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Central Vascular Access Device Guidelines for Pediatric Home-Based Patients: Driving Best Practices

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Abstract

Central vascular access device (CVAD) care for infants and children in home settings is challenging due to small catheter sizes, patient activity, and variation in care and maintenance practices. CVADs require detailed care to prevent complications and unnecessary line replacement. Guidelines that address CVAD care and maintenance for pediatric home-based patients do not exist. This article reviews evidence-based central venous catheter maintenance practices for pediatric home care patients.

Keywords: pediatric, central vascular access device, flushing, dressing, blood sampling, complication

Introduction

For pediatric patients receiving infusion therapy at home, a central vascular access device (CVAD) represents a lifeline to treatment. CVADs are commonly used in home care settings for the administration of antibiotics, parenteral nutrition, and fluids as well as blood sampling for both acute and chronic conditions.¹ Maintaining the CVAD to allow uninterrupted delivery of the prescribed infusion therapy is a primary goal of home infusion providers; however, this goal can be challenging to accomplish given the wide range of professional and lay caregivers who may be involved in a patient's home infusion treatment. Guidelines that address CVAD care and maintenance considerations for pediatric home-based patients do not exist.

In early 2012, a panel of clinicians specializing in pediatric care representing hospital and home-based infusion providers met to review published guidelines and standards of practice with a goal of developing a simple tool promoting

a standardized, evidence-based approach to CVAD care that meets the unique needs of pediatric home-based patients. With few randomized, double-blind clinical trials performed in home care settings, and even fewer focused on pediatric patients, this pediatrics-specific CVAD guideline tool evolved from a combination of acute care-based research, published standards and guidelines, and professional experience. As new research is published, it is vital for clinicians who work in home-based care to review and continuously integrate evidence-based care into their home infusion clinical practice.

Organized into functional sections, the CVAD Guidelines for the Pediatric Home-Based Patient (Appendix 1) is intended to provide a concise, quick-reference tool for the care and maintenance of CVADs in home-based pediatric patients. Because the guideline begins with the care and maintenance of an access device that is already in place, and therefore does not address CVAD selection or placement considerations, this topic is covered briefly before addressing the specific recommendations contained within each functional area of the guideline.

Types of CVADs Used in Pediatric Patients

CVADs provide reliable and safe access for many types of infusion therapies.¹ The catheter tip location is important for decreasing complications and maximizing catheter dwell

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time.² The optimal tip location for all CVADs is the distal superior vena cava for upper extremity sites, and the inferior vena cava for sites in lower extremities.² The vena cava provides rapid hemodilution of infusates, which minimizes trauma to the vessel wall.² Catheter selection begins with the type and length of infusion therapy prescribed, diagnosis, age, developmental level, and patient/parent/clinician preference along with available veins to access.³ In home care settings, patient comfort and ease of use are also factors to consider when selecting a CVAD. The acute care hospital from which a pediatric patient is discharged often drives the decision on what type of CVAD a patient will receive.

Table 1 provides specific information for pediatric CVADs. The chart serves as a resource for types of pediatric CVADs, description, priming volumes, and special considerations. In addition to choosing an appropriate CVAD for a young patient, proper care and maintenance is critical.⁴ Central line maintenance bundles that focus on evidence-based practices grouped together have gained momentum for identifying best practices for pediatric CVAD care. There have been several recent publications on proven success in reducing central line-associated bloodstream infection (CLABSI) and improved catheter outcomes with pediatric central line bundles.⁵ Although the bundle includes many key areas related to infection control, collaborate with the prescribing provider in planning for timely CVAD removal upon completion of therapy.⁶

Flushing or Locking a CVAD

Catheter flushing serves 2 primary purposes: it verifies the patency (in conjunction with a blood return) and serves as a barrier when administered between incompatible medication to prevent precipitation.⁷ Due to the higher risk of catheter occlusion in small-size catheters, robust flushing protocols are essential in preventing fibrin attaching to the catheter wall.⁴ In pediatric populations, there is evidence linking fibrin formation to CLABSI.⁸

Basic tenets of CVAD flushing include syringe size, type and amount of flush, and frequency. The volume of flush should be at least 2 times the internal volume of the catheter and any add-on devices.⁹ The internal volume of the catheter or priming volume can be located on the catheter manufacturer's instructions for use. Documentation of the flushing volume should be documented in the patient's home care medical records as an ongoing reference.⁹

Preservative-free normal saline is the most commonly used flush solution, instilled before and after blood sampling and medication administration.⁴ Dextrose 5% in water is an alternative flush solution when administering medications that are not compatible with normal saline, such as amphotericin. A 10-mL syringe is recommended when performing the initial CVAD flush to assess for patency, and with routine flushing.¹⁰ Syringe sizes smaller than 10 mL can generate excessive intraluminal pressure and lead to catheter damage.⁴ For low-volume medication administration that necessitates a smaller syringe size for dose accuracy, the CVAD should be initially flushed and assessed for patency with a 10-mL syringe.⁹ Upon establishment of patency, a smaller syringe can be

used to carefully administer the medication.⁸ Regardless of the syringe size, flushing should not continue if resistance is met.¹¹ All syringes are for single-use only.⁶

