



Caselyn Sales and Luzzille Virrey

Nursing Strategies in Preventing Catheter-Related Bloodstream In- fection in Hemodialysis Patients

A descriptive literature review

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Authors	Caselyn Sales and Luzzille Virrey
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<p>The purpose of this study was to describe nursing strategies and the challenges nurses encounter in preventing catheter-related bloodstream infection in hemodialysis patients. The aim was to provide new knowledge that could be utilized to strengthen the nurse's expertise to decrease the incidence of catheter-related bloodstream infection in hemodialysis units.</p> <p>In collecting the data, CINAHL and Medline databases and manual search through references of included articles have been used. Through inclusion and exclusion criteria, the search has been narrowed down resulting in the selection of 10 scientific articles. In addition, the articles selected for the study were analyzed by utilizing inductive content analysis.</p> <p>The results of the study revealed nine generic categories related to nursing strategies and thirteen related to challenges encountered by nurses in preventing catheter-related bloodstream infection in hemodialysis patients.</p> <p>This study concluded that nurses play a vital role in preventing catheter-related bloodstream infection (CRBSI), as they are the primary point of contact during the treatment of the patients. It is recommended that healthcare institutions offer support through educational programs or training and prioritize initiatives that enhance quality improvement and patient safety and reduce the risks of CRBSI.</p> <p>The originality of this thesis has been checked using Turnitin Originality Check Service resulting in an acceptable similarity percentage.</p>	
Keywords	nurse, catheter-related bloodstream infection or CRBSI, hemodialysis patient

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1 Introduction

Infection is a crucial concern for patients undergoing hemodialysis because of their compromised immune system and the frequent use of vascular access sites. Bloodstream infections are among the most common and serious complications which may lead to increased morbidity, mortality, and lengthened hospital stays. The presence of central venous catheter, which is commonly used for hemodialysis, increases the risk of infection by providing a direct route for pathogens to enter the bloodstream. To prevent further complications, such as sepsis which can be life threatening, prompt identification and treatment of infections are especially important. (Fisher, Golestaneh, Allon, Abreo and Mokrzycki, 2020: 132-151.)

The initial suspicion of a catheter-related infection is typically based on clinical symptoms and later confirmed through microbiological testing. Recent data indicate that the incidence of catheter-related bloodstream infection (CRBSI) varies widely, not only between countries but also among different hospitals and wards. The associated mortality rate is estimated at around 25%. A recent European study found that 42.6% of bloodstream infections were linked to the use of central venous catheter (CVC), with CRBSI rates still ranging from 1 to 6.2 per 1,000 catheter days. (Iacobone, Elisei, Capozzoli, 2024: 151-160.)

Nurses play a critical role in preventing infections such as CRBSI in hemodialysis units, as they are often the first line of defense in managing and monitoring patients. A nurse's responsibility extends beyond routine care, involving the implementation of strict infection control practices, such as aseptic techniques, and patient education. In addition, Nurses are also key in recognizing early signs of infection and intervening promptly which can significantly reduce the risk of complications. (Vásquez et al. 2022: 14-22.)

The purpose of this study is to describe nursing strategies and the challenges nurses encounter in preventing catheter-related bloodstream infection in hemodialysis patients. Furthermore, it aims to provide new knowledge that could be utilized to strengthen the nurse's expertise to decrease the incidence of catheter-related bloodstream infection in hemodialysis patients.

2 Background

2.1 Kidney failure

Kidney failure, or renal failure, is a condition in which one or both kidneys are no longer able to perform their physiologic functions independently. In some cases, it happens suddenly and is only temporarily known as acute kidney failure (AKF), while in others, it progresses gradually over time and becomes a long-term condition known as chronic kidney failure (CKF). There are common causes of AKF such as specific drugs, significant fluid loss, blockages within the urinary system, and poorly controlled systemic disorders such as cardiovascular and hepatic diseases. (Cleveland Clinic 2025.) In Chronic Kidney Disease (CKD), the typical causes of kidney failure include diabetes, which is the most prevalent cause, and other health issues that have slowly damaged the kidney over a long period of time. The second predominant cause is high blood pressure, and the other symptoms are autoimmune-related illnesses including, IgA nephropathy and lupus, nephrotic syndrome, polycystic kidney disease, a genetic disorder (a condition that are inherited from one or both parents), tobacco use, excessive alcohol consumption. The estimated glomerular filtration rate (eGFR) blood test, urine test, and kidney biopsy, a technique that requires extraction of a small amount of tissue from the kidneys is taken out for microscopic examination, are some of the tests that doctors may use to determine kidney failure. (American Kidney Fund 2022.)

2.2 Hemodialysis

Hemodialysis (HD) is a vital therapeutic intervention for patients with kidneys that are no longer able to function well. It helps to remove excess waste and fluids from the body when the kidney can no longer do its function. The hemodialysis machine acts as an artificial kidney to eliminate waste and excess fluid and to prevent their accumulation in the body. Additionally, it maintains safe mineral levels such as potassium, sodium, calcium, and bicarbonate in the blood, and assists in blood pressure regulation. The machine uses a special filter called a dialyzer to cleanse the blood. To connect the blood to the dialyzer, a surgeon will create an opening in one of the blood vessels, most commonly in the arm, known as vascular access. The dialyzer has two sections, one for the blood and another for the dialysate fluid. The two sections of the dialyzer are separated through a thin film called a membrane. During hemodialysis, the dialysis membrane selectively permits the passage of smaller molecules, allowing substances

such as urea, creatinine, and excess fluid to be filtered out. In contrast, larger components of the blood, including blood cells and proteins, are retained within the circulatory system due to their size. While hemodialysis is highly effective in removing extra fluid and waste from the blood, it does not replace the kidney function hence, it is not a cure for progressive CKD. (National Kidney Foundation 2024.)

2.3 Dialysis-related infection

Patients receiving hemodialysis are more susceptible to transmission of infections, that constitutes a common occurrence for this patient group. Bloodstream infections, vascular access infections, and infections brought on the bloodborne pathogens are among the factors that affect the epidemiology of frequent infections and outbreaks as well as infections within hemodialysis patients. In addition, about 90% of patients receive maintenance dialysis for end-stage renal disease (ESRD), while 10% are receiving peritoneal dialysis. Uremia heightens susceptibility to infections by disrupting cellular immunity, neutrophil responses, and complement activation, the maintenance patients on hemodialysis are more vulnerable to infection. Furthermore, there are numerous chances for infectious agent transmission because the procedure requires long-term use of vascular access in a place where several patients undergo hemodialysis simultaneously. It has been shown that pathogenic organisms can spread from patient to patient either directly or indirectly through contaminated tools, supplies, injectables drugs, surfaces in the environment, or healthcare workers' hands. (Nguyen, Arduino, and Patel 2018: 389-410.)

2.4 Catheter-related bloodstream infection (CRBSI)

CRBSI occurs when bacteria enter the bloodstream through a central venous catheter. CRBSIs are among the most prevalent and severe complications of catheterization, it is the leading cause of nosocomial bacteremia and contributes substantially to patient morbidity and longer hospital stays, and high healthcare costs. (Lu, et al. 2020: 1292-1300.)

In addition, in patients receiving HD, CVCs contribute to half of infections, with CRBSI ranking as the second leading cause of death. Reported rates of this condition vary between 0.6 and 6.5 per 1,000 catheter days, depending on the definition used, local

practices for catheter insertion and maintenance, and the duration of catheterization. (Pasilan, Tomacruz-Amante, and Dimacali 2024.)

2.5 Nurse's role in preventing catheter-related bloodstream infection

Nurses hold a pivotal role in preventing bloodstream infection associated with CVC in hemodialysis patients. Nurses are the primary caregivers who are directly involved in the patient's care and are responsible for ensuring strict adherence to sterile techniques when accessing vascular sites which are crucial in preventing infection. (Hernán et al. 2023: 333-344.) Furthermore, nurses are essential in ensuring the success of infection control practices, especially in specialized settings like hemodialysis units where the risk of infection is elevated due to the frequent use of invasive procedures. Nurses' knowledge, skills and consistent adherence to infection control protocols have a big impact on patient care outcomes. The immune system of hemodialysis patients is often compromised and therefore requires careful management to prevent infections such as bloodstream infections, which can be life-threatening. Educational interventions that focus on improving nurses' understanding of infection control practices are important in providing them with the latest evidenced-based strategies in infection prevention. When nurses are educated and regularly updated on best practices, effective infection prevention measures can be implemented which results in better patient care and safety. (Osman, El Banna, Sharaf and Mohammed 2021: 1739-1748.)

2.6 Nurse's challenges in preventing catheter-related bloodstream infection

Preventing CRBSIs in hemodialysis remains a significant clinical challenge due to several factors. Since arteriovenous fistulas takes a while to develop, many patients begin dialysis using catheters, which increases the risk of infection and makes catheter use longer. It is common for skin flora to colonize catheters, creating biofilms that act as bacterial reservoirs. (Soi, Moore, Kumbar, Yee 2016: 95-103.) Contributing factors include inadequate nurse-to-patient ratios resulting from staffing shortages, high rates of nursing turnover, limited training and clinical competencies among HD staff, insufficient patient and family education regarding infection prevention, restricted access to essential supplies and equipment, poorly designed dialysis unit layouts with overcrowding and insufficient separation for infection control and high incidence of dialysis-related complications, some of which may be severe (Karkar 2018: 1-3).

