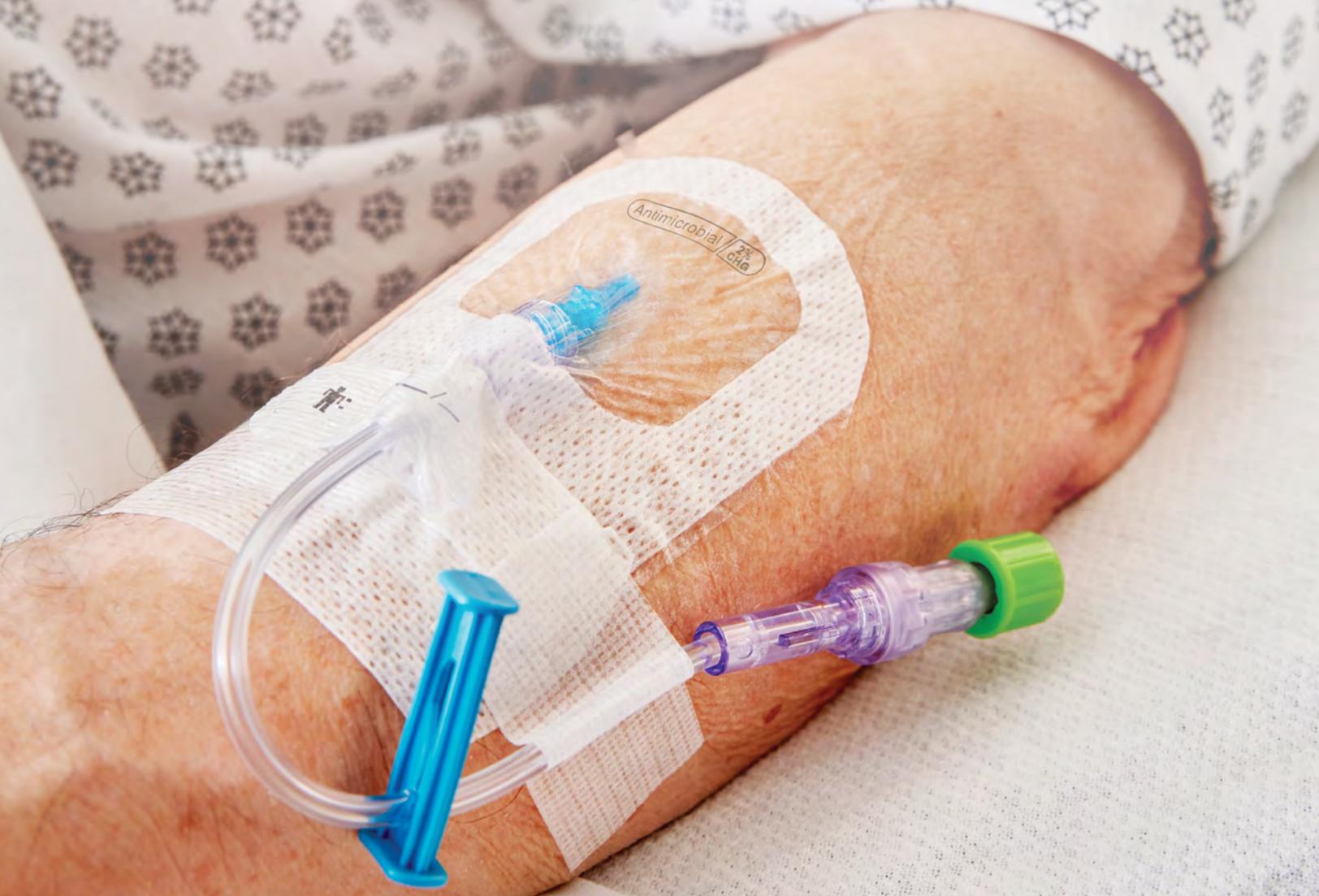




**Science.
Applied to Life.™**

An Evidence-Based Guide to PIVCs.

**Helping to enable better, smarter and safer
clinical practice and outcomes when using
peripheral intravenous catheters.**



Bringing more attention to peripheral intravenous catheters.

Peripheral intravenous catheters (often abbreviated as PIVCs, PIVs, PVAD or PVCs) are commonly used vascular access devices that deliver vital fluids and medications to patients across care settings. They're critical for patient care, but they can also come with risks. When placed improperly, misused or not cared for, PIVCs can affect health care costs significantly in terms of patient quality of life, morbidity, mortality and treatment expenses, particularly when coupled with increased length of hospital stay.^{1,2}

Even though the reported incidence of bloodstream infections (BSIs) is lower in PIVCs compared to central venous catheters (CVCs), PIVCs are much more commonly used. The number of PIVC-BSIs is high because of the high number of patients undergoing PIVC insertion.^{3,4}

Placement of a PIVC is one of the most common invasive medical procedures performed worldwide. It may also be one of the greatest sources of patient dissatisfaction, as well as patient and nurse anxiety.⁵

This guide and references are intended to be used as a resource for all members of the healthcare team involved in the assessment and management of PIVCs. It should be used in conjunction with good clinical practice. It is not intended for patient diagnosis or treatment.

