit*") **AND** TITLE-ABS-KEY (adult* OR elderly OR aged))	360
PubMed	(((((urinary catheter [Title/Abstract]) **AND** (urinary tract infections [Title/Abstract])) **AND** (critical care [Title/Abstract])) **OR** (intensive care unit [Title/Abstract])) **AND** (adult [Title/Abstract])) **AND** (elderly [Title/Abstract])	227
Scielo	(((urinary catheter) **AND** (urinary tract infection)) **AND** (intensive care units) **OR** (critical care)) **AND** (adult) **OR** (elderly) **OR** (aged)	79
LILACS	(Urinary tract infection) **AND** (urinary catheter) **AND** (intensive care units) **OR** (critical care) **AND** (adult) **OR** (elderly)	310

Source: prepared by the authors, 2024.

After conducting the database searches, a total of 976 articles were identified. The previously defined inclusion and exclusion criteria were then applied. The processes of identification, screening, and inclusion were conducted in accordance with the PRISMA flow diagram, as illustrated in Figure 1.

.

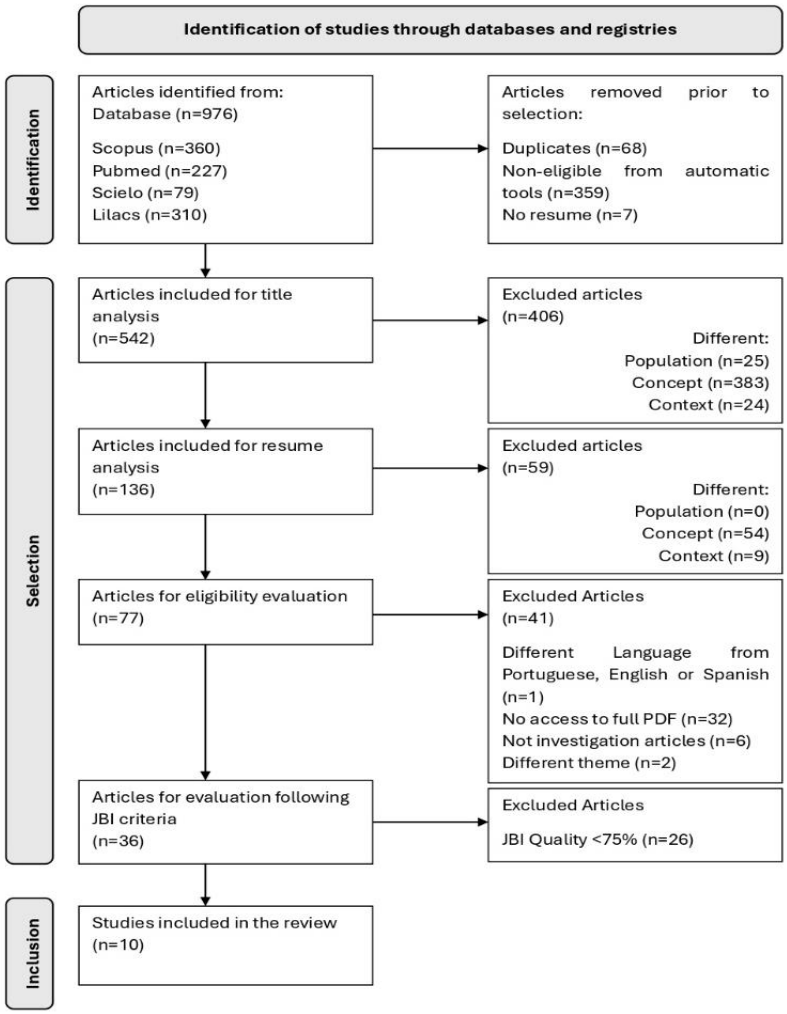

Figure 1

PRISMA flow diagram (*adapted from Page et al., 2021*)

To assess the quality of the selected studies, the JBI Critical Appraisal Tools were used—specifically the tools for Prevalence Studies, Cohort Studies, and Analytical Cross-Sectional Studies (Aromataris & Munn, 2017). A preliminary discussion was conducted to align the parameters used in the analysis of each criterion.

Upon completion of the overall quality appraisal, a subjective interpretation of the results was performed, with scores categorized as follows: 0–25% – very low quality; 25–50% – low quality; 50–75% – moderate quality; 75–100% – high quality.