High patient-to-nurse ratios, staff turnover, and inadequate staffing can all adhere to protocols for infection control, which raises infection rates even more (Fisher, Golestaneh, Allon, Abreo, and Mokrzycki 2020: 132-151). Handling patients with catheter-related infection is extremely difficult since they require frequent hospital stays and ongoing communication with multiple healthcare providers (Hajji et al. 2022). Furthermore, to guarantee appropriate implementation, frequent guidance, training for freshly recruited employees particularly, and surveillance is crucial. All health care providers must be fully informed about infection control procedures and regulations, and frequent educational programs are recommended. (Karkar 2018: 1-3.)

3 Purpose, aim and study questions

The purpose of this study is to describe nursing strategies and the challenges nurses encounter in preventing catheter-related bloodstream infection in hemodialysis patients.

The aim is to provide new knowledge that could be utilized to strengthen the nurse's expertise to decrease the incidence of catheter-related bloodstream infection in hemodialysis patients.

Research Questions:

1. What are the nursing strategies in preventing catheter-related bloodstream infection in hemodialysis patients?
2. What challenges do nurses encounter in preventing catheter-related bloodstream infection in hemodialysis patients?

4 Methodology and methods

4.1 Data collection method

A literature review is an essential component of the research methodology design process since it gives the researchers a perspective on the present situation of the subject

and shows which approaches and recommended methods to utilize. To generate excellent research, this method guarantees that the literature review is accurate and relevant. In research methods, a literature review is crucial for several reasons. It facilitates finding gaps in research and provides additional study. (Lawani and Ilegbedion 2024: 211-218.)

For this study, a descriptive literature review was utilized. This review is to identify the degree wherein a body of information on a given study issue displays a specific pattern or trend in relation to pre-existing hypothesis, theories, methodologies, or outcomes. Descriptive reviews adhere to an open process that involves finding, evaluating, and categorizing research. Furthermore, certain aspects of interest, such as the period of release, research methodologies, data collection procedures, and a path or quality of research findings, are extracted from each study. The research topics in descriptive reviews are often general and pertain to trends and patterns in publications. (Paré and Kitsiou 2017: 157-179).

4.2 Data search and selection

The data was selected through search, evaluation, and analyzation of the scientific articles about nursing strategies and the challenges nurses encounter in preventing catheter-related bloodstream infection in hemodialysis patients.

To generate information about the study, a thorough search was conducted using reliable databases CINAHL and Medline. Various search sentences were used to maximize the retrieval of scientific articles. In addition, manual search was used to identify more articles through the references of included articles.

In this study, a PICO tool (table 1) was used to determine the information that is relevant to the study to avoid deviation. The PICO tool was used to identify the key concepts in the research questions and create relevant search terms. The main population are Registered Nurses, the interest is to identify nursing strategies and the challenges nurses encounter in preventing catheter-related bloodstream infection, and the context is hemodialysis patients. Boolean technique which includes “AND” and “OR” and truncation were used to refine the results. The technique will help to obtain the precise articles that are beneficial to the study. Additionally, different search words were used to collect more articles related to the study.

Table 1. PICO Tool

P - Population	I - Interest	Co- Context
Registered Nurses	Strategies and challenges for the prevention of catheter-related bloodstream infection	Hemodialysis patients

Inclusion and exclusion criteria (table 2) were used to create reliable results and avoid bias.

Table 2. Inclusion and Exclusion Criteria

Inclusion	Exclusion
Registered Nurses who work in hemodialysis or dialysis units	Registered Nurses who do not work in hemodialysis or dialysis units
Studies published in English language	Studies published in other languages
Studies published between 2016 and 2025	Studies published before 2016
Studies related to catheter-related bloodstream infection in hemodialysis patients	Studies not related to catheter-related bloodstream infection in hemodialysis patients
Studies related to infection control in hemodialysis or dialysis units	Studies not related to infection control in hemodialysis or dialysis units
Peer-reviewed articles, primary articles	Non-peer-reviewed articles, dissertations, reviews

The PRISMA flowchart illustrates the article selection process from the databases. Initially, a total of 398 records were identified from the databases. Of these, 343 records were excluded due to titles that did not contain two or more of the specified search terms. The remaining 55 titles were further reduced by excluding 14 duplicated titles, leaving 41 articles for abstract screening. Following this step, 20 articles were excluded based on abstract content, and 21 were assessed in full for eligibility. After reviewing the full texts, 16 articles were excluded as they did not address the research questions. Consequently, 5 articles were selected from the databases. An additional 5 articles were identified through reference lists of included articles and were also selected after full-text review. In total, 10 articles were included in the studies. A database search table can be found in Appendix 1.

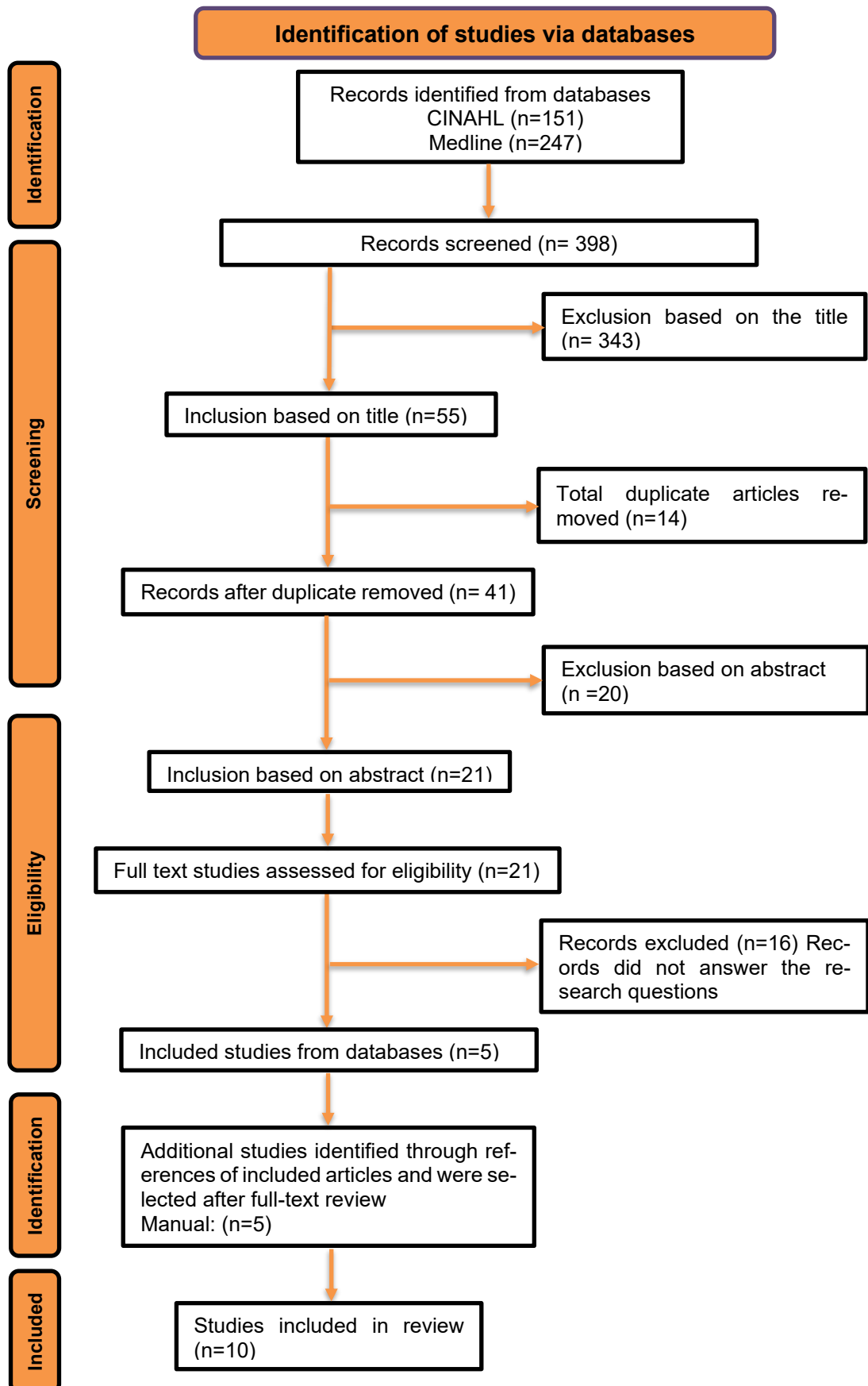


Figure 1. PRISMA flowchart

4.3 Data analysis method

Qualitative research is a type of social investigation that emphasizes how individuals interpret their experiences and the world around them. This research explores human behavior, emotions, and experiences, focusing on what truly matters in people's lives. It takes a holistic, person-centered approach, which is particularly valuable in healthcare, where caring, communication, and human interaction are key. For nurses and other healthcare professionals, this perspective offers deep insights into the lives of patients and coworkers. Qualitative research produces rich, detailed narratives that portray the participants' realities, placing human experiences in their social and cultural contexts rather than solely concentrating on medical conditions or professional roles. It aligns naturally with the study of feelings, thoughts, and behaviors which are fundamentally qualitative aspects of life. (Holloway and Galvin 2023: 3-14.)

In addition, qualitative data can be utilized to describe and identify issues in the field or to clarify routine and technique structures and procedures. When analyzing qualitative data, techniques from a comprehensive analysis (description of categories, narrative interpretations, or identified structures) are often combined with techniques from in-depth examination of the material (overviews, condensation, summaries). Finding generalizable conclusions through analyzing varied materials, texts or scenarios is frequently the goal. (Mezmir 2020: 15-27.)

