Review

JVA The Journal of Vascular Access

# A GAVeCeLT-IVAS bundle for Safe Insertion of Long Peripheral Catheters: The SILPeC protocol

The Journal of Vascular Access
1–8

DOI: 10.1177/11297298261444199
journals.sagepub.com/home/jva
Mary Ann Liebert
A Part of Sage

**Davide Giustivi[1], Giancarlo Scoppettuolo[2], Vincenzo Faraone[3], Maria Giuseppina Annetta[2], Renata Bastos[4], Fabrizio Brescia[5], Gloria Ortiz Miluy[6], Fulvio Pinelli[7], Antonio Gidaro[8], Stefano Elli[9], Adam Fabiani[10], Timothy R. Spencer[11] and Mauro Pittiruti[2]**

## Abstract

In an increasingly complex clinical setting, long peripheral catheters (LPC) are rapidly gaining popularity and represent an effective option for the administration of medications and fluids, especially for patients with difficult venous access. However, inconsistencies in the literature, particularly regarding terminology and insertion techniques, have contributed to significant variability in clinical outcomes. To standardize and promote a safer and more effective insertion of these catheters, the Italian Group of Long-Term Venous Access Devices (GAVeCeLT) and the Italian Vascular Access Society (IVAS) have developed a six-step protocol that provides evidence-based recommendations. This insertion bundle—named SILPeC (Safe Insertion of Long Peripheral Catheters—includes (1) pre-insertion assessment of the vein of the upper limbs, (2) insertion of the optimal site selection, (3) appropriate measures of asepsis, (4) ultrasound-guided puncture, (5) safe connection to infusion lines, and (6) proper device stabilization and appropriate protection of the exit site. Integrating the latest scientific evidence and clinical expertise, the SILPeC bundle provides a standardized and reproducible method for placement and maintenance of LPCs. This project complements the existing GAVeCeLT recommendations for other vascular access devices, contributing to safer and more consistent vascular access practices in both hospital and outpatient settings.

## Keywords

Catheters, vascular access devices, interventional ultrasonography, long peripheral catheters, patient safety

Date received: 20 February 2026; accepted: 4 April 2026

[1]Post Anesthesia Care Unit, Vascular Access Team, ASST Lodi, Lodi, Italy
[2]Vascular Access Team, "Gemelli" University Hospital, Rome, Italy
[3]Vascular Access Team – "Cardarelli" Hospital, Napoli, Italy
[4]Vascular Access Team, Instituto Português de Oncologia "Francisco Gentil," Lisbon, Portugal
[5]Anesthesia and Intensive Care, Centro di Riferimento Oncologico, Aviano, Italy
[6]GloVANet/WoCoVA, Santiago de Compostela, Spain
[7]Vascular Access Team, "Careggi" University Hospital, Firenze, Italy
[8]Department of Biomedical and Clinical Sciences—University of Milan, "Luigi Sacco" Hospital, Milan, Italy
[9]Direction of Health and Social Professions, Fondazione IRCCS "San Gerardo dei Tintori," Monza, Italy
[10]Cardiac Surgery Intensive Care Unit, Vascular Access Team, Azienda Sanitaria Universitaria Giuliano-Isontina, Trieste, Italy
[11]Global Vascular Access, LLC, Scottsdale, AZ, USA

**Corresponding author:**
Mauro Pittiruti, Department of Surgery, Catholic University Hospital "A.Gemelli," Largo Gemelli 8, Rome 00168, Italy.
Email: mauropittiruti@me.com

## Introduction

Intravenous therapy constitutes a fundamental component of pharmacological treatment for both hospitalized and outpatient populations. This route of administration facilitates the delivery of various medications, including antibiotics, hydration fluids, and chemotherapeutic agents. Nevertheless, it is associated with inherent risks. To mitigate these risks, clinicians use an array of devices with diverse features and indications, thereby ensuring the precise and safe delivery of prescribed therapies.

Among peripheral vascular access devices, a specific device has rapidly gained popularity and widespread adoption owing to its simplicity, versatility, and safety profile: the long peripheral catheters (LPC).[1] According to the nomenclature proposed by GloVANet (Global Vascular Access Network)/WoCoVA (World Congress of Vascular Access) in the NAVIGATE document,[2] LPCs are defined as catheters measuring between 6 and 15 cm in length, intended for the administration of drugs compatible with the peripheral route for periods ranging from 1 to 4 weeks, with the distal tip located in a vein of the arm, before the axillary fold. Despite some discrepancies reported in the literature,[3–5] these devices are generally not intended for use longer than 3 or 4 weeks.