Locking solutions may be instilled as a final flush to maintain CVAD patency. Pediatric locking solutions include 1 to 3 mL heparinized saline (10 units/mL) when the CVAD is not in use.⁴

Implanted ports are the exception as they require locking with 5 mL of 100 units/mL heparinized saline before being deaccessed. Valved CVADs should be flushed per the manufacturer's instructions for use. For patients requiring a long-term valved CVAD, heparinized saline may be necessary for preventing catheter occlusion. In select patient populations, ethanol lock therapy has been shown to reduce the incidence of CLABSI. The population includes intestinal failure or patients receiving long-term parenteral nutrition.^{12,13}

Needleless Connector/Injection Cap Care

The Needlestick Safety and Prevention Act of 2000 mandated, among other things, that health care employers implement engineering controls such as needleless connectors to protect health care workers from needlestick exposures. Numerous published studies now suggest that whereas devices such as needleless connectors have protected health care workers and reduced needlestick injury rates over the past 11 years, design characteristics of some needleless connectors are also associated with an increased risk of bloodstream infections.¹⁴

Some of the increases in bloodstream infections observed with needleless connector use have been associated with a convoluted connector surface or gaps that are difficult to clean and disinfect. As needleless connectors become increasingly complex in their overall design, the possibility of incorrectly or inadequately cleaning, flushing, and clamping the connector further adds to these risks. In July 2010, the US Food and Drug Administration sent a letter to infection control practitioners regarding positive displacement needleless connectors.¹⁴ The agency now requires companies that manufacture these devices to conduct after-market surveillance research to assess if the connectors are associated with a higher rate of bloodstream infections. A number of needleless connector manufacturers have responded to this initiative by posting their data on their websites.

Clinicians, as well as caregivers who are taught how to administer the prescribed therapy, should vigorously disinfect the needleless connector with an appropriate agent before each use.^{9,14} The use of friction is essential for working the solution into any recesses or irregular surfaces on which microorganisms can thrive.¹⁴ A solution of at least 70% alcohol has been found to be very effective following a 15-second scrub and a relatively short drying time, and may be the most cost-effective option for needleless connector antisepsis.^{9,14} A combination chlorhexidine gluconate-alcohol solution has also been used for needleless connector antisepsis, with several configurations available from ampule-based applicators to pre-moistened gauze pads.¹⁵ Povidone iodine and/or an iodine tincture are less commonly used because of the prolonged

Table 1. Types of Central Vascular Access Devices

CVAD Type	Description	Priming Volumes	Special Considerations
<p>Midline Catheter</p> <ul style="list-style-type: none"> • Available in single or double lumen • Indicated for therapy between 5 days and up to 4 weeks 	<ul style="list-style-type: none"> • Catheter length is 3-8 inches • Commonly inserted in upper extremity (basilic, cephalic, or brachial vein) with tip termination distal to shoulder. • For infants, site selection may include: <ul style="list-style-type: none"> ○ Lower extremity veins (saphenous or popliteal vein) with tip termination below the groin ○ Scalp veins (temporal or posterior auricular vein) with tip termination in the neck, above the thorax region. 	<p>1.9/2 Fr: 0.08-0.1mL 3Fr: 0.16ml 4Fr: 0.19ml 5Fr: 0.22ml</p>	<ul style="list-style-type: none"> • Infuse peripheral solutions only, pH >5 and < 9, osmolality < 600mOsm/L • Do not infuse irritants, vesicants, and parenteral nutrition • Avoid continuous infusion
<p>Peripherally Inserted Central Catheter (PICC)</p> <ul style="list-style-type: none"> • Available in single, double, or triple lumen • Indicated for therapies 5-7 days or greater, poor peripheral access, infusion of vesicant/irritant solutions 	<ul style="list-style-type: none"> • For upper extremity PICCs, optimal tip location is the distal superior vena cava (SVC) • For lower extremity PICCs, optimal tip location is the inferior vena cava (IVC) 	<p>1.9/2Fr: 0.08-0.1ml 3Fr: 0.2-0.38ml 4Fr: 0.38-1.5ml 5Fr: 0.4-0.8ml 6Fr: 0.5-0.6ml</p>	<ul style="list-style-type: none"> • PICCs can infuse all types of therapies • Measure external length of catheter to assess for catheter migration or dislodgement • Blood sampling acceptable for 3Fr and larger PICCs • Avoid venipuncture or blood pressure in same extremity of PICC • Avoid excessive activity or lifting in same extremity of PICC • Monitor upper arm for edema, redness, or cording of vein
<p>Tunneled Central Venous Catheter</p> <ul style="list-style-type: none"> • Also known as Hickman or Broviac • Available in single, double, or triple lumen • Indicated for long-term or frequent access 	<ul style="list-style-type: none"> • Common insertion site includes chest, may also be inserted in abdominal area • Tunneled under the skin to distal SVC • Dacron cuff under the skin prevents bacterial migration and secures catheter 	<p>2.7Fr: 0.15ml 4.2Fr: 0.3ml 5Fr: 0.5ml 6.6Fr: 0.7ml 7Fr (DL): 0.6-0.9ml 9Fr: 1.5-2ml</p>	<ul style="list-style-type: none"> • Requires surgical placement and removal • May be repaired by using the manufacturer's repair kit • Sutures may be removed 2-3 weeks after insertion with prescriber order • Dacron cuff should not be visible at insertion site
<p>Non-Tunneled Central Venous Catheter</p> <ul style="list-style-type: none"> • Available in single, double, or triple lumen 	<ul style="list-style-type: none"> • Common insertion sites include subclavian, jugular or femoral vein 	<p>2-3Fr: 0.05-0.15ml 4Fr: 0.3ml 4Fr (DL): 0.1-0.2mL 5Fr: 0.2ml</p>	<ul style="list-style-type: none"> • Not intended for home care setting due to risk of infection and air embolism