Inductive content analysis is a qualitative approach to data analysis that is particularly effective in health research, especially for smaller, simpler studies conducted by health researchers pursuing degree programs which are research focused. It is typically applied to text-based data, including either written records of spoken conversation or documents in written form. These texts could be pre-existing ones intended for non-research purposes such as submission for a government query or a referral letter from a physician, or that could be specifically created for a research study such as, a blog which is written by a study participant. Inductive content analysis is considered qualitative because its objective is to acquire an understanding of meanings within the data. Contrary to other methods, it does not involve counting occurrences of content to determine frequencies or recognize statistical relationship among different content components. (Vears and Gillam 2022: 111-127.)

Data was collected from 10 scientific articles focused on nursing strategies and the challenges nurses encounter in preventing CRBSI in hemodialysis patients. After re-viewing all the data, meaningful units were extracted from each article. These meaning units were labeled with brief, descriptive phrases that contained enough words to clearly convey the underlying meaning of the extracted data. The process is illustrated in figure 2.

Meaning Units	Codes
<p>“The association of activities present in the interventions made it possible to list actions for the formulation of eight nursing prescriptions to patients undergoing hemodialysis through CVC namely: 1) measuring pre/post-treatment axillary temperature; 2) maintaining an occlusive dressing; 3) monitoring signs and symptoms associated with local and systemic infection; 4) maintaining the aseptic technique whenever CVC is manipulated; 5) maintaining standard precaution; 6) Replacing the protective covers of the CVC after each hemodialysis session; 7) maintaining permeability of the access with heparin after hemodialysis session; 8) guiding the patient and the family on maintenance of the CVC” (Guimarães, et al. 2017: 1127-1135).</p>	<p>Nursing interventions:</p> <ul style="list-style-type: none"> Temperature monitoring Maintaining of a non-permeable dressing Close monitoring of patient’s signs and symptoms Follow aseptic technique when manipulating CVC Following infection control measures Replacement of CVC protective cover after each hemodialysis session Giving of heparin to prevent catheter from blocking Proper guidance to patient and family on CVC care

Figure 2. Sample of a meaning unit and its extracted codes.

The labels referred to as codes were organized into a column in the analysis table. Codes with similar themes were grouped into subcategories. Several categories were then combined into generic categories, as illustrated in figure 3.

Codes	Sub-category	Generic category
Nurses removed port caps. Replacement of CVC protective cover after each hemodialysis session.	Removal and replacement of CVC protective cover after each hemodialysis session.	CVC device access care
Follow aseptic technique when manipulating CVC.	Compliance with aseptic technique when manipulating CVC.	
Maintaining a non-permeable dressing.	Maintaining a non-permeable dressing.	
Two thirds of nurses scrub the exterior part of the CVC hub with antiseptic.	Scrubbing the exterior of CVC hub with antiseptic.	
Half of nurses placed a clean field under a CVC port.	Placement of clean field under CVC port.	

Figure 3. Sample codes are grouped into sub-categories then into one generic category

The generic categories were ultimately refined into main categories to address research questions. Two main categories were developed, each corresponding to a specific research question as illustrated in Figures 4 and 5.

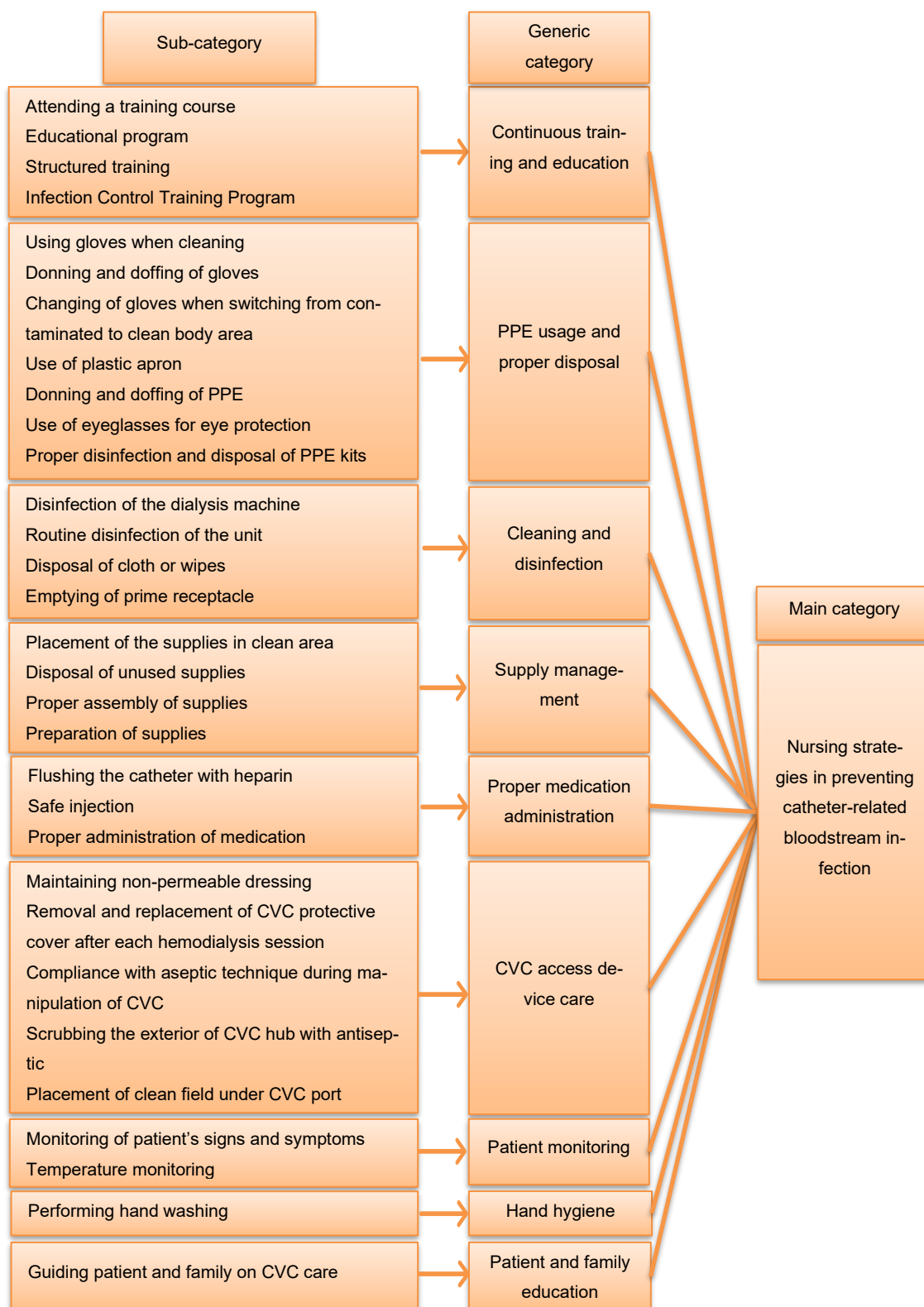


Figure 4. Sub-categories are grouped into generic categories then into one main category.

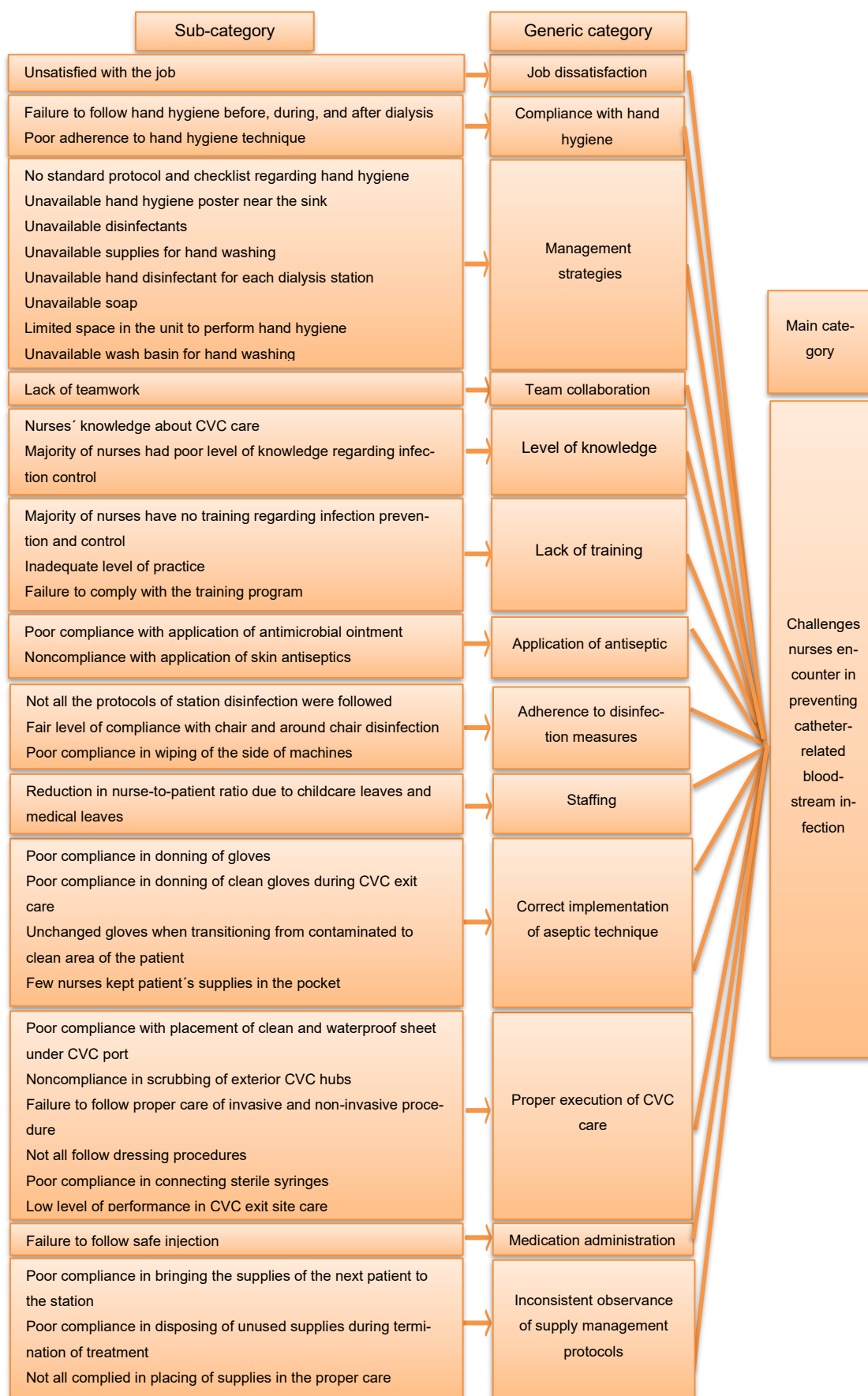


Figure 5. Sub-categories are grouped into generic categories into one main category.

