JOURNAL OF INTERNATIONAL CRISIS AND RISK COMMUNICATION RESEARCH
ISSN: 2576-0017
2024, VOL 7, NO S8

Optimizing Intravenous Line Care: A Guide for Nurses

Ghanem Mogadeb Ghanem Alrowili[1], Sabikah Abdullah Almushawwah[2], Majdah Saead Zaid AlSfyani[3],Amal Eidah Awad Alharhi[4],Amnah Mohammed Mohammad Harthy[5], Norah Obidallah Moneer Alqthami[6], Maha Mesfer Megbel Al Osaimi[7], Areej Mishaal Al Thubaiti[8], Amirah AedhAwadallh Althobaiti[9], Ohoud Ayed Awadallah ALThobaiti[10], Ashwag Saeed Mohmmad Saeed Alsalmi[11], Yahya Mohammed Mofarreh Zaid[12], Eman Abdullah Gadry[13], Asma Hassan Nasser shawlan[14], Hatim Surur Naif Alotaibi[15].

1. Health assistant, Al-qurayyat Directorate of Health Affairs, Ministry of Health,kingdom of Saudi Arabia. galroaylee@gov.sa
2. Nursing, Sajer General Hospital, Ministry of Health, Kingdom of Saudi Arabia. ppmm61024@gmail.com
3. Nursing, Aradah Complex and Mental Health, Ministry of Health, Kingdom of Saudi Arabia. msalsofyani@moh.gov.sa
4. Nurse, Children hospital, Ministry of Health, Kingdom of Saudi Arabia. aahhrty@moh.gov.sa
5. Nurse, Children hospital, Ministry of Health, Kingdom of Saudi Arabia. amharthy@moh.gov.sa
6. Nursing technician, Al-Hawiyah Central Health Center, Ministry of Health, Kingdom of Saudi Arabia. nalqthami@moh.gov.sa
7. Midwife, Al-Hawiyah Central Health Center, Ministry of Health, Kingdom of Saudi Arabia. maloseimi@moh.gov.sa
8. Nurse, SharqAlhawiah, Ministry of Health, Kingdom of Saudi Arabia. amalthubaiti.moh.gov.sa
9. Nursing technician, East Alhawiyah health center, Ministry of Health, Kingdom of Saudi Arabia. Amirahaa@moh.gov.sa
10. Nursing technician, Taif Health Cluster, Ministry of Health, Kingdom of Saudi Arabia. ohalthobaiti@moh.gov.sa
11. King Faisal Medical Complex, Ministry of Health, Kingdom of Saudi Arabia. assalsalmi@moh.gov.sa
12. nurse technician, Aser central hospital, Ministry of Health, Kingdom of Saudi Arabia. abumela1138@gmail.com
13. nurse, Abu Arish General Hospital, Ministry of Health, Kingdom of Saudi Arabia. emoo2010emoo@hotmail.com
14. Nursing Specialist, Abu Arish General Hospital, Ministry of Health, kingdom of saudiarabia. AShawlan@moh.gov.sa
15. Nursing Health Assistant, Um Alhamam PHC, Ministry of Health, kingdom of saudiarabia. hasralotaibi@moh.gov.sa

Abstract

Intravenous (IV) catheterization is a cornerstone of modern medical care, with millions of peripheral intravenous (PIV) and central venous catheters (CVCs) placed annually in the United States. While these devices are essential for administering medications, fluids, and nutrition, they also carry significant risks, including infections and mechanical complications. This article provides a comprehensive guide for nurses on optimizing IV line care based on current evidence-based guidelines and research. For PIVs, site selection should prioritize the forearm and upper extremities, avoiding areas of flexion. Skin preparation involves using chlorhexidine gluconate in alcohol, allowing the site to dry completely before insertion. Proper dressing and stabilization using engineered stabilization devices or medical adhesive securement systems are crucial for maintaining catheter integrity and preventing complications. Regular assessment, at least every four hours, is essential to monitor for signs of infection, infiltration, or dislodgement. PIV catheters should be removed when clinically indicated rather than on a fixed schedule. Bundled strategies, including staff education and strict adherence to best practices, have been shown to significantly reduce PIV-related bloodstream infections. For CVCs, maximum sterile barrier precautions and ultrasound guidance during insertion are critical. Skin preparation with chlorhexidine gluconate and the use of chlorhexidine-impregnated dressings are recommended to minimize infection risks. Daily assessment and prompt removal when the CVC is no longer necessary are crucial. Future research, such as the CLEAN 3 Protocol Study, aims to address gaps in knowledge surrounding antisepsis practices for PIVs and strengthen evidence-based guidelines for optimal IV line care.
Keywords: Nurses, Vascular Access, Peripheral And Central Catheters/Lines, Piv And Cvc Guidelines.

