



SHORT-TERM HEMODIALYSIS CENTRAL VENOUS CATHETER-ASSOCIATED INFECTIONS: EVIDENCE ON THE NURSE'S ROLE IN INTENSIVE CARE UNITS

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ABSTRACT

Acute kidney injury (AKI) is a frequent and severe complication among critically ill patients, often requiring renal replacement therapy through short-term hemodialysis central venous catheters, which are strongly associated with primary bloodstream infections and increased morbidity and mortality. In this context, nurses play a central role in the prevention of catheter-related infections, combining technical, managerial and educational dimensions of care. This integrative literature review aimed to analyze the role of nurses in preventing infections related to short-term hemodialysis central venous catheters in patients with acute kidney injury hospitalized in intensive care units. The review followed six methodological stages and was guided by the PICO strategy (Population, Interest, Context). Searches were conducted in LILACS, BDENF, SciELO and PubMed using controlled descriptors and Boolean operators. Original articles in Portuguese, English or Spanish, published between 2013 and 2025 and addressing nursing actions to prevent catheter-related infections in AKI patients in intensive care were included. Studies were classified according to the Joanna Briggs Institute levels of evidence. Ten studies met the eligibility criteria, predominantly descriptive and cross-sectional designs (Level IV), complemented by analytical retrospective studies (Level III.c) and integrative reviews. The findings revealed recurrent risk factors such as inadequate hand hygiene, poor adherence to preventive bundles, suboptimal antisepsis, prolonged catheter dwelling time, inappropriate insertion sites and insufficient clinical surveillance. Three analytical axes emerged: continuing education and clinical competence as preventive pillars; nursing leadership and care management as organizational devices for patient safety; and the materiality of care expressed in dressing techniques, site surveillance and use of adjunct technologies (chlorhexidine-impregnated dressings, antimicrobial locks and biofilm-control strategies). The review concludes that effective prevention of catheter-related infections depends on the integration of technical expertise, organizational support and permanent education, reinforcing the nurse's protagonism in building safer hemodialysis care in intensive



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Keywords: Acute Kidney Injury; Hemodialysis Catheters; Catheter-Related Bloodstream Infections; Intensive Care Units; Nursing Care

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1- INTRODUCTION

Acute kidney injury (AKI) is characterized by the abrupt loss of renal function and is generally triggered by severe infectious processes such as sepsis, states of hypovolemia, or exposure to nephrotoxic agents (Benichel; Meneguín, 2020). Among critically ill patients, this condition is frequently aggravated by hemodynamic instability and the use of vasoactive drugs, factors that substantially increase the risk of renal injury (Melo *et al.*, 2020). AKI represents a global public health problem, with an estimated 13.3 million cases and approximately 1.7 million deaths annually, particularly in low- and middle-income countries, where hospital infrastructure and clinical complexity sustain higher rates of morbidity and mortality (Duarte *et al.*, 2023). In intensive care settings, its incidence is even more expressive, ranging from 30% to 70% depending on clinical conditions, service profile, and access to dialysis therapies (Barcia-Menéndez; Zambrano-Vera; Bustamante-Cevallos, 2024).

Renal replacement therapy (RRT), especially hemodialysis, plays a fundamental role in removing uremic toxins, correcting electrolyte disturbances, and controlling volume overload, functioning as temporary vital support for kidney function in critically ill patients (Barcia-Menéndez; Zambrano-Vera; Bustamante-Cevallos, 2024). This therapy is predominantly performed through short-term hemodialysis central venous catheters (CVCs), inserted into large-caliber veins such as the internal jugular or subclavian (Ferreira *et al.*, 2020). Although indispensable in the management of AKI, these devices are associated with significant complications, particularly catheter-related bloodstream infections, abscesses, and endocarditis, which have a direct impact on morbidity, mortality, and length of hospitalization (Jesus-Silva *et al.*, 2020; Melo *et al.*, 2020). Inadequate catheter site selection, poor dressing practices, deficient maintenance, and improper manipulation considerably increase the infectious risk (Rocha *et al.*, 2020).