5 Results

A total of 10 articles were selected for this descriptive literature review (Appendix 2). Selected studies were peer-reviewed and primary articles published in English language. In addition, selected studies were written between 2017 and 2025. Studies were executed in Bahrain, Brazil, Kuwait, and United States, two from India and, four from Egypt. The data designs used were ten quantitative studies and collected from databases CINAHL and Medline. In addition, studies were collected manually through references of included articles.

Data gathered were analyzed and classified according to two categories based on research questions. Through inductive content analysis, n= 68 sub-categories, n= 22 generic categories, and 2 main categories were formed. The two main categories were 1) Nursing strategies in preventing catheter-related bloodstream infection which derived from 31 sub-categories and 9 generic categories and 2) Challenges nurses encounter in preventing catheter-related bloodstream infection 37 sub-categories and 13 generic categories (Appendix 4).

5.1 Nursing strategies in preventing catheter-related bloodstream infection

The analyzed data identified that continuous training and education, personal protective equipment (PPE) usage and proper disposal, cleaning and disinfection, supply management, proper medication administration, CVC access device care, patient monitoring, hand hygiene, and patient and family education are nursing strategies in preventing catheter-related bloodstream infection.

5.1.1 Continuous training and education

A statistically significant positive correlation was observed connecting the extent of nurses' knowledge with their practice in clinical environments (Ibrahim, Mokhtar and Hussein 2025: 306-327). Knowledge and practices of nurses have improved after the nursing education initiative had been introduced through teaching sessions for both theory and practice. A booklet which contains all the training contents such as, knowledge related to anatomy of the urinary system in human, kidney and its function, definitions and indications of hemodialysis, and types of vascular access has been

given to distributed. In addition, the program covered topics such as hand hygiene, use of protective equipment, cleaning and disinfection procedures, proper handling of disposable materials, and testing water quality for treatment. Following the program, nurses began practicing infection control measures before, during and, after dialysis. (Morkes, Abozead, S and Azer 2018: 162-168.) The educational sessions provided to nurses included theoretical knowledge on CVC care, maintenance and potential complications, and the risk factors and prevention of CRBSIs, based on Center for Disease Control and Prevention (CDC) and national protocols. Through the intervention, knowledge and practices of nurses were improved. (Abdo, Ramadan, Tosson and Al-Fadhli 2018.) Lectures were delivered through audiovisual aids alongside hands-on training sessions and found out that there was a positive impact from structured training or educational intervention on the infection prevention measures of healthcare staff in hemodialysis facility (Singh, Pandey, Aggarwal and Pal 2023). Group discussions, demonstrations and re-demonstrations, modified lectures, brainstorming were included in teaching methods. In addition, booklet, real equipment, flip chart, and PowerPoint presentations have been used to deliver the educational program to nurses which helped in the improvement of nurses' practice and knowledge regarding CVC care in hemodialysis unit. (Ibrahim, Mokhtar and Hussein 2025: 306-327.) Furthermore, a CDC/STRIVE Infection Control Training Program has been implemented and participants' knowledge and practice regarding cross-contamination infection control have improved which reduced the rate of CRBSIs significantly (Hutchins, Blessitt and Giles 2022: 12-19).

5.1.2 Personal protective equipment (PPE) usage and proper disposal

Nursing professionals agreed that using PPE such as gloves, plastic apron, eye-glasses, correct application and removal of PPE kits along with proper disinfection and disposal of used PPE kits are practices which may help in providing optimal patient care to control infection in hemodialysis patients (Singh, Pandey, Aggarwal and Pal 2023). During initiation and termination of treatment and reinfusion of extracorporeal circuit, proper practice of donning and doffing of gloves included in NOTICE assessment checklist helps nurses to prevent the transmission of infection (Bayoumi, Ahmed and Hassan 2019: 90-101). Upon implementation of infection control training program, participants were able to adhere to the cross-contamination infection control guidelines. This is part of the nurses' role in preventing catheter-related cross-contamination which can decrease the occurrence of CRBSIs. (Hutchins, Blessitt and Giles 2022: 12-19.)

5.1.3 Cleaning and disinfection

Nurses sanitized the dialysis station, dialysis machine, and chairs and emptied the prime waste receptacle as part of the infection control measures in a dialysis unit (Bayoumi, Ahmed and Hassan 2019: 90-101). CDC guidelines recommended routine disinfection of the hemodialysis station as hospital acquired infection can be transmitted through contaminated surfaces. Dialysis machine disinfection is also recommended before and after each treatment. (Mahran, Ahmed, and Ameen 2024: 283-293.) Furthermore, station disinfection was one of the criteria in CDC/STRIVE Infection Control Program that has been used to manage patients with ESRD and to decrease CRBSIs (Hutchins, Blessitt and Giles 2022: 12-19).

5.1.4 Supply management

The nursing role is crucial in preventing and controlling infections in the hemodialysis unit, and one of the key preventive measures is the proper handling of disposable supplies (Morkes, Abozead and Azer 2018: 162-168). Nurses prepare the necessary supplies before the procedure and dispose of any unused supplies after the treatment. All supplies should be stored in the assigned clean area, and keeping patient's supplies in the pocket must be prohibited. (Bayoumi, Ahmed and Hassan 2019: 90-101.) Hemodialysis patients are vulnerable to infections, and contaminated supplies may serve as the source of these infections (Morkes, Abozead and Azer 2018: 162-168).

5.1.5 Proper medication administration

In terms of preventing obstruction and infection, managing CVC is a significant challenge. One of the developed nursing interventions for patients undergoing hemodialysis via a central venous catheter is preserving the access patency with heparin following a hemodialysis treatment. (Guimarães, et al. 2017: 1127-1135.) A checklist was developed based on CDC guidelines which includes safe injection practices to assess nurses' performance level in demonstrating measures for preventing and controlling infections (Mahran, Ahmed and Ameen 2024: 283-293). A CDC/STRIVE Infection Control Training Program was introduced to educate nurses on preventing infection and managing CRBSIs. One of the criteria was Medications-RN Quick Observation Tool which was used to identify the compliance of nurses with the protocols in administering medication. (Hutchins, Blessitt and Giles 2022: 12-19.)

5.1.6 CVC access device care

CVC is commonly utilized in patients undergoing hemodialysis treatment. Its use demands active involvement from nurses to reduce health risks and minimize morbidity and mortality of the patients. Understanding the care of patients with CVCs is notably essential. One of the nurses' responsibilities is to maintain a permeable dressing that protects the catheter insertion site from microbial colonization. Another responsibility of the nurse is to replace the CVC protective cover, intended for sterile or single use, after each hemodialysis treatment. In addition, nurses should follow an aseptic technique during manipulation of venous access to prevent infections such as bloodstream infection. CRBSI is a complication arising from using catheter and it is the responsibility of the unit members to ensure patient safety. (Guimarães, et al. 2017: 1127-1135.) During initiation and termination of hemodialysis treatment, it is essential to scrub the outside of the CVC hub and place a clean field under the CVC port as part of infection prevention (Bayoumi, Ahmed and Hassan 2019: 90-101). It is the nurses' responsibility to develop strategies for preventing, addressing, and managing adverse events associated with CVC use (Guimarães, et al. 2017: 1127-1135).

5.1.7 Patient monitoring

The patients with CKF undergoing hemodialysis treatment are highly vulnerable to infection, and one of the factors of this vulnerability is due to prolonged use of CVC. Signs and symptoms of infection are fever, general discomfort, chills, pain, and the presence of discharge at the catheter insertion site. Fever is the most frequent clinical indicator of infection. Half of the hemodialysis patients have a lower-than-normal basal body temperature for reasons that were not yet fully understood, and even slight changes in temperature of the patients can indicate a heightened risk of infection. Therefore, it is crucial for nurses caring for hemodialysis patients with CVC to know the importance of accurately checking and recording patient's temperature both before and after the hemodialysis treatment, and to stay alert and vigilant in monitoring of signs and symptoms of infection as complications from CVC infection may lead to a major decline in a patient's quality of life or even results in death. (Guimarães, et al. 2017: 1127-1135.)

5.1.8 Hand hygiene

One of the main causes of healthcare associated infection is the contamination of healthcare workers' hands, and maintaining proper hand hygiene can significantly reduce infection rates and enhance patient safety (Harsvardhan, Mishra, Kushwaha and Prasad 2022: 10-13). Nurses encounter challenges in adhering to hand hygiene practices, but neglecting these during dialysis procedure can lead to serious consequences for both nurses and patients (Bayoumi, Ahmed and Hassan 2019: 90-101). In addition, nurses maintain frequent and ongoing contact with patients, so it is essential to adhere to infection control guidelines, including proper hygiene (Hosney, Mohamed, Abdelmowla and Azous 2021: 145-154).