(Continued on next page)

Table 1. (Continued)

CVAD Type	Description	Priming Volumes	Special Considerations
<ul style="list-style-type: none"> Indicated for urgent access, critically-ill patient, short-term therapy (<7 days) or failed attempts of other CVADs 	<ul style="list-style-type: none"> Tip resides in distal SVC for subclavian and jugular vein insertion, IVC for femoral vein insertion 	<p>5Fr (TL): 0.2-0.3mL 7Fr (TL): 0.3-0.5ml</p>	<ul style="list-style-type: none"> May be removed with prescriber's order by nurses with demonstrated competency (Consult organizational policies/procedures for removal guidelines)
<p>Implanted Port</p> <ul style="list-style-type: none"> Available in single or double lumen. Appropriate for long-term or intermittent therapy 	<ul style="list-style-type: none"> Common insertion sites include the chest or arm Catheter attached to reservoir, which is implanted under the skin Tip resides in distal SVC 	<p>6Fr: 1.6mL 8Fr: 1.8mL 10Fr: 1.8mL</p>	<ul style="list-style-type: none"> Requires surgical placement and removal With infusion therapy, access with Huber non-coring needle, using aseptic technique every 7 days Flush every 30 days when not accessed Folded gauze beneath Huber needle wings and covered with a transparent dressing can be changed every 7 days

drying time required for full efficacy, unless they are combined with alcohol in a formulation that greatly enhances drying time. It is important to note that although all 3 of these agents are considered skin antiseptics, only isopropyl alcohol is approved by the Environmental Protection Agency for nonorganic surface disinfection.¹⁶

Innovative disinfectant products have also entered the marketplace, some that bathe the needleless connector with antiseptic for a prolonged period and others that are designed to penetrate the crevices that can harbor bacteria in difficult-to-reach places. Although more costly than alcohol prep pads, some providers are reporting fewer CLABSIs after implementing an innovative antiseptic device.¹⁷

One of the earliest types of needleless connectors still in use today is the split-septum design that is accessed with a blunt cannula or syringe/tubing tip. Because the split-septum connectors have not been implicated in the recent reports of increased connector-related CLABSIs, the 2011 Centers for Disease Control and Prevention guidelines specifically note that the split-septum connector “may be preferred over some mechanical valves due to the increased risk of infection with the mechanical valves.”¹⁴ However, because CLABSI is just 1 example of a CVAD complication that may be associated with specific needleless connectors, infusion providers are encouraged to once again closely examine their own clinical outcomes, in addition to published research, as they select the best needleless connector for their patients.

In the race to design the ideal connector that either reduces microbial ingress, reduces blood backflow into the catheter tip upon disconnection, or that accomplishes both at the same

time, manufacturers have brought more than 21 needleless connectors to market in the past 15 years. These connectors vary in shape, size, color, and functionality—a perfect recipe for confusion among end users, particularly nurses in home care settings who encounter many different types of these needleless connectors. To minimize confusion by end users (both patients and nurses) needleless connectors are now being categorized in terms of the movement of fluid at the tip of the catheter that occurs when the syringe or tubing is removed from the device. Classified as either positive, negative, or neutral displacement, each cap that moves fluid upon disconnection requires a specific flush-clamp sequence to minimize the movement of blood back up into the catheter tip where it can cause an eventual occlusion.¹⁸ This flush-clamp sequence is an essential element of clinician and caregiver education.

The next section of the CVAD guidelines address frequency and technique for changing the needleless connector. In general, connectors must be replaced after they have been removed from a catheter, or when blood pulled into the connector cannot be completely flushed out. Connectors that show signs of contamination or defect, such as cracks, leaks, or septum damage, should also be changed as soon as possible. When a needleless connector is appropriately disinfected before each use, it can generally remain in place for 3 to 4 days. An exception to this rule that would necessitate a more frequent change schedule might be a manufacturer recommendation for more frequent changes. See Blood Sampling below for recommendations regarding needleless connector change when blood cultures are drawn through a CVAD.