PIVCs are not innocuous.

CVCs often get more attention, but the cumulative duration of PIVC insertion is 15 times greater.^{3,4}

Here are a few reasons to focus on PIVC maintenance:



Up to
90%
of inpatients have
PIVCs inserted⁶



A failure rate of
63%
with a mean and
median of 46% and
43%, respectively⁶



7-20
additional days in
the hospital due
to complications
and infections⁶



\$56K USD
additional cost per
patient for catheter-
related complications⁶



81%
of health systems rate
nurse PIVC competency
as 'novice'⁷

Common reasons why PIVCs fail.⁶

Knowing why PIVCs fail can help care teams identify future risks and areas where additional support is needed. Data shows that these three causes can lead to or contribute to PIVC failure.



Caregiver's skills during insertion, maintenance and care



Technology used, such as catheter material, dressing, securement device and add-ons



Intrinsic patient factors, such as comorbidities, body's response and activity

The 5 modes of PIVC failure.⁶

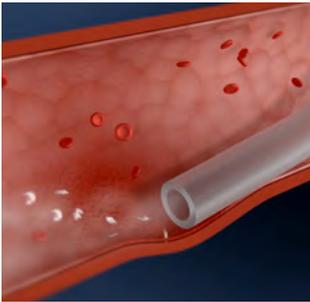
When PIVCs do fail, these are the most common complications patients face.

Complication	Range	Mean	Median
Catheter-related infection	0.0%-0.44%	0.2%	0.2%
Catheter-related phlebitis	0.1%-63.3%	15.4%	9.0%
Catheter mechanical failure	2.5%-32.7%	18.8%	22.8%
Catheter dislodgement	3.7%-9.9%	6.9%	7.0%
Catheter infiltration	15.7%-33.8%	23.9%	22.2%

Prospective Randomized Controlled Studies, 1990-2014.

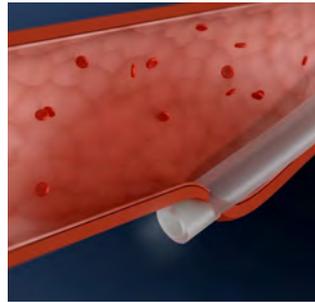


Signs and symptoms of PIVC complications.



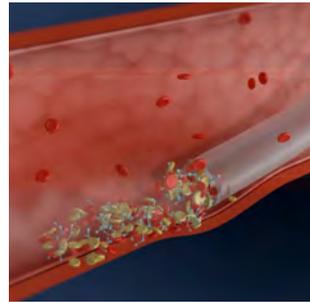
Phlebitis

- ▶ Inflammation of the vein from mechanical, chemical, or bacterial sources⁸
- ▶ May present with pain, erythema, edema, streak formation, palpable venous cord, or purulent drainage⁸



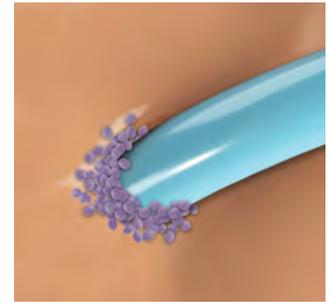
Infiltration and extravasation

- ▶ The accidental infusion of fluid into the tissue, differentiated by infiltration being the infusion of a non-vesicant and extravasation being a vesicant⁸
- ▶ May present with pain, leaking from the insertion site, vesicle formation, swelling, edema, changes in colour such as blanching or redness, changes in temperature such as cooling or warmth⁸



Thrombophlebitis

- ▶ Inflammation of the vein secondary to the formation of a blood clot
- ▶ Signs and symptoms may be similar to phlebitis; pain, erythema, edema, streak formation, palpable venous cord



Catheter-Associated Bloodstream Infection (CABSI)

- ▶ Bloodstream infection from any vascular access device including central vascular access device and peripheral intravenous catheters^{8,9}
- ▶ May present with changes in body temperature, rigors, insertion site abnormalities such as pain, swelling, discharge, altered mental status, hypotension, and abnormal blood laboratory results^{8,9}

Infiltration and extravasation prevention through infusate assessment.

An important step in preventing and managing infiltration and extravasation is the recognition of vesicant infusates.