For the purposes of this review, only studies scoring 75% or higher were included, as shown in Table 2, resulting in a final selection of 10 articles.

Table 2

Results of the quality assessment of selected studies (n=10)

Studies with Prevalence Data	**Quality**
Prevalence and Risk Factors of Healthcare-Associated Infections in Thailand 2018: A Point-Prevalence Survey	100%
Catheter-associated urinary tract infections in intensive care units at a university hospital in Turkey	88,88%
An observational case study of hospital associated infections in a critical care unit in Astana, Kazakhstan	77,77%
Assessment of the occurrence of nosocomial infections in the Intensive Care Unit in the St. Lukas District Hospital in Tarnów in 2012-2016	77,77%
Surveillance of healthcare-associated infections in Piemonte, Italy: results from a second regional prevalence study	77,77%
Epidemiology of Healthcare-Associated Infections and Adherence to the HAI Prevention Strategies	77,77%
Analytical Cross-Sectional Studies	**Quality**
Infección del tracto urinario por uso del catéter vesical en pacientes ingresados en cuidados intensivos	87,5%
Factores de riesgo para infección del tracto urinario asociado al uso de catéter urinario permanente en pacientes adultos hospitalizados	75%
Device-Associated Nosocomial Infection Rates and Distribution of Antimicrobial Resistance in a Medical-Surgical Intensive Care Unit in Turkey	75%
Cohort Studies	**Quality**
Applying preventive measures leading to significant reduction of cateter associated urinary tract infections in adult intensive care unit	81.81%

Source: prepared by the authors, 2024

RESULTS

Regarding the overall characterization of the 10 studies included in the review, 6 were prevalence/incidence studies, 3 were analytical cross-sectional studies, and 1 was a cohort study. In terms of publication dates, 3 articles were published in 2014, 2 in 2018, and the remaining 5 in 2013, 2017, 2019, 2020, and 2022.

Concerning the language of publication, 8 articles were in English and 2 in Spanish. Geographically, 3 articles were from Europe (Poland, Italy, and Switzerland), 2 from the Americas (Chile and Cuba), and 5 from Asia (1 in Thailand, 2 in Turkey, 1 in Kazakhstan, and 1 in Saudi Arabia). This information is summarized in Table 3.

Table 3

Global characterization of studies included in the review

	Authors	Year and Country	Study Type	Sample Size	Study Objective
1	Charrier et al.	2014, Italy	Prevalence Study	333 ICU patients	To identify the prevalence of HAIs.
2	Keten et al.	2014, Turkey	Prevalence Study	832 patients (101 developed CAUTI) in 5 different ICU units	To identify the incidence of CAUTIs, risk factors, causative agents, and their antimicrobial susceptibilities.
3	Tukenmez et al.	2014, Turkey	Retrospective Analytical Cross-Sectional Study	1798 patients	To calculate the rate of device-associated nosocomial infections.
4	Reyes et al.	2014, Cuba	Analytical Cross-Sectional Study	37 patients	To identify the causes leading to the acquisition of CAUTIs.
5	Połeć et al.	2017, Poland	Prevalence/ Incidence Study	886 patients	To identify epidemiological indicators and the main healthcare-associated infections in the ICU, as well as the mortality rate over a 5-year period.
6	Hameed et al.	2018, Saudi Arabia	Cohort Study	Sample size not reported	To determine the impact of applying the best available clinical evidence on preventive measures to reduce CAUTI rates.
7	Viderman et al.	2018, Kazakhstan	Prevalence Study	1257 patients	To assess the rate of device-associated infections and the etiological agents causing HAIs in an ICU.
8	Moolasart et al.	2019, Thailand	Prevalence Study	12,643 patients (541 in the ICU)	To determine the prevalence of HAIs and identify associated risk factors.
9	Véliz and Vergara	2020, Chile	Analytical Cross-Sectional Study	186 patients (63 cases and 123 controls)	To identify risk factors for CAUTI in adult patients.
10	Alrebish et al.	2022, Switzerland	Retrospective Prevalence Study	Sample size not reported	To identify the prevalence of HAIs and preventive interventions.