When changing a needleless connector, some organizations utilize a sterile cap-change kit to facilitate aseptic technique and standardized supplies during the cap change procedure. Additionally, some organizations mandate that users clean the catheter hub with an antiseptic solution between every needleless connector change; others perform this disinfection only when dried blood or medication/solution precipitate is visible on the catheter hub. In the absence of published data to support these practices, infusion providers are encouraged to evaluate their patient outcomes and specific patient and caregiver circumstances that may warrant these additional steps.

Blood Sampling

Blood sampling is safe and effective in CVADs larger than 3 Fr.¹⁹ Although CVAD blood sampling is routinely performed in pediatric patients, there is an inherent risk of infection. The risk of CLABSI is lower in home care patients although the risk remains due to the presence of a CVAD.⁶ The alternative to obtaining a CVAD blood sample is performing a venipuncture and in the home care setting, this is a difficult task for pediatric patients due to their small veins, limited sites, and patient activity level. As with any procedure, risks and benefits should be thoroughly discussed with the prescribing provider.

Before obtaining a blood sample for laboratory analysis, a blood discard is necessary (see below for an exception when blood is drawn for culture). The Infusion Nursing Society's standard is to discard 1 to 3 mL blood or 2 times the internal volume of the catheter and any add-on devices (such as extension sets).⁹ The internal volume of the catheter or priming volume is usually described in the manufacturer's instructions for use. The total volume of blood withdrawn for lab sampling should be limited to 3 mL/kg/day in a 24-hour period to minimize the volume of blood loss. Immediately following the blood sampling, flush with 10 to 20 mL normal saline unless the patient is fluid restricted.⁸ Follow the flush with a lock solution if CVAD will not be in continuous use.

When obtaining a blood culture from a CVAD, sterile technique must be used to avoid contaminating the specimen. A blood discard is not recommended. Infusion Nursing Society standards also recommend that the needleless connector be removed from the CVAD before obtaining blood for culture, withdrawing the specimen directly from the CVAD hub before replacing the needleless connector to avoid contamination of the specimen through a potentially colonized device.⁹ If multiple laboratory tests are necessary, the blood culture should be drawn first. The procedure for obtaining a blood culture from a CVAD is considered sterile.

Blood Return

A CVAD whose tip resides in the superior vena cava or inferior vena cava should flush and aspirate freely. The vena cava provides a large volume of blood that facilitates brisk hemodilution of blood.² Nurses should assess for blood return before medication administration in CVADs >3Fr.¹⁹ Patients and caregivers are not routinely taught to assess patency by checking for a blood return, given the increased risk for

catheter occlusion that can result from the checking process, particularly if the blood is not completely flushed out of the CVAD before therapy is begun. However, self-administration of vesicant or irritant medications would necessitate a blood-return verification before each dose.⁴ If unable to obtain a brisk blood aspirate, rule out mechanical complications such as a kinked/clamped catheter, position of the patient, or a precipitate.⁴ If a thrombotic occlusion is suspected, a thrombolytic may be indicated.⁹

Tubing/Add-On Devices

Medication administration through a CVAD is either continuous or intermittent. A continuous infusion consists of a predetermined volume of fluid/dose of medication that is delivered over several days.⁹ The infusion includes an infusion pump and an administration set or tubing that is connected to the CVAD.

Chemotherapy and medications to manage severe, malignant pain are commonly given in the continuous mode. Depending on the type of CVAD, add-on devices may also be present. A disadvantage of continuous infusion, particularly with young patients, is the limitation it can place on their mobility. However, a number of innovative ambulatory infusion pumps and carrying cases are now available to facilitate maximal patient independence and activity level.

Intermittent infusions are administered at predetermined intervals, generally over 15 to 90 minutes. Common intermittent infusions are a single dose of an antibiotic. In home care, the majority of infusion therapies are delivered intermittently. The infusion may include an infusion pump in addition to tubing that is connected to the CVAD. Regardless of the type of infusion, di-2-ethylhexylphtalate-free (DEHP-free) tubing is preferred for all administration sets and IV add-on devices for all pediatric patients.

Tubing and add-on devices are changed at intervals that are dependent on the type of infusate:

- Lipids or lipid-based drugs, at least every 24 hours.^{9,14}
- Blood/blood products, every 4 hours.^{9,14}
- Parenteral nutrition solutions, every 24 hours. (Note that tubing may be used up to 96 hours for parenteral nutrition solutions given continuously without lipids).^{9,14}
- Continuous infusion (ie, tubing remains connected to the CVAD), every 96 hours.^{9,14}
- Intermittent infusion (ie, disconnected from the CVAD or primary line when infusion is complete), every 24 hours.^{9,14}
- Extension sets or inline filters and manual flow-control devices, with each tubing change or when damaged or compromised.⁹
- Devices added to the CVAD (between the CVAD and the needleless connector), when the needleless connector is changed, or at least every 7 days.
- All add-on devices and tubing should be luer-lock.⁹

Dressing Change

The purpose of a dressing over a CVAD is to protect the site from microbial colonization and the catheter from migrating.^{10,20} CVAD site care and dressing changes should

occur at established intervals and if the integrity of the dressing becomes compromised at any time.^{9,14} Examples of compromised dressings include those that are damp, loosened, or soiled and if the insertion site is not visible through the dressing.²⁰ A dressing change should be performed using aseptic technique, donning a mask and sterile gloves.⁶

Site care includes removing the existing dressing, assessing the site, cleansing the CVAD–skin junction, and replacement of a stabilization device, if indicated.⁶ Clinicians should assess the site for any redness, swelling, drainage, or tenderness, notifying the prescriber immediately if such symptoms are identified.^{6,9} Skin should be cleansed with an appropriate antiseptic solution, and a sterile dressing applied over the site. Ideally the sterile dressing selected will be sufficient to cover and protect the patient's CVAD while minimizing adhesive contact with the skin.