Within this scenario, nurses play a central role in preventing complications associated with short-term hemodialysis catheters, as they operate simultaneously in technical-care activities, clinical management, and the permanent education of healthcare teams. The literature indicates that knowledge gaps, insufficient adherence to protocols, and the absence of continuous training compromise patient safety,



particularly in intensive care units where clinical complexity demands a systematic approach and standardized practices (Araújo *et al.*, 2021; Vicente; Contrin; Werneck, 2023). The implementation of bundles, checklists, continuous surveillance of the insertion site, appropriate antisepsis, and careful dressing management are well-established strategies that contribute to the reduction of catheter-related infections.

Given the clinical magnitude of AKI, the frequent use of hemodialysis catheters, and the vulnerability of critically ill patients, it becomes imperative to understand how evidence-based nursing practice influences clinical outcomes. Therefore, this study aimed to analyze the role of nurses in the prevention of infections related to short-term hemodialysis central venous catheters in patients with acute kidney injury hospitalized in intensive care units.

2- METHOD

This study is an Integrative Literature Review (ILR), a methodological approach that enables critical synthesis of evidence and the incorporation of different research designs, integrating quantitative, qualitative, and mixed results in a systematic and interpretative manner (Lemes *et al.*, 2021; Ganong, 1987). The methodological process followed six stages: (1) definition of the guiding research question; (2) database searching; (3) selection of studies based on inclusion and exclusion criteria; (4) categorization and data extraction; (5) critical analysis and interpretation; and (6) presentation of findings. The PICO strategy was used to structure the research question, considering Population (P), Interest/Intervention (I), and Context (Co) (Stern; Jordan, McArthur, 2014). Accordingly, the following question was formulated: “What is the role of nurses in preventing infections related to short-term hemodialysis central venous catheters in patients with acute kidney injury hospitalized in intensive care units?” In this model, the population corresponded to AKI patients undergoing hemodialysis; the interest focused on infection prevention associated with short-term central venous catheters; and the context referred to nursing practice in intensive care units.

The search was conducted in the LILACS, BDENF, SciELO, and PubMed databases. Controlled descriptors from the Health Sciences Descriptors (DeCS) and Medical Subject Headings (MeSH) were used, combined with the Boolean operators AND and OR



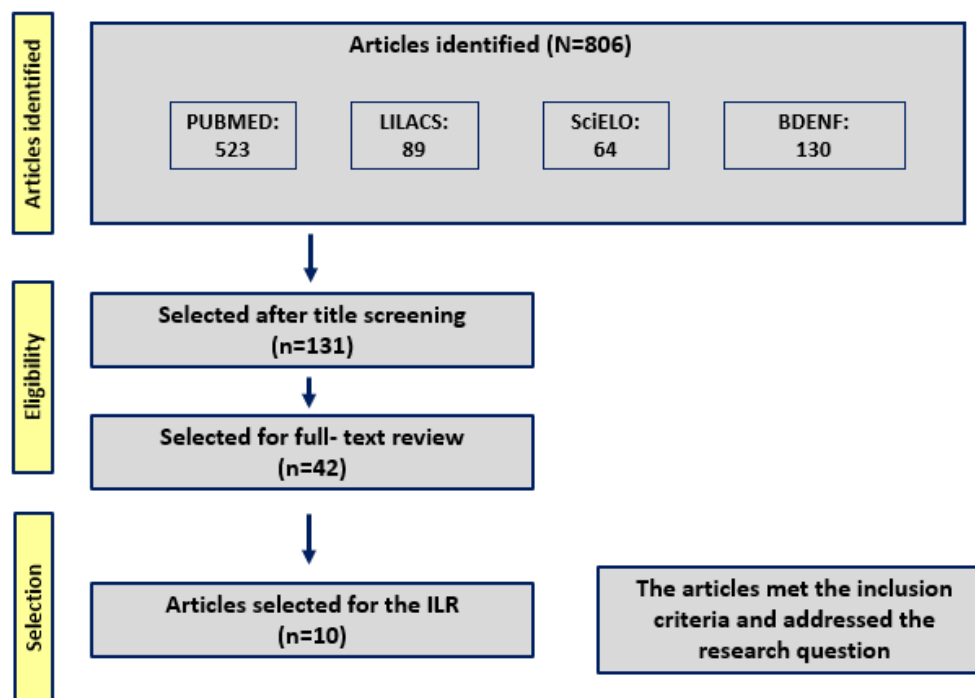
according to the PICO strategy: “Acute Kidney Injury” OR “Insuficiência Renal Aguda” AND “Hemodialysis” OR “Hemodiálise” AND “Intensive Care Unit” OR “Unidade de Terapia Intensiva”; “Central Venous Catheter” OR “Cateter Venoso Central” OR “Dual Lumen Catheter” AND “Bloodstream Infection” OR “Infecção da Corrente Sanguínea”; “Nursing Care” OR “Enfermagem” AND “Infection Prevention.” Full-text original articles published in Portuguese, English, or Spanish between 2013 and 2025 that addressed the role of nurses in preventing catheter-related infections in AKI patients in ICUs were included. Dissertations, theses, undergraduate papers, editorials, institutional documents, duplicates, and studies that did not answer the research question were excluded.