Know your infusates and review the provided drug information and a known vesicant list. Consult the pharmacist for drug information.¹⁰



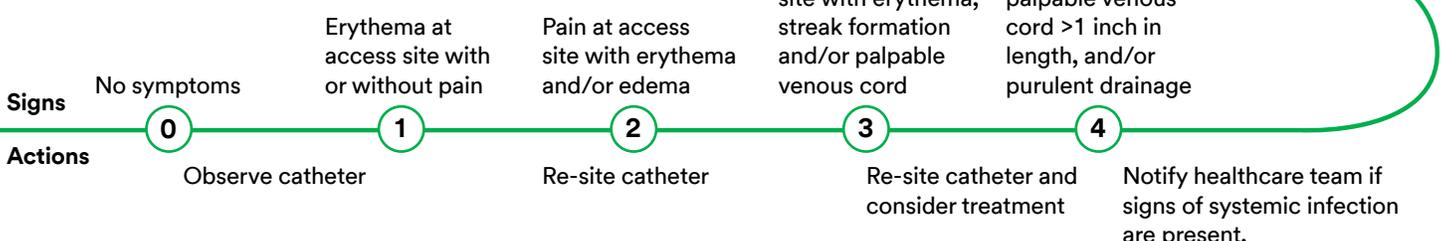
Address infiltration and extravasation prevention and management in policies and procedures.¹⁰



Develop an infiltration and extravasation checklist that outlines risk reduction strategies, including early recognition of signs and symptoms.¹⁰

Phlebitis scale⁸

Use the phlebitis scale to provide guidance on a visual rating system that can help you properly observe and treat phlebitis.



Refer to the full article for the complete summary.⁸

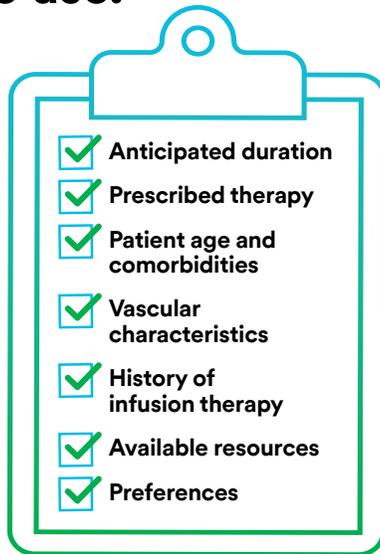
Following best practice guidance can help to reduce the risk of PIVC complications.



While not intended to provide medical advice or replace facility protocols, this guide pulls from over 30 articles of clinical evidence to give your team more evidence-based PIVC education and information.

Determining the right PIVC type and insertion method to use.

The PIVC type you select should factor in the following considerations:



Short peripheral intravenous catheter

For superficial peripheral veins, extremities, and scalp veins in neonates when the anticipated duration of therapy is less than five days.⁸



Long peripheral intravenous catheter

Inserted in either superficial or deep peripheral veins and offers an option when a short PIVC is not long enough to adequately cannulate the available vein.³²



Midline catheter

For use in peripheral veins in the upper forearm scalp veins for neonates.³²

Summary of PIVCs^{10-11,14}

Type	Catheter characteristics	Insertion Method	Use	Anticipated dwell	Description
PIVC	<ul style="list-style-type: none"> ▶ Short (1.2"-2.3"; 3-6 cm)^{11,14} ▶ Long (2.3"-6"; 6-15 cm)^{11,14} 	Direct visual approach of visual aid technology	<ul style="list-style-type: none"> ▶ Non-vesicant ▶ Non-irritant ▶ General purpose ▶ Not intended for high osmolarity and/or extreme pH (<5 or >9)^{12,13} 	<ul style="list-style-type: none"> ▶ Five days or less ▶ Removal when clinically indicated 	<ul style="list-style-type: none"> ▶ Very common ▶ Low cost and lower infection risk ▶ Placed by most health care professionals ▶ Less invasive than central access ▶ Consider using visual aid technology after multiple failed attempts, if there's an inability to identify veins or for difficult intravenous access (DIVA)
Midline catheter	<ul style="list-style-type: none"> ▶ Midline (2.7"-10"; 7.5-25 cm)¹⁴ 	Ultrasound-guided technology	<ul style="list-style-type: none"> ▶ Non-vesicant ▶ Non-irritant ▶ DIVA patients ▶ Not intended for high osmolarity and/or extreme pH (<5 or >9)^{12,13} 	<ul style="list-style-type: none"> ▶ Five to fourteen days ▶ Removal when clinically indicated 	<ul style="list-style-type: none"> ▶ Single-lumen midline is preferred ▶ For DIVA patients despite ultrasound-guided PIVC attempts

Consider a bundled approach to help reduce the risk of PIVC complications.⁸

You can't mitigate every risk factor. However, you can consider a bundled, best practice approach to PIVC care. Bundles are straightforward sets of evidence-based practices. When performed collectively and reliably, bundles have been shown to help improve patient outcomes.¹⁵

Given the success of bundles in helping to prevent BSIs in CVCs, bundles have also been promoted for PIVC use.^{12,16,17} With more than 2,500 cited references and 120 reviewers from 14 countries, the Infusion Nurses Society's *Infusion Therapy Standards of Practice* provide a solid foundation to help develop PIVC insertion, maintenance and removal bundles.