In performing a peripherally inserted central catheter (PICC) site assessment, measure the external length of the catheter and compare it to the previously documented or original length. If the PICC has migrated in, retract the PICC to the documented external catheter length.²⁰ If the catheter has migrated out or if there are concerns with catheter tip malposition, contact the prescribing provider. Reassessment of the catheter tip location by chest radiograph is recommended for changes in the external length of the catheter.

A combination of skin antiseptic is preferred for cleansing the CVAD site. The primary antiseptic agent is chlorhexidine with 70% alcohol or providone-iodine with 70% alcohol.²⁰ All antiseptics should be applied to the skin with friction to penetrate the epidermal layers, even if applying in a circular motion from the exit site outward. The scrubbing method for chlorhexidine is 30 seconds followed by a 30-second dry time. Historically, chlorhexidine products have not been recommended for children younger than age 2 months; however, evolving research is proving it to be safe and effective.⁹ Skin antiseptics should be allowed to dry completely and naturally before a dressing is applied.²⁰ This may take anywhere from 1 to 5 minutes, depending on a number of factors, including the presence of alcohol in the formulation to hasten drying, and the relative environmental humidity.

Skin irritation under the transparent semipermeable membrane dressing can occur with CVADs. Risk factors include allergy/sensitivity to the transparent semipermeable membrane dressing, tape, or skin antiseptic agent. If this occurs, change either the skin antiseptic agent or the dressing to rule out what may be causing the irritation. Changing both at the same time will hinder telling what led to the irritation. Some key factors to minimize skin irritation include:

- Allow for complete drying of the skin antiseptic before applying the dressing.^{10,20}
- Avoid adhesives on irritated skin until healed. Consider applying skin protectant solution that is safe for irritated skin if adhesive cannot be avoided.
- Avoid using alcohol on irritated skin. Besides being cytotoxic, alcohol stings and dries skin. If skin irritation persists after changing antiseptic products, apply a gauze dressing and change every 2 days until skin is healed.²⁰

The preferred dressings for CVAD's are transparent semipermeable membrane dressings.²⁰ The transparent dressings allow the caregiver to easily view the insertion site.¹⁵ Dressing change intervals are every 7 days and as needed.^{9,14} Gauze dressings are commonly used for patients who are diaphoretic or in the presence of irritation or drainage at the site. Gauze dressings are changed every 2 days.^{9,14} Gauze used under a transparent dressing to support the wings of a noncoring needle in an implanted port does not require more frequent dressing changes. Dressing changes on children can be challenging; a 2-person dressing change is recommended to reduce the risk of catheter migration. If the caregiver is the second person, be certain he or she can adequately secure the patient.

Pediatric-sized products are available for many components of the CVAD dressing procedure. Some transparent semipermeable membrane dressings may have antimicrobial properties impregnated in the dressing or an antimicrobial sponge may be used at the insertion site. Although commonly used for inpatients, there are no published studies for the long-term use of these products on home-based patients.⁶

CVAD Securement

Vascular access device stabilization products are specifically designed and engineered to control movement at the catheter hub, thereby decreasing catheter movement internally and externally.²⁰ Catheter movement has been shown to increase the risk of phlebitis, infection, and dislodgement.

Securement devices are commonly used with PICCs in the home care setting due to the patient activity, diaphoresis, or environmental factors (eg, humidity). Securement devices should not interfere with assessment/monitoring of the site or impede circulation or delivery of the therapy.²⁰ Catheter securement devices are changed in conjunction with the dressing change.

Patient/Caregiver Education

The long-term patient and/or caregiver(s) often perform independently with CVAD care and maintenance in the home care setting.⁷ CVAD education and ongoing support is paramount to their independence and confidence in providing safe care. Education has the ability to empower patients and their caregivers to become partners in the CVAD care and maintenance.³ Provide clear expectations for the patient/caregiver's responsibility with CVAD care and maintenance.⁶ Many types of teaching tools have been developed to enhance learning, including checklists and step-by-step instructions.

