Check for updates

JVA The Journal of Vascular Access

Editorial

The Journal of Vascular Access
1–10
© The Author(s) 2026
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/11297298261500583
journals.sagepub.com/home/jva
Mary Ann Liebert
A Part of Sage

The SAMP algorithm: Recommendations for safe access and management of ports

Gloria Ortiz Miluy[1], Timothy R. Spencer[2], Renata Bastos[3], Christian Dupont[4], Fulvio Pinelli[5] and Mauro Pittiruti[6]

Abstract

Totally implantable venous access devices (TIVADs or ports) are integral to long-term intravenous therapy, particularly for patients receiving oncology treatments. Despite their widespread use, late complications, including infection, occlusion, extravasation, and pain during access, are not uncommon and are often linked to inconsistent clinical practices and the absence of standardized protocols for port management. A novel algorithm for the Safe Access and Management of Ports (SAMP) has been developed by a panel of experts from the World Conference on Vascular Access/Global Vascular Access Network (WoCoVA/GloVANet), the Italian Group for Long Term Central Venous Access (GAVeCeLT), and the Italian Society of Vascular Access (IVAS). The algorithm provides an evidence-based, standardized approach to promoting safe, consistent, and patient-centered port management. The algorithm was developed through a comprehensive review of current evidence and best-practice recommendations, and it is presented as a sequential, evidence-based approach to port management. Its key recommendations include skin antisepsis with 2% chlorhexidine in 70% isopropyl alcohol, use of sterile gloves during access, topical local anesthesia where appropriate, verification of catheter patency and/or tip location before therapy administration, and appropriate needle securement. The SAMP algorithm offers a practical, evidence-based framework intended to support safe port management, from needle access to needle removal. By standardizing procedures and consolidating best evidence, the algorithm may improve patient comfort, enhance clinician consistency, reduce preventable complications, and has the potential to strengthen quality and safety in vascular access care. It also provides a foundation for standardized education, competency assessment, and future clinical research to evaluate its impact on patient outcomes and device performance.

Keywords

Totally implanted venous access devices, venous ports, nursing care, pain management, standardization of care, infection control, needlestick injuries prevention

Date received: 3 September 2026; accepted: 8 October 2026

Introduction

Totally implantable venous access devices—also called "ports"[1]—are widely used in clinical practice, primarily in cancer patients undergoing chemotherapy,[2] but also in other chronic disease settings where reliable long-term venous access is needed for drug administration, blood sampling, and supportive care (antibiotics, home parenteral nutrition, etc.).

The main indication for port insertion is the need for infrequent infusion therapy (less than once a week) in patients requiring long-term venous access (>3 months).[3,4] When indicated, ports are preferable to external central

[1]Universidad Islas Baleares, Santiago de Compostela, Spain
[2]Global Vascular Access, LLC, Scottsdale, AZ, USA
[3]Instituto Português de Oncologia Francisco Gentil, Lisbon, Portugal
[4]Cochin University Hospital, Assistance Publique–Hôpitaux de Paris, Paris, France
[5]Vascular Access Center, Department of Anesthesia and Intensive Care, Ospedale Careggi, Firenze, Italy
[6]Department of Surgery, Fondazione Policlinico Universitario Agostino Gemelli- IRCCS, Rome, Italy

Corresponding author:
Mauro Pittiruti, Department of Surgery, Policlinico Universitario Agostino Gemelli, Largo Gemelli 8, Roma 00168, Italy.
Email: mauropittiruti@me.com

venous catheters because they are associated with improved patient comfort and quality of life, allowing greater freedom in daily activities.[5]

The current state of the art in port insertion is based on ultrasound-guided venipuncture and intraprocedural tip location.[6,7] Several veins can be cannulated, and the reservoir can be placed at different sites, so that at least four categories of ports can be described: (a) PICC-port (puncture of deep veins of the arm and reservoir over the biceps muscle)[7]; (b) chest-port (puncture of deep veins of the supra/infraclavicular area and reservoir over the pectoral muscle)[6]; (c) chest-to-arm port (puncture of deep veins of the supra/infraclavicular area and reservoir over the biceps muscle)[8]; (d) FICC-port (puncture of the common or superficial femoral vein and reservoir at mid-thigh or over the abdomen).[9] The catheter tip is located centrally at the junction between the superior vena cava and the right atrium (for PICC-ports, chest-ports, and chest-to-arm ports) or in the subdiaphragmatic vena cava (for FICC ports), preferably using intra-procedural, accurate, non-radiological methods such as intracavitary ECG or transthoracic echocardiography with a bubble test.[10–13]

Proper insertion bundles for the safe insertion of PICC ports and chest ports have been developed and published in the last decade.[6,7] A protocol for the safe removal of ports was also published in 2026.[14] The importance of such protocols lies in providing safe, cost-effective strategies that promote the safety of the patient and the healthcare provider, standardize clinical practice, and facilitate education and training. While many studies have described the critical role of port management quality in the development of port-related complications such as infection and malfunction,[15–17] no evidence-based management protocol has been introduced in clinical practice. Although many international recommendations and textbooks[3,4,18,19] advocate a systematic approach to port management, this remains an area without clearly defined protocols and with wide variations in clinical practice.

Additionally, port design presents specific challenges and risks not associated with external catheter management, such as difficulty placing the needle inside the reservoir, patient discomfort and pain during the procedure, and potential extravasation due to needle dislodgement.