LPCs are manufactured from diverse materials such as poly-ether bloc-amide (PEBA), polyurethane (PUR), and polyethylene (PE), and can be inserted using various techniques: "catheter-over-needle" (as for short peripheral catheters), direct Seldinger technique ("catheter over guidewire"), modified Seldinger technique ("catheter through micro-introducer"), or the so-called "accelerated" Seldinger technique (AST), which is a variant of the direct Seldinger, but using an all-in-one device where needle, guidewire, and catheter are combined co-axially.

In the context of the growing adoption of ultrasound-guided insertion techniques,[6] LPCs are especially indicated for patients with difficult venous access (DIVA—Difficult Intravenous Access), encompassing both adult and pediatric populations.[7] Their length (6–15 cm) allows easy access to both superficial and deep veins; for optimal device function, at least 2/3 of the length of the catheter is expected to dwell inside the vein.[8,9] Consequently, they are frequently employed in emergency departments.[10,11] In this setting, multiple studies have demonstrated the superior performance of LPC compared with conventional short peripheral catheters (SPC), particularly when inserted via ultrasound-guided venipuncture.[12–14]

Furthermore, in non-emergency settings, the use of LPCs is recommended when the peripheral venous access device is expected to be required for more than 1 week,[3,15,16] in both DIVA and non-DIVA patients.

Nevertheless, their recent introduction, combined with discrepancies in the literature, has led to confusion among clinicians, largely due to the lack of a universally accepted terminology.[17–19] Different terms have been used in the literature for naming the LPCs (mini-midline, short midline, extended-dwell catheters, etc.) and many studies have confused LPCs with midline catheters (MCs) (also known as "midclavicular catheter," MC is a completely different peripheral venous access device, being 16–25 cm long and with the distal tip located in the thoracic tract of the axillary vein or in the subclavian vein).[3] These issues have led to wide variations in usage, indications, and insertion techniques, as well as conflicting results in reporting clinical outcomes.[19]

Aiming to address these inconsistencies, GAVeCeLT and IVAS have developed a well-defined bundle (Table 1), consisting of a set of six recommendations grounded in current evidence, so as to provide clinicians with a guide to safe, effective, and standardized insertion of LPC, limiting the variability due to different approaches to the device. Similar bundles have already been published by GAVeCeLT for different types of central venous access devices[20–23] and for peripheral arterial catheters.[24]

As mentioned above, GAVeCeLT and IVAS have chosen to adopt the terminology recommended by GloVANet/WoCoVA,[2] defining LPC as peripheral venous access devices 6–15 cm long, with the distal tip located in veins of the upper limb, so to avoid any confusion with MC (>15 cm long, distal tip located in the thoracic tract of the axillary vein or in the subclavian vein).[3]

## Preparation and assessment

The preparation phase for LPC insertion comprises three fundamental steps: verifying the clinical necessity for the device, evaluating the patient's renal history, and systematically assessing the venous patrimony.

The maneuver should be performed only after verification of the proper indication for a peripheral venous access device (infusion of peripherally compatible solutions) and the specific indication for LPC insertion (DIVA patient and/or expected intravenous treatment for more than 1 week but less than 3–4 weeks).

The presence of advanced chronic renal disease (stage 3b-4–5) may be considered as a relative contraindication to LPC placement, since device-associated complications may impair the creation of an arteriovenous fistula in the arm; therefore, the maneuver should be performed only after an overall exam of the clinical situation, even considering a consultation with a nephrologist.[25] In fact, in selected patients with chronic renal failure with poor prognosis and low probability of future arteriovenous fistula, LPC may still be an option.[26]

After confirming the clinical indication, a careful assessment of the upper-extremity venous structures should be performed. The application of a rating scale may be useful for stratifying the patient's venous status and qualifying it as DIVA or non-DIVA. In the literature,