Introduction

Intravenous (IV) catheterization is a cornerstone of modern medical care in the United States, with over 200 million peripheral intravenous (PIV) catheters placed annually. Additionally, more than 5 million central intravenous catheters (CVCs) are inserted each year, reflecting their critical role in managing a wide range of medical conditions. Research indicates that 60% to 90% of hospitalized patients require the placement of a PIV

catheter during their treatment. These devices are essential for administering parenteral medications, fluids, nutrition, and blood products (Helm et al., 2019; Lim et al., 2019; Patel et al., 2017).

The utility of intravenous access devices extends beyond inpatient care, playing a vital role in outpatient medical settings such as infusion clinics, diagnostic imaging centers, urgent care facilities, and even in-home care environments. The selection of a specific intravenous access device is influenced by several factors, including the clinical purpose, the patient's vascular anatomy, and the anticipated duration and complexity of the therapy required. For example, short-term treatments like fluid infusions or routine medications in an acute care setting are commonly administered through PIV catheters. In contrast, longer-term treatments involving vesicant medications, vasopressors, or other irritant solutions often necessitate the use of CVCs.

The prevalence of intravenous catheter use highlights the need for clinicians to be proficient in selecting and managing these devices. Peripheral intravenous catheters are generally favored for their ease of insertion and lower risk profile compared to central lines. However, they are typically used for short-term or less intensive therapies due to their limited ability to accommodate certain drugs or prolonged infusions. Central venous catheters, on the other hand, provide more reliable access for therapies requiring high-flow rates, irritant solutions, or longer durations. Despite their advantages, CVCs carry a higher risk of complications, such as infections, thrombosis, and mechanical issues, which underscores the importance of proper insertion techniques and maintenance protocols.

In recent years, advances in catheter technology and insertion techniques have expanded the range of clinical applications for intravenous access devices. For example, midline catheters, which offer an intermediary option between PIVs and CVCs, have gained popularity for treatments lasting longer than a few days but not requiring the direct access of central lines. Similarly, ultrasound-guided catheter placement has improved the success rates of IV insertions, especially in patients with difficult venous access, such as those undergoing chemotherapy or with a history of repeated cannulation.

Furthermore, the growing emphasis on outpatient and home-based care has driven innovations in catheter design and securement technologies. Devices that minimize dislodgement risks, reduce infection rates, and improve patient comfort are now widely used in diverse care settings. The increasing utilization of ambulatory infusion therapies, including antibiotic administration, parenteral nutrition, and biologics, has further reinforced the importance of versatile and durable intravenous access options.

As healthcare delivery evolves, the appropriate selection, placement, and management of intravenous catheters remain critical to optimizing patient outcomes. While their benefits in facilitating effective treatment are undeniable, the risks associated with intravenous devices demand ongoing vigilance from healthcare professionals. From infection control measures to patient education on catheter care, each step plays a pivotal role in maximizing the therapeutic potential of these devices while minimizing complications.

History

The Infusion Nurses Society (INS) publishes evidence-based standards of practice for intravenous (IV) therapy and revises these guidelines approximately every five years to ensure they reflect current research and clinical practices(Gorski, 2017). The most recent edition of the Infusion Therapy Standards of Practice served as the foundational reference for the authors' exploration of best practices in the management of intravenous access lines. Additionally, the Centers for Disease Control and Prevention (CDC) has issued detailed recommendations for safe and effective IV line management, which were also referenced during the development of best practices. In 2012, the Joint Commission on Accreditation of Healthcare Organizations released a monograph titled Preventing Central Line-Associated Bloodstream Infections: A Global Challenge, A Global Perspective, which provided a valuable perspective on addressing central line-associated bloodstream infections (CLABSIs). Further, the authors conducted extensive literature searches in established databases, including the Cochrane Library, UpToDate, CINAHL, PubMed, and Medline, using keywords related to IV safety, complications, procedures, and maintenance. This comprehensive approach was essential to identify up-to-date research and guidelines on minimizing complications associated with both peripheral and central venous lines.