Insertion bundle.

All PIVC insertions should be done by a care team trained in these practices, and include documentation, care planning and patient education. (Std. 26, pg. S74)⁸

- 1 Use aseptic non touch technique** for all vascular access and infusion therapy procedures. Prepare the procedure tray and protect it from contamination. (Std. 18, pg. S56)⁸
- 2 Remove excess hair** around the site of insertion with single-use scissors or surgical clippers with a disposable head. (Std. 33, pg. S96)⁸
- 3 Perform skin antisepsis** using a single-use applicator containing antiseptic solution. (Std. 33, pg. S96)⁸
- 4 Select the appropriate catheter type and insertion site** for the prescribed therapy and patient. Avoid the wrist and areas of flexion. (Std. 27, pg. S81)⁸
- 5 Correctly apply** the appropriate securement dressing, securement device, short extension set and needleless connector. (Std. 38, pg. S109)⁸

Additional considerations:

- ▶ Do not touch PIVC or associated equipment. Do not repalpate the insertion site. If repalpation is required after skin antisepsis use sterile gloves and adhere to surgical aseptic non touch technique principles.
- ▶ Personal protection equipment (gloves, mask, etc) is recommended anytime you are manipulating PIVCs and related equipment.
- ▶ Dispose of sharp immediately after its removal into a biohazard container that cannot be tampered with or punctured.
- ▶ Flush the PIVC with sterile, preservative free, 0.9% sodium chloride to maintain patency.

Crucial hand hygiene moments.¹⁸

The World Health Organization (WHO) provides hand hygiene recommendations that should be incorporated into patient care. Below is an abbreviated list with full recommendations available on the WHO website.



- Before touching a patient
- Before clean/aseptic procedure
- After body fluid exposure risk
- After touching patient
- After touching patient surroundings



Maintenance bundle.

Comprehensive, routine assessment, combined with a commitment to safety and quality, is important for the early detection and management of complications. With a maintenance bundle based on the following steps and considerations, you can help reduce the risk of catheter-related infections. (Std. 42, pg. S119)⁸

Help empower patients by providing knowledge on treatments, tools, procedures, rationales and signs and symptoms of PIVC complications.

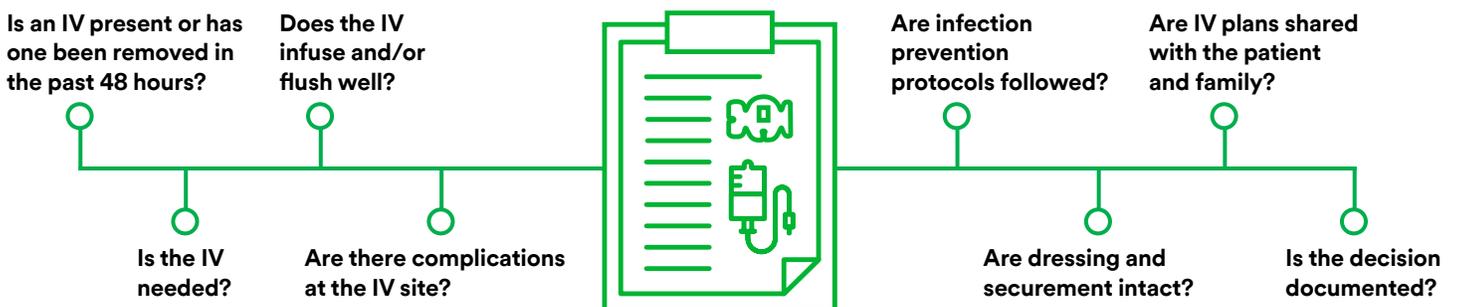
- 1 **Assess the insertion site**, entire infusion system, and patient at least every 4 hours. Assessment may be more frequent (every 1 to 2 hours) for those critically ill, sedated, or those with cognitive deficits. Assess hourly for pediatric and neonate patients. Assess more frequently for vesicant infusions. (Std. 42, pg. S119)^{8,19}
- 2 **Use non-sterile gloves** using standard aseptic non-touch technique. Use sterile gloves if key-sites (such as the insertion site) or key-parts must be touched. (Std. 18, pg. S56)⁸
- 3 **Prepare skin at each dressing change** with 2% chlorhexidine gluconate in 70% alcohol following the manufacturer's instructions for use. (Std. 33, pg. S96)⁸
- 4 **Change and correctly apply all components of the PIVC system;** securement dressing, extension set, needleless connector, etc. (Std. 36, pg. S105; Std. 37, pg. S107; Std. 38, pg. S110; Std. 42, pg. S119)⁸
- 5 **Disinfect needleless connector or open female luer** using an active or passive, standardized method, each time the PIVC is accessed. (Std. 36, pg. S105)⁸
- 6 **Re-site PIVCs when clinically indicated** and not routinely unless the device-specific manufacturer's instructions indicate otherwise. (Std. 45, pg. S133)⁸