**Table 1.** The bundle for Safe Insertion of Long Peripheral Catheters (SILPeC).

| | |
|---|---|
| Step 1 | Preparation and assessment: the preparation phase involves three key steps: (1) verifying the clinical indication for an LPC, (2) evaluating renal function to rule out advanced chronic kidney disease, and (3) assessing the venous capital using forearm ultrasound and the RaPeVA protocol (without tourniquet). |
| Step 2 | Site selection, taking in consideration the patient's preference, and choosing either the basilic vein or the cephalic vein, either at the forearm or at the upper arm. At the upper arm, cannulation of cephalic vein should be preferred. The site of venipuncture should be chosen so to obtain that the whole length of the catheter is not located in areas of flexion. |
| Step 3 | Aseptic technique: hand hygiene, 2% chlorhexidine in 70% IPA, aseptic barrier precautions. The level of barrier precaution must be tailored following the clinical setting (emergency vs non-emergency), the type of device (in terms of insertion technique), and the expected indwelling time. |
| Step 4 | Ultrasound-guided insertion: Puncture may be performed by different techniques, depending on the type of device and on the venous patrimony of the patient. After the cannulation, the successful intravenous location of the LPC must be proven by easy blood aspiration (with or without tourniquet) and by easy flushing the device with 10 ml saline (without tourniquet). |
| Step 5 | Device connections: In non-emergency insertions, if the LPC has no pre-assembled extension, it is recommended to connect the device with a short extension, closed with a needle free connector. |
| Step 6 | Securement and site protection: The LPC must be secured by a sutureless device, and the exit site is covered with semipermeable transparent membrane, preferably with high permeability. Sealing the exit site with cyanoacrylate glue, soon before application of the transparent membrane, is recommended in all patients and particularly in children, in patients with risk of local bleeding, or whenever a high risk of dislodgement is anticipated. |

**Table 2.** Rapid Peripheral Vein Assessment (RaPeVA).

| | |
|---|---|
| Step 1 | Visualization of the cephalic vein at the antecubital fossa |
| Step 2 | Identification of the artery and brachial veins and of the confluence between the antecubital vein and basilic vein |
| Step 3 | Identification of the basilic vein in the bicipital-humeral groove |
| Step 4 | Examination of the nerve-vascular bundle of the arm (brachial artery, brachial veins, median nerve) |
| Step 5 | Visualization of the cephalic vein over the biceps muscle |
| Step 6 | Examination of the axillary vein in the infraclavicular area |
| Step 7 | Examination of the internal jugular, the subclavian, and the brachiocephalic vein in the supraclavicular area |

several tools are available for standardized assessment.[27] Recently, a scoping review and a large prospective study have suggested that the modified A-DIVA scale[28] and the EA-DIVA score[29] may be adopted, respectively, in hospitalized patients and in the emergency room.[30,31]

In DIVA patients, LPC insertion necessarily implies ultrasound-guided venipuncture. In this case, it is advisable to perform a complete scan of the main veins of the forearm (cephalic and basilic), followed by a systematic scan of the veins of the arm using the RaPeVA scanning protocol (Table 2).[21] This assessment also includes scanning the deep veins of the infra- and supraclavicular areas (steps 6–7 of RaPeVA) to rule out venous thrombosis or anomalies that may impair blood flow from the arm.

In non-DIVA patients, LPC may nonetheless be indicated if the expected duration of intravenous treatment exceeds 1 week. In these patients, we recommend a visual inspection of the veins with a tourniquet, as well as a systematic ultrasound scan, as described above, to weigh the pros and cons of ultrasound-guided venipuncture versus direct puncture of visible/palpable superficial veins in every case. In many of these cases, insertion of an MC should also be considered as an alternative, since it is associated with better clinical performance in terms of duration, blood sampling, and mechanical complications.[3]

## Site selection

Building upon the initial assessment, the site selection process must prioritize identifying the most suitable vessel by integrating technical requirements for optimal clinical outcomes with the patient's preferences.

First, it is wise to preserve the deep veins of the patient (i.e. the basilic veins and the brachial veins in the arm) for future possible insertion of Peripherally Inserted Central Catheters (PICCs) or MCs. Therefore, it is recommended to insert the LPC either into the basilic vein or the cephalic vein at the forearm; at the upper arm, cannulation of the cephalic vein should be preferred. Insertion at the upper arm seems to be associated with a longer duration of the LPC, if compared to insertion in the forearm.[32] In non-emergency conditions, the insertion of an MC rather than an LPC might be considered, since MCs are associated with longer duration and better clinical performance.[3]

The site of venipuncture should be chosen so that the entire length of the catheter avoids areas of joint flexion (e.g. the antecubital fossa or the axilla).

Venipuncture in areas with venous thrombosis, phlebitis, edema, infection, or skin damage must be obviously avoided.[4]

The internal diameter of the vein should be assessed using ultrasound to ensure the most favorable catheter-to-vein ratio (CVR), whenever possible. Sonographic evaluation must be performed without a tourniquet to avoid artificial vein distension and ensure an accurate baseline measurement. Regarding the clinical cut-off, a CVR between 33% and 45% is considered acceptable to maintain adequate blood flow around the device and reduce the risk of venous thrombosis.