Definitions

- **CLABSI:** Central line–associated bloodstream infection refers to a primary bloodstream infection in a patient who had a central catheter in place during the 48 hours preceding the onset of the infection, provided the infection is not attributed to another source.
- **PIV:** Peripheral intravenous catheter is a short catheter inserted into a vein in the peripheral circulation to deliver medications, fluids, or other solutions directly into the bloodstream.
- **CVC:** Central venous catheter is an IV device that terminates in the central circulation, typically within the superior vena cava. Various types of CVCs exist, including surgically implanted, tunneled, nontunneled, and peripherally inserted central catheters (PICC).
- **PICC:** Peripherally inserted central catheter is a long, flexible catheter inserted into peripheral veins, such as the basilic, cephalic, median cubital, or brachial veins, and terminating in the superior vena cava or its junction with the right atrium. PICCs are a type of central venous access and are placed under sterile conditions using maximal barrier precautions.

- **Nontunneled CVC:** This type of CVC is inserted into large veins, such as the subclavian, internal jugular, or femoral veins, and terminates in the central circulation, often in the superior vena cava, its junction with the right atrium, or the right atrium itself. These catheters are inserted using strict aseptic techniques and maximal barrier precautions.

Background

While intravenous lines are indispensable in modern healthcare, they are not without significant risks, including infection and mechanical complications. Studies have shown that failure rates for PIVs in hospitalized patients can reach as high as 53%, with complications such as infiltration, extravasation, occlusion, dislodgement, and phlebitis affecting up to 69% of patients. Furthermore, infection rates for PIVs at the time of removal have been reported to range from 5% to 25% (Marsh et al., 2018; Steere et al., 2020; Zingg & Pittet, 2009). These complications often result in extended hospital stays, increased healthcare costs, and elevated mortality risks, highlighting the critical need for vigilance in IV line management (Morrell, 2020).

Although all types of vascular access devices carry a risk of localized infections or catheter-related bloodstream infections (CRBSIs), central venous catheters pose a particularly high risk due to their placement in large, centrally located vessels. Central line-associated bloodstream infections (CLABSIs) are particularly concerning, as a single infection can extend a patient's hospital stay by 7 to 20 days and incur additional costs averaging $46,000 per incident. The Agency for Healthcare Research and Quality (AHRQ) reports that annually, CLABSIs result in 84,551 to 203,916 preventable infections, 10,426 to 25,145 preventable deaths, and an estimated $1.7 to $21.4 billion in avoidable healthcare expenditures in the United States (Haddadin et al., 2024).

Given these figures, healthcare providers, particularly nurses, have an ethical and professional obligation to adhere to evidence-based practices to reduce the risks associated with IV lines. By staying informed about the latest research and ensuring that evidence-based standards are implemented in their facilities, nurses can significantly mitigate the complications and infection risks linked to intravenous therapy. Adopting rigorous infection control measures, engaging in ongoing education, and fostering a culture of safety within healthcare settings are pivotal steps toward improving patient outcomes and reducing the burden on healthcare systems.

Peripheral Intravenous Catheters

Site Selection and Insertion

When the placement of a peripheral intravenous (PIV) catheter is indicated, it is essential for the nurse to evaluate the patient's venous anatomy, medical history, and the clinical purpose for the catheter. The selection of an appropriate catheter gauge is influenced by the type of fluids or medications to be infused and the patient's overall condition. Various considerations and guidelines inform the decision on where to place the PIV. According to the Infusion Nurses Society (INS), healthcare providers should prioritize using a venous site that is most likely to sustain the prescribed therapy's entire duration. The INS particularly recommends placing PIVs in the forearm, as these sites generally offer greater stability, longer dwell times, and less interference with the patient's daily activities. The organization also suggests considering veins on the dorsal and ventral surfaces of the upper extremities, including the metacarpal, cephalic, basilic, and median veins, while discouraging the use of veins in the lower extremities for adults.

Guidelines from the Centers for Disease Control and Prevention (CDC) advise the use of veins in the upper extremities, and additional studies support initiating placement in distal veins and progressing proximally. Both the INS and UpToDate recommend avoiding areas of flexion, such as joints, to reduce the risk of movement, occlusion, and dislodgement of the catheter. Proper evaluation of the patient's vascular system is essential and can be enhanced using anatomical landmarks to identify the most suitable vein. During this assessment, the clinician should consider the patient's overall health, age, skin integrity, body habitus, fluid balance, and any history of intravenous drug use. Additionally, previous puncture sites, scar tissue, and tattoos should be avoided to minimize complications.