Additional considerations:

- ▶ Implement a prospective surveillance process for complications. Assess regularly, based on patient population, therapy, risk factors and vascular access site. Implement checks to prevent unnecessary variation in practice.
- ▶ Do not touch the PIVC or associated equipment unless you are compliant with hand hygiene precautions.
- ▶ Personal protection (gloves and mask) is recommended when completing any interaction that requires touching or manipulation of the VAD or associated equipment. A single-use disposable gown or apron is recommended when contact with blood or body fluids is anticipated.⁸
- ▶ Adhere to aseptic non touch technique at all times.
- ▶ Dispose of sharp immediately after its removal into a biohazard container that cannot be tampered with or punctured.
- ▶ Avoid disconnecting or disrupting the infusion unless clinically required.
- ▶ Label administration set with the due date to change: Continuous infusions no more frequently than 96 hours but at least every 7 days. Intermittent and parenteral nutrition infusions every 24 hours. Blood products every 4 hours.
- ▶ Replace administration sets for separate Intravenous lipid infusions every 12 hours.³²

Assessment forms best practices.

Not all vascular access device assessment forms are as comprehensive as they could be. Abbreviated below, the I-DECIDED[®] clinical tool²⁰⁻²² includes evidence-based prompts with corresponding actions to incorporate into your PIVC practice. Full recommendations are available in the study.





Removal bundle.

Healthcare providers should be trained in PIVC removal processes, including identifying potential complications, appropriate clinical intervention or emergency measures as needed, and patient and caregiver education. (Std. 45, pg. S133)⁸

- 1 Replace PIVCs inserted under emergent conditions** as soon as possible and no later than 48 hours. (Std. 45, pg. S133)⁸
- 2 Remove PIVCs** as soon as no longer clinically indicated. (Std. 45, pg. S133)⁸
- 3 Phlebitis, infiltration, extravasation or signs of local or systemic infection** should prompt PIVC removal. (Std. 47, pg. S143; Std. 50, pg. S154)⁸

Additional considerations:

- ▶ Always consider your institutional policy for PIVC removal and consult with trained care teams and patients as required.

Impact of clinically indicated PIVC removal on health economics.

According to a *Journal of Infusion Nursing* evidence-based practice study on before and after implementation, clinically indicated PIVC removal led to no significant PIVC-related infections²³ along with the following outcomes:



70

hours of nursing time saved over the course of 3 months

Could save 2 million hours annually²³



14.2%

decrease in PIVC use

Could prevent 6 million PIVC insertions annually within the US²³



\$2,100

saved over the course of 3 months

Could save \$60 million USD annually²³

Guidelines and evidence about clinically indicated removal of PIVCs.

Research is evolving regarding clinically indicated removal¹ with some organizations and guidelines, including the Infusion Nurses Society (INS), Canadian Vascular Access Association (CVAA), Centers for Disease Control and Prevention (CDC), Royal College of Nursing and epic3, starting to recommend clinically indicated removal.^{8,24-26} Some studies have shown there is a significant increased risk of infections with removing PIVCs when clinically indicated so strategies to mitigate that risk of infection may be appropriate.^{27,28} Consult your organization and assess available resources before updating your practices regarding PIVC removal.

Organization	Recommendation
INS (2021) ⁸	Yes
CDC (2011) ²⁴	Pediatrics only
CVAA 2019 ³²	Yes
Royal College of Nursing (2016) ²⁵	Yes
epic3 (2014) ²⁶	Yes

Current PIVC clinical guidelines.

	Recommendation	INS 2021 ⁸	CVAA 2019 ³²	CDC 2011 ²⁴
Prepare and assess 	Choose upper extremity for insertion	Forearm preferred for long and short length PIVCs	Forearm preferred	✓
	Avoid areas of flexion	✓	✓	
	Designate personnel with IV therapy education, training and competency	Infusion vascular access specialists demonstrated lower PIVC complication rates	✓	✓
	Use smallest gauge indicated	✓	✓	
Insertion 	Prepare skin with antiseptic, allow site to dry	Use an alcohol-based CHG skin antiseptic	Select preferred formulation (at least 0.5% CHG) in 70% alcohol	✓
	Practice aseptic technique	Do not palpate insertion site after skin antiseptics	✓	Do not palpate insertion site after skin antiseptics
Secure and protect 	Consider securement device options for advanced catheter stabilization	✓	Use a securement dressing for lines dwelling more than 6 hours.	✓
	Use a sterile, transparent, semi-permeable polyurethane dressing	✓	✓	✓
	Change dressing at least every 7 days or sooner if compromised	✓	✓	✓
	Visually inspect insertion site at regular intervals	✓	✓	
	Gather/collect data about PIV complications and culture sites when suspected of PIV-infection	✓		
	Disinfect injection port/access site	✓	✓	✓
	Ensure disinfecting supplies are readily available at the bedside to facilitate compliance	✓	✓	
	Disinfect needleless connector and add-on devices with active or passive disinfection cap	✓	✓	
Remove 	Assess daily and remove if no longer included in the plan of care or not used	✓	✓	
	Remove PIV catheters when clinically indicated	✓	✓	CDC does not make a recommendation for adults but does support for pediatrics.
	Remove emergently placed catheters ASAP, within 24–48 hours	✓	✓	✓

Elevating PIVC care through education, tools and support.