The selected studies were classified according to the Joanna Briggs Institute (JBI) levels of evidence to ensure methodological quality and reliability of findings. Level I includes systematic reviews of randomized controlled trials; Level II comprises individual randomized controlled trials; Level III is subdivided into quasi-experimental studies with a control group (III.a), quasi-experimental studies without a control group (III.b), and analytical observational studies such as cohort and case-control designs (III.c); Level IV includes descriptive, observational, exploratory studies and case reports, which, despite their lower generalizability, contribute to identifying relevant care patterns (Lockwood *et al.*, 2020). The adoption of this framework enabled critical evaluation of the consistency of findings and contextualization of their applicability to infection prevention practices discussed in this review.

After evidence classification, the studies proceeded to identification, screening, and eligibility stages, as demonstrated in the following flowchart.



Flowchart 1. Process of identification, screening, and inclusion of studies in the integrative review



Flowchart developed according to the PRISMA guidelines, adapted to the specific characteristics of this integrative review.

3- RESULTS

A total of ten studies met the eligibility criteria, with a predominance of publications between 2017 and 2025, reflecting the growing scientific interest in the topic. Descriptive and cross-sectional observational designs were the most frequent, accounting for most of the evidence classified as Level IV according to the Joanna Briggs Institute. Retrospective analytical and cohort studies were also identified, particularly those addressing infectious complications, catheter dwell time, and patient clinical profiles, corresponding to Level III.c. The scarcity of clinical trials and interventional research reflects ethical and operational constraints inherent to the intensive care environment, favoring the predominance of observational studies focused on care practices.

The findings revealed a set of determinants associated with the risk of infections related to short-term hemodialysis central venous catheters, including inadequate hand



hygiene, poor adherence to preventive bundles, insufficient antisepsis prior to manipulation, limited professional training, and non-sterile dressing techniques. Studies also demonstrated the association between prolonged catheter permanence, inappropriate insertion site selection, and deficits in clinical surveillance with increased incidence of catheter-related bloodstream infections. The nurse’s role emerged as a central axis in preventing such complications, both through direct care delivery and through leadership in continuing education, standardization of routines, monitoring, and implementation of institutional protocols.

The main methodological characteristics and findings of the included studies are summarized in the table below.

Table 1. Summary of key studies on nursing practices for the prevention of infections related to short-term hemodialysis central venous catheters