The teaching methods should be developed and based on patient/caregiver age, developmental and cognitive level, health literacy, cultural influences, and language preference.⁸ Health literacy is a critical component of communication and patient education. Written educational materials and verbal presentation of teaching should be made as simple as possible.⁶ Use of materials such as pictures, diagrams, and audio/video instructional aids should be considered for patients with low or limited literacy and/or for those who speak English as a second language. Medical jargon and abbreviations should be avoided, and simple terminology should be used.⁸

CVAD education should minimally include:

- Initial and periodic evaluation of patient/caregiver knowledge of CVAD care,⁹
- Infection control measures (eg, hand hygiene and aseptic technique),^{9,14}
- Thorough education on the care and maintenance of CVADs,
- CVAD assessment and recognition of complications,⁴
- Knowledge of steps necessary to administer infusion therapy or flushing (independent return demonstration of the procedure(s)),
- Knowledge of adverse events related to medication,
- Safe storage of all supplies and equipment,
- Patient/caregiver aware of who/when to call if a problem or concern arises, and
- Ongoing care coordination with the prescribing provider.

Health Care Professionals Education

Clinicians caring for a pediatric patient with a CVAD in the home care setting face many hurdles due to the variation in the types, manufacturers, and sizes of catheters. Additionally, catheter care practices and products differ by health care facility. The lack of standardization in pediatric CVAD care creates a complex situation.⁷ It is vital for clinicians to be aware of the catheter demographics and the necessary care and maintenance procedures when providing outpatient care. Home care clinicians are role models for performing every procedure correctly.³ Clinicians should also abide by their organizational policies and procedures.⁹

The clinician should be competent in all areas of CVAD care.⁹ This competency should be assessed periodically as new knowledge is attained and products emerge. Types of competency validation include didactic, online modules, practicum, and case studies for assessment of critical thinking skills. Competency validation content should be specific for pediatric patients and include CVAD care, developmental levels, culture, and ethnically diverse patient populations.

Continuing education and certification for home care clinicians help promote the profession of vascular access nursing. Development of specialty vascular teams in the home care arena can assist with providing standardized practices, data collection, and being a resource to less-experienced staff.

Conclusions

With the goal of optimal care of CVADs in home settings, clinicians must evaluate existing guidelines and practice standards along with their organization's infection and catheter outcomes data to arrive at best practices for pediatric patients.⁷ The National Home Infusion Association CVAD Guidelines for the Home-Based Pediatric Patient were compiled to provide a concise, easy-to-apply format for a standardized approach to basic CVAD care by infusion providers and home health agencies alike (Appendix 1).

Standardizing the provision of care is just the first step in sharing patient outcomes that will ultimately lead to improvements in patient care and the advancement of the home infusion industry. The majority of home infusion providers already

document infection, occlusions, and dislodgement rates. We now need to take this data collection to the next level by publishing our outcomes. When we share this information, and make home infusion-based research more readily available, we move forward in creating a standard of care for home-based patients that will improve patient outcomes. Adopting the National Home Infusion Association's guidelines can provide a baseline of care from which infusion providers can standardize, track outcomes, and begin to define evidence-based best practices for CVADs in this patient population.

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Appendix 1. National Home Infusion Association Central Vascular Access Device Guidelines for the Pediatric Home-Based Patient
NHIA Central Vascular Access Device (CVAD) Guidelines for the Pediatric Home-Based Patient

INTRODUCTION: With few randomized, double-blind clinical trials performed in the home care setting, and even fewer focused on pediatric patients, these clinical practice guidelines for care of the home-based pediatric patient have evolved from a combination of acute care-based research, hospital protocols, published standards and guidelines, and home infusion provider best practices. The acute care hospital from which the pediatric patient is discharged plays a significant role in patient and caregiver education, and often drives the specific protocols and practice decisions which home infusion providers may follow. Collaboration between the home infusion provider and the referring institution is an essential element to providing coordinated, consistent patient care, and may result in different practices than those described in this guideline document.