Source: prepared by the authors, 2024

In terms of intrinsic factors (Table 4) potentially related to CAUTI, the studies by Charrier et al. (2014) and Keten et al. (2014) mention that patients over 65 years of age and female are more likely to develop CAUTI. Conversely, the studies by Reyes et al. (2014) and Moolasart et al. (2019) agree on age but consider male gender to be more susceptible. Other intrinsic factors include immunocompromised patients, those with Diabetes Mellitus, and patients with altered consciousness (Keten et al., 2014).

Regarding extrinsic factors (Table 4), Charrier et al. (2014) highlight hospital size and catheter condition. Reyes et al. (2014) identify catheter duration over 15 days and prior antibiotic use before the presence of multidrug-resistant bacteria as key factors.

In the study by Véliz and Vergara (2020), there was no consensus that patients with neurogenic bladder, Diabetes Mellitus, or aged over 80 were definitively considered intrinsic risk factors. However, they concluded that having a catheter for more than 7 days constituted an extrinsic risk factor.

Concerning CAUTI incidence, rates ranged from a minimum of 2.7% in Charrier et al. (2014) to a maximum of 19.3% in Viderman et al. (2019) (Table 4).

Table 4

Risk factors and incidence of CAUTI in the included studies

	Risk Factors of CAUTIs		CAUTIs Incidence
	Intrinsic	**Extrinsic**	
1	Age > 65 years, female sex	Hospital size and catheter status	2.7% among 333 patients
2	Age > 65 years, female sex, immunocompromised, Diabetes Mellitus, altered consciousness	NA	12.13% (101 out of 832 patients)
3	NA	NA	CAUTI rate of 4.3 per 1000 catheter-days
4	Age > 60 years, male sex, urological, anatomical and/or functional abnormalities	Catheter presence > 15 days, antibiotic therapy prior to multi-resistant bacteria	NA
5	NA	NA	3.3 per 1000 person-days
6	Female sex, advanced age, immunocompromised, Diabetes Mellitus, orthopedic and neurological conditions	NA	Average rate of 2.3 per 1000 catheter-days (2008–2010). Dropped to 1.9, then 0.9, and finally 0.3 by end of 2011. In 2015–2016: 0.1–0.2 per 1000 catheter-days.
7	NA	NA	Annual CAUTI rate: 19.3% (2014), 18.5% (2015)
8	Age > 60 years, male sex	Hospital size and catheter status	13.5% of HAIs are CAUTIs
9	Neurogenic bladder, Diabetes Mellitus, age ≥ 80 years	Catheter presence ≥ 7 days	NA
10	NA	NA	Average CAUTIs: 0.76 per 1000 catheter-days

Source: prepared by the authors, 2024

Regarding preventive nursing interventions (Table 5), Alrebish et al. (2022) and Reyes et al. (2014) mention proper hand hygiene, correct use of personal protective equipment, aseptic techniques, and consistent evidence-based practices. They advise against prophylactic antibiotic use due to the risk of resistance. Al-Hameed et al. (2018) adds infection control training sessions, hand hygiene audits, and daily reminders for catheter removal or reinsertion.

For corrective interventions, Reyes et al. (2014) recommend sterile, closed, and continuous drainage systems. Véliz and Vergara (2020) suggest catheter removal between the 4th and 7th day, daily assessment of catheter necessity, and implementation of technological alert strategies. Al-Hameed et al. (2018) also recommends screening ICU patients upon admission for appropriate catheter indications, using silicone catheters, maintaining a closed system, emptying the drainage bag, fixing the catheter to the inner thigh so the bag remains below the bladder level, and removing the catheter as early as possible.

Table 5

Nursing interventions from the included studies

	Nursing Interventions	
	Preventive Interventions	**Corrective Interventions**
1	NA	NA
2	NA	NA
3	Infection control seminars, hand hygiene audits.	Increased seminars if hygiene standards not met.
4	Aseptic catheter handling, hand hygiene, no prophylactic antibiotics.	Use of sterile, closed, continuous drainage systems.
5	NA	NA
6	Regular educational sessions for staff; daily maintenance forms; daily catheter removal/reminder prompts.	Patient screening on ICU admission; silicone catheters; maintain closed circuit; empty full bag; secure catheter to thigh; keep bag below bladder level and off the floor.
7	NA	NA
8	NA	NA
9	Clear guidelines for local decision-making, training; remove catheter before 4th–7th day.	Daily evaluation of catheter need; tech-based alert systems.
10	Hand hygiene, proper PPE use, evidence-based practices.	NA

Source: prepared by the authors, 2024.