5.1.9 Patient and family education

Providing education to both patient and family is a nurse's role. Educating both patient and family is a recommended approach for preventing infections related to hemodialysis and should be readily available. Through offering this guidance, nurses alongside the healthcare team can encourage ongoing learning, which contributes to improved care and helps minimize the risk of infection in patients with CVC receiving hemodialysis treatment. (Guimarães, et al. 2017: 1127-1135.)

5.2 Challenges nurses encounter in preventing catheter-related bloodstream infection

The analyzed data determined that job dissatisfaction, compliance with hand hygiene, management strategies, team collaboration, level of knowledge, lack of training, application of antiseptic, adherence to disinfection measures, staffing, correct implementation of aseptic technique, proper execution of CVC care, medication administration, and inconsistent observance of supply management protocols are challenges nurses encounter in preventing catheter-related bloodstream infection.

5.2.1 Job dissatisfaction

Feeling unfulfilled in the workplace was identified as a significant challenge among nurses in the dialysis unit. Many nurses expressed feelings of discontent related to their job. This dissatisfaction may contribute to challenges in maintaining consistent

hand hygiene practices, as reduced morale and motivation can lead to lapses in adherence to infection prevention protocols. As job dissatisfaction directly influences motivation and attention protocols, addressing this issue could play a crucial role in improving hand hygiene compliance and contributing to improved infection control by reducing bloodstream infection risk in the unit. (Bayoumi, Ahmed and Hassan 2019: 90-101.)

5.2.2 Compliance with hand hygiene

Ensuring proper hand hygiene was a significant challenge in the prevention of bloodstream infections among nurses. During the observations in the practice of infection control measures, it was noted that nurses consistently failed in performing hand hygiene prior to, throughout and following procedures. (Bayoumi, Ahmed and Hassan 2019: 90-101.) Although hand hygiene is a simple yet a crucial practice, the compliance rate among healthcare workers was low, indicating that adherence to the basic infection prevention step was not consistently followed (Harsvardhan, Mishra, Kushwaha and Prasad 2022: 10-13).

5.2.3 Management strategies

Nurses identified several concerns related to the lack of effective management strategies that contributed to non-compliance with infection prevention practice, particularly hand hygiene. They highlighted issues such as the inaccessibility of essential equipment and wash basins, and the absence of clearly defined standard operating protocols and checklists for hand hygiene. Additionally, they pointed out that there was no structured system in place for conducting regular hand hygiene audits. Nurses also raised concerns about the unavailability of essential supplies, such as hand rub at each dialysis station and soap at wash basins. Moreover, the lack of hand hygiene posters near sinks reduced that could reinforce proper practices. These challenges point to critical gaps in management strategies and emphasize the need for better resource allocation, clearer protocols, and consistent monitoring to support effective infection prevention in the dialysis unit. (Harsvardhan, Mishra, Kushwaha and Prasad 2022: 10-13.)

5.2.4 Team collaboration

Nurses encounter difficulties in preventing bloodstream infections due to a lack of effective team collaboration. Staff members expressed concerns about non-compliance

with infection prevention protocols, which is frequently attributed to insufficient coordination among healthcare team members. Lack of teamwork undermines the overall effectiveness of prevention strategies, making it harder for nurses to maintain high standards of care. (Harsvardhan, Mishra, Kushwaha and Prasad 2022: 10-13.)

5.2.5 Level of knowledge

Limited knowledge about hemodialysis and infection control poses a barrier to preventing bloodstream infections. Before undergoing any training, their knowledge scores were notably low, which highlighted significant gaps in their understanding and indicating a lack of awareness regarding the care of CVC in hemodialysis units. (Ibrahim, Mokhtar and Hussein 2025: 306-327.) Many nurses demonstrate a poor understanding of hemodialysis and hemodialysis-associated infections, as evidenced by their low scores on related knowledge assessments (Mahran, Ahmed and Ameen 2024: 283-293). Additionally, a significant portion of nurses showed inadequate knowledge about infection control practices related to hemodialysis, indicating that further education and ongoing training are necessary to address these knowledge issues and reduce infection risk to ensure the safety of hemodialysis patients (Hosney, Mohamed, Abdelmowla and Azouz 2021: 145-154).

5.2.6 Lack of training

Nurses encounter challenges in preventing bloodstream infection due to lack of adequate training. Prior to the implementation of a structured training program, many of the nurses demonstrated inadequate levels of practice, which could compromise the increased risk of bloodstream infections. (Ibrahim, Mokhtar and Hussein 2025: 306-327.) Most of the nurses had not received any formal training on infection prevention, especially in the hemodialysis unit. Lack of training is concerning, as infection control knowledge is essential for minimizing risks of infection. (Mahran, Ahmed and Ameen 2024: 283-293.) While more than two thirds had not attended any infection control programs in the workplace (Morkes, Abozead and Azer 2018: 162-168). Additionally, a portion of nurses had previously received specific training in infection control, the overall number was still low (Abdo, Ramadan, Tosson and Al-Fadhli 2018). However, some nurses participated in training programs related to infection control. The difference shows that many nurses may not have necessary skills and knowledge to handle infec-

tion risks effectively. These results emphasize the need for more consistent and accessible training to ensure that all nurses are prepared to follow the best infection prevention practices. (Hosney, Mohamed, Abdelmowla, and Azouz 2021: 145-154.)

5.2.7 Application of antiseptic

Inconsistent compliance with the proper application of antiseptics during CVC care is one of the notable challenges identified in preventing bloodstream infections. During the care of CVC exit sites, certain key infection control practices, such as donning clean gloves and applying antimicrobial ointment were followed by only a portion of the nurses, reflecting a lack of consistency in practice. (Bayoumi, Ahmed, and Hassan 2019: 90–101.) Furthermore, although there was a significant improvement in the overall knowledge of infection control practices, there was no statistically significant improvement in the specific area of applying skin antiseptics. This highlights that additional focus on hands-on training is necessary to help nurses use their knowledge effectively and safely in patient care. (Abdo, Ramadan, Tosson and Al-Fadhli 2018.)

5.2.8 Adherence to disinfection measures

Nurses encounter significant challenges in ensuring proper disinfection measures to prevent bloodstream infections, particularly in dialysis settings. While most nurses consistently disinfect the patient's chair and surrounding area, fewer nurses adhere to the recommended protocols for cleaning all sides of the dialysis machine. (Bayoumi, Ahmed and Hassan 2019: 90-101.) Furthermore, an assessment using the Station Disinfection Quick Observation Tool, majority of pre-program station disinfection procedures were found to follow the specified protocols, yet there were still notable instances of non-compliance. These inconsistencies in disinfection practices highlight the need for better adherence to cleaning procedures, as failing to follow the protocols could increase the risk of infection. (Hutchins, Blessitt and Giles 2022: 12-19.)

5.2.9 Staffing

The reduced nurse-to-patient ratio, frequently attributed to childcare and medical leaves remains a significant challenge in the implementation of infection prevention measures. Nurses expressed concerns that these absences created a strain on the remaining staff, making it more difficult to maintain consistent compliance with infection

prevention protocols. The lower staffing levels resulted in increased workloads, leaving less time and resources to focus on tasks, such as maintaining strict infection control practices. This finding highlights the importance of addressing staffing shortages to ensure effective prevention of bloodstream infections. (Harsvardhan, Mishra, Kushwaha and Prasad 2022: 10-13.)

5.2.10 Correct implementation of aseptic technique

Nurses often struggle to prevent bloodstream infection, especially when it comes to staying consistent with aseptic practices during dialysis treatment. The study showed that some nurses did not follow basic precautions, such as avoiding the placement of patient supplies in their pockets, which can contribute to contamination. During the performance of initiation of treatment through CVC exit sites, many nurses did not wear clean gloves, which increases the risk of infection. (Bayoumi, Ahmed, Hassan 2019: 90-101.) Additionally, the infection control audit conducted before implementation of a training program showed that none of the participants met the criteria for preventing cross-contamination. These results show that some nurses struggle to follow proper aseptic practices and highlight the need for more consistent adherence to protocols and the importance of ongoing training to ensure safe and effective prevention practices. (Hutchins, Blessitt and Giles 2022: 12-19.)

5.2.11 Proper execution of CVC care

Compliance with CVC care protocols among nurses showed several areas needing improvement, particularly during initiation of CVC access. Many nurses did not consistently place a waterproof sheet under the CVC port, and scrubbing the exterior CVC hubs was frequently missed, which is a critical step in infection prevention. While all nurses removed the port caps as required, the use of sterile syringes was inconsistent. (Bayoumi, Ahmed, and Hassan 2019: 90-101.) During dressing changes, only a portion of the CVC procedures aligned with the standard outlined in the observation tool (Hutchins, Blessitt, and Giles 2022: 12-19). Furthermore, the correct aseptic techniques on both invasive and non-invasive procedures were observed in less than the majority of cases, indicating a significant gap in standard compliance that may contribute to an increased risk of bloodstream infections (Hosney, Mohamed, Abdelmowla and Azouz 2021: 145-154). In addition, nurses encounter significant challenges in preventing bloodstream infections due to inadequate skills in caring for CVC exit sites. The study

highlighted that performance in caring for CVC exit sites was particularly low, indicating that many nurses may not be following the correct procedures to ensure the proper care and hygiene at the exit site. This lack in skills and knowledge could increase the risk of infection, as improper care at the exit site is a common source of contamination. The findings emphasize the need for more training and support to improve nurses' abilities in patient's care. (Bayoumi, Ahmed and Hassan 2019: 90-101.)