Particular attention must also be paid to the depth of the vessel, which will guide the choice of the device length, since it is recommended that at least 2/3 of the length of the catheter should be located inside the vein.[9]

Placement of the tip near valves should probably be avoided, since the creation of turbulent flow may theoretically increase the possibility of device failure.[33]

Considering the aforementioned anatomic and physiologic factors, insertion of a long peripheral catheter (LPC) in the forearm will, in most cases, require relatively small-diameter devices (e.g. 20G/3 Fr) of limited length (6–8 cm). In contrast, placement of an LPC in the upper arm is typically feasible with larger-diameter catheters (e.g. 4 Fr) and longer lengths (8–15 cm).[34]

## Aseptic technique

Catheter-related infections, both local (exit-site infection) and systemic (such as catheter-related bloodstream infection, CRBSI), represent one of the most complex challenges during insertion and management of any vascular device. Although clinical studies have reported a low infection rate associated with LPCs,[35–37] it is nonetheless important not to underestimate these infections, as their severity and consequences are similar to those of PICC-related infections.[38–40] It is therefore necessary to ensure strict asepsis during the insertion procedure.

Before beginning the insertion procedure, the operator must always perform proper hand hygiene and disinfect the skin of the patient with 2% chlorhexidine in 70% isopropyl alcohol, preferably using disposable sterile applicators, which reduce the risk of contamination of the antiseptic solution and deliver a well-defined volume of antiseptic, proportional to the skin area to be disinfected. In this regard, a 3 ml applicator is often sufficient for both adults and children to ensure proper disinfection of the puncture site before LPC insertion. In patients with documented intolerance to chlorhexidine, povidone iodine should be used, preferably in 70% alcohol. If proper hand hygiene and/or proper skin antisepsis have not been performed—for instance, because of insertion in emergency/urgency—the catheter should be removed within 24–48 h.[4,41]

As regards the barrier precautions, strong evidence is lacking, and recommendations are based only on experts' opinions. While basic aseptic principles should be upheld, the level of barrier precautions can be tailored to the type of LPC, the technique of insertion, and the expected indwelling time. Three different levels of aseptic barrier precautions may be identified.

For LPCs inserted using the "catheter-over-needle" technique, which involves minimal manipulation of the catheter, a low level of barrier precautions (non-sterile mask, non-sterile cap, sterile gloves, and a sterile fenestrated drape over the insertion site) may be appropriate. For LPCs inserted using the direct Seldinger technique ("catheter over guidewire"), it is advisable to use a sterile gown and an appropriate sterile field to display the materials necessary for the maneuver. Maximal barrier protection (non-sterile mask, non-sterile cap, sterile gloves, sterile gown, sterile fenestrated drape over the insertion site and large patient drape) must be provided for catheters inserted using the modified Seldinger technique ("catheter through micro-introducer"), which requires multiple procedural steps and a high level of manipulation of the different parts of the catheter and the materials necessary for its insertion.[41]

The adoption of maximal barrier precautions will nonetheless be adopted: (a) in emergency, if the LPC is expected to stay in place for more than few days (such as in the case of a non-DIVA patients requiring a peripheral venous access device for a prolonged period), (b) in non-emergency insertions in critically ill patients, (c) when there is the possible option of future guidewire replacement of the LPC with another device (PICC or Midline).[42]

Please note that in any situation, including emergencies, the ultrasound probe must be covered with a sterile cover, and sterile gel must be used.[43]

## Ultrasound-guided insertion

The ultrasound-guided puncture represents the most operator-dependent phase of the SILPeC protocol, making specific training and the mastery of needle-tip tracking techniques essential for a successful outcome. Despite the lack of a standardized international curriculum, competency should be ensured through a structured educational path (from high-fidelity simulation to supervised clinical practice). This approach minimizes inter-operator variability and ensures that the technical precision of the puncture is consistently maintained, optimizing patient safety and resource efficiency.[4]

Ultrasound-guided puncture is strongly recommended as the first option for all LPC insertions and can be performed with any type of LPC, regardless of the specific insertion technique used (catheter-over-needle, catheter-over-guidewire, or catheter-through-introducer). Regarding

the ultrasound technique for venipuncture, the short-axis/out-of-plane approach is commonly used, as it provides a comprehensive panoramic view of all structures (vein, artery, nerve, muscle), making the puncture safer. In particular, a dynamic short-axis/out-of-plane technique should be used to track the needle tip in real time, thereby avoiding accidental injury to adjacent structures.[41] Catheters to be inserted according to the catheter-over-needle technique should preferably be placed in superficial veins of the forearm, since the catheter sometimes cannot easily proceed into the vessel, due to the absence of a guidewire.

There is no strong evidence regarding the advantages and disadvantages of using the catheter-over-needle technique versus the Seldinger technique, or of the direct versus modified Seldinger technique. If the vein is deep and expected to be difficult to cannulate, the modified Seldinger technique should be considered, as it is usually more effective in terms of clinical outcomes.

