

Knowledge of Catheter-Related Bloodstream Infections Prevention among Staff Nurses in Dialysis Centre

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ABSTRACT

Background: Patients with end-stage renal disease initially starting haemodialysis treatment require reliable arteriovenous access to perform the procedure. However, using a Central Venous Catheter (CVC) for haemodialysis poses risks, including the potential for life-threatening Catheter-Related Bloodstream Infections (CRBSIs). These infections raise mortality rates and treatment costs. Safer alternatives must be prioritised in order to improve patient outcomes and reduce expenses. Alarming, only 42% of nurses have an intermediate understanding of CRBSIs, highlighting the need for comprehensive training and adherence to updated practices among dialysis nurses and healthcare personnel. **Objective:** This study aimed to assess dialysis nurses' understanding of preventing catheter-related bloodstream infections (CRBSI) to pinpoint knowledge gaps and strengthen infection control measures. Addressing these gaps will improve training programmes, promote best practices, and ultimately reduce the risk of CRBSIs in dialysis settings. **Methods:** A cross-sectional study was conducted with 100 nurses in the dialysis centre. A purposive sampling method was used. The tool for data collection was a questionnaire consisting of participants' sociodemographic data and the level of knowledge of dialysis nurses regarding the prevention of CRBSI. The data were analysed using IBM Statistical Package for Social Science (SPSS) version 27. **Results:** The survey findings indicate the following percentages: 42.0% (n=42) of the participants had an intermediate level of knowledge, while 21.0% (n=21) had low knowledge, and only 37.0% (n=37) had a high level of knowledge. **Conclusion:** The study results suggest that the majority of dialysis nurses possess an intermediate level of knowledge regarding CRBSI prevention. Organisations can improve CVC care by using simulation training, competency workshops, and case-based learning. Bundle training, audits, e-learning, shadowing, and drills reinforce best practices, boost staff skills, and enhance patient safety.

Keywords: Catheter-related Bloodstream Infection; Dialysis; Knowledge; Staff Nurse

INTRODUCTION

A newly initiated haemodialysis treatment patient requires vascular access to perform the therapy. Central Venous Catheters (CVC) are the most common form of vascular access in newly diagnosed patients, utilised by approximately 80% of individuals in the United States (Sohail, Vachharajani & Anvari, 2021). Their widespread use highlights their importance in facilitating timely and efficient medical treatment. The procedure involves the insertion of a catheter beneath the skin. CVC placement in haemodialysis is associated with risk and life-threatening Catheter-Related Bloodstream Infections (Alqalah, 2024). Maintaining CVC procedures remains a significant challenge due to various adverse events, including infections (such as CRBSIs and sepsis) (Lai, Tay & Lee, 2025), blockages (like occlusions and thrombosis), and mechanical issues (such as malposition, breakage, and dislodgement). Other risks include air embolism, haemorrhage, haematoma, and pneumothorax (Baldauf *et al.*, 2025). These complications often lead to frequent hospital admissions and increased morbidity and mortality (Worku & Gessese, 2025; Belloni *et al.*, 2025). CRBSI is an infection in the bloodstream associated with the central line used, whereby the catheter is in place for 48

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hours. The appearance of early signs and symptoms after the catheter is placed the day before or on the same day of placement is used to meet the definition. Specific laboratory testing is required to identify or confirm the source of the CRBSI infection (Dasgupta, 2022).

A study conducted by Shahar *et al.* (2021) in Malaysia found that 47% of the study population acquired CRBSI, with 8% ICU admission and a recurrent rate of 28%. The dialysis nurse's role is to maintain the functionality of dialysis access, eliminating any risk of failure and preventing other complications. Therefore, dialysis nurses' knowledge and skills must be up to date and be able to apply related information from research and evidence-based practices to their daily tasks. Initiatives by dialysis organisations, nephrologists, public health personnel, and patients have joined forces with the Centres for Disease Control and Prevention (CDC) to launch a campaign in 2016 to provide safer dialysis for patients' benefit. The top priority is empowering dialysis personnel and patients by increasing their awareness of preventing bloodstream infections in patients on haemodialysis. Education should be developed based on evidence and followed by regular enforcement and daily monitoring to comply with CRBSI guidelines (O'Grady, 2023).