This article presents an evidence-based algorithm for port access and management. The algorithm, named SAMP (Safe Access and Management of Ports), has been developed as a joint project of the World Conference on Vascular Access/Global Vascular Access Network (WoCoVA/GloVANet), the Italian Group for Long Term Central Venous Access (GAVeCeLT), and the Italian Society of Vascular Access (IVAS). Because evidence on port access is scarce, the algorithm was derived by integrating current evidence with the clinical judgment of an international panel of experts convened by WoCoVA, GAVeCeLT, and IVAS through a non-anonymous exchange of opinions and clinical experience. The final algorithm provides a structured approach to port management, from needle access to needle removal, along with practical recommendations for assessing catheter function before infusion, with the overall goal of reducing variability in practice, promoting consistent care, and increasing patient safety.

Safe access and management of ports (SAMP)

The SAMP Algorithm consists of eight sequential steps (Figures 1 and 2). As recommended, before using any central venous catheter, it is necessary to confirm the patient's identity and explain the procedures to be performed. Through a brief interview with the patient and a review of their latest clinical reports, the professional must assess for the absence of port-related infection or any other prior complication that would preclude its use.

Skin and reservoir assessment

As a first step in the algorithm, before any further action, a careful inspection of the skin overlying the reservoir site must be performed. Pre-puncture skin assessment is mandatory to prevent device complications[5,7,9,18,19] and/or early device removal.[14] Skin assessment includes evaluating skin integrity over the reservoir and tunnel. With the patient's consent and privacy preserved, the anatomical area required for complete inspection of the port pocket and catheter tunnel should be exposed (chest, arm, or thigh, depending on the reservoir site). Skin assessment includes evaluation of signs and symptoms of infection (erythema, warmth, exudate, redness, swelling), decubitus, collateral circulation, pain, skin erosion, or port chamber extrusion. Local infection of the subcutaneous tunnel and/or chamber area must be identified early so that necessary measures can be taken to avoid progression to systemic infection.[3,4,20] Decubitus, skin erosion, or port extrusion (protrusion of the chamber through the skin) are mechanical complications that increase the risk of infection and require immediate catheter removal. In the rare case of a central catheter-associated skin impairment (CASI), classification of the damage is needed for proper local treatment,[21] and device use should be avoided.

If the skin is intact, the reservoir is assessed by palpation to estimate reservoir depth (which helps select the appropriate Huber needle), identify the port design and profile height, confirm device stability, and exclude port rotation.[3,18,19] In most cases, port rotation is not painful and causes no local signs, so palpation is crucial to rule out this complication. When palpation does not establish chamber orientation with sufficient confidence, or when the reservoir appears unusually deep, mobile, displaced, or morphologically abnormal, the port must not be punctured.

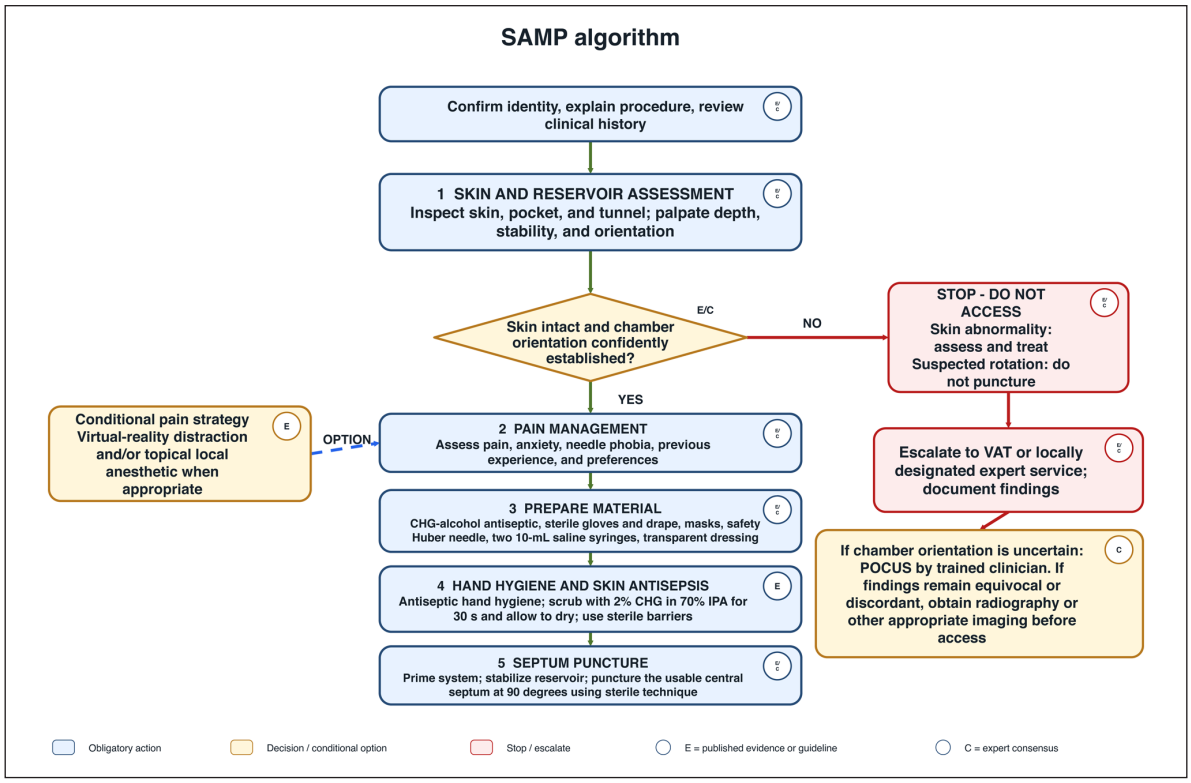

Figure 1. Pre-access assessment, preparation, antisepsis, and septum puncture.