Also, there is no evidence about the most appropriate catheter material. Similar clinical outcomes have been reported with PUR and PEBA, whereas PE is generally discouraged because it is associated with a higher risk of venous thrombosis.[3] Power-injectable LPCs should be preferred, particularly in the emergency department or intensive care unit, that is, when the infusion of contrast medium for a CT scan is expected or likely.[41]

In selected cases (non-DIVA patients with adequate superficial veins), "blind" venipuncture may be considered; though, a recent study suggests that LPCs, if placed with the blind technique, have the same rate of catheter failure as short peripheral cannulas (SPC),[14] while many studies have shown that ultrasound guided LPCs have better clinical outcome than SPC.[11–13]

After cannulation, the successful intravenous location of the LPC must be confirmed by easy blood aspiration (with or without a tourniquet) and by easy flushing of the device with 10 ml of saline (without a tourniquet), without evidence of swelling or pain at the insertion site. If there is any uncertainty, the intravenous location of the device can be verified by ultrasound.

## Device connections

The adoption of LPC with preassembled extensions is preferable, as recommended by current guidelines.[3,4,41] If the LPC has no pre-assembled extension, the device should be connected to a short extension set to avoid direct manipulations of the catheter hub, leaving it under the protection of the transparent dressing. A recent prospective, open-label, quasi-experimental study found that peripheral intravenous catheter failure was significantly lower with an extension set than without.[44]

According to the most recent guidelines and systematic reviews,[4,41,45] any venous access device—if not used continuously—must be closed with a needle-free connector (NFC). The use of three-way stopcocks not assembled with NFC should be avoided, since it increases the risk of bacterial contamination of the infusion line[4,41,46,47]; also, all NFCs must be properly disinfected before each access, preferably using disinfecting caps (often called port protectors).[4,41,47]

As regards the choice of NFC type, there is no strong evidence in the literature. Some experimental and clinical studies, as well as recent expert-based documents, suggest that specific features (minimal internal volume, inner laminal flow, neutral displacement at disconnection) may be associated with easier management and better clinical outcomes.[41,46–48]

## Securement and site protection

The clinical success and longevity of a vascular access device depend significantly on the rigorous stabilization and protection of the exit site, as inadequate securement is a primary driver of mechanical complications and infectious risks.

The currently preferred options for catheter securement are (a) skin-adhesive sutureless devices, (b) transparent dressings with integrated securement, and (c) subcutaneous anchorage: securement by stitches must always be avoided.[3,4,41,47] Subcutaneous anchorage is not recommended for LPC because it requires at least 2–2.5 cm of extracutaneous catheter tract, thereby limiting the length of the intravascular catheter tract. Additionally, given the limited duration of LPC, the actual cost-effectiveness of subcutaneous anchorage is questionable.

The exit site should always be covered with a semipermeable transparent membrane, preferably with high permeability; this is measured as Moisture Vapor Transfer Rate (MVTR), and values of MVTR $>1500\,g\,H_2O/m^2/day$ are associated with the best profile.[49] Membranes with MVTR $>1500$ are strongly recommended, particularly for children and adults with high perspiration.[41,47]

The application of cyanoacrylate glue over the exit site is an effective tool for preventing local bleeding/oozing, reducing the risk of bacterial contamination via the extraluminal route, and reducing the risk of dislodgment.[50–54] Before placement of the transparent membrane, sealing the exit site with cyanoacrylate is strongly recommended in special populations: children, patients at risk of local bleeding, or any patient at risk of early dislodgment of the device.[3,41,47,55]

## Conclusions

The LPCs are currently indicated for adults and children with difficult venous access requiring intravenous infusions compatible with the peripheral route; they are also used in hospitalized patients, either DIVA or non-DIVA, with a required duration of peripheral venous access longer than 1 week.[3]

The SILPeC bundle developed by GAVeCeLT-IVAS includes six evidence-based recommendations that, if properly implemented, may help minimize complications associated with LPC insertion. The bundle highlights several evidence-based strategies—such as proper selection of the insertion site, use of ultrasound, application of strict aseptic measures, proper preparation of the catheter for use, and protection and stabilization at the exit site—which are aligned with the current state of the art of venous access device insertion. When performed correctly, these strategies ensure safe and effective insertion of LPCs.

Also, the existence of a standardized bundle of insertion may facilitate comparison of clinical outcomes across studies and provide a structured educational tool for training.