DISCUSSION

Among the articles included in this review, those that specified sample sizes totaled 5,870 participants and generally demonstrated high methodological quality. These studies were published in reputable scientific journals and reflect a current and widespread issue within ICUs across different continents (Europe, America, and Asia).

Regarding intrinsic and extrinsic risk factors associated with CAUTI, the most frequently mentioned intrinsic factors were age and sex. However, based on the available evidence, no definitive age threshold has been established, with variations ranging between 60 and 80 years. Until 2019, the evidence generally pointed to age over 60, but from 2020 onwards, a new perspective emerged in one study, suggesting that patients over 80 might be at increased risk. Despite these variations, all articles agree that older patients are more prone to developing CAUTI. As for sex, the evidence is not consistent over the years, with some studies pointing to females and others to males being more affected, although female sex appears more frequently.

It is estimated that 95% of UTIs are caused by ascending infections through the urethra, while only 5% are of descending origin (i.e., via venous or renal routes) (Imam, 2021). Charrier et al. (2014), Keten et al. (2014), and Al-Hameed et al. (2018) identified the female sex as more susceptible, which may be explained by anatomical differences, such as the proximity of the anus and vagina to the urethra, facilitating microorganism migration. The risk increases with catheter insertion, as these microorganisms can be mechanically introduced into the bladder (Centers for Disease Control and Prevention, 2025).

The presence of immunocompromised patients or

those with Diabetes Mellitus also constitutes important intrinsic risk factors. In such cases, the immune system is weakened, increasing susceptibility to infections. Additionally, in diabetic patients, granulocyte dysfunction facilitates the adhesion of pathogenic microorganisms to bladder epithelial cells, promoting colonization and increased CAUTI prevalence (Alexander, 2024).

Among the most relevant extrinsic risk factors, catheter duration stood out. Prolonged use beyond 7 or 15 days, as identified by Véliz and Vergara (2020) and Reyes et al. (2014), respectively, significantly increases CAUTI risk, making it a modifiable factor. Prolonged catheter use is also associated with higher morbidity, mortality, extended hospital stays, and increased costs (Marlene et al., 2018).

According to Al-Hameed et al. (2018), there should be a daily assessment of catheter necessity and duration. In Portugal, this assessment is guided by Norm n.º 019/2015, updated on 29/08/2022: "Bundle of Interventions" for the Prevention of Catheter-Associated Urinary Tract Infection (Direção-Geral da Saúde, 2022, p. 3), which states in section f): "evaluate daily the possibility of removing the urinary catheter, remove it as soon as possible, and record in the medical file the reasons for its maintenance."

Regarding incidence rates, CAUTI remains a global issue, frequently cited when discussing HCAIs in ICUs. Among the analyzed studies, CAUTI incidence ranged from 2.7% to 19.3%, with no clear explanation for this variation.

Concerning nursing interventions, a key area in clinical practice for CAUTI prevention, both preventive and corrective measures are essential. General measures such as proper hand hygiene, use of personal protective equipment, aseptic techniques, and infection control training are vital in preventing infections.

Corrective actions include removing the catheter as early as possible, preferably between the 4th and 7th day (Al-Hameed et al., 2018; Véliz & Vergara, 2020). Urinary catheterization in critically ill patients is common and necessary for monitoring urinary output, so it's important to evaluate the risk-benefit before insertion. CAUTIs "are not entirely preventable, and UTI risk in appropriately catheterized patients cannot be eliminated" (Centers for Disease Control and Prevention, 2025). Other corrective measures include using silicone catheters, maintaining a closed system, emptying the drainage bag regularly, and securing the catheter below the bladder level. These are also recommended in Centers for Disease Control and Prevention Guidelines (2025).

Study limitations included the use of the term "bundles," which is broad and widely used in international literature, limiting access to specific nursing interventions. Additionally, there was a noticeable gap in Portuguese studies on CAUTI, highlighting the need for further research in national hospitals to understand prevalence and improve nursing practices.

CONCLUSION

Healthcare-associated infections (HCAIs), specifically CAUTIs, are of extreme importance in the healthcare field, particularly in ICUs. Nurses are the professionals responsible for catheter insertion, maintenance, and removal, making them key players in identifying potential UTIs.