5.2.12 Medication administration

Giving medication safely is an important part of preventing bloodstream infections, especially for patients on hemodialysis. The average scores from observations showed that safe injection procedures were not consistently followed. (Hosney, Mohamed, Abdelmowla and Azouz 2021: 145-154.) Additionally, the performance score level in infection prevention and control measures indicated that nurses demonstrated a generally inadequate level of competency in safe injection practices. This shows that there is a need for better training and support to help nurses improve their safe injection practices and protect patients from infection. (Mahran, Ahmed and Ameen 2024: 283-293.)

5.2.13 Inconsistent observance of supply management protocols

Nurses often struggle with supply management during dialysis, which can interfere with their ability to prevent bloodstream infections. During the termination of treatment for patients with CVC, about half of the participants followed appropriate procedures, such as assembling necessary supplies, placing a clean field under the CVC port, discarding unused supplies, and removed gloves, a significant portion did not follow this procedure. Furthermore, many nurses failed to bring the necessary supplies for the next patient to the station which could disrupt the flow of care. Another notable challenge was that some nurses did not properly store patients' supplies, among some of the staff neglecting to keep items in their pocket, which could increase the risk of contamination. This lack of compliance with supply management protocols is a challenge that requires attention to improving infection control measures in dialysis units. (Bayoumi, Ahmed and Hassan 2019: 90-101.)

6 Discussion

6.1 Discussion of results

Patients undergoing hemodialysis are particularly vulnerable to infection transmission, which are commonly observed in this patient population (Nguyen, Arduino, and Patel 2018: 389-410). CVCs are responsible for approximately 50% of these infections in HD patients, with CRBSI being the second most common cause of death (Pasilan, Tomacruz-Amante, and Dimacali 2024).

Pathogens can be transmitted directly or indirectly between patients via contaminated medical equipment, medications, environmental surfaces, or the hands of healthcare personnel (Nguyen, Arduino, and Patel 2018: 389-410). In this context, nurses play a crucial role in the implementation and success of infection prevention strategies. Nurses' clinical expertise, compliance with evidence-based protocols, and consistent application of infection control measures significantly influence patient outcomes, particularly in high-risk environments such as hemodialysis units where invasive procedures are routinely performed. (Osman, El Banna, Sharaf and Mohammed 2021: 1739-1748.)

However, the prevention of CRBSIs in HD settings continues to present significant clinical challenges. Contributing factors include inadequate nurse-to-patient ratios resulting from staffing shortages, high rates of nursing turnover, limited training and clinical competencies among HD staff, insufficient patient and family education regarding infection prevention, restricted access to essential supplies and equipment, poorly designed dialysis unit layouts with overcrowding and insufficient separation for infection control and high incidence of dialysis-related complications, some of which may be severe. (Karkar 2018: 1-3).

Based on the results of the study, educational programs will help the nurses improve their knowledge and practice and therefore promote patient safety. The finding was supported by Ibrahim, Mokhtar and Hussein (2025) who conducted a study about the impact of educational programs on nurses' performance claiming that knowledge and practices regarding CVC care in HD unit correlates. Correct donning and doffing of gloves are important in infection control in hemodialysis units according to the results of this study. This corresponds to the study of Bayoumi, Ahmed, and Hassan (2019) who

evaluated nursing practices through NOTICE checklist. In addition, one of the nurses' responsibilities is to change gloves whenever caring from an area of the patient's body that is contaminated to one that is clean. This is supported by the study of Hutchins, Blessitt, and Giles (2022) wherein they have used a CDC/STRIVE Infection Control Training Program to improve nurses' expertise in the maintenance care of CVC and to lower the rate of CRBSI.

Cleaning and disinfecting the station is one of the nursing strategies when promoting aseptic technique in hemodialysis units according to the results of this study. This corresponds to the study of Mahran, Ahmed, and Ameen (2024) who assessed nurses' performance using an observation checklist based on CDC. Proper handling and disposing of supplies in hemodialysis unit is crucial in preventing contamination which must be performed by nurses accurately, as they are the one who prepare the patient's supplies and dispose the unused supplies. This corresponds to the study of Morkes, Abozead, and Azer (2018) who evaluated the nurses' knowledge and practice using educational nursing program on infection control in hemodialysis. Safe administration of medications and injections is a nursing strategy which could help in preventing infection such as CRBSI. The study conducted by Hutchins, Blessitt, and Giles (2022) assessed nurses' compliance through CDC/STRIVE Infection Control Training Program.

One of the important practices of nurses which can prevent catheter-related infections is to perform the proper care for CVC device. Nurses hold an essential responsibility in managing and maintaining CVCs. This corresponds to the study of Guimarães, et al. (2017) who discussed nursing interventions for hemodialysis patients who have CVCs. Nurses monitor patient's vital signs and signs and symptoms during hemodialysis treatment. Being attentive with these responsibilities is important to know if the patient is suffering from infection. This is supported by the study of Guimarães, et al. (2017) who conducted a study about the nursing interventions.

Nurses serve as the primary caregivers, maintaining continuous and direct contact to the patients throughout their care. Hand hygiene is part of the infection control guidelines which must be adhered by nurses. This corresponds to the study of Hosney, Mohamed, Abdelmowla, and Azous (2021) which assessed nurses' understanding and application of aseptic techniques. Patients and their families are essential in infection prevention, and it is the responsibility of the nurses to provide them with appropriate guidance and education. This is supported by the study of Guimarães, et al. (2017), who

found out that when patient and family receive guidance, they become actively involve in working toward therapeutic goal.

One of the challenges of nurses' encounter in infection prevention is the lack of interest in performing related tasks. This corresponds to the study of Bayoumi, Ahmed, and Hassan (2019) who found out that many nurses were not satisfied with their job. Non-compliance with hand hygiene guidelines was observed among many nurses in this study, which may contribute to contamination and subsequently increases the risk of infection. This corresponds to the study of Harsvardhan, Mishra, Kushwaha, and Prasad (2022). Management plays a significant role in influencing nurses' adherence to infection control. This is supported by the study of Harsvardhan, Mishra, Kushwaha, and Prasad (2022) which found that in hemodialysis unit, the absence of structured system and protocols, along with unavailability of necessary supplies hindered proper hand hygiene practices.

A lack of support among team members has been identified as one of the challenges nurses' encounters in infection prevention. This aligns with the findings of Harsvardhan, Mishra, Kushwaha, and Prasad (2022) who reported that poor teamwork negatively impacts nurses' compliance with hand hygiene practices. The extent of nurses' knowledge about infection control in hemodialysis plays a crucial role in their performance. This study reveals that many nurses lack sufficient knowledge, which poses a risk to patient safety. This corresponds to the study conducted by Hosney, Mohamed, Abdelmowla, and Abdel (2021).

The insufficient training of nurses in infection control is a contributing factor to increasing infection rates. This aligns with the study by Mahran, Ahmed, and Ameen (2024) which found that many nurses lacked formal training. The result of this study also indicates that the use of antiseptic during CVC care is a practice that often overlooked by nurses. This is supported by the study of Bayoumi, Ahmed, and Hassan (2019) which revealed that not all nurses applied antimicrobial ointment during CVC care. Neglecting proper disinfection measures increases the risks of bloodstream infections. In this study, a small number of nurses did not adhere to the established guidelines for station disinfection. This corresponds to the study of Hutchins, Blessitt, and Giles (2022) which found that while most nurses followed the infection control protocols, there were still few who did not comply.

In this study, number of nurses providing care to patients is insufficient. This is supported by the study of Harsvardhan, Mishra, Kushwaha, and Prasad (2022), which identified that childcare and medical leaves affect the nurse-patient-ratio. Not all nurses adhere to the aseptic technique during CVC care such as contaminating a clean area of the patient with dirty gloves. This corresponds to the study of Hutchins, Blessitt, and Giles (2022), who found that some nurses struggled to follow correct aseptic practices. During CVC care, some nurses did not follow to the established protocols. This is supported by the study of Bayoumi, Ahmed, and Hassan (2019), which found that many nurses neglected to use waterproof sheet or scrub the exterior hubs. In addition, this study revealed that numerous nurses lack sufficient skills in performing CVC exit care. This is supported by the study of Bayoumi, Ahmed, and Hassan (2019), which highlights the need for enhancing nurses' competencies.

Nurses did not consistently follow safe injection practices, which may contribute to the increased number of infections according to the results of this study. This corresponds to the study of Mahran, Ahmed, and Ameen (2024) who emphasized the need for training support to enhance nurses' adherence to safe injection practices. Poor handling of supplies can compromise sterility and contributes to infections. Furthermore, this study found that many nurses failed to prepare and dispose of supplies properly. This corresponds to the study of Bayoumi, Ahmed, and Hassan (2019), which emphasized that nurses lack adherence to proper supply management practices.

6.2 Validity and ethics

Validity and reliability are essential elements of research, ensuring that the findings are both accurate and trustworthy. These factors are particularly significant in health care and social science studies, where accurate data collection is essential. In qualitative research, it highlights the importance of concepts such as credibility, transferability, dependability, and confirmability. Ensuring the validity and reliability of research findings is essential for producing high-quality academic studies. Strengthening these aspects is key to ensuring that research outcomes are both credible and trustworthy. (Kouman and William 2024: 287-292.) Establishing reliability in context can be challenging, as there are no standardized statistical tests available to assess it directly. A commonly recommended method to enhance reliability in qualitative research is the use of multiple coding, such as peer review, consistency checks or intercoder reliability. (Coleman 2021: 2041-2045.)