The purpose of this study is to evaluate staff nurses' knowledge of catheter-related bloodstream infection (CRBSI) prevention in dialysis centres, with the goal of enhancing infection control practices, improving patient safety, and reducing healthcare costs. Identifying knowledge gaps may help guide targeted training programmes, encourage adherence to best practices, and contribute to lowering CRBSI rates. This reduction in CRBSI rates can lead to significantly better patient outcomes and more efficient healthcare delivery. Currently, no published research has examined dialysis nurses' knowledge of infection prevention guidelines related to CVC use in private dialysis centres in Sabah. The haemodialysis unit needs a database on CRBSI as a point of reference to develop a plan to reduce CRBSI incidents and improve patients' quality of life.

METHODOLOGY

Study Design

This study employs a qualitative research design, which focuses on exploring and understanding the knowledge level of dialysis nurses regarding catheter-related bloodstream infection (CRBSI) prevention. It does not aim to establish causal relationships or correlations but provides descriptive insights into the current state of knowledge among the target population.

Study Population and Sampling

A cross-sectional survey was conducted among 100 staff nurses employed at Dialysis Centres in Sabah. Purposive sampling, similar to a study that was conducted by Binti and Thandar (2021), was utilised in the research. Purposive sampling is a research method used to identify specific participants with relevant knowledge or experience related to the study topic (Nyimbili & Nyimbili, 2024). This approach ensures that the data collected is rich, suitable, and directly applicable to the research objectives. In the context of preventing Catheter-Related Bloodstream Infections (CRBSIs) among dialysis nurses, purposive sampling enables researchers to select participants who are directly involved in catheter care and infection control, leading to more meaningful insights.

Data Collection Instrument

A structured questionnaire, adopted from Ntlhokoe (2016), was developed in English and distributed during the data collection period from August to December 2023. The Content Validity Index (CVI) was established through expert reviews, and a pilot test with five respondents confirmed that the instrument effectively assessed knowledge of evidence-based guidelines for preventing haemodialysis catheter-related infections, scoring 0.98 in content validity.

Questionnaire Structure

Demographic data collected included gender, age, education, years of experience, and participation in infection control training, gathered at the beginning of the questionnaire. Part II included eleven questions with one correct answer and two distractors, along with an "I do not know" option to avoid speculation.

Correct answers received 1 point, while incorrect and "I do not know" responses received zero points. The total scores ranged from 0 to 11 and were converted to a percentage scale for clarity.

Statistical Analysis

Preliminary data analysis was conducted using SPSS version 27, describing demographic and knowledge findings in percentages, frequencies, and standard deviations.

Ethical Consideration

The research obtained ethical clearance from the Medical Research Ethics Committee, Universiti Malaysia Sabah, Malaysia with reference number JKEtika 3/23 (2) on 31st of July 2023.

RESULTS

Sociodemographic Data

The sociodemographic characteristics of the study participants provide essential context for understanding the knowledge levels and practices of dialysis nurses regarding catheter-related bloodstream infection (CRBSI) prevention. This section presents key variables, including gender, age, educational background, years of dialysis experience, and prior infection control training. All data is shown in Table 1.

Table 1: Sociodemographic Data of Staff Nurses in Dialysis Centres

Variables	Category	%	n
Age (years)	20-30	19	19
	31-40	76	76
	41-50	5	5
Gender	Male	17	17
	Female	83	83
Educational background	Diploma	94	94
	Bachelor	6	6
Post Basic in Renal	Yes	78	78
	No	22	22
Experience in Dialysis (years)	Below 1	10	10
	2 to 5	17	17
	6-10	62	62
	11-15	11	11
Infection Control Training	Yes	29	29
	No	71	71

Table 1 presents the demographic characteristics of the nurses who participated in this study. The participants included 83% (n = 83) female nurses and 17% (n = 17) male nurses. The age distribution of participants was as follows: 19 nurses (19.0%) were aged between 20 and 30 years, 76 nurses (76.0%) were between 31 and 40 years, and five nurses (5.0%) were aged between 41 and 50 years. Most participants held a diploma in nursing, accounting for 94.0% (n = 94), while only 6% (n = 6) possessed a bachelor's degree. Additionally, 78% (n = 78) of the nurses had a renal post-basic speciality, whereas 22% (n = 22) had no post-basic qualification. In terms of work experience in dialysis, 27 nurses (27.0%) had 1 to 5 years of experience, 62 nurses (62.0%) had 6 to 10 years, and 11 nurses (11.0%) had between 11 and 15 years of experience. Furthermore, a significant majority of participants, 71% (n = 71), had not received infection control training, while only 29 nurses (29.0%) had attended such training.