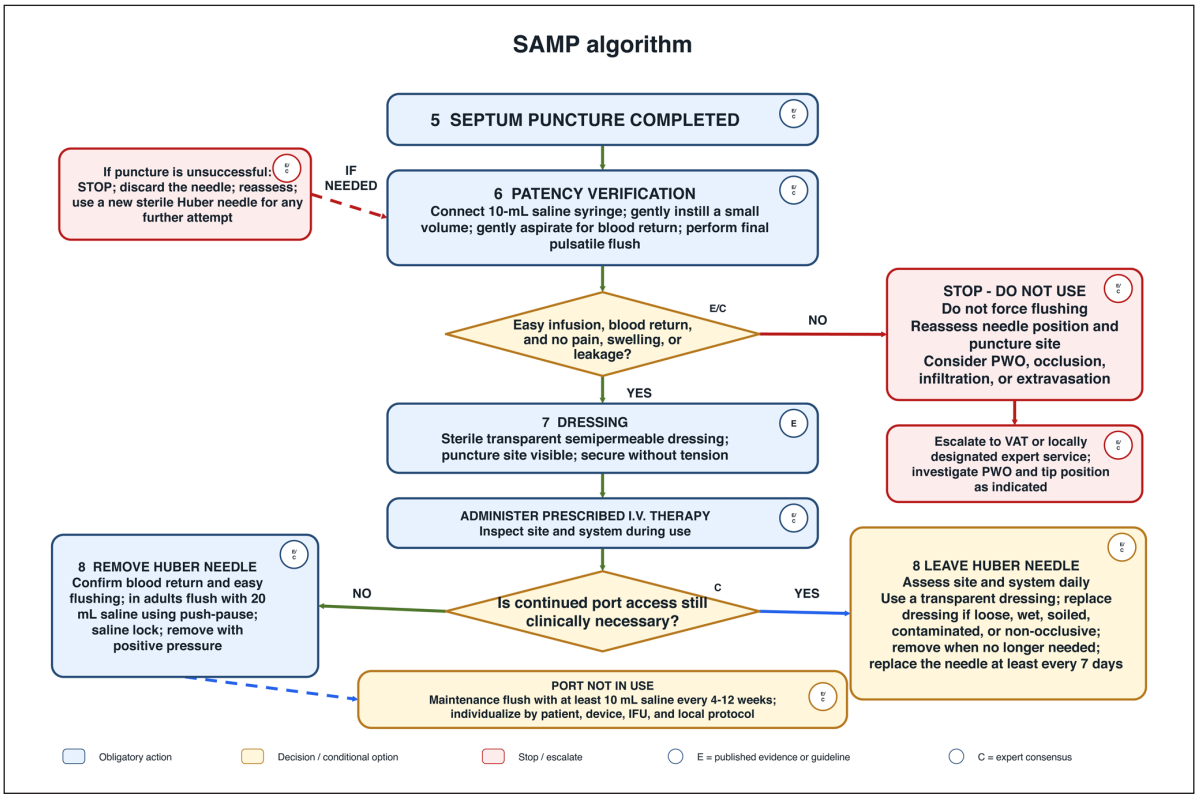

Figure 2. Patency verification, dressing, therapy, and Huber needle removal or continued access.

Point-of-care ultrasound should then be performed by an appropriately trained clinician. A normally oriented chamber is characterized by an expected reservoir profile, with the access septum facing the skin and a stable relationship to the subcutaneous pocket. An altered profile or depth, displacement, abnormal orientation, or inability to identify the expected septum should raise suspicion of partial or complete rotation. Ultrasound assessment may be limited by acoustic artifacts from reflective components, device depth, port design, and operator experience. If clinical and ultrasound findings remain equivocal or discordant, radiography of the anatomical segment containing the port, or another appropriate imaging examination, should be obtained before access is attempted.

If any abnormality is detected, the device must not be used, and prompt referral should be made to the vascular access team (VAT) or to the locally designated clinician or service with equivalent expertise. For the purposes of this algorithm, the term "VAT" refers to a team of clinicians with documented training and competency in vascular access assessment, troubleshooting, ultrasound where applicable, and escalation of device complications. In centers without a formal VAT, escalation may involve interventional radiology, surgery, anesthesiology, oncology, or an infusion-therapy service, according to local organization. Findings and management decisions must be documented in the patient's medical record. Patients and caregivers should be trained to recognize relevant signs and receive clear instructions on how to seek assessment.[3]

Pain management

Pain can be a factor in stress and anxiety for many patients during Huber needle insertion into the reservoir.[22,23] Various strategies may reduce discomfort and local pain, making the overall experience less stressful for the patient.[24]

In this context, distraction techniques such as virtual reality have been extensively studied and have demonstrated reduced pain perception and anxiety among cancer patients undergoing Huber needle placement.[22,23,25–28] Children and adolescents with cancer can experience high levels of pain.[25,26] A recent systematic review[23] and a randomized controlled trial[26] have found that virtual reality reduces pain and anxiety in pediatric oncology patients during port access.

Topical preparations, such as tetracaine gel and lidocaine-prilocaine cream, may be effective for pain management during port access in both adults and children.[29,30] However, these topical anesthetics require prior application, and a prolonged waiting time of 45 to 60 min is needed for maximal efficacy. Nonetheless, they are strongly recommended for children and individuals with needle phobia.[31,32] Preventing pain improves patient satisfaction, reduces procedural delays, and may improve compliance with care protocols. In adults with adequate pain tolerance, topical anesthesia is not routinely required but should be offered to anxious patients with a low pain threshold or needle phobia. Patient needs must be assessed prior to the procedure, including anticipated pain associated with port puncture.[3,31]

Preparation of the material

The materials for the procedure must be properly assembled before the maneuver: 2% chlorhexidine in 70% isopropyl alcohol, sterile gloves, sterile fenestrated drape, non-sterile masks, Huber needle with preassembled extension, prefilled syringes, and semipermeable, transparent dressing.