To ensure validity and reliability, a structured method was used in selecting, appraising, and synthesizing the relevant scientific articles. The PiCo table guided the identification of the relevant information to study and avoid deviation. Additionally, inclusion and exclusion criteria were defined prior to the literature search and focused on peer-reviewed and primary articles published between 2016 and 2025, written in English, and specifically related to nursing strategies in preventing catheter-related bloodstream infection in hemodialysis patients. This study utilized scientific articles from Metropolia databases including CINAHL and Medline, and in addition, relevant articles cited within the selected database sources were also included. A combination of keywords, Boolean operators and truncation were used to optimize the search process. The credibility of the publishing channels was assessed using the Julkaisufoorumi or publication forum (JUFO). JUFO is designed to evaluate the quality of research publications. The classification system of JUFO is well-suited for broad-level analysis of publication output by research institutions, academic disciplines, or the entire country. One of its strengths is the wide coverage which allows it to reflect the unique publishing practices of different academic fields, unlike citation analyses that rely solely on international database content. (Julkaisufoorumi 2024.) The quality of the included studies was critically assessed using the PRISMA flowchart, ensuring the inclusion of only methodologically sound and credible studies. All selected articles were reviewed collaboratively by two authors to address the research question effectively.

This study was conducted in accordance with the Ethical Recommendations for Thesis Writing at Universities of Applied Science (Arene), with compliance to a responsible code of conduct monitored by TENK. Research studies must be carried out in accordance with the Finnish Code of Conduct for Research Integrity for their findings to be credible and ethically acceptable. Reliability, honesty, respect, and an accountability are the core values of research integrity in the Finnish Code of Conduct, which is in accordance with European Code of Conduct for Research Integrity. Additionally, the Finnish National Board on Research Integrity (TENK) has also established the definition of a violation of appropriate research conduct. The most serious offence is misconduct, which includes fabrication or falsification, which is the presentation of fabricated outcomes and findings; or purposeful modification to make them false plagiarism. (TENK 2024.) A Turnitin check has been performed for this study resulting in an acceptable percentage determining plagiarism.

This study prioritized transparency and academic integrity by presenting results accurately, proper citation of all sources and adherence to ethical guidelines. However, this literature review has certain limitations. The development of codes is subject to the authors' interpretations, introducing potential bias. The results are limited by variability, as nursing strategies and challenges identified in preventing CRBSI in hemodialysis patients may not be applicable universally. Additionally, findings are limited to reviewed studies, which may not comprehensively represent all existing knowledge due to restrictions related to language and publication dates.

6.3 Conclusion and utilization of the results and recommendations

This study highlights the importance of nursing strategies in the prevention of CRBSI among patients undergoing hemodialysis. It concludes that the consistent implementation of strategies such as continuous training and education, PPE usage and proper disposal, cleaning and disinfection, supply management, proper medication administration, CVC access device care, patient monitoring, hand hygiene, and patient and family education contributes to CRBSI prevention.

Furthermore, this study reveals the multifaceted challenges nurses encounter in clinical settings. These include factors such as job dissatisfaction, compliance with hand hygiene, management strategies, team collaboration, level of knowledge, lack of training, application of antiseptic, adherence to disinfection measures, staffing, correct implementation of aseptic technique, proper execution of CVC care, medication administration, and inconsistent observance of supply management protocols. Such barriers can compromise the effectiveness of infection control strategies.

To address these issues, it is imperative for healthcare institutions to provide strong support through investing in continuous professional development, ensuring sufficient resources, and promoting quality improvement and patient safety initiatives. Enhancing the working environment and ensuring adherence to standardized protocols can empower nurses to provide safer and more effective care. Ultimately, the successful prevention of CRBSIs in hemodialysis patients relies not only on clinical expertise but also on ongoing institutional dedication to enhancing care and ensuring patient safety. By putting these recommendations into practice, healthcare providers can achieve better outcomes and significantly reduce CRBSIs rates.

References

Abdo, N., Ramadan, M., Tosson, M., and Al-Fadhli, M. 2018. Effectiveness of An Educational Program on Knowledge and Practices Regarding Care of Central Venous Catheters among Dialysis Nurses. *The Egyptian Journal of Community Medicine* 38 (1).

American Kidney Fund. Kidney failure (ESRD) - Symptoms, causes and treatment options 2022. <<https://www.kidneyfund.org/all-about-kidneys/kidney-failure-symptoms-and-causes#what-is-kidney-failure>>. Accessed 5 April 2025.

Bayoumi, M., Ahmed, A. and Hassan, H. 2019. Nurses' Practice Toward Applying Infection Control Measures Using NOTICE Checklists at a Dialysis Unit. *Connect: The World of Critical Care Nursing* (13) 2. 90-101.

Cleveland Clinic. Kidney Failure. Updated 17 January 2025. <<https://my.clevelandclinic.org/health/diseases/17689-kidney-failure>>. Accessed 11 April 2025.

Coleman, P. 2021. Validity and Reliability within Qualitative Research in the Caring of Sciences. *International Journal of Caring Sciences*. (14) 3. 2041-2045.

Finnish National Board on Research Integrity TENK. Research Integrity (RI). Updated 5 March 2024. <<https://tenk.fi/en/research-integrity-ri>>. Accessed 1 March 2025.

Finnish National Board on Research Integrity TENK. Research Misconduct. 22 April 2024. <<https://tenk.fi/en/research-integrity/research-misconduct>>. Accessed 4 March 2025.

Fisher, M., Golestaneh, L., Allon, M. Abreo, K., and Mokrzycki, M. 2020. Prevention of Bloodstream Infections in Patients Undergoing Hemodialysis (15) 1. 132-151. Corrected 17 April 2022.

Guimarães, G., Goveria, V., Mendonza, I., Corrêa, A., De Matos, S., and Guimarães, J. 2017. Nursing Interventions for Hemodialysis Patients Through Central Venous Catheter (11) 3. 1127-1135.

Hajji, M., Neji, M., Agrebi, S., Nessira, S.B., Hamida, F.B., Samia, B., Harzallah, A., and Abderrahim, E. 2022. Incidence and challenges in management of hemodialysis catheter-related infections. *Scientific Reports* (12) 20536.

Harsvardhan, R., Mishra, R., Kushwaha, R., and Prasad, N. 2022. Hand hygiene: An effective key HIC parameter for reducing healthcare-associated infections in haemodialysis unit – Identification and analysis of work system factors. *Journal of Patient Safety & Infection Control* (10) 1. 10-13.

Hernán, V., Muñoz, G., Monroy, A., Cabana, A., Rivas, E. Garcia, I., and Soriano, I. 2023. Influence of Care on the Prevention of Bacteremia in Hemodialysis: Systematic Review (50) 4. 333-344.

Holloway, I. and Galvin, K. 2023. *Qualitative Research in Nursing and Healthcare*. 3-14.

Hosney, Z., Mohamed, M., Abdelmowla, R., and Azous, N. 2021. Nurses' Aseptic Technique Knowledge, Practice, and Compliance for Patients Receiving Hemodialysis (9) 25. 145-154.

Hutchins, R., Blessitt, L., and Giles, C. 2022. Management of Catheter-Related Bloodstream Infections (CRBSIs) Among African American Patients with End Stage Renal Disease (ESRD). *The ABNFF Journal* (1) 2. 12-19.

Iacobone, E., Elisei, D, and Capozzoli, G. 2024. Catheter-associated bloodstream infections. Principles of prevention and management. In Sartelli, M., Coccolini, F., Catena, F., and Pagani, L. (Eds.). *Global Infection Prevention and Management in Healthcare* (2). 151-160.

Ibrahim, M., Mokhtar, I., and Hussein, R. 2025. Impact of Educational Program on Nurses' Performance Regarding Care of Central Venous Catheter in Hemodialysis Unit. *Journal of Healthcare Research* (2) 1. 306-327.

Julkaisufoorumi. Last Updated 26.4.2024. < <https://julkaisufoorumi.fi/fi/julkaisufoorumi-0>>. Accessed 4 May 2025.

Karkar, A. 2018 Infection control guidelines in hemodialysis facilities. *Kidney Research and Clinical Practice* (37) 1. 1-3.

Kouman, F., and William, A. 2024. Mastering Validity and Reliability in Academic Research: Meaning and Significance. *International Journal of Research Publications*. 144 (1). 287-292.

Lawani-Luwaji, E. And Ilegbedion, G.I. 2024. Literature Review in Scientific Research: An Overview. *East African Journal of Education Studies* 7 (2). 211-218.

Lu, H., Hou, Y., Chen, J., Guo, Y., Lang, L., Zheng, X., Xin, X., Lv, Yi, and Yang, Q. 2020. Risk of catheter-related bloodstream infection associated with midline catheters compared with peripherally inserted central catheters: A meta-analysis. *Nursing Open* 8 (3). 1292-1300.

Mahran, E., Ahmed, A., and Ameen, N. 2024. Nursing staff's Knowledge and Performance regarding Infection Prevention and Control Measures at the Hemodialysis Unit. *Mansoura Nursing Journal* (11) 1.

Metropolia IT Services. Turnitin. <<https://wiki.metropolia.fi/display/itservices/Turnitin>>. Accessed 4 March 2025.

Mezmir, E. 2020. Qualitative Data Analysis: An Overview of Data Reduction, Data Display and Interpretation. *Research on Humanities and Social Sciences* (10) 21. 15-27.

Morkes, S., Abozead, S., and Azer, S. 2018. Effect of Educational Program on Nurses Performance About Infection Control for Patients Undergoing Hemodialysis. *Assiut Scientific Nursing Journal* (6) 15. 162-168.

National Kidney Foundation. Hemodialysis. Updated 26 April 2024. <<https://www.kidney.org/kidney-topics/hemodialysis>>. Accessed 02 March 2025.

Nguyen, D., Arduino, M., and Patel P. 2018. Hemodialysis-Associated Infections. 389-410.