Understanding and implementing these bundles can help you enable better, smarter and safer clinical practice and patient outcomes. As this guide explains, there are many ways you can help improve PIVC maintenance, including:



Being aware of the signs and symptoms of complications



Providing adequate training and education



Understanding interventions



Making documentation thorough and available to care teams



Assessing patients, insertion sites, skin condition, dressings, pain and devices often



Removing unnecessary catheters when treatment is complete and oral medications have been instituted¹⁰

A consistent approach is critical in helping to reduce complications, improve outcomes and enhance patient satisfaction. It can help you protect every IV line, every time. However, you don't have to do it alone.

We are here when you need help.

This guide is just a start. 3M is here to help you in your mission of achieving the best possible outcomes with:



Actionable resources



Evidence-based products



Training and education

To get more support or to find education for your team, connect with your 3M Account Manager or visit [3M.ca/VascularAccess](https://www.3m.ca/VascularAccess)

Definitions of related terms:

Catheter dislodgement

When a catheter moves into a suboptimal position out of or into the site of insertion. This may include partial dislodgement, where the tip remains within the vein but in a suboptimal location or total dislodgement, where the catheter is completely removed from the vein.⁸

Catheter failure

Unplanned removal of the vascular access device before the completion of intravenous therapy owing to any of the following complications: infiltration/extravasation, phlebitis, occlusion, partial or total dislodgement, and local/systemic bloodstream infection.^{6,8}

Clinically indicated peripheral intravenous catheter (PIVC) replacement

Replacement of a PIVC only if there are clinical indications to do so. Clinical indications include occlusion, pain, redness, infiltration, phlebitis, swelling, leakage, accidental removal, suspected infection, and when the therapy is completed, or the catheter is no longer necessary for the plan of care.^{8,29,30}

Irritant

An agent that can cause burning, discomfort, stinging or other pain. This can be caused by irritation in the internal lumen of the vein. There might not be visible signs of vein inflammation externally right away.⁸

Necrosis

Unprogrammed form of cell death that occurs in response to overwhelming chemical or physical tissue insult (e.g., chemical stress, extreme temperature, pressure, toxins, hypoxia, loss of blood supply, and osmotic shock).³¹

Non-peripherally compatible

Do not use short PIVC, long PIVC or midline catheters for repeated or prolonged (> 30 minutes) administration of solutions that are not peripherally compatible (i.e., irritants, vesicant, parental nutrition >850 mOsm/L).¹³