Article Title	First Author	Journal / Year	Method & JBI Level of Evidence	Key Findings
Analysis of care practices for the prevention of primary bloodstream infections	Araújo	Ciência, Cuidado e Saúde, 2021	Cross-sectional observational study - Level IV	Demonstrated correlation between gaps in knowledge, poor hand hygiene adherence and increased bloodstream infection (BSI) rates; highlighted the need for structured continuing education.
Central line-associated bloodstream infections: nursing team knowledge and practice	Silva	Revista de Pesquisa: Cuidado é Fundamental, 2021	Descriptive observational study - Level IV	Identified insufficient knowledge about BSI pathophysiology; low adherence to insertion checklist and preventive bundles; reinforced educational interventions as core preventive strategy.
Adherence of the nursing team to the bundle for prevention of central venous catheter-related bloodstream infections in intensive care units	Vicente	Cuidar em Enfermagem, 2023	Observational study with performance monitoring - Level III.c	Demonstrated improved adherence to preventive bundles when nurses understood the rationale behind each protocol step; emphasized reflective practice and safety culture.
Infection prevention and control measures associated with the use of peripheral and	Oliveira	REVISA, 2021	Integrative review - Level IV (qualitative synthesis)	Highlighted nurse leadership in standardizing workflows, infection control supervision, and protocol implementation as key



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central venous catheters				factors in reducing CVC-related complications.
Cuidados de enfermagem ao paciente renal crônico em hemodiálise em uso de cateter duplo lúmen	Maia	Revista de Pesquisa: Cuidado é Fundamental, 2021	Descriptive observational study - Level IV	Showed that adherence to basic measures-hand hygiene, sterile technique, clorexidine antiseptis, and dual-mask use-only generates protective effect when built into stable institutional routines.
Central venous catheter-related bloodstream infection for hemodialysis: integrative review	Danski	Revista Baiana de Enfermagem, 2017	Integrative review - Level IV (secondary evidence)	Reported infection rates as low as 0.45/1000 catheter-days when antibiotic lock and barrier strategies were implemented; reinforced biofilm prevention as critical.
Care of the vascular access for hemodialysis: an integrative review	Rocha	Revista Cuidarte, 2020	Integrative review - Level IV (secondary evidence)	Demonstrated superiority of transparent dressings impregnated with chlorhexidine; established aseptic handling and dressing renewal frequency as determinants of CCP safety.
Time of permanence and reasons for removal of central venous catheter in chronic renal patients in ambulatory hemodialysis	Santos	Clinical and Biomedical Research, 2021	Retrospective analytical study - Level III.c	Linked catheter permanence time and repeated manipulation to increased infection risk; indicated removal criteria and surveillance protocols as protective mechanisms.
Nursing care for patients with short-term central venous catheters: an integrative review	Silva	Revista de Enfermagem UFPE Online, 2023	Integrative review - Level IV (secondary evidence)	Reinforced that prevention transcends procedural knowledge; pointed to organizational aspects, feedback mechanisms, and monitoring as critical to clinical outcomes.
Biofilm in catheters associated with bloodstream infections in intensive care units: an integrative literature review	Pereira	Revista de Pesquisa: Cuidado é Fundamental, 2025	Integrative review - Level IV	Described colonization routes, biofilm dynamics, and benefits of antimicrobial barrier methods; recommended combined strategies to mitigate systemic infection.

Table 1. Summary of key studies addressing the nurse’s role in the prevention of short-term hemodialysis central venous catheter–related infections in intensive care settings.

4- DISCUSSION

The body of analyzed studies indicates that the prevention of infections associated with



short-term hemodialysis central venous catheters extends beyond the strict application of protocols and technical guidelines. Nursing practice in intensive care units integrates educational, care-related, and technical–operational dimensions, all interdependent in the control of catheter-related bloodstream infections. Within this context, three essential interpretive axes emerge: (1) the development of clinical competence through continuing education; (2) nursing leadership and care management as organizational devices for patient safety; and (3) procedural practices related to catheter maintenance, dressing, and clinical monitoring.

4.1 Continuing education and clinical competence as a preventive axis

The literature demonstrates that the level of technical-scientific knowledge among professionals directly influences the safety of patients undergoing hemodialysis. Studies such as Araújo *et al.* (2021) show that failures in hand hygiene, lack of mastery of protocols, and limited ability to recognize early clinical signs of infection contribute to higher rates of catheter-related bloodstream infections. Similarly, Silva *et al.* (2021) identified significant gaps in the nursing staff’s physiopathological understanding of bloodstream infections, including limited knowledge of national and international guidelines and low adherence to insertion checklists. These findings reinforce educational fragility and highlight the need for continuous educational processes that go beyond sporadic training sessions and are incorporated into institutional routines.