## Author contributions

DG: Conceptualization, Investigation, Visualization, Writing-original draft, Writing-review and editing; MP: Conceptualization, Project administration, Supervision, Writing-review and editing; GS: Conceptualization, Project administration, Supervision, Writing-review and editing; VF: Conceptualization, Project administration, Supervision, Writing-review and editing; FP: Writing-review and editing; FB: Writing-review and editing; MGA: Writing-review and editing; RB: Writing-review and editing; GOM: Writing-review and editing; AG: Writing-review and editing; AF: Writing-review and editing; SE: Writing-review and editing; TRS: Writing-review and editing.

## Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

## ORCID iDs

Davide Giustivi https://orcid.org/0000-0002-5912-1822
Maria Giuseppina Annetta https://orcid.org/0000-0001-7574-1311
Fabrizio Brescia https://orcid.org/0000-0002-6892-474X
Gloria Ortiz Miluy https://orcid.org/0000-0003-2252-3649
Fulvio Pinelli https://orcid.org/0000-0002-9926-2128
Antonio Gidaro https://orcid.org/0000-0002-5379-1091
Stefano Elli https://orcid.org/0000-0002-8785-824X
Adam Fabiani https://orcid.org/0000-0002-9823-554X
Timothy R. Spencer https://orcid.org/0000-0002-3128-2034
Mauro Pittiruti https://orcid.org/0000-0002-2225-7654

## References

1. 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): 767–777.
2. van Rens MR, van der Lee R, Spencer TR, et al. The NAVIGATE project: a GloVANet-WoCoVA position statement on the nomenclature for vascular access devices. *J Vasc Access* 2025; 26(5): 1439–1446.
3. 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. *J Vasc Access* 2023; 24(1): 165–182.
4. Nickel B, Gorski L, Kleidon T, et al. Infusion therapy standards of practice, 9th edition. *J Infus Nurs* 2024; 47(1S Suppl 1): S1–S2.
5. 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 method. *Ann Intern Med* 2015; 163(6 Suppl): S1–S40.
6. Pandurangadu AV, Tucker J, Brackney AR, et al. Ultrasound-guided intravenous catheter survival impacted by amount of catheter residing in the vein. *Emerg Med J* 2018; 35(9): 550–555.
7. Burek AG, Liljestrom T, Dundon M, et al. Long peripheral catheters in children: a scoping review. *J Hosp Med* 2022; 17(12): 1000–1009.
8. Bahl A, Hang B, Brackney A, et al. Standard long IV catheters versus extended dwell catheters: a randomized comparison of ultrasound-guided catheter survival. *Am J Emerg Med* 2019; 37(4): 715–721.
9. Bahl A, Hijazi M, Chen NW, et al. Ultralong versus standard long peripheral intravenous catheters: a randomized controlled trial of ultrasonographically guided catheter survival. *Ann Emerg Med* 2020; 76(2): 134–142.
10. Gilardi E, Giannuzzi R, WoldeSellasie K, et al. Mini-midline in difficult intravenous access patients in emergency department: a prospective analysis. *J Vasc Access* 2020; 21(4): 449–455.
11. Scoppettuolo G, Pittiruti M, Pitoni S, et al. Ultrasound-guided "short" midline catheters for difficult venous access in the emergency department: a retrospective analysis. *Int J Emerg Med* 2016; 9(1): 3.
12. Anderssen LM, Petersen MS, Wang AG, et al. The efficacy of ultrasound-guided peripheral intravenous cannulation versus the landmark technique in emergency department patients with difficult intravenous access: a systematic review and meta-analysis. *J Vasc Access* 2026; 27(2): 435–443.
13. Paladini A, Chiaretti A, Sellasie KW, et al. Ultrasound-guided placement of long peripheral cannulas in children over the age of 10 years admitted to the emergency department: a pilot study. *BMJ Paediatr Open* 2018; 2(1): e000244.
14. Binda F, Galazzi A, Marelli F, et al. Long versus conventional peripheral intravenous catheters to reduce venipunctures during hospital stay: a randomized controlled trial. *J Vasc Access*. Epub ahead of print 3 November 2025. DOI: 10.1177/11297298251385595.
15. Pittiruti M, Crocoli A, Zanaboni C, et al. The pediatric DAV-expert algorithm: a GAVeCeLT/GAVePed consensus for the choice of the most appropriate venous access device in children. *J Vasc Access* 2025; 26(3): 715–725.
16. Donadoni M, Calloni M, Romano ME, et al. Long peripheral catheters for intravenous infusions of iloprost or alprostadil