Non-vesicant

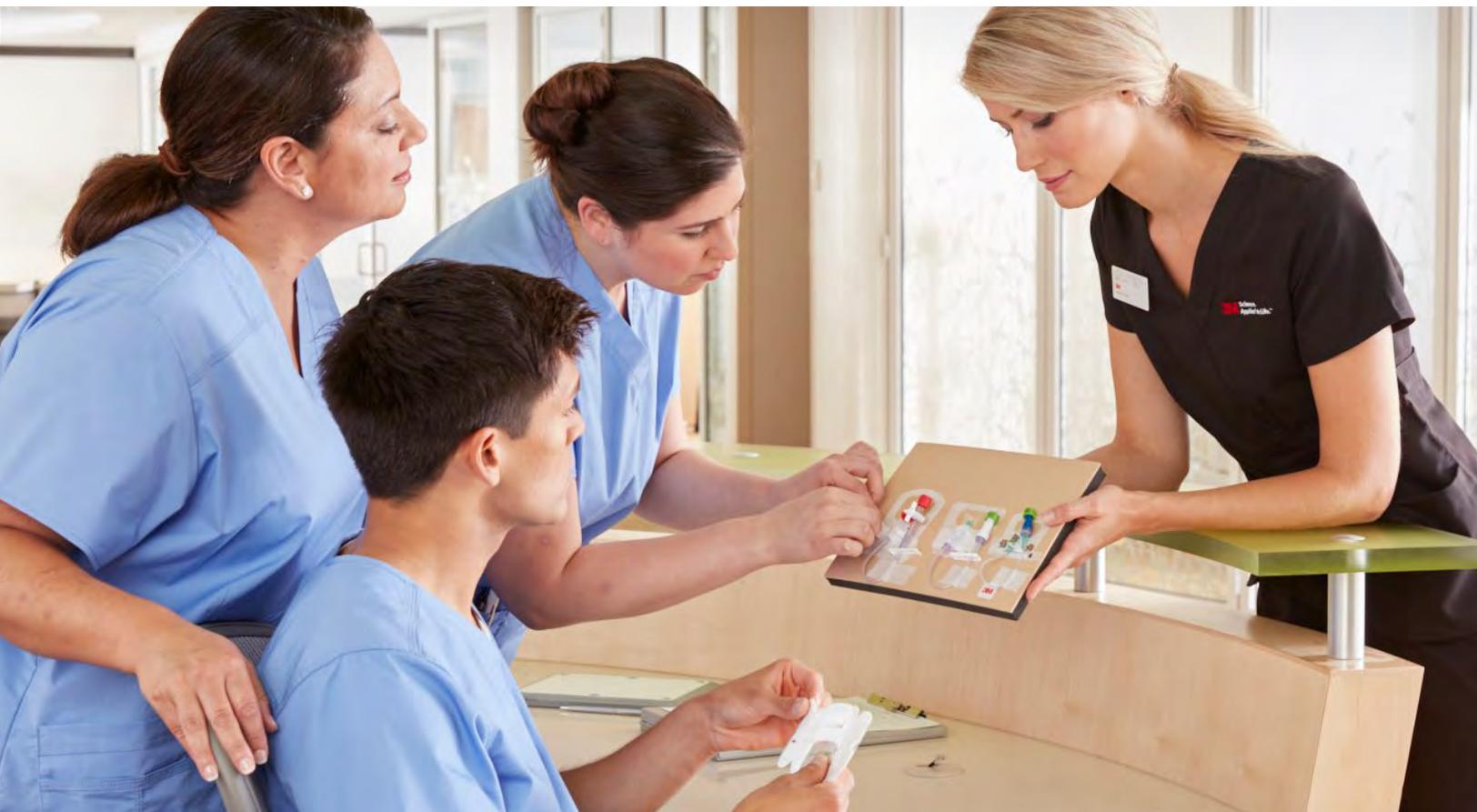
Solutions or medications that do not cause tissue damage if accidentally delivered into the tissue right under the skin; However, large amounts of non-vesicant can contribute to tissue damage through compartment syndrome. It wouldn't cause tissue destruction or result in blistering and necrotic tissue.⁸

Peripherally compatible solutions

Solutions with pH 5-9; Drugs or solutions with osmolarity <600 mOsm/L; Parental nutrition with osmolarity <800-850 mOsm/L; Any drug or solution not associated with potential endothelial damage.¹³

Vesicant

An agent that can cause tissue damage if it exists in the surrounding tissue, outside of the intended vascular pathway.⁸