From this perspective, Continuing Health Education represents a structuring tool. By linking learning to real care demands, it promotes the reorganization of practice, fosters critical reasoning, and enhances professional autonomy (Silva *et al.*, 2021). Vicente, Contrin, and Werneck (2023) complement this approach by demonstrating that adherence to preventive bundles does not rely solely on the availability of protocols, but rather on professionals’ capacity to understand the rationale behind each step and its impact on morbidity and mortality. Thus, continuing education transcends the transmission of instructions and situates nurses as reflective actors who share responsibility for clinical indicators (Araújo *et al.*, 2021).

Moreover, educational initiatives strengthen safety culture. Evidence shows that essential skills for catheter management-such as antisepsis, site surveillance, clinical



assessment, and proper use of supplies-are not merely procedures, but practices that are consolidated through training, institutional feedback, and performance monitoring (Silva *et al.*, 2023; Oliveira; Pinto; Souza, 2021). In intensive care environments, where hemodynamic instability, high device burden, and polypharmacy are common, the incorporation of updated knowledge becomes an ethical and technical requirement, particularly considering the risk of biofilm formation and device-associated bloodstream infections (Pereira; Farias; Santos, 2025; Neves; Rodrigues, 2022). Accordingly, the nurse’s role as educator, peer trainer, and mediator of evidence constitutes the first preventive axis.

4.2 Care management and nursing leadership as organizational safety devices

Evidence shows that preventing infections related to short-term hemodialysis catheters requires more than individual technical proficiency. Findings highlight the relevance of the nurse as a care manager and as an articulator of clinical processes, particularly in intensive care units where clinical complexity and high technological density make each intervention potentially critical. In ICUs, nursing constitutes the largest workforce and occupies a central position in clinical routines, being responsible for team guidance, standardization of procedures, and supervision of best practices (Oliveira; Pinto; Souza, 2021). This operational centrality positions nurses as agents of clinical governance, monitoring indicators, reviewing care flows, identifying vulnerabilities, and intervening before failures lead to adverse events-particularly in contexts characterized by multiple invasive devices, polypharmacy, and time-sensitive decision-making (Silva *et al.*, 2023).

Llapa-Rodríguez *et al.* (2019) demonstrate that consistent adherence to catheter care bundles and checklists substantially reduces infection incidence, especially when combined with systematic monitoring of team performance. Such adherence, however, does not arise solely from the existence of protocols; it depends on stable managerial processes, ongoing feedback, performance monitoring, and institutional accountability mechanisms. In this sense, the nurse functions as a facilitator of evidence-based practice, ensuring that preventive measures-from environmental preparation to documentation of device manipulation-are uniformly applied (Ferreira *et al.*, 2020). In



the absence of strong nursing leadership, protocols tend to become empty normative structures, superficially adopted and unable to impact care indicators (Maia *et al.*, 2021).

This understanding is reinforced by studies associating organizational structure with patient safety. Maia *et al.* (2021) show that practices considered basic—such as hand hygiene, sterile technique, chlorhexidine antiseptics, and the use of masks by professionals and patients—only produce meaningful effects when incorporated into stable routines with supervision. Therefore, nursing leadership in catheter management goes beyond procedural execution: it involves coordinating teams, reinforcing safe practices, and integrating infection control services (Ferreira *et al.*, 2020). By consolidating routines, providing feedback, and aligning professionals with protocols, nurses foster a culture of safe performance in which infection prevention becomes organizational rather than individual (Silva *et al.*, 2023).

4.3 Dressing care, clinical surveillance, and assistive technologies: the materiality of care

The third category emerges from the technical–operational dimension of catheter management. The literature highlights that infection control is not an abstract concept; it is materialized on the patient’s body through concrete interventions: selection of the insertion site, dressing integrity, sterility of connectors, catheter dwell time, and continuous inspection of the access. Studies by Ferreira *et al.* (2020), Danski *et al.* (2017), Jesus-Silva *et al.* (2020), and Santos *et al.* (2021) show that proper site selection—particularly the right internal jugular vein—and strictly monitored catheter dwell time reduce the risk of stenosis, mechanical complications, and infectious events. Conversely, prolonged permanence and recurrent manipulation substantially increase the incidence of bloodstream infections, especially among critically ill patients requiring renal replacement therapy (Neves; Rodrigues, 2022).

