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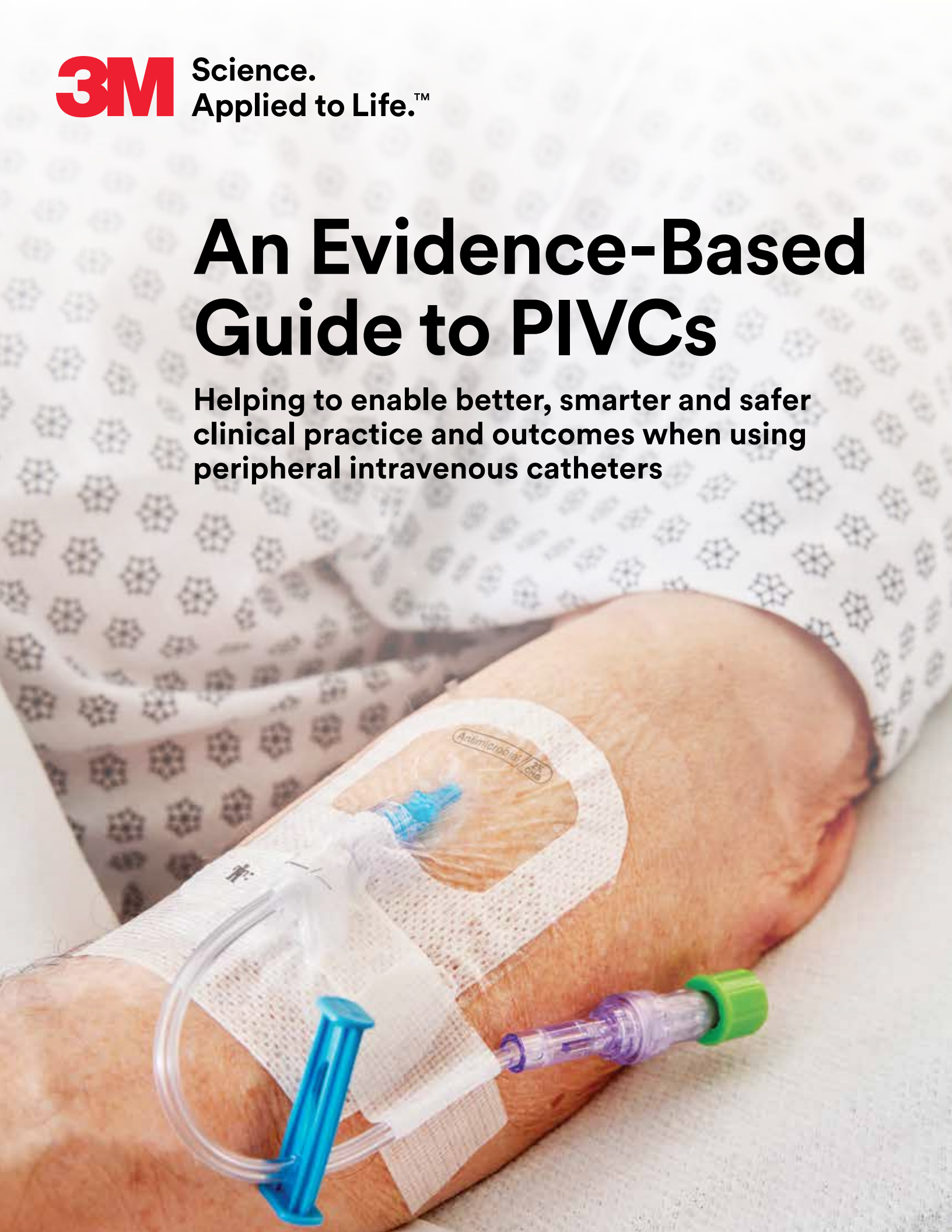
An Evidence-Based Guide to PIVCs

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 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]

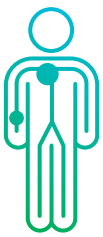
Placement of a PIVC is one of the most common invasive medical procedures performed worldwide. It may also be one of the greatest sources of patient dissatisfaction, as well as patient and nurse anxiety.[5]

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

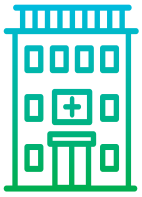
CVCs often get more attention, but the cumulative duration of PIVC insertion is 15 times greater.[3,4]

Here are a few reasons to focus on PIVC maintenance:



Up to **90%** of inpatients have PIVCs inserted[6]

A failure rate of **63%** with a mean and median of 46% and 43%, respectively[6]



7-20 additional days in the hospital due to complications and infections[6]

$56K additional cost per patient for catheter-related complications[6]