Barrier precautions include sterile gloves, a small sterile fenestrated drape, and non-sterile masks for both the patient and the clinician.

The sterile Huber needle must be preassembled with a short extension and closed with a needle-free connector. Selecting a Huber needle of the appropriate length (15, 17, 20, or 25 mm) is essential: a needle that is too long may compromise access stability, whereas one that is too short may fail to fully penetrate the septum, resulting in resistance during infusion and an increased risk of extravasation. Appropriate length allows the external components of the Huber needle to rest securely on the skin, minimizing movement.[3,4] If a high-pressure intravenous infusion is planned, a Huber needle suitable for this purpose must be selected (i.e., power-injectable).[33] The caliber of the Huber needle (21 G, 20 G, or 19 G) should be selected based on the type of infusion.

It is recommended to use safety-engineered Huber needles with an extension set that includes a preassembled clamp and a needle-free connector. A safety mechanism for healthcare professionals should also be included to avoid accidental needlestick injuries when removing the needle from the chamber. The external design of the needle should provide a user-friendly system for securely holding the device between the fingers, ensuring proper and safe insertion and removal of the needle from the chamber, and providing comfortable support on the patient's skin without creating pressure points, thereby enhancing device stability during use.

At least two separate 10-mL prefilled saline syringes should be available: one for the initial patency-assessment sequence and another for the final post-aspiration or post-therapy flush. Their preparation and use must comply with local medication-preparation regulations, aseptic practice, compatibility requirements, and institutional policy.

For coverage and securement of the Huber needle, a sterile semipermeable transparent dressing is required. When selecting the transparent dressing, it is recommended to choose semipermeable membranes with a high moisture-vapor transmission rate (MVTR)[4,34] and

reinforced borders to optimize skin transpiration, dressing adhesion, and durability.

The use of standardized kits, including the materials listed above, has been associated with reduced infection rates and improved procedural consistency.[3,4,20]

Hand hygiene and skin antisepsis

Port access is performed after antiseptic hand hygiene, before donning sterile gloves (i.e. according to surgical aseptic non-touch technique). When hands are visibly soiled, or when otherwise indicated by infection-prevention guidance, they should be washed with antiseptic soap and water.[3,4,20]

Any residual local anesthetic ointment on the patient's skin, as well as skin oiliness or visible soiling, should be removed before applying the skin antiseptic. If excess hair is present at the port insertion site and may interfere with the application of a transparent dressing, hair removal may be performed. When necessary, only scissors or surgical clippers should be used for this purpose.[3,4,20]

The skin area that will be covered by the transparent dressing must be disinfected for 30 s with 2% CHG in 70% IPA, preferably using single-dose, single-use applicators.

The use of single-dose sterile applicators for skin antisepsis is recommended for several reasons, including: (a) the content is a certified sterile solution; (b) being single-use, they reduce cross contamination between patients; (c) they are sterile also exteriorly, allowing it to be opened directly onto the sterile field; (d) they contain a pre-measured dose matching the skin area, avoiding waste and underdosing; (e) the integrated sterile sponge facilitates uniform solution application; (f) allowing an aseptic no-touch technique, it keeps hands away from the prepared skin; (g) it allows flexibility in scrubbing, being effective with both a circular and back-and-forth application.[3,4,20] A 3 mL applicator may be sufficient to disinfect the area around the reservoir. An alcohol-based povidone-iodine preparation may be used when CHG is contraindicated or not tolerated. Evidence demonstrates that 2% CHG in 70% IPA is the most effective antiseptic strategy to reduce CRBSIs.[3,4,20,35,36] With a single-dose dispenser, concentric-circle and back-and-forth techniques show no difference in microbial reduction.[37] After disinfection, 30 s are required to achieve maximal antibacterial activity. If povidone-iodine is used, 2 or 3 min may be required.

Septum puncture

This step is crucial for the catheter's proper function, especially to prevent infiltration and extravasation complications. Sterile technique must be followed when inserting indwelling invasive medical devices, as with Huber needle insertion.[3,4,20] The patient must be positioned comfortably and appropriately so that the needle can be inserted safely.

After hand hygiene, while wearing sterile gloves and after skin disinfection, the Huber needle must be primed within the sterile field with sterile saline (and connected to the needle-free connector if not pre-assembled on the device) before accessing the port, ensuring the entire system is ready before puncture.

Using the non-dominant hand, the operator should locate and stabilize the subcutaneous reservoir between two fingers. The needle should enter perpendicularly within the usable central area of the silicone septum, avoiding repeated punctures at the exact same point; the peripheral rim should not be targeted. Repeated punctures at the same point, or exclusive or repeated use of a 19-G Huber needle, may damage the septum and lead to leakage or extravasation.[18,19,38] The Huber needle must be inserted at a perpendicular angle (90°) in the silicone septum. Misalignment and/or oblique punctures increase the risk of septum damage, extravasation, or needle dislodgment. Precision in needle puncture may reduce mechanical complications and repeated attempts, which are themselves risk factors for infection, pain, and unwarranted damage to the port. The Huber needle is advanced until it touches the metallic base of the chamber and no further forward movement is possible. The tip of the needle should not be forced against the bottom of the chamber. If the tip is crushed, removal of the needle may be associated with damage to the septum, which may reduce the practical life of the catheter and increase the risk of infiltration/extravasation.