therapy in rheumatologic outpatients. *J Vasc Access* 2025; 26(3): 904–908.
17. Fabiani A, Eletto V, Dreas L, et al. Midline or long peripheral catheters in difficult venous access conditions? A comparative study in patients with acute cardiovascular diseases. *Am J Infect Control* 2020; 48(10): 1158–1165.
18. Fabiani A, Aversana N, Santoro M, et al. Complications associated to midline- and long peripheral catheters in adults. Systematic review of literature and proposal for a standardized model for data collection. *Thromb Res* 2024; 236: 117–126.
19. Qin KR, Nataraja RM and Pacilli M. Long peripheral catheters: is it time to address the confusion? *J Vasc Access* 2019; 20(5): 457–460.
20. Brescia F, Annetta MG, Pinelli F, et al. A GAVeCeLT bundle for PICC-port insertion: the SIP-Port protocol. *J Vasc Access* 2024; 25(6): 1713–1720.
21. Brescia F, Pittiruti M, Spencer TR, et al. The SIP protocol update: eight strategies, incorporating Rapid Peripheral Vein Assessment (RaPeVA), to minimize complications associated with peripherally inserted central catheter insertion. *J Vasc Access* 2024; 25(1): 5–13.
22. Brescia F, Pittiruti M, Ostroff M, et al. The SIF protocol: a seven-step strategy to minimize complications potentially related to the insertion of femorally inserted central catheters. *J Vasc Access* 2023; 24(4): 527–534.
23. Brescia F, Annetta MG, Pinelli F, et al. A GAVeCeLT bundle for chest-port insertion: the SIC-Port protocol. *J Vasc Access*. Epub ahead of print 12 November 2025. DOI: 10.1177/11297298251375833.
24. Spencer TR, Imbriaco G, Bardin-Spencer A, et al. Safe Insertion of Arterial Catheters (SIA): an ultrasound-guided protocol to minimize complications for arterial cannulation. *J Vasc Access* 2024; 25(5): 1403–1408.
25. Lok CE, Huber TS, Lee T, et al. KDOQI clinical practice guideline for vascular access: 2019 update. *Am J Kidney Dis* 2020; 75(4 Suppl 2): S1–S164. Erratum in: *Am J Kidney Dis* 2021; 77(4): 551.
26. Bartoli A, Gallieni M, Cogliati C, et al. A decision-making algorithm proposal for PICCs and midlines insertion in patients with advanced kidney disease: a pilot study. *J Vasc Access* 2024; 25(4): 1151–1157.
27. Paterson RS, Schults JA, Slaughter E, et al. Review article: peripheral intravenous catheter insertion in adult patients with difficult intravenous access: a systematic review of assessment instruments, clinical practice guidelines and escalation pathways. *Emerg Med Australas* 2022; 34(6): 862–870.
28. van Loon FHJ, van Hooff LWE, de Boer HD, et al. The modified A-DIVA scale as a predictive tool for prospective identification of adult patients at risk of a difficult intravenous access: a multicenter validation study. *J Clin Med* 2019; 8(2): 144.
29. Civetta G, Cortesi S, Mancardi M, et al. EA-DIVA score (Enhanced Adult DIVA score): a new scale to predict difficult preoperative venous cannulation in adult surgical patients. *J Vasc Access* 2019; 20(3): 281–289.
30. Nannini F, Mancin S, Morales Palomares S, et al. Predicting difficult peripheral venous access in hospitalized adult patients: a scoping review. *J Vasc Access*. Epub ahead of print 3 October 2025. DOI: 10.1177/11297298251374415.
31. Petta D, Longobucco Y, Magi CE, et al. Implementation of the enhanced adult DIVA score in an emergency department: a prospective observational study. *J Vasc Access* 2025; 26(6): 1888–1894.
32. Bahl A, Drogowski M, Gutta A, et al. Upper arm versus forearm placement of long peripheral catheters for blood sampling: a randomized controlled trial. *J Nurs Care Qual* 2025; 40(4): 310–317.
33. Foor JS, Moureau NL, Gibbons D, et al. Investigative study of hemodilution ratio: 4Vs for vein diameter, valve, velocity, and volumetric blood flow as factors for optimal forearm vein selection for intravenous infusion. *J Vasc Access* 2024; 25(1): 140–148.
34. Ostroff M, Spencer TR and Moureau N. Ultrasound-guided peripheral intravenous catheter placement locations: a retrospective study of 29,436 cases. *J Vasc Access*. Epub ahead of print 3 November 2025. DOI: 10.1177/11297298251389647.
35. Urtecho M, Torres Roldan VD, Nayfeh T, et al. Comparing complication rates of midline catheter vs peripherally inserted central catheter. A systematic review and meta-analysis. *Open Forum Infect Dis* 2023; 10(2): ofad024.
36. Hogle NJ, Balzer KM, Ross BG, et al. A comparison of the incidence of midline catheter-associated bloodstream infections to that of central line-associated bloodstream infections in 5 acute care hospitals. *Am J Infect Control* 2020; 48(9): 1108–1110.
37. Swaminathan L, Flanders S, Horowitz J, et al. Safety and outcomes of midline catheters vs peripherally inserted central catheters for patients with short-term indications: a multicenter study. *JAMA Intern Med* 2022; 182(1): 50–58.
38. Tsuboi M, Hayakawa K, Mezaki K, et al. Comparison of the epidemiology and microbiology of peripheral line- and central line-associated bloodstream infections. *Am J Infect Control* 2019; 47(2): 208–210.
39. Tatsuno K, Ikeda M, Wakabayashi Y, et al. Clinical features of bloodstream infections associated with peripheral versus central venous catheters. *Infect Dis Ther* 2019; 8(3): 343–352.
40. Zhu S, Kang Y, Wang W, et al. The clinical impacts and risk factors for non-central line-associated bloodstream infection in 5046 intensive care unit patients: an observational study based on electronic medical records. *Crit Care* 2019; 23(1): 52.
41. Pittiruti, M and Scoppettuolo, G (eds). Raccomandazioni GAVeCeLT 2024 Per l'indicazione, l'impianto e la gestione dei dispositivi per accesso venoso, https://www.gavecelt.it/nuovo/sites/default/files/uploads/raccomandazioni-gavecelt-2024.pdf (posted on April 2024, accessed December 2025).
42. Brugioni L, Bertellini E, Ravazzini M, et al. Guide-wire replacement of a mini-midline catheter with a central venous catheter: a retrospective study on 63 cases. *J Vasc Access* 2021; 22(3): 394–397.
43. Estrella Y, Panzlau N, Vinokur K, et al. Comparing contamination rates of sterile-covered and uncovered transducers for ultrasound-guided peripheral intravenous lines. *Ultrasound J* 2024; 16(1): 6.