This systematic review found that intrinsic and extrinsic

risk factors for CAUTI, as highlighted in the studied literature, include advanced age, female sex, patients with comorbidities such as Diabetes Mellitus and immunosuppression, and the duration of catheter use. The incidence of CAUTI in ICUs ranged from 2.7% to 19.3%. However, in some studies, the implementation of preventive and corrective nursing interventions resulted in a reduction of incidence rates, emphasizing the crucial role that healthcare professionals play daily by adopting evidence-based practices. These practices lead to more effective and efficient conduct using standardized guidelines integrated into ICU infection control protocols.

To reduce CAUTI incidence in ICUs, it is essential to implement evidence-based protocols, provide ongoing training to the nursing team, and rigorously apply aseptic techniques in catheter management. Daily assessment of catheter necessity and early removal are vital strategies, complemented by the use of alternative devices and systematic audits. Based on the findings, future studies are recommended to investigate the impact of ongoing training and the influence of sociodemographic and clinical factors on CAUTI incidence. Additionally, analyzing organizational culture may also contribute to improving adherence to guidelines and ensuring patient safety in ICUs.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

FUNDING SOURCES

This study received no funding.

REFERENCES

Alexander, M. (2024). Pathology of Diabetes-Induced Immune Dysfunction. *International Journal of Molecular Sciences, 25*(13), 7105. https://doi.org/10.3390/ijms25137105

Al-Hameed, F. M., Ahmed, G. R., Alsaedi, A. A., Bhutta, M. J., Al-Hameed, F. F., & Alshamrani, M. M. (2018). Applying preventive measures leading to significant reduction of catheter-associated urinary tract infections in adult intensive care unit. *Saudi Medical Journal*, *39*(1), 97–102. https://doi.org/10.15537/smj.2018.1.20999

Alrebish, S. A., Yusufoglu, H. S., Alotibi, R. F., Abdulkhalik, N. S., Ahmed, N. J., & Khan, A. H. (2022). Epidemiology of healthcare-associated infections and adherence to the HAI prevention strategies. *Healthcare (Basel, Switzerland)*, *11*(1), 63. https://doi.org/10.3390/healthcare11010063

Araújo, W. C. O. (2020). Recuperação da informação em saúde: construção, modelos e estratégias. *ConCI: Convergências em Ciência da Informação, 3*(2), 100–134. https://doi.org/10.33467/conci.v3i2.13447

Aromataris, E., & Munn, Z. (2017). Chapter 1: JBI Systematic Reviews. In E. Aromataris & Z. Munn (Eds.), *JBI Manual for Evidence Synthesis*. Joanna Briggs Institute. https://doi.org/10.46658/JBIMES-20-02

Barbosa, L. R., Mota, É. C., & Oliveira, A. C. (2019). Infecção do trato urinário associada ao cateter vesical em unidade de terapia intensiva. *Revista de Epidemiologia e Controle de Infecção*, *9*(2), 4–9. https://doi.org/10.17058/reci.v9i1.11579

Centers for Disease Control and Prevention. (2025). *Urinary tract infection (catheter-associated urinary tract infection [CAUTI] and non-catheter-associated urinary tract infection [UTI]) events*. National Healthcare Safety Network. https://www.cdc.gov/nhsn/pdfs/pscmanual/7psccauticurrent.pdf

Charrier, L., Argentero, P. A., Farina, E. C., Serra, R., Mana, F., & Zotti, C. M. (2014). Surveillance of healthcare-associated infections in Piemonte, Italy: results from a second regional prevalence study. *BMC Public Health, 14*, 558. https://doi.org/10.1186/1471-2458-14-558

Cunha, J. C. V. (2020). *Prevenção da infeção urinária na pessoa em situação crítica: intervenção especializada de enfermagem* [Tese de Mestrado, Escola Superior de Enfermagem de Lisboa]. Repositório Comum. http://hdl.handle.net/10400.26/37412

Direção-Geral da Saúde. (2022). *Norma nº 019/2015 atualizada a 29/08/2022*. "Feixe de Intervenções" para a prevenção da infeção urinária associada a cateter vesical. https://normas.dgs.min-saude.pt/wp-content/uploads/2015/12/norma_019_2015_atualizada_29_08_2022_feixe-de-intervencoes-de-prevencao-de-infecao-urinaria-associada-a-cateter-vesical.pdf