If the inserted needle must remain in place, folded sterile gauze may be used only when necessary to support the needle wings. The gauze must not obscure the Huber needle puncture site or compromise dressing adhesion or occlusion. If direct visualization cannot be maintained, an alternative stabilization method should be used. The puncture site must remain clinically assessable throughout use.[3,4,18,19]

In the event of an unsuccessful puncture attempt, puncture with a new sterile Huber needle is recommended.

Patency verification

Patency must be verified before any port is used.[3,4] After successful puncture: (a) connect a 10-mL saline syringe; (b) gently instill a small volume of saline to confirm easy infusion, stopping immediately if resistance, pain, swelling, leakage, or another abnormality occurs; (c) gently aspirate to confirm blood return; and (d) perform a final pulsatile flush using the push-pause technique. Blood return is mandatory before vesicant administration,[3] and failure to obtain it is associated with an increased risk of complications.[39] Excessive pressure must never be applied. Failure at any stage requires reassessment and referral to the VAT or the locally designated expert service rather than continued flushing.

Occlusion of the device may be classified as partial occlusion (difficult infusion and/or aspiration) or total

occlusion (impossible infusion and aspiration). A special type of partial occlusion is the persistent withdrawal occlusion (PWO), that is, infusion is easy, but aspiration is impossible. PWO may have several causes, one of which is the so-called pinch-off syndrome (pinching of the catheter between the first rib and the clavicle), typically associated with the landmark-based infraclavicular subclavian puncture. Another possible cause is the use of older closed-ended silicone catheters with a distal valve. Nowadays, PWO is usually related to the presence of a fibroblastic sleeve (FS). FS is a frequent pathophysiological phenomenon occurring to varying degrees in all central venous access devices.[40,41] The pathogenesis of FS remains unclear, and prevention is not possible. It consists of a sleeve of connective tissue surrounding the catheter. If the sleeve reaches the catheter tip, it may cause malfunction, typically during aspiration while infusion is maintained. FS is never associated with local signs or symptoms, and it should be suspected when PWO occurs. Ultrasound can identify FS; however, if the sleeve is around the catheter in the superior vena cava or right atrium, it can be detected only by echocardiography. A safe, cost-effective protocol has been published for managing the port with PWO.[42] It consists of a rapid injection of saline solution through the Huber while visualizing the right atrium by transthoracic echocardiography. If the catheter tip is in the lower SVC or cavo-atrial junction (CAJ), microbubbles appear immediately in the atrium after injection; if this happens, it means that the tip is properly placed and the port can be safely used for any type of infusion. In case of a FICC-port, the same "bubble test" can be applied by visualizing the subdiaphragmatic tract of the vena cava through a transhepatic ultrasound window.[13] The bubble test should be performed by the VAT or by properly trained clinicians.

Partial or complete infusion difficulty is usually due to occlusion of the reservoir and/or catheter lumen from drug precipitates and/or blood clots. It can be prevented by proper flushing technique before and after each infusion, adoption of neutral displacement needle-free connectors, and active flushing during Huber removal.[4,39] If partial or total occlusion occurs, the clinician should notify the local VAT, which will attempt to dislodge the obstruction using hydraulic or pharmacological methods.

Proper dressing of the puncture site

When the Huber needle is inserted, the puncture site must be protected with a semipermeable transparent dressing, which also helps stabilize the needle. Transparent dressings allow visual inspection of the Huber needle puncture site, which is essential for ruling out local complications such as infection and extravasation, and for protecting against bacterial contamination.[3,4,20]

Because patients with a port are often cancer patients receiving antineoplastic, corticosteroid, and immunosuppressive agents, these treatments may increase skin fragility and sensitivity.[37] For this reason, transparent membranes with high MVTR ($>1500\,g/m^2/24\,h.$) should be preferred.[34] The dressing should have borders and be applied to secure the Huber needle and its extension properly, avoiding tension on the tubing or pressure on the skin.[43] In cases of very fragile skin, the use of a skin barrier product should be considered.[21] Care should be taken when removing or replacing the membrane, using "low and slow" movements and/or a removal agent to avoid skin tears.[3]

Huber needle removal or replacement

If the port is used for acute, short-term infusions, the Huber needle is usually removed soon after intravenous treatment. Before Huber removal, catheter function should be assessed by confirming blood return and the absence of resistance to flushing. Once the dressing is gently removed, the Huber needle's bevel must be oriented opposite the outflow channel connecting the catheter to the reservoir. Some in vitro experiments suggest that this orientation may remove more residual blood from the reservoir.[44] In adult patients, flushing with 20 mL of saline solution is recommended using the "push-pause" technique.[45]

Safety-engineered Huber needles may have one-handed or two-handed removal mechanisms. In one-handed systems, stabilization and safety activation are performed with one hand as designed; in two-handed systems, one hand stabilizes the reservoir/device while the other activates withdrawal and shielding. Removal may generally be performed by one trained operator when the device and clinical circumstances permit; a second trained operator should assist when patient movement, difficult stabilization, impaired cooperation, complex dressing removal, or another safety concern makes single-operator removal unreliable.

After flushing, the device is locked with saline. Comparative studies have not demonstrated a significant difference in overall adverse-event rates between heparin and saline locking, while heparin exposes patients to rare but potentially serious drug-specific complications, particularly heparin-induced thrombocytopenia and bleeding. Therefore, routine heparin lock is not recommended, since it is useless and potentially harmful.[2,45–48] The Huber needle should be removed while flushing with an additional amount of saline to maintain positive pressure inside the device. For prolonged infusions, the needle must be removed and replaced at least every 7 days.[3,15] The maneuvers for removal and replacement should follow the same recommendations reported in this algorithm at step 8 (removal) and step 5, respectively.