Clinical follow-up, therefore, cannot be episodic. Silva *et al.* (2021) point out that visible inflammatory signs at the insertion site, fever, chills, and hypotension are early indicators that must be monitored by ICU nurses and integrated into the comprehensive assessment of the patient’s condition (Barbosa *et al.*, 2024). Bedside surveillance allows rapid interventions, therapeutic adjustments, and prevention of systemic complications.



Rocha *et al.* (2020), complemented by the operational recommendations of Maia *et al.* (2021), broaden this perspective by demonstrating that transparent chlorhexidine-impregnated dressings, when combined with rigorous aseptic technique and appropriate replacement intervals, outperform conventional dressings by providing an antimicrobial barrier and reducing local contamination risk.

Finally, protective adjunct Technologies-such as antimicrobial lock solutions and specialized dressing systems-function as therapeutic complements, especially in catheters with extended dwell time. Danski *et al.* (2017) reported rates as low as 0.45 infections per 1,000 catheter-days when these solutions were properly used, highlighting their potential to reduce secondary invasive procedures. Recent studies on catheter biofilms reinforce that combining physical barriers, antiseptics, and intraluminal lock strategies reduces microbial colonization and progression to systemic infection (Pereira; Farias; Santos, 2025; Neves; Rodrigues, 2022). Regardless of the specific material employed, the literature converges on a central point: prevention does not stem from isolated resources, but from the integration of knowledge, organization, and technique. The materiality of care, operationalized by nursing, constitutes the final preventive axis.

5- CONCLUSION

This integrative review demonstrated that the prevention of infections associated with short-term hemodialysis central venous catheters depends on a nursing practice that integrates technical competence, care management, and continuous educational processes. Nurses emerge as key actors not only in performing procedures, but also in creating safe environments that enable rigorous protocol adherence, early identification of complications, and the adoption of systematic clinical surveillance strategies. The structured implementation of care bundles, the use of appropriate dressings, and careful monitoring of the catheter insertion site reduce infectious complications, improve care indicators, and directly influence outcomes in critically ill patients with acute kidney injury.

However, the findings reveal important weaknesses in everyday clinical practice. Knowledge gaps, low adherence to institutional guidelines, and limited interpretation of



scientific recommendations contribute to increased risk. In this context, Continuing Health Education serves as a structural component: learning processes that are sensitive to the real clinical environment and aligned with care demands strengthen professional autonomy and expand decision-making capacity when facing complex situations. Improvements in clinical indicators are therefore not the result of isolated actions, but of the integrated functioning of training, standardized care practices, and institutional support.

Despite the relevance of the synthesis, this review presents limitations inherent to its design. The predominance of observational and cross-sectional studies reduces the generalizability of findings and limits causal interpretations between nursing interventions and reductions in infection. Methodological heterogeneity, as well as the absence of randomized clinical trials or multicenter longitudinal studies, hinders direct comparison of preventive strategies. These limitations, however, reflect the reality of intensive care, where ethical constraints, time-sensitive decisions, and clinical severity restrict the feasibility of experimental research designs.

Finally, it is important to emphasize that the prevention of infections related to short-term hemodialysis catheters is not merely a mechanical execution of technical routines. It is a daily exercise of care, attentiveness, and discernment. In light of Michel de Certeau, each intervention performed by the nurse—from dressing replacement to team guidance—can be understood as an “art of doing”: a gesture that reconciles technical knowledge, sensitivity to suffering, and inventiveness amid the concrete conditions of work. Thus, nursing practice transcends protocol—it constructs meaning, humanizes treatment, and reinforces the idea that in the most complex clinical scenarios, life is preserved not only by technology, but by the ethics of care materialized in each action.

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