Once the optimal site has been identified, it is recommended that a single nurse attempt no more than two insertions and that the total number of attempts not exceed four. Repeated attempts can cause patient discomfort, delay treatment, and increase healthcare costs.

Skin Asepsis

PIV insertion practices often vary even among nurses working in the same unit. Nevertheless, adherence to evidence-based standards is critical to minimize infection risk and ensure consistent, high-quality care. Like the placement of Foley catheters, PIV insertion demands rigorous aseptic technique. Nurses must perform proper hand hygiene with soap and water or an alcohol-based hand rub and don clean gloves before beginning the procedure. Trimming excessive hair near the insertion site is advised to reduce the potential for accidental skin cuts that could serve as sources of infection.

For skin preparation, the CDC recommends cleaning the site with a solution of 70% alcohol, tincture of iodine, iodophor, or chlorhexidine gluconate. However, the INS emphasizes using a solution containing more than 5% chlorhexidine in alcohol as the preferred antiseptic. After cleaning, the insertion site should not be palpated to maintain its sterility.

Traditional circular cleaning motions have been widely practiced for skin asepsis, but evidence supporting their effectiveness is limited. In contrast, the INS now advocates for a back-and-forth scrubbing technique, which has been shown to disinfect up to the first five dermal layers of skin more effectively. One comparative study found that using a back-and-forth motion with chlorhexidine resulted in a statistically significant reduction in contamination rates compared to the circular motion using tincture of iodine, decreasing contamination rates from 3.5% to 2.2% (Stonecypher, 2009; Tepus et al., 2008). Additional research comparing these techniques with modern antiseptic solutions, such as chlorhexidine in alcohol, would help refine evidence-based standards for PIV insertion and infection prevention.

Dressings and Stabilization

Proper dressing and stabilization of PIV catheters are essential to maintaining catheter integrity, reducing complications, and preventing infection. Effective application and maintenance of dressings can extend the catheter's functional lifespan, minimize dislodgement risk, and prevent bacterial contamination at the insertion site (Corley et al., 2019). The use of nonsterile tape is not recommended for securing PIVs. Instead, engineered stabilization devices (ESDs) are advised to enhance catheter stabilization alongside the dressing.

Catheter stabilization plays a crucial role in preventing vessel irritation, catheter dislodgement, and kinking. Current recommendations include using one of two approaches: a peripheral catheter hub with a bordered polyurethane securement dressing or a standard round hub catheter paired with an adhesive ESD. Rolled bandages should not be used for securing PIVs as they can obstruct circulation and hinder visualization of the insertion site.

If the dressing becomes loose, wet, or visibly soiled, it should be promptly replaced to maintain sterility and integrity. Furthermore, dressings should be dated according to organizational policies to ensure proper monitoring and timely changes (4). Ensuring that securement and dressing techniques align with evidence-based standards is crucial for reducing the risk of infection and optimizing patient outcomes.

Assessment

The nursing assessment of peripheral intravenous (PIV) catheter dressings and securement plays a critical role in ensuring patient safety. Guidelines established by the Infusion Nurses Society (INS) recommend that PIV catheters be assessed at least every four hours, with more frequent evaluations depending on patient conditions and specific hospital protocols. Such assessments should include a thorough visual inspection and palpation of the insertion site to check for redness, swelling, tenderness, or any signs of drainage. For catheters not used for continuous fluid infusion, their functionality must be verified prior to each use by aspirating and flushing the catheter. In addition, the Centers for Disease Control and Prevention emphasizes the importance of patient education, urging nurses to instruct patients on recognizing symptoms of infection, infiltration, or catheter dislodgement.

Dwell Time and Removal

The CDC advocates that PIV catheters should not be routinely replaced more frequently than every 72 to 96 hours. Studies reinforce the principle that replacement should only occur if clinically indicated rather than routinely. The INS guidelines further recommend that catheters should be removed as soon as they are no longer essential to the patient's care plan or when their removal is warranted by clinical signs, such as malfunction or complications.

Site Selection

According to evidence-based guidelines, the recommended sites for PIV catheter placement include the forearm and the dorsal or ventral surfaces of the upper extremities. Specific sites, such as the ventral surface of the wrist and areas with significant flexion, should be avoided to minimize complications. The CDC advises initiating catheter placement in distal veins of the upper extremities, favoring options such as the dorsal metacarpal, cephalic, or median antebrachial veins in the forearm. INS guidelines also echo the recommendation to prioritize upper extremity veins, emphasizing the avoidance of areas prone to movement or irritation.