The Knowledge of Staff Nurses on Catheter-Related Bloodstream Infections Prevention

Concerning the knowledge of CRBSI prevention, none of the respondents answered accurately all the questions as shown in Table 2.

Table 2: Knowledge of Catheter-Related Bloodstream Infections Prevention

No.	Questions	Correct Answers	
		n	(%)
1	When should hands be washed during a vascular access procedure?	88	88%
2	What material should be used for vascular access skin cleaning?	77	77%
3	What is the most suitable dressing to cover a vascular access exit site?	50	50%
4	When is the appropriate time to remove the vascular access dressing?	31	31%
5	What is a suitable antibiotic/ antiseptic ointment used to reduce infection on vascular access sites?	78	78%
6	What anticoagulant is recommended to prevent clotting on the catheter's lumen?	87	87%
7	When is the appropriate time to assess vascular catheter exit sites, and should any abnormalities be reported immediately?	75	75%
8	When should Fistula and Grafts be checked for any infection?	28	28%
9	When is the appropriate time to change the vascular catheter dressing?	69	69%
10	What is the appropriate personal protective equipment a staff should wear in addition to a face mask to avoid the risk of mouth and nasal vascular catheter exit site contamination?	41	41%
11	What is the appropriate action a patient should take during a vascular access procedure to help minimise contamination through the mouth and nasal flora?	51	51%

Table 2 summarises dialysis nurses' knowledge regarding CRBSI prevention. Results show that 88% correctly answered Question 1 on hand hygiene timing during vascular access, while 77% identified the correct skin-cleaning material (Question 2). Only 50% knew the appropriate dressing for exit sites (Question 3), and 31% correctly answered when to remove dressings (Question 4). For Question 5, 78% identified suitable antibiotic/antiseptic ointments, and 87% knew the recommended anticoagulant to prevent clotting (Question 6). Question 7, on assessing catheter exit sites and reporting abnormalities, was answered correctly by 75%, but only 28% knew when to check fistulas and grafts for infections (Question 8). For Question 9, 69% correctly identified the timing for changing catheter dressings. Questions 10 and 11 revealed gaps, with 41% knowing the appropriate PPE beyond face masks to prevent contamination and 51% aware of patient actions to minimise contamination during procedures. These findings indicate varying knowledge levels, highlighting areas for targeted education.

Level of Knowledge of the Prevention of CRBSI

The assessment of dialysis nurses' knowledge regarding catheter-related bloodstream infection (CRBSI) prevention is crucial in identifying gaps that may impact patient safety and infection control practices. This section presents the distribution of knowledge levels among participants, categorised as inadequate, intermediate, and high. Understanding these levels can help guide targeted training programmes and reinforce adherence to best practices in infection prevention. All data is shown in Figure 1.

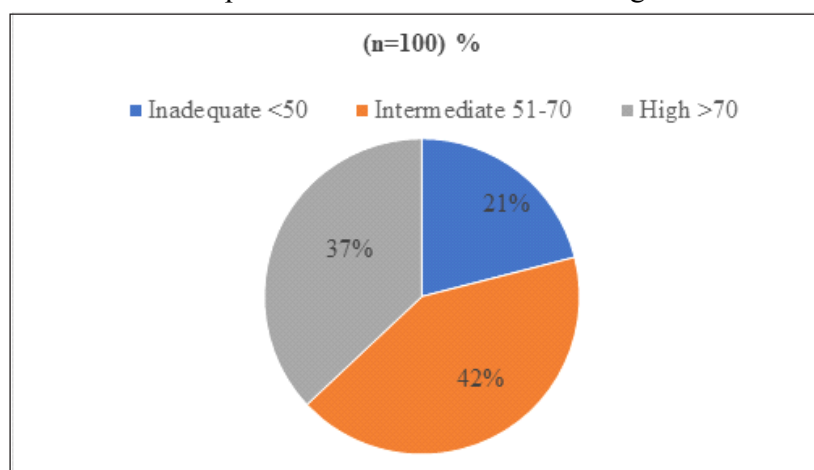


Figure 1: Level of Knowledge of the Prevention of CRBSI

Figure 1 illustrates the level of knowledge of CRBSI prevention. The study revealed that only 37.0% (n=37) of dialysis nurses with a total score of 71% to 100% have a high level of knowledge. In addition, 42.0% (n=42) of dialysis staff achieved an intermediate level of knowledge, with a total score ranging from 51% to 70%. Without exception, 21.0% (n=21) of dialysis nurses performed poorly, with a range score of 0% to 50%.