References

1. Rickard CM, Webster J, Wallis MC, et al. Routine versus clinically indicated replacement of peripheral intravenous catheters: a randomized controlled equivalence trial. *Lancet*. 2012; 380(9847):1066-1074.
2. Ansel B, Boyce M, Embree J. Extending short peripheral catheter dwell time. *J Infus Nurs*. 2017;40(3):143-146
3. Sato A, Nakamura I, Fujita H, et al. Peripheral venous catheter-related bloodstream infection is associated with severe complications and potential death: a retrospective observational study. *BMC Infect Dis*. 2017;17(1):434.
4. Maki DG, Kluger DM, Crnich CJ. The risk of bloodstream infection in adults with different intravascular devices: a systematic review of 200 published prospective studies. *Mayo Clin Proc*. 2006;81(9):1159-1171.
5. Jones RK. Short peripheral catheter quality and economics. The intravenous quotient. *J Infus Nurs*. 2018;41(6):365-71.
6. Helm RE, Klausner JD, Klempner JD, et al. Accepted but unacceptable: peripheral IV catheter failure. *J Infus Nurs*. 2015;38(3):189-203.
7. Owens AK, Vandenhouten C. Addressing the silence: Standardized PIV education & training in pre-licensure nursing curriculum. Poster presented at: Association of Vascular Access Annual Meeting; Oct. 4-7, 2019.
8. Gorski LA, Hadaway L., Hagle ME, et al. Infusion Therapy Standards of Practice. *J Infus Nurs*. 2021;44(suppl 1): S1-S224.
9. Chopra V, Felix K, Jones K, et al. Central Line-Associated Bloodstream Infection (CLABSI): An Introduction. 2019. <https://www.cdc.gov/infectioncontrol/pdf/strive/CLABSI101-508.pdf>
10. Moureau NL, Chopra V. Indications for peripheral, midline and central catheters: summary of the MAGIC recommendations. *Br J Nurs*. 2016 Apr 28 - May 11;25(8):S15-S24.
11. Qin KR, Ensor N, Barnes R, et al. Long peripheral catheters for intravenous access in adults and children: A systematic review of the literature. *J Vasc Access*. 2021; 22(5):767-77.
12. Steere L, Ficara C, Davis M, et al. Reaching one peripheral intravenous catheter (PIVC) per patient visit with lean multimodal strategy: the PIV5Rights™ Bundle. *J Assoc Vasc Access*. 2019;24(3):31-43.
13. Pittiruti M, Van Boxtel T, Scoppettuolo G, et al. European recommendations on the proper indication and use of peripheral venous access devices (the ERPIUP consensus): A WoCoVA project. *The Journal of Vascular Access*. June 2021.
14. Chopra V, Flanders SA, Saint S, et al. The Michigan appropriateness guide for intravenous catheters (MAGIC): Results from a multispecialty panel using the RAND/UCLA appropriateness. *Ann Intern Med*. 2015; 163:S1-S39. [Epub 15 September 2015]. doi:10.7326/M15-0744.
15. Institute for Healthcare Improvement Evidence-Based Care Bundles. 2022. Accessed 05/01/2022. <http://www.ihc.org/Topics/Bundles/Pages/default.aspx#:~:text=A%20bundle%20is%20a%20structured,proven%20to%20improve%20patient%20outcomes>.
16. Duncan M, Warden P, Bernatchez SF, Morse D. A Bundled Approach to Decrease the Rate of Primary Bloodstream Infections Related to Peripheral Intravenous Catheters. *Journal of the Association for Vascular Access*. 2018;23(1):15-22.
17. Ray-Barruel G, Xu H, Marsh N, et al. Effectiveness of insertion and maintenance bundles in preventing peripheral intravenous catheter-related complications and bloodstream infection in hospital patients: A systematic review. *Infect Dis Health*. 2019;24(3):152-168.
18. World Health Organization. A guide to the implementation of the WHO multimodal hand hygiene improvement strategy. 2009.
19. Gorski LA, Hallock D, Kuehn SC, et al. INS Position Paper: Recommendations for frequency of assessment of the short peripheral catheter site. *J Infus Nurs*. 2015;35(5):290-92
20. Ray-Barruel G, Cooke M, Mitchell M, et al. Implementing the I-DECIDED® clinical decision-making tool for peripheral intravenous catheter assessment and safe removal: protocol for an interrupted time-series study. *BMJ Open*. 2018 Jun 4;8(6):e021290.
21. Ray-Barruel G, Cooke M, Chopra V, et al. The I-DECIDED® clinical decision-making tool for peripheral intravenous catheter assessment and safe removal: a clinimetric evaluation. *BMJ Open*. 2020;10(1):e035239.
22. Ray-Barruel G. I-DECIDED® a decision tool for assessment and management of invasive devices in the hospital setting. *Br J Nurs*. 2022;31(8):S37-s43.
23. Stevens C, Milner KA, Trudeau J. (2018). Routine Versus Clinically Indicated Short Peripheral Catheter Replacement: An Evidence-based Practice Project. *J Infus Nurs*. 2018;41(3):198-204.
24. O'Grady NP, Alexander M, Burns LA, et al. Guidelines for the prevention of intravascular catheter-related infections. *Clin Infect Dis*. 2011;52(9):e162-e193. doi:10.1093/cid/cir257
25. Denton A, et al. Royal College of Nursing: *Standards for Infusion Therapy*, 2016. 4th ed., London: RCN.
26. Loveday HP, Wilson JA, et al. epic3: National evidence-based guidelines for preventing healthcare-associated infections in NHS hospital in England. *J Hosp Infect*. 2014; 86S1:S1-S70.
27. Buetti N, Abbas M, Pittet D, et al. Comparison of routine replacement with clinically indicated replacement of peripheral intravenous catheters. *JAMA Intern Med*. 2021;181(11):1471-1478.
28. Mermel L. Short-term Peripheral Venous Catheter-Related Bloodstream Infections: A Systematic Review. *Clin Infect Dis*. 2017;65(10):1757-1762.
29. Webster J, Osborne S, Rickard CM, Marsh N. Clinically indicated replacement versus routine replacement of peripheral venous catheters. *Cochrane Database of Systematic Reviews* 2019, Issue 1. Ar. No: CD007798.
30. Tuffaha HW, Rickard CM, Webster J, et al. Cost-effectiveness analysis of clinically indicated versus routine replacement of peripheral intravenous catheters. *Applied Health Economics and Health Policy* 2014;12(1):55-58.
31. Westman J, Gristein S, Marque PE. Phagocytosis of necrotic debris at sites of injury and inflammation. *Front Immunol*. 2020;10:3030.
32. Canadian Vascular Access Association. (2019). Canadian Vascular Access and Infusion Therapy Guidelines. Pembroke, ON: Pappin Communications.



Available in Canada from

3M Canada Company
Medical Solutions Division
300 Tartan Drive
London, ON N5V 4M9
Canada

1-800-364-3577
3M.ca

© 2023 3M. All rights reserved. 3M and the other marks shown are marks and/or registered marks. Unauthorized use is prohibited. Used under license in Canada. 2304-26118 E