**Jurnal Ilmu Kesehatan,** Volume 1, Nomor 2, Juli-Desember 2024
E-ISSN 3047-8766
**doi: https://doi.org/10.58222/jurik.v1i2.1019**

# INFECTION CONTROL MEASURES IN HAEMODIALYSIS CATHETERIZATION : A NARRATIVE REVIEW

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***ARTICLE INFO***

***Article history***

Submitted : 2024-06-10
Revised : 2024-06-22
Accepted : 2024-07-12

***Keywords:***

*haemodialysis catheterization, infection control measures, central venous catheter, staff education and training*

***ABSTRACT***

Hemodialysis catheterization is the medical procedure performed in patients with acute renal failure or chronic kidney diseases. However, there is high risk of catheter related bloodstream infection with the use of central venous catheter which effects patients health. In this review, different approaches to control such infection is highlighted. Those measures are hand hygiene, catheter site care and implementation of antimicrobial strategies. The review also adds on to the importance of education and training to the staff related to infection control protocol. Factors like prolonged catheter use, poor insertion technique and non adherence to protocol leads to infection. There are advanced interventions like ethanol lock therapy and use of antimicrobial catheter that reduces. Catheter related bloodstream infections challenges like staph shortage and patient non-compliance has to be addressed to optimize infection control practice in dialysis unit.



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## INTRODUCTION

Short-term central venous catheters (CVCs) are frequently employed for hemodialysis, especially in urgent situations when enduring vascular access is not readily accessible . Hemodialysis catheterization is a critical procedure for patients with acute renal failure (ARF) or chronic kidney disease requiring dialysis[1]Hemodialysis catheters are primarily used to provide vascular access for patients undergoing hemodialysis treatment. They allow for the removal of waste products and excess fluid from the blood when the kidneys are unable to perform these functions effectively(1) CVCs allow for the efficient removal and return of blood during hemodialysis sessions. They are essential for patients who cannot use traditional arteriovenous (AV) fistulas or grafts due to various medical conditions[2] There are two main types of CVCs used in hemodialysis: tunneled and untunneled catheters. Tunneled catheters are inserted under the skin and are typically used for long-term access, while untunneled catheters are used for short-term access and are inserted directly into a large vein(2), Infections are a leading cause of death among hemodialysis patients, with Staphylococcus being the most common bacterium, often treated with vancomycin.(3). The main objective of this review is to provide insight into the importance of hand hygiene, catheter site care, as well as the implementation of antimicrobial strategies to reduce the risk of infection

## METHODS

This study uses a systematic literature review approach to identify and analyze various risk factors associated with catheter-related bloodstream infections (CRBSIs) in hemodialysis patients, as well as the infection control strategies implemented in dialysis units. The review also evaluates interventions that have been implemented to reduce catheter-related infection incidents, such as the use of antimicrobial catheters and ethanol lock therapy. Data for this review were collected from various relevant studies on infection management in hemodialysis patients, focusing on risk factors such as prolonged catheter use, catheter insertion techniques, and inadequate catheter management practices. The analyzed articles also provide information on hand hygiene, catheter site care, catheter monitoring, and staff training related to infection control protocols. The review was conducted by accessing and evaluating articles published in reputable medical journals and academic papers from credible databases.

## RESULTS AND DISCUSSION

### Importance of infection control measures in hemodialysis

Infection control measures in hemodialysis are vital for reducing infection rates, ensuring quality care, and addressing the specific needs of patients with comorbidities. By adhering to established guidelines and continuously evaluating practices, healthcare providers can significantly improve patient outcomes.(1) Identified risk factors for infection include length of hospital stay and catheter insertion site, The study emphasizes the importance of recognizing these risks to develop protocols that can reduce infection rates and improve care quality for hemodialysis patients.(1)Central venous catheters (CVCs) are commonly used in hemodialysis, but they are associated with a significant risk of Catheter-related bloodstream infection [CRBSI] which can lead to serious complications and increased morbidity and mortality among patients(2) infection control protocols in hemodialysis are crucial for the prevention of catheter-related bloodstream infections (CRBSI) and associated complications. The implementation of efficacious strategies, encompassing the utilization of ethanol locks, comprehensive staff education, and the establishment of standardized protocols, is imperative to optimize patient safety and clinical outcomes.(2) Infections represent the second most prevalent etiological factor contributing to mortality among individuals undergoing hemodialysis, with staphylococcus identified as the most commonly isolated bacterial species. This situation highlights the imperative for the implementation of robust infection control measures to safeguard at-risk patient populations(3).Vancomycin is frequently utilized in the management of infections among patients undergoing hemodialysis. Nevertheless, the initiation of its administration is often postponed until subsequent to dialysis sessions, which may complicate therapeutic outcomes and elevate the likelihood of insufficient drug exposure. The administration of vancomycin during the final hour of dialysis may enhance infection management by ensuring that appropriate drug concentrations are sustained.(3)