Giles, M., Graham, L., Ball, J., Watts, W., King, J., Bantawa, K., Paul, M., Harris, A., O'Brien, A. P., & Parker, V. (2019). Variations in indwelling urinary catheter use in four Australian acute care hospitals. *Journal of Clinical Nursing*, *28*(23–24), 4572–4581. https://doi.org/10.1111/jocn.15048

Imam, T. H. (2024). *Infecções bacterianas do trato urinário relacionadas a catéter.* Manual MSD. https://www.msdmanuals.com/pt-pt/profissional/distúrbios-geniturinários/infecções-do-trato-urinário/infecções-bacterianas-do-trato-urinário-itus

Keten, D., Aktas, F., Tunccan, O. G., Dizbay, M., Kalkanci, A., Biter, G., & Keten, H. S. (2014). Catheter-associated urinary tract infections in intensive care units at a university hospital in Turkey. *Bosnian Journal of Basic Medical Sciences, 14*(4), 227–233. https://doi.org/10.17305/bjbms.2014.4.140

Marlene, R., Ramos, V., Patrícia, S., Coelho, F., Celeste, M., Ferreira, S., Pedro, J., & Coelho De Oliveira, P. (2018). Revisão integrativa: avaliação da necessidade de algaliação/manutenção do cateter vesical na pessoa em situação crítica. *Cadernos de Saúde*, *10*(1), 5–13. https://doi.org/10.34632/cadernosdesaude.2018.7216

Moolasart, V., Manosuthi, W., Thienthong, V., Vachiraphan, A., Judaeng, T., Rongrungrueng, Y., Vanprapar, N., & Danchaivijitr, S. (2019). Prevalence and risk factors of healthcare-associated infections in Thailand 2018: a point-prevalence survey. *Journal of the Medical Association of Thailand*, *102*(12), 1309–1316. http://www.jmatonline.com/view.php?id=2306

Mota, É. C. (2019). *Infecção do trato urinário associada ao uso do cateter vesical em paciente crítico: impacto do bundle na prevenção* [Tese de doutorado, Universidade Federal de Minas Gerais]. Repositório Institucional UFMG. https://repositorio.ufmg.br/handle/1843/35366

Nicolle, L. E., Gupta, K., Bradley, S. F., Colgan, R., DeMuri, G. P., Drekonja, D., Eckert, L. O., Geerlings, S. E., Köves, B., Hooton, T. M., Juthani-Mehta, M., Knight, S. L., Saint, S., Schaeffer, A. J., Trautner, B., Wullt, B., & Siemieniuk, R. (2019). Clinical practice guideline for the management of asymptomatic bacteriuria: 2019 update by the Infectious Diseases Society of America. *Clinical Infectious Diseases, 68*(10), e83–e110. https://doi.org/10.1093/cid/ciy1121

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, *372*(71). https://doi.org/10.1136/bmj.n71

Reyes, S. V. F., Castellanos, M. R. P., N., R. Z., Veranes, F. N. L., & Fernández, Z. R. F. (2014). Infección del tracto urinario por uso del catéter vesical en pacientes ingresados en cuidados intensivos. *Medisan*, *18*(11), 1524–1530. https://doaj.org/article/3265183672df4791916dc59f0dedaeaf

Tukenmez Tigen, E., Dogru, A., Koltka, E. N., Ünlü, C., & Maden, M. (2014). Device-associated nosocomial infection rates and distribution of antimicrobial resistance in a medical-surgical intensive care unit in Turkey. *Japanese Journal of Infectious Diseases, 67*(1), 5–8. https://doi.org/10.7883/yoken.67.5

Véliz, E., & Vergara, T. (2020). Factores de riesgo para infección del tracto urinario asociado al uso de catéter urinario permanente en pacientes adultos hospitalizados. *Revista Chilena de Infectología*, *37*(5), 509–514. https://doi.org/10.4067/s0716-10182020000500509

Viderman, D., Khamzina, Y., Kaligozhin, Z., Khudaibergenova, M., Zhumadilov, A., Crape, B., & Azizan, A. (2018). An observational case study of hospital associated infections in a critical care unit in Astana, Kazakhstan. *Antimicrobial Resistance and Infection Control*, *7*, 57. https://doi.org/10.1186/s13756-018-0350-0