Osman, F., El Banna, H., Sharaf, A., and Mohammed, Y. 2021. The Effects of Educational Interventions on Nurses' Knowledge and Practices in Hemodialysis Unit Regarding Infection Control Practices (84). 1739-1748.

Paré G., and Kitsiou S. 2017. Handbook of eHealth Evaluation: An evidenced based approach. Chapter 9 Methods for Literature Reviews. 157-179.

Pasilan, R.M., Tomacruz-Amante, I.D. and Dimacali, C.T. 2024. The epidemiology and microbiology of central venous catheter related bloodstream infections among hemodialysis patients in the Philippines: a retrospective cohort study. *Biomed Central Nephrology* (2024) 25. 331.

Singh, S., Pandey, H., Aggarwal, H., and Pal, S. 2023. Assessing the Impact of Training on Healthcare Providers' Adherence to Infection Control Measures in Hemodialysis Services. *Cureus* (15) 8.

Soi, V., Moore, C., Kumbar, L., and Yee, J. 2016. Prevention of catheter-related bloodstream infections in patients on hemodialysis: challenges and management strategies. *Int J Nephrol Renovasc Disc* (9). 95-103.

Vásquez, P., Martínez, I., Gonzáles, L., Campos, E., Mayoral, L. Huerta, M., and Martínez, E. 2022. The role of nursing in the prevention of catheter-associated infections in hemodialysis: A literature review 2022 (6) 2. 14-22.

Vears, D.F. and Gillam, L. 2022. Inductive content analysis: A guide for beginning qualitative researchers. *Focus on Health Professional Education* (23) 1. 111-127.

Appendices

Appendix 1. Database search results table

Database	Search sentence	Total number of hits	Papers/Records included based on title	Papers/Records included based on abstract	Papers/Records included based on full text
CINAHL	(infection control or infection prevention) AND bloodstream infection AND (hemodialysis or haemodialysis or dialysis)	79	13	4	2
	nurs* AND (infection control or infection prevention) AND (hemodialysis or haemodialysis or dialysis)	72	10	3	1
Medline	(practice or intervention or management) AND (prevention infection or control infection or reduction) AND (bloodstream infection or catheter infection) AND (hemodialysis or dialysis)	122	17	8	1
	(infection control or infection prevention) AND bloodstream infection AND (hemodialysis or haemodialysis or dialysis)	125	15	6	1
Manual Search		5	5	5	5
Limiters	Past 10 years, peer-reviewed, English language				
Records in Total		403	60	26	10

Appendix 2. Summary of selected articles

Author (s), year, country	Topic/Title	Methodology & Methods	Participants	Main Outcomes
Abdo, Ramadan, Tosson, Al- Fadhli 2020 Kuwait	Effectiveness of An Educational Program on Knowledge and Practices Regarding Care of Central Ve- nous Catheters among Dialysis Nurses	Quantitative study Pre-test/Post- test educa- tional interven- tion Tool 1: pre- constructed self-adminis- tered question- naire Tool 2: Obser- vation check- lists Using sam- pling method	n = 92 nurses working over three working shifts in Hemo- dialysis unit	The study emphasizes that educational intervention pro- gram is important in improving the knowledge and prac- tices of healthcare workers regarding care and mainte- nance of central venous catheters and prevention of CRBSIs. The study found out also that nurses did not re- ceive previous infection control training about CVCs maintenance and care. Even though training was pro- vided for nurses, only a few were able to attend because they were busy providing care for the patients.

Bayoumi, Ahmed, and Hassan 2019 Bahrain	Nurses' Practices Toward Applying Infection Control Measures Using NOTICE Checklists at a Dialysis Unit	Quantitative, Cross-sectional study NOTICE Checklists	n = 17 nurses, all female, aged 25-30	The study emphasizes the significance of infection control systems in dialysis units through NOTICE checklist aiming to encourage nurses to prevent infection. The study found out that compliance rate of hand hygiene was very low, and Nurses did not follow the technique in the initiation of treatment via CVC. In addition, other techniques such as, donning and doffing of clean gloves, scrubbing of exterior CV port, connecting of sterile syringes, assembling of supplies, placing of clean sheet under the CVC port, and disinfecting of the machine and chairs have not been done by all nurses.
Guimarães, Goveia, Mendonza, Corrêa, De Matos, and Guimarães 2017 Brazil	Nursing Interventions for Hemodialysis Patients Through Central Venous Catheter	Quantitative, descriptive study	n = 57 patients, adults, both sexes, aged 18-60	The study emphasizes the importance of nursing interventions in handling central venous catheters such as, measuring of axillary temperature pre/post-treatment, maintaining occlusive dressing, monitoring signs and symptoms associated with local and systemic infection, maintaining the aseptic technique every time the venous access is handles, maintaining standard precaution and exchanging occlusive protectors of the CVC after each hemodialysis session, maintaining the permeability of the catheter, and guiding the patient and the family on maintenance of the CVC. These interventions are effective in maintaining the catheter and preventing complications such as infection.
Harsvardhan, Mishra, Kushwaha, and Prasad	Hand hygiene: An effective key HIC parameter for reducing healthcare-associated infections in a haemo-	Quantitative, Prospective cross-sectional study	Nursing staffs	The study found out that the compliance rate of healthcare staffs in hand hygiene was extremely poor, which contributes to healthcare-associated infections.

2022 India	dialysis unit – Identification and analysis of work system factors			
Hosney, Mohamed, Abdelmowla, and Azouz 2021 Egypt	Nurses' Aseptic Technique Knowledge, Practice, and Compliance for Patients Receiving Hemodialysis	Quantitative study Tool 1: Nurses questionnaire Tool 2: Observation Checklist Tool 3: Assessment of nurses' compliance with aseptic technique sheet	n = 40 nurses	The study shows that most of the nurses have poor knowledge about infection control in hemodialysis unit and were non-compliance to the aseptic technique. According to the data collected, there were challenges in accessing educational resources such as insufficient funds for ongoing education, lack of interest or motivation, workload and the absence of a supportive learning environment.

<p>Hutchins, Blessitt, and Giles</p> <p>2022</p> <p>United States</p>	<p>Management of Catheter-Related Bloodstream Infections (CRBSIs) Among African American Patients with End Stage Renal Disease (ESRD)</p>	<p>Quantitative, quasi-experimental</p> <p>Pre-test and post-test intervention</p> <p>Quality improvement project</p>	<p>n = 2 registered nurses and 2 patient care technicians</p>	<p>The study shows that Nursing participants' knowledge and practice performance have improved after the infection control training program. As a result, there was a significant decrease in the incidence of CRBSIs.</p>
<p>Ibrahim, Mokhtar, Hussein</p> <p>2025</p> <p>Egypt</p>	<p>Impact of Educational Program on Nurses' Performance Regarding Care of Central Venous Catheter in Hemodialysis Unit</p>	<p>Quantitative, Quasi-experimental design (pre-test and post-test)</p> <p>Tool 1: interview questionnaire</p> <p>Tool 2: Observation checklist</p>	<p>n = 60 nurses divided into four groups, with 15 nurses in each group</p>	<p>The study shows that educational program was effective as Nurses' knowledge and practices on caring for central venous catheters (CVC) in the hemodialysis unit (HD) have increased after it was implemented.</p>

Mahran, Ahmed, and Ameen 2024 Egypt	Nursing Staff's Knowledge and Performance regarding Infection Prevention and Control Measures at the Hemodialysis Unit	Quantitative, Cross-sectional study Tool 1: Demographic and occupational data self-administered structured questionnaire Tool 2: Nursing staff's knowledge self-administered structured questionnaire Tool 3: Nursing staff's performance observation checklist	n = 40 nurses	The findings of the study indicate that most of the nursing staff have poor knowledge, and two-thirds of them have demonstrated inadequate performance levels in infection prevention and control measures within hemodialysis unit.
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<p>Morkes, Abozead, and Azer</p> <p>2018</p> <p>Egypt</p>	<p>Effect of Educational Program on Nurses performance About Infection Control for Patients Undergoing Hemodialysis</p>	<p>Quantitative, Pre-test and post-test experimental design</p> <p>Tool 1: Self-administered questionnaire sheet</p> <p>Tool 2: Educational nursing program</p> <p>Tool 3: Evaluational tool</p>	<p>n = 55 nurses of both sexes, age ranges from 18-60 years</p>	<p>The study shows that, after the implementation of an educational nursing program which includes teaching session for both theory and practice, nurses' knowledge and performance regarding infection control in hemodialysis were improved. Nurses were provided by an educational nursing booklet consisting of knowledge related to the anatomy of urinary system in human, kidney and its function, definition and indications of hemodialysis, and types of vascular access. The booklet also included information about pre-hemodialysis, hand hygiene, protective equipment, cleaning and disinfection, handling of disposable supplies, water treatment purity and testing.</p>
<p>Singh, Pandey, Aggarwal, Pal</p> <p>2023</p> <p>India</p>	<p>Assessing the Impact of Training on Healthcare Providers' Adherence to Infection Control Measures in Hemodialysis Services</p>	<p>Quantitative, single-group, pre- and post-interventional study</p>	<p>n = 208 nursing professionals, the majority of whom are married females (86%) and residents in urban areas (81%). Most of the participants held a</p>	<p>The findings of the study show that educational program has a positive impact regarding infection control in hemodialysis services. Enhanced practices will enable healthcare providers to perform their duties safely and efficiently, resulting in high quality of care and a reduction in bloodstream infection among hemodialysis patients.</p>

			General Nursing & Midwifery diploma (52%) and were nursing officers (88%) with 0-5 years of professional experience (39%).	
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