### Risk factors for infection in hemodialysis catheterization

1. **Prolonged catheter use**

The longer a catheter remains in place, the higher the risk of infection. Prolonged exposure can lead to biofilm formation on the catheter, which is a significant risk factor for infection(1). the opportunity for bacteria to colonize the catheter surface. This colonization can lead to CRBSI, as bacteria can migrate from the skin along the catheter into the bloodstream. The study emphasizes that the mechanism of CRBSI is often due to such colonization, making prolonged use a critical risk factor .(2) The study indicates that tunneled catheters are associated with a lower risk of CRBSI compared to untunneled catheters. However, prolonged use of any catheter type can still elevate infection risks. The effectiveness of interventions like ethanol lock may vary based on the duration of catheter use, as longer exposure may diminish the protective effects of such solutions (2). The duration of catheter retention is directly proportional to the likelihood of infection occurrence. In the research conducted, individuals exhibiting bacterial colonization of the catheter were subjected to prolonged treatment, thereby underscoring the association between extended catheter application and the heightened risk of infection.(3)

**2. Catheter insertion technique**

The choice of insertion site is critical. The research indicated that the left femoral vein was associated with a higher risk of infection. therefore , careful consideration of the insertion site can help mitigate infection risks (1).the methodology employed for the insertion of catheters, encompassing the selection of antiseptic agents and the protocols for dressing application, substantially influences the infection risk among patients undergoing hemodialysis. Ongoing enhancements in these procedural practices are imperative to mitigate the prevalence of Catheter-Related Bloodstream Infections (CRBSI)(2). For individuals possessing catheters, a therapeutic locking solution has been formulated, integrating vancomycin and heparin. This formulation was administered into the arterial and venous branches, which indicates that meticulous management of catheters is imperative for the efficacy of treatment.(3)The selection of an appropriate catheter type, along with the establishment of meticulous post-insertion care protocols, constitutes essential elements in mitigating the infection risks that are concomitant with hemodialysis catheterization(4).the NexSite catheter insertion methodology demonstrated significant efficacy and safety, emphasizing the importance of adequate training, judicious site selection, and vigilant monitoring to guarantee optimal results for patients receiving hemodialysis(5). The methodologies employed for catheter insertion are of paramount importance in the clinical care of patients undergoing hemodialysis. Through the selection of an appropriate catheter type, the reduction of insertion site frequency, and the strict adherence to rigorous hygiene protocols, healthcare practitioners can markedly diminish the incidence of nosocomial infections within this susceptible demographic(6).

3. **Poor catheter practices**

poor catheter practices, such as inadequate hand hygiene, improper skin disinfection, and prolonged catheter use, can lead to increased infection rates and complications. Adhering to established protocols and guidelines is essential for improving patient outcomes in catheter management.(1)

Central venous catheters (CVCs) are integral components in the administration of diverse medical interventions; however, inadequate management and upkeep can result in catheter-related bloodstream infections (CRBSIs), which represent a frequent and significant complication. Notwithstanding the progress made in catheter management, the incidence of infections persists, exacerbating morbidity and mortality rates among the patient population.(2) Suboptimal practices can precipitate catheter colonization, wherein bacteria attach to the surface of the catheter. Among the studies examined, merely two trials provided insights into catheter colonization, underscoring a deficiency in comprehensive data pertaining to this vital domain. The aggregated data revealed no statistically significant disparity in catheter colonization rates between the ethanol lock and control cohorts, implying that current interventions may not effectively address the issues stemming from poor practices(2), The investigation encompassed individuals possessing dialysis catheters, which were employed for the delivery of therapeutic agents such as vancomycin. Inadequate upkeep of these catheters may precipitate adverse outcomes, including infections or thrombosis. The manuscript underscores the critical significance of implementing a lock therapy solution that synergistically incorporates vancomycin and heparin to preserve catheter patency and mitigate the risk of infection.(3)To mitigate the risks associated with poor catheter practices, the study suggests implementing regular monitoring, infection prevention strategies (such as hand hygiene and environmental cleaning), and providing education on antimicrobial stewardship for both staff and patients.(4)

**Infection control measures in hemodialysis catheterization**

**1. Hand hygiene**

Effective hand hygiene practices involve washing hands with soap and water or using alcohol-based hand sanitizers before and after handling catheters. This is essential for healthcare providers and patients alike to minimize the risk of introducing pathogens during catheter insertion or maintenance(7). Prior to the interventions, compliance with hand hygiene was reported as "poor." Factors contributing to this poor compliance included nursing staff shortages, high workloads, lack of resources, skin irritation from frequent handwashing, and time constraints due to rapid patient turnover