DISCUSSION

The findings of the survey suggest an intermediate level of knowledge regarding CRBSI prevention. The link between years of dialysis experience and knowledge of CRBSI prevention implies that those with more experience are likely to have more excellent knowledge. However, this study reveals a concerning reality: Despite 62% of nurses having 6 to 10 years of experience in dialysis, most still demonstrate only an intermediate understanding of CRBSI prevention. This gap in knowledge highlights the urgent need for targeted education and training to enhance their expertise and improve patient outcomes. These findings related to the fact that only 29% of the staff had undergone infection control training. The limited participation in training could lead to gaps in understanding and implementation of effective CRBSI prevention measures. These findings are in line with a study done by Moustafa *et al.* (2024) in an adult intensive care unit to assess the knowledge of ICU nurses related to the maintenance, care, and prevention of CRBSI. The results showed that 70 % of nurses had an average level of total knowledge. Dsilva, Mathew, and Joseph (2022) conducted a pre- and post-intervention study on nurses' knowledge and practices in CRBSI prevention. Baseline findings showed moderate expertise, which improved significantly post-intervention, highlighting the need for ongoing education and training. Ahmed *et al.* (2024) found substantial knowledge gaps among healthcare workers in Egypt regarding practices for inserting haemodialysis catheters. Despite established protocols, adherence was inconsistent due to limited training access and high workloads. Alqalah (2024) identified knowledge and attitude barriers as contributors to inadequate CRBSI prevention in critical care settings, suggesting that behavioural reinforcement is necessary for adherence to best practices. In a contrasting study, Al Qadire and Hani (2022) reported low awareness of CRBSI prevention guidelines among healthcare providers in Jordan. Conversely, Binti and Thandar (2021) found that 94.2% of ICU nurses in Malaysia exhibited strong knowledge and good practices regarding CRBSI.

The question, "What material should be used for vascular access skin cleaning?" was answered correctly by 77.0% (n = 77). According to research, using chlorhexidine for central line hub cleaning dramatically reduces the rate of catheter-related infections among dialysis patients (Buetti *et al.*, 2022). Alcoholic chlorhexidine 2%, compared with 5% alcoholic povidone-iodine, significantly reduced the risk of catheter-related infection and should become the standard of care (De Grooth, Hagel & Mimoz, 2024). The question "What is the most suitable dressing to cover a vascular access exit site?" had a correct response rate of only 50.0% (n=50). Several factors may contribute to this deficiency, such as limited training participation, with only 29% of staff having attended infection control training, and many may lack essential knowledge about proper dressing selection and application. The absence of standardised, regular training sessions can also lead to staff knowledge and practice variability. Staff with varying years of experience may not have received updated information on best practices, leading to outdated or inconsistent knowledge. The following actionable solutions are recommended to implement and develop mandated comprehensive infection control training for all staff, ensuring consistent education on the latest best practices (Iskender & Karadeniz, 2025). Establishment of clear standards and protocols and evidence-based guidelines for vascular access care, including dressing selection and maintenance, to ensure uniformity across the team. Less experienced staff should be paired with seasoned professionals to facilitate knowledge transfer and practical skill development. Azzopardi and Trapani (2022) conducted an evidence-based review evaluating the effectiveness of chlorhexidine-based CVC dressings in reducing catheter-related bloodstream infections (CRBSI) compared to traditional sterile gauze or transparent polyurethane dressings.

The low score of 31.0% for timely vascular access dressing changes indicates a lack of adherence to best practices. The CDC advises changing gauze dressings every two days and transparent dressings every seven days, replacing them immediately if wet, soiled, or dislodged (CDC Prevention in Dialysis Settings, 2024). Additionally, the 28.0% correct response rate for checking fistulas and grafts for infection reveals a need for improved training and adherence to monitoring protocols. Timely detection is vital to prevent complications

like sepsis and access failure, and best practices include daily assessments and recognising infection signs (redness, swelling, fever, or purulent drainage). If complications arise, duplex ultrasonography can assess potential issues, or patients can be referred to a vascular access service for management (Arasu, Jegatheesan & Sivakumaran, 2022).