ALL CVADS:	
Flushing/ Locking	<ul style="list-style-type: none"> • Flush volume should be at least 2x the internal volume of the CVAD and all add-on devices (e.g., extension sets). Document catheter priming volume to be used in the PMR*. • Flush before and after each medication with a minimum of 3-5 mL preservative-free normal saline or compatible solution. • Lock solution may be instilled as a final flush to maintain CVAD patency; instill 1-3mL heparin 10 units/mL when CVAD is not in use (<i>EXCEPTION:</i> Implanted Ports should be locked with 5mL of 100 units/mL heparin before being de-accessed). • Flush valved CVADs per manufacturer’s recommendation. NOTE: Valved CVADs may need heparin lock when used long-term. • Flush/lock CVAD at least once per day when not in use. <p>SYRINGE SIZE: Use a 10mL for initial flush to establish CVAD patency; with patency confirmed, smaller syringes may be used if needed for IV push drug-dose accuracy.</p>
Needleless Connector/ Injection Cap Care	<ul style="list-style-type: none"> • Vigorously scrub needleless connectors with 70% alcohol prep or CHG*/alcohol prep antiseptic solution for a minimum of 15 seconds and allow to dry <i>before every use</i>. • Antiseptic cap covers or protectors may be used when indicated by organizational outcomes data; follow manufacturer’s instructions for use when applying/removing these devices. <p>CHANGE CAP/NEEDLELESS CONNECTOR EVERY 3-4 DAYS, WITH EACH PRIMARY TUBING/SET CHANGE. AND:</p> <ul style="list-style-type: none"> ○ When the cap is removed for any reason; or when damaged or malfunctioning; ○ After blood sampling through the cap; ○ When signs of blood precipitate, cracks, leaks or other defects are visible (such as the septum is no longer intact); ○ In accordance with manufacturer’s recommendations, or as defined in the organization’s policies and procedures; ○ When drawing blood for culture—refer to “Blood Sampling/Blood Return” section below. ○ Some organizations utilize a sterile cap-change “kit” to facilitate aseptic technique during the cap change procedure. ○ Consider use of mask for the nurse and patient during the cap/connector change procedure. <ul style="list-style-type: none"> • Some organizations clean the catheter hub with an antiseptic solution between cap/connector changes; others do so only if dried blood or medication/solution precipitate is visible on the hub; when performing this step, maintain aseptic technique and allow antiseptic solution to dry thoroughly before placing new cap/connector on the catheter hub.
Blood Sampling/ Return	<ul style="list-style-type: none"> • Limit total volume of blood withdrawn for lab sampling to 3mL/kg/day (24 hours). • Discard first 1-3 mL blood drawn or 2x the internal volume of the catheter + extension sets, connectors, etc. <i>except when obtaining a blood culture</i>. • Remove cap/needleless connector <i>before</i> obtaining blood sample for culture, and include <i>all</i> blood drawn in the specimen (no discard). • Flush with 10-20mL saline immediately following any lab draw (unless patient is fluid-restricted), followed by lock solution if CVAD will not be in continuous use. • Nurses should assess catheter for blood return before medication administration; patients/caregivers are not routinely taught to assess for patency via blood return unless administering certain therapies (e.g., chemotherapy).
Tubing/Add-on Device	<ul style="list-style-type: none"> • DEHP-free tubing is preferred for all administration sets and IV add-on devices for all pediatric therapies. • Tubing used to administer lipids or lipid-based drugs <i>must</i> be DEHP-free and changed with each solution container and at least every 24 hours. • Replace tubing used to administer blood or blood products every 4 hrs. • Replace tubing used to administer Parenteral Nutrition (PN) solutions every 24 hours. NOTE: tubing may be used for up to 96 hours for PN solutions given continuously without lipids. • Replace tubing used to administer a <i>continuous</i> infusion (tubing remains connected to the CVAD) every 96 hrs. • Replace tubing used to administer a <i>intermittent</i> infusion (disconnected from the VAD or primary line when infusion is complete) every 24 hours • Devices added to the tubing, such as extension sets or inline filters and manual flow-control devices, should luer-lock, and be changed with each tubing change or when damaged/compromised; devices added to the CVAD (between the CVAD and the injection cap) should be changed when the cap is changed or at least every 7 days.

(Continued on next page)

NHIA Central Vascular Access Device (CVAD) Guidelines for the Pediatric Home-Based Patient

ALL CVADS:

- NOTE: A PICC dressing change is a 2-person procedure to minimize the risk of catheter migration; if a caregiver is the 2nd person, be certain they can adequately secure the patient.
- Change dressing when damp, loosened or soiled; and when site inspection is necessary but cannot be performed through the dressing.
- A combination antiseptic is preferred for skin antiseptics at the CVAD exit site [such as CHG 2-3.5% + IPA 70%, OR PVP-I 10-15% + EtOH or IPA 62-74%]
- NOTE: Manufacturers of CHG-based products do not recommend their use on infants less than 2 months of age, however evolving evidence/research demonstrates it is safe.¹³
- Apply all antiseptics to the skin with friction (scrubbing motion) to penetrate epidermal layers, even if applying in a circular motion from exit site outward.
- Allow all antiseptics (and skin protectants, if used) to dry completely before applying dressing. Antiseptics that do not contain alcohol (e.g. povidone iodine or tincture of iodine) may take 1-5 minutes to dry completely depending on humidity levels. Do not hasten the drying process by wiping/blotting the area, fanning or blowing.
- Additional antimicrobial products such as impregnated dressings or patches may be indicated for patients at increased risk for CRBSI, as identified by organizational outcomes data.

Transparent Semi-Permeable Membrane (TSM) dressing: Change every 7 days & PRN.

- Gauze beneath transparent dressing = gauze dressing (unless used to support wings of Huber needle in an implanted port, leaving needle insertion site visible)
- If skin irritation develops beneath a TSM or any adhesive dressing/tape, change the antiseptic product or the transparent dressing to rule out specific product sensitivity:
 - Avoid adhesives on irritated skin until healed; consider applying skin protectant solution that is safe for irritated skin if adhesive use cannot be avoided.
 - Avoid alcohol on irritated skin (may be in the antiseptic or skin protectant solution). In addition to being cytotoxic, alcohol stings when applied to broken skin.
 - If skin irritation persists after changing the antiseptic and transparent dressing, apply a gauze dressing until skin has healed.