44. Piriz-Marabajan M, Rombauts A, Roch-Villaverde N, et al. Impact on peripheral catheter failure with the use of an extension set with integrated needleless connector compared with a straight hub: a prospective quasi-experimental study. *J Hosp Infect* 2025; 167: 36–41.
45. Rosenthal VD, Memish ZA, Shweta F, et al. Preventing central line-associated bloodstream infections: a position paper of the International Society for Infectious Diseases, 2024 update. *Int J Infect Dis* 2025; 150: 107290.
46. Rosenthal VD. Clinical impact of needle-free connector design: a systematic review of literature. *J Vasc Access* 2020; 21(6): 847–853.
47. Cellini M, Bergadano A, Crocoli A, et al. Guidelines of the Italian Association of Pediatric Hematology and Oncology for the management of the central venous access devices in pediatric patients with onco-hematological disease. *J Vasc Access* 2022; 23(1): 3–17.
48. Giustivi D, Gidaro A, Nardin E, et al. Effect of different needleless connector technologies on backflow volume in the long peripheral catheter: a bench study. *J Vasc Access* 2026; 27(1): 221–226.
49. Bainbridge P, Browning P, Bernatchez SF, et al. Comparing test methods for moisture-vapor transmission rate (MVTR) for vascular access transparent semipermeable dressings. *J Vasc Access* 2021; 24(5): 1000–1007.
50. Bugden S, Shean K, Scott M, et al. Skin glue reduces the failure rate of emergency department-inserted peripheral intravenous catheters: a randomized controlled trial. *Ann Emerg Med* 2016; 68(2): 196–201.
51. Özkula U, Özhasenekler A, Çelik GK, et al. Tissue adhesives to secure peripheral intravenous catheters: a randomized controlled trial in patients over 65 years. *Turk J Emerg Med* 2018; 19(1): 12–15.
52. Zhang S, Guido AR, Jones RG, et al. Experimental study on the hemostatic effect of cyanoacrylate intended for catheter securement. *J Vasc Access* 2019; 20(1): 79–86.
53. Nicholson J and Hill J. Cyanoacrylate tissue adhesive: a new tool for the vascular access toolbox. *Br J Nurs* 2019; 28(19): S22–S28.
54. Waller SC, Anderson DW, Kane BJ, et al. In vitro assessment of microbial barrier properties of cyanoacrylate tissue adhesives and pressure-sensitive adhesives. *Surg Infect (Larchmt)* 2019; 20(6): 449–452.
55. Pittiruti M, Annetta MG, Marche B, et al. Ten years of clinical experience with cyanoacrylate glue for venous access in a 1300-bed university hospital. *Br J Nurs* 2022; 31(8): S4–S13.