The 41.0% correct response rate regarding PPE use highlights gaps in staff understanding of infection control and vascular catheter contamination prevention. Factors include inconsistent training and misunderstandings about proper PPE requirements includes a face mask, gloves, gown, and eye protection as needed. Adherence to sterile barriers during central venous catheter (CVC) insertion is essential for preventing infection (Sivakumar *et al.*, 2024; Ahmed *et al.*, 2024; Yuan *et al.*, 2022). The question "When should hands be washed during a vascular access procedure?" had a correct response rate of 88.0% (n=88). Hand hygiene is crucial for preventing catheter-related infections (De Kraker *et al.*, 2022), but heavy workloads can limit time for proper handwashing (Ahmadipour *et al.*, 2022). Improving hand hygiene practices, wearing protective clothing, and applying aseptic techniques during intravascular catheter procedures are essential (Gomaa, Zeid & Nagy, 2024). The study emphasises the need for staff to adhere to infection prevention guidelines for central venous catheters (CVCs), as CVC-related infections are costly and can lead to mortality (Mer, 2022). A critical care study showed a significant increase ($P < 0.05$) in knowledge and practice scores after intervention, with hand hygiene compliance rising from 47.1% to 78.4% (Dsilva, Mathew & Joseph, 2022). Training for healthcare staff on catheter insertion and maintenance is vital to prevent bloodstream infections (Buetti *et al.*, 2022). Continuous education can enhance adherence to catheter care guidelines (Lin *et al.*, 2023) and improve care quality. A survey by Abou Zed and Mohammed (2020) indicated a significant increase in mastery post-education about catheter care bundles. Ensuring all healthcare personnel understand these guidelines is essential for optimal outcomes in healthcare facilities.

Limitation

This study has several limitations. First, its cross-sectional design restricts the ability to establish causal relationships between CRBSI risk factors and prevention practices. Longitudinal research would offer better insights into causality. Second, reliance on self-reported data may introduce biases such as social desirability, recall, and acquiescence bias, potentially affecting validity. Additionally, the study was limited to a specific region, reducing generalisability to other settings. Finally, confounding factors like differences in provider experience could not be fully controlled. Future studies should consider using objective data and ensuring anonymity to minimise these biases.

CONCLUSION

The survey results show that all dialysis nurses did not necessarily come to work prepared or were supposedly adequately trained once on the job. Therefore, to prevent central line-associated bloodstream infections, it is important to provide clinical education through workshops and simulation-based training to enhance proficiency. Additionally, involving patients and their families in catheter care is beneficial through organised education programmes. In addition, organisations should allocate a budget to encourage staff to participate in seminars or courses related to the topic. To ensure all healthcare personnel are proficient in preventing catheter-related bloodstream infections, organisations should provide comprehensive training upon hiring, followed by annual refresher courses to reinforce best practices. Additionally, conducting quarterly competency assessments can help maintain adherence to infection prevention protocols. Regular monthly audits and feedback mechanisms further support compliance and identify areas for improvement. The frequency of infection prevention audits should be tailored according to the healthcare facility's specific needs and risk profile. This structured approach follows established best practices that have been proven effective in reducing CRBSI rates. Also, policies should ensure that all staff adhere to the rules and recommendations to provide best practices. New orientation training programmes must emphasise the importance of the issues. It is recommended that all organisations providing care to CVC patients continuously and consistently update staff knowledge for CRBSI prevention based on evidence-based practice (EBP).

The future research on catheter-related bloodstream infection prevention should investigate emerging risk factors, assess the adoption and effectiveness of new preventive technologies, and compare practices across different healthcare settings. Additionally, examining adherence to guidelines and the impact of education programmes can provide further insights into effective prevention strategies. By focusing on high-risk

populations and conducting multi-centre or international studies, researchers can contribute to the development of standardised, globally applicable CRBSI prevention practices. These directions help lay the foundation for more targeted and effective CRBSI prevention measures and ultimately contribute to improved patient safety and healthcare outcomes.

Conflict of Interest

The authors declare that they have no competing interests.

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