When a port is not in use for a prolonged period, flushing with at least 10 mL of saline every 4 to 12 weeks represents a conventional, guideline-compatible maintenance range.[2,4] Extension beyond 12 weeks has emerging but not definitive support, including retrospective evidence from selected low-comorbidity survivors, and should not be

generalized without further prospective evaluation. Interval selection should consider the patient population, port type, previous dysfunction, expected reuse, and institutional protocol. When dysfunction or abnormal reservoir contents are suspected after a prolonged interval, the port should be assessed according to protocol. The access technique for periodic maintenance is otherwise the same as described in the SAMP algorithm.

Discussion

Published port-maintenance strategies do not provide a single standardized pathway for bedside access. Complications have been associated with both device characteristics and procedural factors, and variability in practice remains a potentially modifiable contributor.[15–17] Only a small number of studies have addressed specific aspects of port access, including difficult Huber needle insertion and the patient's experience of reservoir puncture.

The Infusion Nurses Society[3] and the GAVeCeLT[4] have issued general recommendations on vascular access management, but neither includes a protocol specifically for port access. The SAMP Algorithm was developed by WoCoVA, GAVeCeLT, and IVAS to address this gap, translating existing standards and procedure-specific evidence into an eight-step, sequential process that may be consistently reproduced at the bedside by any healthcare professional, even those who are not vascular access experts.

SAMP may support more consistent practice by bringing together evidence that is currently dispersed across recommendations concerning skin antisepsis,[35–37] dressings and securement[34] patency assessment,[39–42] the importance of the orientation of the Huber needle bevel and catheter locking[39,44] In this regard, locking with normal saline appears to provide patency outcomes comparable to those obtained with heparin. Avoiding unnecessary heparin exposure also eliminates the small but clinically relevant risks of heparin-related adverse events, including heparin-induced thrombocytopenia, bleeding, hypersensitivity, and medication errors.[2,45,48–51]

The algorithm also addresses the procedure from the patient's perspective. Pain and anxiety during repeated port access are particularly relevant in children and adolescents.[26–28] SAMP addresses pain and stress by incorporating recent evidence on non-pharmacological strategies, such as virtual reality distraction,[22–28,52] as adjuncts to local anesthesia[29,30] to reduce anxiety during needle insertion. By embedding this technique within the stepwise process of port access, the algorithm aims to reduce not only the physical, but also the psychological burden of repeated port access–an outcome increasingly recognized as central to patient-reported quality of life in long-term vascular access care.[4,24,53–55]

The sequential structure of SAMP makes it an ideal tool for training and competency development. Because each step corresponds to an assessable action–from skin and reservoir assessment through needle removal–the algorithm lends itself naturally to standardized teaching, simulation-based training for new professionals, and structured competency checklists, in line with the educational emphasis already present in existing infusion-therapy and vascular-access standards.[3,4]

Finally, the SAMP algorithm completes an evidence-based continuum of care for ports developed over the last decade, including standardized insertion bundles for chest ports and PICC ports[6,7,10–13] and for port removal.[14] By formalizing the previously unstandardized intermediate phase—port access and needle removal over the life of the device—SAMP addresses a recognized gap in the literature[50] and provides the missing link between insertion and removal in the clinical management pathway for implanted ports.

Conclusion

The SAMP algorithm is consistent with international recommendations from vascular access societies and provides greater specificity for puncture and management procedures, offering a sequential, actionable algorithm suitable for bedside use and for standardizing practice among healthcare professionals. It addresses the major preventable complications associated with implanted port use identified throughout the literature reviewed in this article.

Adopting the SAMP algorithm may require institutional commitment to education and training, provision of appropriate resources and consumables, and ongoing auditing to ensure clinician competency. Hospitals and cancer centers may consider incorporating the SAMP algorithm into their vascular access policies, nursing competency programs, and training curricula for new staff.

Although promising in theory and grounded in current literature, the SAMP protocol requires empirical validation through prospective, multicenter studies to confirm its effectiveness, safety, and cost-benefit profile. Future research should specifically evaluate the impact of algorithm adherence on clinically meaningful outcomes—infection, extravasation, occlusion and persistent withdrawal occlusion, procedural pain and anxiety, and patient satisfaction—as well as its feasibility across resource settings and its performance as an educational and competency-assessment tool.

Author contributions

All authors made equal contributions in the conception of the paper and in the revision of the manuscript.

Availability of data and materials

Not applicable for this submission.

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.

Ethics approval and consent to participate

Not applicable to this work.

Consent for publication

All authors consent to the submission and publication of this work.

Duplicate publication policy

The content of this work has not been previously published or submitted for publication elsewhere.

ORCID iDs

Gloria Ortiz Miluy https://orcid.org/0000-0003-2252-3649
Timothy R. Spencer https://orcid.org/0000-0002-3128-2034
Fulvio Pinelli https://orcid.org/0000-0002-9926-2128
Mauro Pittiruti https://orcid.org/0000-0002-2225-7654