Skin Preparation

For optimal skin preparation, the INS suggests using a solution containing at least 0.5% chlorhexidine combined with alcohol, ensuring the area is allowed to dry completely before catheter insertion. Similarly, the CDC recommends the use of 70% alcohol, tincture of iodine, or chlorhexidine gluconate in alcohol solution to sterilize the site. Consistent with these recommendations, UpToDate highlights the importance of utilizing chlorhexidine-based preparations with alcohol to minimize infection risks.

Dressing and Securement

The INS underscores the importance of using engineered stabilization devices or medical adhesive securement systems to maintain catheter stability. Transparent occlusive dressings are frequently recommended for site coverage. Similarly, the CDC and UpToDate endorse the use of sterile gauze or transparent, semipermeable dressings, emphasizing that these should be replaced if they become damp, loose, or visibly soiled. Dressing changes should be performed based on condition rather than on a rigid schedule, with some guidelines specifying changes every 5–7 days unless indicated by clinical circumstances.

Removal and Replacement

Guidelines from all sources emphasize the clinical judgment required for catheter removal and replacement. The INS specifies that catheters should be removed or replaced only when clinically indicated, such as in cases of malfunction or complications. Although the CDC identifies catheter replacement every 72–96 hours as a potential standard, it notes this as an unresolved issue and prioritizes clinical indications over routine replacements. UpToDate aligns with this perspective, emphasizing that catheter removal or replacement should depend on patient-specific clinical needs rather than adherence to fixed timelines.

Peripheral Intravascular Bundles to Reduce Infection

The Centers for Disease Control and Prevention advocates for the use of bundled strategies to optimize compliance with best practices for peripheral intravenous (PIV) catheter insertion in healthcare settings. These bundle strategies are designed to standardize procedures and improve outcomes by minimizing the risk of infections associated with PIVs. A systematic review of hospitals across various countries revealed the successful implementation of these care bundles, highlighting some common features, although minor variations were noted across studies (Ray-Barruel et al., 2019). Common components of these bundles included the use of 2% chlorhexidine gluconate for skin preparation, stringent hand hygiene practices, strategic site selection for catheter placement, and the adoption of closed catheter systems alongside transparent film dressings.

Duncan et al. conducted a study in a nonprofit tertiary care trauma center located in a large metropolitan area of the Midwest. The facility, which accommodates over 9000 patient beds, implemented a bundle aimed at reducing bloodstream infections associated with PIVs. Over a seven-month period, the study audited 1977 PIVs and 378 central lines. The bundle components included a systematic assessment of PIV sites, with immediate removal of catheters showing signs of phlebitis. Care was taken to ensure that catheter dressings remained dry, intact, and occlusive, with replacements carried out for dressings that were nonocclusive or visibly contaminated with blood. Other elements of the bundle involved using alcohol-impregnated disinfecting caps on all needleless connectors and alcohol-impregnated tip protectors on disconnected intravenous tubing. Staff education also played a critical role in enhancing compliance and adherence to these best practices(Duncan et al., 2018).

The findings from this study were significant. There was an 81% reduction in bloodstream infections associated with peripheral lines compared to the preintervention period. This decline was reflected in the infection rate, which dropped from 0.57 to 0.11 infections per 1000 patient-days ($P < .001$). Additionally, the intervention led to a 6% increase in the proportion of PIVs without signs of pain, redness, or swelling, improving from 92% before the intervention to 98% afterward.

A second study by DeVries et al. focused on a community hospital with more than 625 beds in Northwest Indiana. The study did not specify the size of the population but provided detailed descriptions of the methods used to evaluate the impact of the bundle. The bundle included several critical components, such as skin preparation with chlorhexidine gluconate, the use of sterile gloves, and the integration of intravenous catheters with extension sets. Other measures included the utilization of chlorhexidine gluconate-impregnated sponge dressings, securement dressings, and alcohol disinfection caps to further reduce the risk of infections(DeVries et al., 2016).

The outcomes of this study demonstrated a 37% reduction in central and peripheral line infections, decreasing from 0.052 infections per 100 patient-days to 0.033 infections per 100 patient-days ($P = .03$). For PIVs specifically, the infection rate dropped by 19%, from 0.0150 infections per 100 patient-days to 0.0121 infections per 100 patient-days.