Gauze dressing: Secure all edges with tape, change every 2 days (gauze dressing = gauze under a transparent dressing, unless used to support wings of a Huber needle)

- CVADs should be stabilized or secured to minimize movement in/out of the insertion site. Use of stabilization method is based on evidence as well as analysis of risks vs. benefits.
- Consider use of a securement device if the patient is at increased risk for CVAD dislodgement (e.g., CVAD is a peripherally inserted central catheter [PICC], patient has a high activity level, prone to diaphoresis, lives in hot/humid environment, and other risk factors as identified by the organization's CVAD outcomes tracking results)
- Removal/replacement of the securement device should be done at established intervals and in accordance with Mfg.'s recommendations, and/or when the VAD dressing is changed.

SPECIAL CONSIDERATIONS BY CVAD TYPE:

	TUNNELED	NON-TUNNELED	IMPLANTED PORT
<p>PERIPHERALLY INSERTED CENTRAL CATHETER (PICC)/MIDLINE</p> <ul style="list-style-type: none"> Avoid lifting > 10 pounds; encourage movement of arm to maintain ROM. Monitor upper arm for edema, redness and cording of vein. Measure external length of catheter with each dressing change & compare to external length recorded after insertion to assess for catheter migration. Avoid accessed arm for BP or phlebotomy. Blood sampling acceptable for 3 FR and larger PICCs. <p>MIDLINE CATHETERS: Considered a long peripheral catheter. Do not infuse medications greater than 600-900 mOsm/l or with pH <5 or >9).</p> <p>REMOVING PICC/ MIDLINE:</p> <ul style="list-style-type: none"> Apply digital pressure to site until hemostasis is achieved, approx. 3-5 minutes (time will vary based on patient's coagulation status). Apply a petroleum-based ointment dressing to seal the skin-to-vein tract and decrease risk of post-removal air embolus. Record length of catheter removed & condition of tip. If resistance is met, do not attempt removal. Place warm pack on arm for 15 minutes, then attempt again. If still unable to remove, notify prescriber and wait 24 hrs. before another attempt. If unable to remove after 48 hours notify prescriber for alternative arrangements. 	<ul style="list-style-type: none"> Tunneled CVADs can be repaired by an experienced clinician using a Mfg.'s repair kit. Sutures may be removed from a tunneled CVAD insertion site 2-3 wks after insertion, with prescriber order. 	<ul style="list-style-type: none"> Non-tunneled CVADs may be removed with a prescriber's order by nurses who have demonstrated competency. Consult organizational policies and procedures for removal guidelines. 	<ul style="list-style-type: none"> Use only non-coring Huber needle and aseptic technique to access an implanted port. Change needle at least every 7 days, or as needed. Folded gauze beneath wings of Huber needle that is covered with a transparent dressing can be changed every 7 days (not considered a gauze dressing as long as insertion site is visible). <p>HEPARIN LOCK</p> <ul style="list-style-type: none"> Instill 5mL of heparin 10units/mL when port remains accessed and patient is receiving intermittent therapy. Lock with 5mL of heparin 100units/mL prior to de-accessing. <p>MAINTENANCE: Flush monthly with 5mL of heparin 100units/mL.</p>

Appendix 1. (Continued)**NHIA Central Vascular Access Device (CVAD) Guidelines for the Pediatric Home-Based Patient**

***Key:** PICC = peripherally inserted central catheter; mL = milliliter; FR = French; Mfg=manufacturer; ROM= Range of Motion; Tubing= Administration Set; CRBSI=Catheter Related Bloodstream Infection; CHG (chlorhexidine gluconate); PMR (patient medical record)

DISCLAIMER: The National Home Infusion Association (NHIA) produces guidelines as an educational aid to good clinical practice that reflects the input of its members and experienced clinicians in the field. Clinical material offered in these guidelines is intended as a guide for information purposes only and does not replace or remove clinical judgment or the professional care and duty necessary for each specific patient case. The information contained within these guidelines has been prepared using a multidisciplinary approach with reference to pertinent information available/identified at the time of preparation. While great effort has been made to assure all information is complete and accurate as of the time these guidelines are issued, given the continuously evolving health care environment and the particular circumstances of individual cases, no assurance is given that the information is entirely complete or accurate in every conceivable respect (and, as such, NHIA and its board members, committee/work group members, officers and employees disclaim all liability for the accuracy or completeness of these guidelines, and disclaim all warranties, express or implied to their incorrect use). Additionally, clinical care carried out in accordance with these guidelines should be provided within the context of a prescriber's oversight and orders, locally available resources and expertise, and all relevant regulatory requirements. These guidelines do not address all elements of standard practice and, as such, presume and necessitate that individual clinicians have the responsibility to:

- Discuss all care with patients/consumers in an environment that is culturally appropriate and which enables comfortable and confidential discussion. This includes the use of interpreter services where necessary.
- Advise consumers of their choice and ensure informed consent is obtained prior to delivering care.
- Provide care within scope of practice, meet all legislative/regulatory requirements and maintain standards of professional conduct.
- Apply standard precautions, and additional precautions as necessary, when delivering care.
- Document all care in accordance with mandatory and local requirements.
- Seek out newer information that might affect the diagnostic and treatment recommendations contained within these Guidelines.