References

1. van Rens M, 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.
2. Jahanzeb M, Wu CY, Lim H, et al. International experts consensus on optimal central vascular access device selection and management for patients with cancer. *J Vasc Access* 2025; 26(5): 1447–1458.
3. Nickel B, Gorski L, Kleidon T, et al. Infusion therapy standards of practice, 9th edition. *J Infus Nurs* 2024; 47(1S Suppl 1): S1–S285.
4. Pittiruti M and Scoppettuolo G (eds). *Raccomandazioni GAVeCeLT 2024 per la indicazione, l'impianto e la gestione dei dispositivi per accesso venoso* [Internet]. GAVeCeLT, 2024 https://gavecelt.it/nuovo/biblioteca/raccomandazioni-gavecelt-2024
5. Pinelli F, Barbani F, Defilippo B, et al. Quality of life in women with breast cancer undergoing neoadjuvant chemotherapy: comparison between PICC and PICC-port. *Breast Cancer* 2024; 31(5): 945–954.
6. Brescia F, Annetta MG, Pinelli F, et al. A GAVeCeLT bundle for chest-port insertion: the SIC-Port protocol. *J Vasc Access* 2026; 27(3): 877–884.
7. 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.
8. Annetta MG, Ostroff M, Marche B, et al. Chest-to-arm tunneling: a novel technique for medium/long term venous access devices. *J Vasc Access* 2023; 24(1): 92–98.
9. Annetta MG, Marche B, Ortiz Miluy G, et al. Totally implanted central venous access devices inserted by the femoral route: a narrative review and the proposal of a novel approach, the FICC-port. *J Vasc Access* 2025; 26(3): 871–879.
10. Faraone V, Pittiruti M, Annetta MG, et al. An Italian expert consensus on the choice of the method of tip location for central venous access devices. *J Vasc Access* 2026; 27(1): 12–25.
11. Pittiruti M, Pelagatti F and Pinelli F. Intracavitary electrocardiography for tip location during central venous catheterization: a narrative review of 70 years of clinical studies. *J Vasc Access* 2021; 22(5):778–785.
12. Annetta MG, Elli S, Gidaro A, et al. Ultrasound-based tip navigation and tip location during placement of central venous access devices in adult patients: the ECHOTIP protocol revisited. *J Vasc Access* 2026; 27(2): 409–415.
13. Annetta MG, Marche B, Giarretta I, et al. Applicability and feasibility of intraprocedural tip location of femorally inserted central catheters by transhepatic ultrasound visualization of the inferior vena cava in adult patients. *J Vasc Access* 2024; 25(2): 651–657.
14. Annetta MG, Pinelli F, Ortiz Miluy G, et al. The SaRePo protocol: a seven-step strategy to minimize complications potentially related to the removal of totally implanted central venous access devices. *J Vasc Access* 2026; 27(1): 5–11.
15. Groeger JS, Lucas AB, Thaler HT, et al. Infectious morbidity associated with long-term use of venous access devices in patients with cancer. *Ann Intern Med* 1993; 119(12): 1168–1174.
16. Kock HJ, Pietsch M, Krause U, et al. Implantable vascular access systems: experience in 1500 patients with totally implanted central venous port systems. *World J Surg* 1998; 22(1): 12–16.
17. Yıldırım NÖ. Totally implantable venous access devices: study of 1,613 patients and complication management. *GKDA Derg* 2023; 29(4): 211–217.
18. Pittiruti M and Pinelli F. *Manuale GAVeCeLT Dei Port*. Milano: EDRA, 2024.
19. Dupont C and Kriegel I. *Guide pratique des chambres à cathéter implantables*. Paris: Lamarre Edition, 2019.
20. Scoppettuolo G and Pittiruti M. Prevenzione e gestione delle infezioni associate a catetere venoso. *Documento SIMPIOS–GAVeCeLT* (cap. 25). 2025. https://gavecelt.it/nuovo/sites/default/files/uploads/Prevenzione%20e%20gestione%20delle%20Infezioni%20da%20catetere.pdf
21. Broadhurst D, Moureau N, Ullman AJ, et al. Management of central venous access device-associated skin impairment: an evidence-based algorithm. *J Wound Ostomy Continence Nurs* 2017; 44(3): 211–220.
22. Menekli T, Yaprak B and Doğan R. The effect of virtual reality distraction intervention on pain, anxiety, and vital signs of oncology patients undergoing port catheter implantation: a randomized controlled study. *Pain Manag Nurs* 2022; 23(5): 585–590.
23. Dong J, Wang W, Khoo KYJ, et al. Effects of virtual reality interventions for needle-related procedures in patients with cancer: a systematic review and meta-analysis. *Cancers (Basel)* 2025; 17(12): 1954.
24. Wild EM, Piccolo G, Syrimi E, et al. Pain management during interventions in paediatric oncology in Europe – results from a pan-European survey. *EJC Paediatr Oncol* 2025; 7: 100481.