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

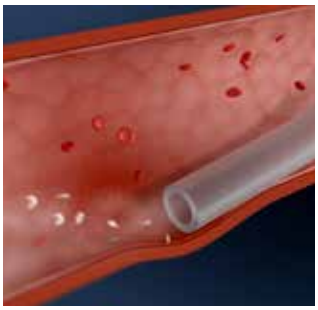
The 5 modes of PIVC failure[6]

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%

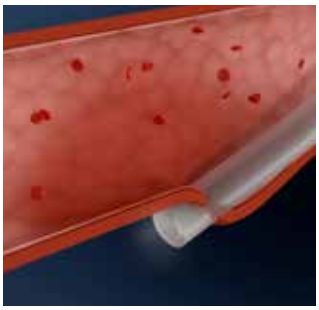
Prospective Randomized Controlled Studies,1990-2014

Signs and symptoms of PIVC complications[8-13]



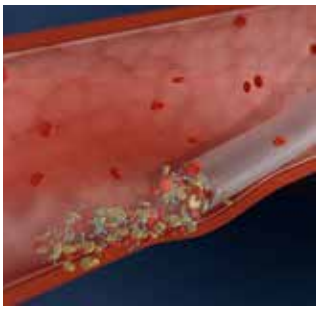
Phlebitis

- Inflammation of the vein wall that can be accompanied by edema, pain and erythema near the catheter insertion site or along the affected vein, sometimes progressing to a palpable venous cord, intense redness, tenderness and fever[14]



Infiltration and extravasation

- Pain, stinging or burning sensations, edema, blanching, blistering and discoloration of the skin
- Excessive fluid in one or more compartments of the arm, damage to nerves, arteries and muscles
- Tight, cool skin with swelling around the insertion site



PIVC-related venous thrombosis

- Pain, edema, venous engorgement and/or difficulty moving the affected extremity or shoulder, neck or chest
- Decreased blood oxygen levels, shortness of breath, racing heartbeat, pressure on the heart, low blood pressure and chest pain

Catheter-associated bloodstream infection (CABSI)

- Erythema, edema, pain, tenderness, induration and/or site drainage (may be purulent)
- Skin breakdown
- Body temperature elevation

Infiltration and extravasation prevention through infusate assessment

The first step in preventing infiltration and extravasation is the recognition of vesicant infusates.

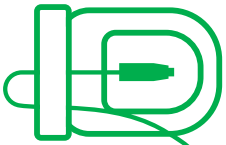
Create an evidence-based list of vesicant infusates, cytotoxic and noncytotoxic vesicant medications/solutions.[15]

Address infiltration and extravasation prevention and management in policies and procedures.[15]

Develop an extravasation checklist that outlines risk reduction strategies, including early recognition of signs and symptoms.[15]

Visual infusion phlebitis assessment tool[12]

Below is a consolidation of two published studies[16,17] that provide guidance on a visual rating system that can help you properly observe and treat phlebitis. View each study for complete information.



	0	1	2	3	4	5
Signs		Slight pain or redness at IV site	If two are evident: Pain, erythema, swelling	All signs are evident: Pain along cannula path, erythema, induration	All previous symptoms plus palpable venous cord	All previous symptoms plus pyrexia
Actions	Observe cannula		Re-site cannula	Re-site cannula and consider treatment		Initiate treatment and re-site cannula

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[8]

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

- Anticipated duration
- Prescribed therapy
- Patient age and comorbidities
- Vascular characteristics
- History of infusion therapy
- Available resources
- Preferences

Short peripheral intravenous catheter

For superficial peripheral veins, extremities, external jugular veins and scalp veins in neonates[8]

Long peripheral intravenous catheter

For use when a short PIVC isn't long enough to be inserted into the patient's superficial or deep peripheral veins[8]

Midline catheter

For use in the upper arm's peripheral veins or the scalp vein for neonates[8]

Summary of PIVCs[15,18-21]