Central Venous Catheters (CVCs)

Site Selection and Insertion

The placement of central venous catheters (CVCs) often involves specialized teams trained in surgical asepsis to ensure proper technique and reduce complications (19). Strict adherence to maximum sterile barrier precautions is necessary during insertion and dressing changes. These precautions include using a full body drape, surgical mask, sterile gown, cap, and sterile gloves. Ultrasound guidance is frequently employed during insertion to minimize multiple attempts, reduce the risk of infection, and prevent complications (O'Grady et al., 2011). While nurses typically do not select insertion sites, they must understand the potential risks associated with these sites, such as infection, arterial puncture, vein laceration, thrombosis, and catheter misplacement. To further reduce infection risks, CVCs should be placed as far as possible from open wounds or burns. The CDC recommends the subclavian vein for nontunneled CVCs over the jugular and femoral veins, citing lower infection rates. The basilic vein is often chosen for peripherally inserted central catheters (PICCs) due to its size and superficial location (Gonzalez & Cassaro, 2023). A U.S. hospital survey revealed that 60% of facilities use specialized PICC teams for central catheter placement (Krein et al., 2019).

Skin Asepsis

Aseptic technique is critical before accessing a CVC, replacing lines, performing repairs, or redressing the insertion site. The skin should be prepared with an alcohol-based solution containing at least 0.5% chlorhexidine gluconate and allowed to dry prior to CVC insertion. In cases where chlorhexidine is

contraindicated, alternatives such as tincture of iodine, iodophor, or 70% alcohol may be used. Studies have demonstrated that daily cleansing of the body with a 2% chlorhexidine gluconate solution reduces the incidence of central line-associated bloodstream infections (CLABSIs) among hospitalized patients. Daily bathing with chlorhexidine gluconate–impregnated bath wipes is now a widely accepted standard of care for patients with CVCs (Dombecki et al., 2020).

Dressings and Stabilization

Proper stabilization of CVCs is essential to prevent catheter migration, dislodgement, and other complications such as infiltration, malfunction, and infection. The use of catheter securement devices is highly recommended. Sterile dressings must be applied to the CVC site and replaced according to the dressing type and condition. Transparent dressings should be changed every 5–7 days, while gauze dressings should be replaced every two days or sooner if they become soiled or loose. Chlorhexidine-impregnated dressings, or sponges placed at the insertion site, are recommended to further reduce infection risks. Dressings should always be replaced using sterile technique to ensure patient safety and adherence to infection control protocols.

Assessment

Daily assessment of CVC sites is integral to preventing CLABSIs. The insertion site should be monitored for cleanliness, dryness, and intactness, with careful observation for any signs of infection or catheter migration. Routine staff education and training on proper line maintenance and protocols are critical to ensuring compliance with infection prevention standards. Additionally, patient education is essential, empowering patients to recognize potential signs of infection or complications. CVCs should be promptly removed when they are no longer necessary for the patient's care plan.

Dwell Time and Removal

The dwell time for CVCs should be determined by ongoing clinical need and daily assessments for signs of infection or complications. Research has indicated that the risk of CVC-associated infections increases with the duration of catheter use, though no definitive guidelines exist for routine replacement intervals. Instead, removal should be guided by clinical indications and the exclusion of other potential infectious or noninfectious sources. As CVCs carry a higher infection risk than peripheral lines, frequent and careful assessments are necessary. Prompt removal is advised as soon as the catheter is no longer required for the patient's medical care.

Recommendations for Central Venous Catheters

The preferred site for nontunneled CVC placement is the subclavian vein, as recommended by the Infusion Nurses Society, CDC, and UpToDate. For PICCs, veins such as the basilic, cephalic, brachial, or median cubital are commonly utilized. Skin preparation should include a solution of greater than 0.5% chlorhexidine in alcohol, with alternatives like tincture of iodine or 70% alcohol reserved for cases of contraindication. Transparent dressings, particularly those impregnated with chlorhexidine, are advised for infection control, with replacements occurring every 5–7 days, or more frequently if the dressing becomes soiled or loose. Gauze dressings should be changed every two days. CVC stabilization should involve adhesive-engineered or sutureless securement devices. Daily assessment of the catheter's necessity and timely removal when no longer required are essential to minimize infection risks and enhance patient safety.

Future Directions

Although numerous studies have evaluated the effectiveness of antiseptic solutions such as chlorhexidine, alcohol, and betadine for central line placement, there is limited research addressing how these findings specifically apply to peripheral intravenous (PIV) catheter placement. Further investigation focusing on antisepsis in PIV placement is necessary to support and enhance evidence-based guidelines and standards for PIV management.