(2). The study highlighted that nurses are required to perform hand hygiene between 60 to 100 times per hemodialysis session per patient. This high frequency is one reason for the observed poor compliance rates(2)

**2. Catheter site care**

Proper care of the catheter insertion site is crucial in reducing the risk of catheter-related infections (CRI). The paper highlights that CRI is a significant cause of morbidity and mortality in chronic hemodialysis patients, emphasizing the need for effective site management(1) effective catheter site care is vital in hemodialysis units to minimize infection risks. The study highlights the positive impact of educational interventions on nurses' practices, emphasizing the need for ongoing training and adherence to infection control protocols.(8)

**3. Catheter maintenance and monitoring**

catheter maintenance and monitoring involve regular assessments, patient education, and adherence to hygiene protocols. These practices are essential for preventing complications and ensuring the safety and well-being of patients undergoing hemodialysis(1) effective catheter maintenance and monitoring are critical for preventing infections in hemodialysis patients. The study underscores the importance of educational interventions in enhancing nurses' practices and highlights the need for ongoing training to ensure adherence to infection control protocols.(8)

Table 1. Key infection control measures in hemodialysis catheterization.(1,2,7,8)

| Control Measure | Description | Impact |
|---|---|---|
| **Hand Hygiene** | Washing hands with soap or using alcohol-based sanitizers before and after catheter handling. | Reduces pathogen transmission and infection rates. |
| **Catheter site care** | Proper cleaning and care of the insertion site using antiseptics and sterile dressing. | Decreases risk of catheter-related infections. |
| **Antimicrobial catheters** | Use of catheters coated with antimicrobial agents to prevent bacterial colonization. | Lowers incidence of bloodstream infections. |
| **Ethanol lock therapy** | Using ethanol to lock catheters between dialysis sessions to prevent microbial growth. | Effective in reducing catheter-related bloodstream infections (CRBSI). |
| **Staff education and training** | Continuous training on infection control protocols for healthcare workers. | Improves compliance with hygiene practices and protocols. |
| **Regular catheter surveillance** | Routine monitoring of catheter use and site condition. | Identifies potential infection risks early, reducing morbidity. |

**Evidence based practices for preventing infections**

**1. Use of antimicrobial catheters**

Antimicrobial catheters are designed to reduce the risk of catheter-related bloodstream infections (CRBSIs) by preventing bacterial colonization on the catheter surface. This is particularly important for patients undergoing hemodialysis, who are at a higher risk for infections due to the use of central venous catheters (CVCs) for vascular access. Catheter-related infections are a major cause of increased morbidity and mortality in HD patients. The most effective strategy to prevent these infections is to minimize the use of catheters altogether. This suggests that while antimicrobial catheters may help, reducing catheter use is a more effective primary strategy (5),(6)

**2. Regular catheter site surveillance**

Catheter-related infections are a major cause of increased morbidity and mortality in HD patients. The most effective strategy to prevent these infections is to minimize the use of catheters altogether. This suggests that while antimicrobial catheters may help, reducing catheter use is a more effective primary strategy(6)

**3. Staff education and training on infection control**

The study emphasizes the necessity of constant training programs within healthcare settings. These programs should be comprehensive, covering both theoretical and practical aspects to enhance nurses' adherence to infection control practices. The lack of training has been identified as a significant barrier to effective infection control.(8)

**Challenges in implementing infection control measures**

**1. Patient non compliance**

Non-compliance can lead to increased rates of infection, which is a significant concern in hemodialysis patients. The study notes that infection is the second leading cause of mortality in these patients, underscoring the critical need for adherence to infection control practices(7). patient non-compliance in hemodialysis is a multifaceted issue that requires targeted educational programs, regular follow-up, and a supportive healthcare environment to improve health outcomes and reduce the incidence of CRI.(8)

**2. Limited resources**

Addressing limited resources is essential for enhancing infection control practices among nurses in hemodialysis units. While educational interventions can lead to improvements in knowledge and practices, systemic issues such as staffing shortages and inadequate supplies must also be tackled to ensure sustainable compliance with infection control measures(7)

**3. Staff turnover and training issues**

The combination of high turnover and inadequate training contributes to poor compliance with infection control practices. The study found that a significant number of nurses had "poor" overall knowledge and practices regarding infection prevention before educational interventions were implemented (7)

## CONCLUSION

To reduce the incidents of catheter related infections effective infection control measures are crucial. Adhering to protocols for hand hygiene, catheter maintenance, and site care significantly improves patient safety. For the infection prevention, there should be good staff education and training, patient compliance and few advanced techniques like ethanol lock therapy should be used. Sustained effort and investment in training and resources are required to overcome the problems like limited resources and staff turnover. This review highlights the importance of proactive infection control strategies to ensure better outcomes for patient undergoing hemodialysis.

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