Insertion method	Catheter type	Use	Dwell time	Description
PIVC inserted using direct visual approach	▸ Short (1.2"-2.3"; 3-6 cm)[18] ▸ Long (2.3"-6"; 6-15 cm)[18]	▸ Non-vesicant ▸ Non-irritant ▸ General purpose ▸ Not intended for high osmolarity and/or extreme pH (<5 or >9)[19,20]	▸ Peripherally compatible solutions for five days or less ▸ Removal when clinically indicated	▸ Very common ▸ Low cost and lower infection risk ▸ Placed by most health care professionals ▸ Less invasive than central access
PIVC inserted using ultrasound-guided or infrared technology	▸ Long (2.3"-6"; 6-15 cm)[18] ▸ Midline (2.7"-10"; 7.5-25 cm)[21]	▸ Contrast-based radiological studies requiring upper extremity access ▸ Not intended for high osmolarity and/or extreme pH (<5 or >9)[19,20]	▸ Less than 5 days for long PIVCs, more than 5 days and less than 14 days for midline catheters	▸ Use after multiple failed attempts ▸ Incorporate if there's an inability to identify veins ▸ For difficult intravenous access (DIVA)
Midline catheter inserted using ultrasound-guided technology	▸ Midline (2.7"-10"; 7.5-25 cm)[21]	▸ Non-vesicant ▸ Non-irritant ▸ DIVA patients ▸ Not intended for high osmolarity and/or extreme pH (<5 or >9)[19,20]	▸ Equal or less than 14 days ▸ Removal when clinically indicated	▸ 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.[22]

Given the success of bundles in helping to prevent BSIs in CVCs, bundles have also been promoted for PIVC use.[19,23,24] 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 a specific and comprehensive aseptic technique** when manipulating catheter hubs, connectors, stopcocks and associated equipment. Prepare the procedure tray and protect it from touch 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 sterile applicator containing 2% chlorhexidine gluconate in 70% isopropyl alcohol, following the manufacturer's instructions for use. *(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 and do not re-palpate the insertion site after skin antisepsis unless you are wearing sterile gloves and are compliant with hand hygiene precautions. *Please reference Crucial Hand Hygiene Moments below.*
- Personal protection (gloves, mask and apron) is required anytime you are touching or 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 sodium chloride 0.9% for intravenous use.

Crucial hand hygiene moments[25]

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** and surrounding skin daily. Check for dressing integrity, signs of local inflammation or skin injury. Some patient populations could require hourly assessments for continuous infusions. *(Std. 42, pg. S119)*[8,26]
2. **Use non-sterile gloves** for catheter maintenance and dressing change. *(Std. 34, pg. S97)*[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 the appropriate securement dressing,** adhesive securement device, short extension set and needleless connector. *(Std. 36, pg. S105; Std. 37, pg. S107; Std. 38, pg. S110; Std. 42, pg. S119)*[8]
5. **Open female Luer,** needleless connector and vascular access entry point. Disinfect in an active or passive, standardized manner each time the PIVC is accessed. Maintain high compliance and consistency. *(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, mask, and apron) is required when completing any interaction that requires touching or manipulation of the VAD or associated equipment.
- Prepare the procedure tray and protect it from touch contamination.
- 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: 72 hours for fluid sets, 24 hours for TPN, and 12 hours for blood.

Assessment form best practices

Not all vascular access device assessment forms are as comprehensive as they should be. Abbreviated below, the I-DECIDED® clinical tool[27-29] 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 infections[30] along with the following outcomes:

70
hours of nursing time saved over the course of 3 months

Could save 2 million hours annually[30]

14.2%
decrease in PIVC use

Could prevent 6 million PIVC insertions annually[30]

$2,100
saved over the course of 3 months

Could save $60 million annually[30]

Guidelines and evidence about clinically indicated removal of PIVCs

Research is evolving regarding clinically indicated removal[1] with some organizations and guidelines, including the Infusion Nurses Society (INS), Centers for Disease Control and Prevention (CDC), Royal College of Nursing and epic3, starting to recommend clinically indicated removal.[8,31-33] However, some studies have shown limited benefit, and therefore, more research is needed.[34,35] Consult your organization and assess available resources before updating your practices regarding PIVC removal.

Organization	Recommendation
INS (2021)[8]	Yes
CDC (2017)[31]	Pediatrics only
Royal College of Nursing (2016)[32]	Yes
epic3 (2014)[33]	Yes

Current PIVC clinical guidelines

	Recommendation	INS 2021[8]	CDC 2011/2017[31]
Prepare and assess 	Choose upper extremity for insertion	Forearm preferred for long and short length PIVCs	●
	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	●
	Practice aseptic technique	Do not palpate insertion site after skin antisepsis	Do not palpate insertion site after skin antisepsis
Secure and protect 	Consider securement device options for advanced catheter stabilization	●	●
	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	●	
	Evaluate adverse events regularly	●	
	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	●	
	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

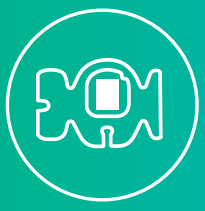
Removing unnecessary catheters when treatment is complete and oral medications have been instituted[10]

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.com/PIVCare

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.[8,36,37]

Irritant
An agent that can cause burning, discomfort, stinging or other pain. This can be caused by irrigation 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).[38]

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).[20]

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.[20]

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

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