An example of such research is the CLEAN 3 Protocol Study, initiated in April 2019. This study aims to address the gap in knowledge surrounding antisepsis practices for PIVs. As outlined in its preliminary article, the CLEAN 3 Protocol Study is designed as an open-label, single-center, randomized trial employing a 2-by-2 factorial design(Guenezan et al., 2019). The study involves 1000 patients recruited from a hospital emergency department. It specifically evaluates the rates of antisepsis achieved using two different skin preparation solutions: 2% chlorhexidine-alcohol and 5% povidone iodine-alcohol.

Although the results of the study have not yet been published, the findings are expected to provide valuable evidence supporting infection control practices for PIV placement. This research has the potential to strengthen guidelines and contribute to the refinement of antiseptic protocols for PIV insertion, thereby enhancing patient safety and infection prevention practices(Guenezan et al., 2019).

Conclusion

The use of intravenous catheters, whether peripheral or central, is an indispensable component of modern healthcare. However, their widespread use also brings significant risks, including catheter-associated infections and complications. The implementation of evidence-based guidelines, such as those provided by the Centers for Disease Control and Prevention (CDC) and the Infusion Nurses Society (INS), is critical for mitigating these risks.

For peripheral intravenous (PIV) catheters, best practices emphasize appropriate site selection, meticulous skin preparation using chlorhexidine-alcohol solutions, and diligent maintenance of dressings and securement devices. Regular assessments and prompt removal when no longer clinically necessary further reduce infection risks. Similarly, central venous catheters (CVCs) require strict aseptic techniques during placement and maintenance, with daily evaluation of insertion sites and proactive removal when they are no longer needed.

Emerging research, such as the CLEAN 3 Protocol Study, aims to refine antiseptic protocols for PIV placement, contributing to a broader evidence base for infection prevention. As healthcare technology and practices evolve, ongoing studies and innovations will continue to inform the development of robust, evidence-based standards that prioritize patient safety.

Ultimately, a combination of rigorous training, adherence to established guidelines, and continuous research will ensure that venous access devices are used safely and effectively, enhancing outcomes across diverse care settings.

References

Corley, A., Ullman, A. J., Mihala, G., Ray-Barruel, G., Alexandrou, E., & Rickard, C. M. (2019). Peripheral intravenous catheter dressing and securement practice is associated with site complications and suboptimal dressing integrity: A secondary analysis of 40,637 catheters. *International Journal of Nursing Studies*, *100*, 103409. https://doi.org/10.1016/j.ijnurstu.2019.103409

DeVries, M., Valentine, M., & Mancos, P. (2016). Protected Clinical Indication of Peripheral Intravenous Lines: Successful Implementation. *Journal of the Association for Vascular Access*, *21*(2), 89–92. https://doi.org/10.1016/j.java.2016.03.001

Dombecki, C., Sweeney, J., White, J., Valyko, A., Stillwell, T., Mills, J., & Washer, L. (2020). CHG Skin Application in Non-ICU Patients with Central Venous Catheters: Impact on CLABSI, MRSA Bacteremia, and LabID Rates. *Infection Control & Hospital Epidemiology*, *41*(S1), s164–s165. https://doi.org/10.1017/ice.2020.690

Duncan, M., Warden, P., Bernatchez, S. F., & Morse, D. (2018). A Bundled Approach to Decrease the Rate of Primary Bloodstream Infections Related to Peripheral Intravenous Catheters. *Journal of the Association for Vascular Access*, *23*(1), 15–22. https://doi.org/10.1016/j.java.2017.07.004

Gonzalez, R., & Cassaro, S. (2023). Percutaneous Central Catheter. In *StatPearls [Internet]*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK459338/

Gorski, L. A. (2017). The 2016 Infusion Therapy Standards of Practice. *Home Healthcare Now*, *35*(1), 10–18. https://doi.org/10.1097/NHH.0000000000000481

Guenezan, J., Drugeon, B., O'Neill, R., Caillaud, D., Sénamaud, C., Pouzet, C., Seguin, S., Frasca, D., & Mimoz, O. (2019). Skin antisepsis with chlorhexidine–alcohol versus povidone iodine–alcohol, combined or not with use of a bundle of new devices, for prevention of short-term peripheral venous catheter-related infectious complications and catheter failure: An open-label, single-centre, randomised, four-parallel group, two-by-two factorial trial: CLEAN 3 protocol study. *BMJ Open*, *9*(4), e028549. https://doi.org/10.1136/bmjopen-2018-028549