25. Novials C, Badas J, Duranteau O, et al. Utility of virtual sedation in subcutaneous implantable access port placement: a randomized controlled trial. *J Vasc Access* 2026; 27(1): 176–182.
26. Gerçeker GÖ, Bektaş M, Aydınok Y, et al. The effect of virtual reality on pain, fear, and anxiety during access of a port with Huber needle in pediatric hematology-oncology patients: randomized controlled trial. *Eur J Oncol Nurs* 2021; 50: 101886.
27. Savaş EH, Semerci R and Bayram C. The effect of a biofeedback-based virtual reality game on pain, fear and anxiety levels during port catheter needle insertion in pediatric oncology patients: a randomized controlled study. *Eur J Oncol Nurs* 2024; 70: 102621.
28. Önel AE, Gıynaş T, Küçük S, et al. The effect of virtual reality application on pain in port catheter access in pediatric oncology patients: systematic review and narrative synthesis. *J Nursology* 2025; 28(1): 76–88.
29. Shi S, Zhu R, Huang X, et al. Comparison of the effects of Valsalva maneuver, EMLA cream, and the combination of both in relieving pain of needle insertion on totally implantable access port: a randomized controlled study. *J Vasc Access* 2024; 25(5): 1576–1583.
30. Loeffen EAH, Mulder RL, Font-Gonzalez A, et al. Reducing pain and distress related to needle procedures in children with cancer: a clinical practice guideline. *Eur J Cancer* 2020; 131: 53–67.
31. Nie S, Wang L, Li X, et al. Satisfaction and health-related quality of life in cancer patients with chest ports: a cross-sectional multicenter parallel mixed-methods study. *J Vasc Access* 2026; 27(1): 201–214.
32. World Health Organization. *Guidelines for the prevention of bloodstream infections and other infections associated with the use of intravascular catheters: part 2: central venous catheters* [Internet]. Geneva: World Health Organization, 2026. https://iris.who.int/handle/10665/385723
33. Bonciarelli G, Batacchi S, Biffi R, et al. GAVeCeLT consensus statement on the correct use of totally implantable venous access devices for diagnostic radiology procedures. *J Vasc Access* 2011; 12(4): 292–305.
34. 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.
35. Deng A, Xiong F and Ren Q. Chlorhexidine solutions are more effective than povidone-iodine solutions as skin disinfectants for the prevention of intravascular catheter-related infections: a meta-analysis. *Sci Rep* 2025; 15(1): 10657.
36. Mimoz O, Lucet JC, Kerforne T, et al. Skin antisepsis with chlorhexidine-alcohol versus povidone iodine-alcohol, with and without skin scrubbing, for prevention of intravascular-catheter-related infection (CLEAN): an open-label, multicentre, randomised, controlled, two-by-two factorial trial. *Lancet* 2015; 386(10008): 2069–2077.
37. Carre Y, Moal B, Germain C, et al. Randomized study of antiseptic application technique in healthy volunteers before vascular access insertion (TApAS trial). *J Infect* 2020; 81(4): 532–539.
38. Goossens GA, Kerschaever I, Despierre E, et al. Access of a fully rotated implantable port leads to extravasation. *J Vasc Access* 2013; 14(3): 299–300.
39. Goossens GA. Flushing and locking of venous catheters: available evidence and evidence deficit. *Nurs Res Pract* 2015; 2015: 985686.
40. Trezza C, Califano C, Iovino V, et al. Incidence of fibroblastic sleeve and of catheter-related venous thrombosis in peripherally inserted central catheters: a prospective study on oncological and hematological patients. *J Vasc Access* 2021; 22(3): 444–449.
41. Passaro G, Pittiruti M and La Greca A. The fibroblastic sleeve, the neglected complication of venous access devices: a narrative review. *J Vasc Access* 2021; 22(5): 801–813.
42. D'Arrigo S, Annetta MG and Pittiruti M. An ultrasound-based technique in the management of totally implantable venous access devices with persistent withdrawal occlusion. *J Vasc Access* 2023; 24(1): 140–144.
43. Lacouture ME, Sibaud V, Gerber PA, et al. Prevention and management of dermatological toxicities related to anticancer agents: ESMO Clinical Practice Guidelines. *Ann Oncol* 2021; 32(2): 157–170.
44. Guiffant G, Durussel JJ, Flaud P, et al. Flushing ports of totally implantable venous access devices, and impact of the Huber point needle bevel orientation: experimental tests and numerical computation. *Med Devices (Auckl)* 2012; 5: 31–37.
45. Pittiruti M, Bertoglio S, Scoppettuolo G, et al. Evidence-based criteria for the choice and the clinical use of the most appropriate lock solutions for central venous catheters (excluding dialysis catheters): a GAVeCeLT consensus. *J Vasc Access* 2016; 17(6): 453–464.
46. Goossens GA, Jérôme M, Janssens C, et al. Comparing normal saline versus diluted heparin to lock non-valved totally implantable venous access devices in cancer patients: a randomised, non-inferiority, open trial. *Ann Oncol* 2013; 24(7): 1892–1899.
47. Bertoglio S, Solari N, Meszaros P, et al. Efficacy of normal saline versus heparinized saline solution for locking catheters of totally implantable long-term central vascular access devices in adult cancer patients. *Cancer Nurs* 2012; 35(4): E35–E42.
48. Brito ARO, Nishinari K, Saad PF, et al. Comparison between Saline solution containing heparin versus saline solution in the lock of totally implantable catheters. *Ann Vasc Surg* 2018; 47: 85–89.
49. Egnatios D and Gloria C. Implanted port patency: comparing heparin and normal saline. *Clin J Oncol Nurs* 2021; 25(2): 169–173.
50. Baek G, Huynh P, Cunningham T, et al. Central line patency: management with normal saline flushes for adult patients with cancer. *Clin J Oncol Nurs* 2023; 27(3): 274–280.
51. Ullman AJ, Edwards R, Walker R, et al. Routine catheter lock solutions in pediatric cancer care: a pilot randomized controlled trial of heparin vs saline. *Cancer Nurs* 2022; 45(6): 438–446.

52. Comparcini D, Simonetti V, Galli F, et al. Immersive and non-immersive virtual reality for pain and anxiety management in pediatric patients with hematological or solid cancer: a systematic review. *Cancers (Basel)* 2023; 15(3): 985.
53. Abou-Mrad A, Marano L and Oviedo RJ. A monocentric analysis of implantable ports in cancer treatment: five-year efficacy and safety evaluation. *Cancers (Basel)* 2024; 16(16): 2802.
54. Civetta G, Lombardi L, Lanotte A, et al. Needle Insertion Difficulty Algorithm (NIDA): a novel pilot study to predict Huber needle insertion difficulty in totally implanted devices. *J Vasc Access* 2023; 24(3): 492–496.
55. Goossens GA, Douchy T, Jérôme M, et al. Port REMoval Outcomes (PREMO) study: patients' experiences with a totally implantable venous access device: a questionnaire at device removal. *J Vasc Access* 2026; 27(2): 486–494.