Haddadin, Y., Annamaraju, P., & Regunath, H. (2024). Central Line–Associated Blood Stream Infections. In *StatPearls*. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK430891/

Helm, R. E., Klausner, J. D., Klemperer, J. D., Flint, L. M., & Huang, E. (2019). Accepted but Unacceptable: Peripheral IV Catheter Failure. *Journal of Infusion Nursing*, *42*(3), 151. https://doi.org/10.1097/NAN.0000000000000326

Krein, S. L., Kuhn, L., Ratz, D., & Chopra, V. (2019). Use of Designated Nurse PICC Teams and CLABSI Prevention Practices Among U.S. Hospitals: A Survey-Based Study. *Journal of Patient Safety*, *15*(4), 293. https://doi.org/10.1097/PTS.0000000000000246

Lim, S., Gangoli, G., Adams, E., Hyde, R., Broder, M. S., Chang, E., Reddy, S. R., Tarbox, M. H., Bentley, T., Ovington, L., & Danker, W. (2019). Increased Clinical and Economic Burden Associated With Peripheral Intravenous Catheter–Related Complications: Analysis of a US Hospital Discharge Database. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing*, *56*, 0046958019875562. https://doi.org/10.1177/0046958019875562

Marsh, N., Webster, J., Larsen, E., Cooke, M., Mihala, G., & Rickard, C. M. (2018). Observational Study of Peripheral Intravenous Catheter Outcomes in Adult Hospitalized Patients: A Multivariable Analysis of Peripheral Intravenous Catheter Failure. *Journal of Hospital Medicine*, *13*(2), 83–89. https://doi.org/10.12788/jhm.2867

Morrell, E. (2020). Reducing Risks and Improving Vascular Access Outcomes. *Journal of Infusion Nursing*, *43*(4), 222–228. https://doi.org/10.1097/NAN.0000000000000377

O'Grady, N. P., Alexander, M., Burns, L. A., Dellinger, E. P., Garland, J., Heard, S. O., Lipsett, P. A., Masur, H., Mermel, L. A., Pearson, M. L., Raad, I. I., Randolph, A. G., Rupp, M. E., Saint, S., & Healthcare Infection

Control Practices Advisory Committee (HICPAC) (Appendix 1). (2011). Summary of recommendations: Guidelines for the Prevention of Intravascular Catheter-related Infections. *Clinical Infectious Diseases: An Official Publication of the Infectious Diseases Society of America*, *52*(9), 1087–1099. https://doi.org/10.1093/cid/cir138

Patel, S. A., Alebich, M. M., & Feldman, L. S. (2017). Routine Replacement of Peripheral Intravenous Catheters. *Journal of Hospital Medicine*, *12*(1), 42–45. https://doi.org/10.1002/jhm.2676

Ray-Barruel, G., Xu, H., Marsh, N., Cooke, M., & Rickard, C. M. (2019). Effectiveness of insertion and maintenance bundles in preventing peripheral intravenous catheter-related complications and bloodstream infection in hospital patients: A systematic review. *Infection, Disease & Health*, *24*(3), 152–168. https://doi.org/10.1016/j.idh.2019.03.001

Steere, L., Ficara, C., Davis, M., & Moureau, N. (2020). Reaching One Peripheral Intravenous Catheter (PIVC) Per Patient Visit With Lean Multimodal Strategy: The PIV5Rights™ Bundle. *Journal of the Association for Vascular Access*, *24*(3), 31–43. https://doi.org/10.2309/j.java.2019.003.004

Stonecypher, K. (2009). Going around in circles: Is this the best practice for preparing the skin? *Critical Care Nursing Quarterly*, *32*(2), 94–98. https://doi.org/10.1097/CNQ.0b013e3181a27b86

Tepus, D., Fleming, E., Cox, S., Hazelett, S., & Kropp, D. (2008). Effectiveness of Chloraprep in reduction of blood culture contamination rates in emergency department. *Journal of Nursing Care Quality*, *23*(3), 272–276. https://doi.org/10.1097/01.NCQ.0000324593.84213.4f

Zingg, W., & Pittet, D. (2009). Peripheral venous catheters: An under-evaluated problem. *International Journal of Antimicrobial Agents*, *34*, S38–S42. https://doi.org/10.1016/S0924-8579(09)70565-5