Paediatric Intensive Care Unit

PAEDIATRIC INTENSIVE CARE UNIT CENTRAL VENOUS ACCESS DEVICES

Staff relevant to:	Healthcare Professionals working within UHL who insert or care for centrally inserted vascular access devices in Leicester Children's Hospital, including those on honorary, bank or agency contracts
Approval date:	January 2024
Version:	3
Revision due:	January 2027
Written by: Reviewed by:	CLABSI Team June 2016 Julia Vujcikova
Trust Ref:	**C112/2016**

Contents

Related documents:

B13/2010 UHL Vascular Access policy

C157/2016 Needling and flushing implanted and CVAD - Port-A-Cath UHL Children's Nursing guideline

C12/2019 Central line infection UHL CHG

B22/2015 Parenteral nutrition via central venous

catheter B32/2003 Hand hygiene policy

B20/2013 Aseptic Non-Touch technique

B25/2010 Preparation and administration of intravenous medication and fluids to adults, babies and young people

B45/2018 Parenteral nutrition UHL CHG

C15/2018 Continuous renal replacement therapy in PICU (VasCath sizes)

1. INTRODUCTION AND OVERVIEW

1.1 This document complements UHL policy "Vascular access in adults and children" B13/2010, and clarifies specifics of the management of central access and midlines in paediatric patients, including neonates admitted to PICU/CICU LCH. (Vascular access policy UHL- valid for children > 2 months old, NNU has its own policy)

1.2 This document provides evidence-based criteria for intravenous catheter selection (from umbilical catheters to totally implanted venous devices) in paediatric patients across a range of clinical indications, with aim to:

- preserve central venous pathways
- reduce complications: mortality, morbidity, length of stay, and cost
- improve quality of care and patients experience

2. Guideline scope

2.1 This guideline applies to all Healthcare Professionals working within UHL who insert or care for centrally inserted vascular access devices in Leicester Children's Hospital, including those on honorary, bank or agency contracts.

2.2 This guideline applies to all types of central vascular access devices irrespective of indications and use.

2.3 This gudeline applies to all PICU patients within LCH.

3. DEFINITIONS AND ABBREVIATIONS

LocSSIP - Local Safety Standards for Invasive Procedures - Local adaptation of NatSSIP (National Safety Standard for Invasive Procedures).

Central Line Days are used to compare morbidity and mortality related to central lines. Patients with >2 central lines only get counted as having 1 central line day. Central line days for patients with tunnelled or implanted central lines begin recording from the 1st day the device is accessed.

Peripheral Vascular Access Device (PVAD) is defined as a short, flexible cannula placed into a peripheral vein in order to administer medication or fluids.

Midline catheters ("short long line") are peripheral vascular access devices used for medium to long term access. They are usually placed in peripheral vein such as the brachial or cephalic. It is not central catheter as the tip terminates in peripheral vein below the level of the axillary line, and is not positioned in central veins. It is suitable for peripheral infusates, usual duration is 7-14 days, up to 30 days.

Arterial Line - The arterial line (abbreviation: art-line or a-line) is a catheter inserted into an artery. It is most commonly used to monitor blood pressure directly and in real-time, and to obtain samples for arterial blood gas analysis. Arterial lines must not be used for the administration of any infusate. Patients with an arterial line in situ must be nursed in PICU.

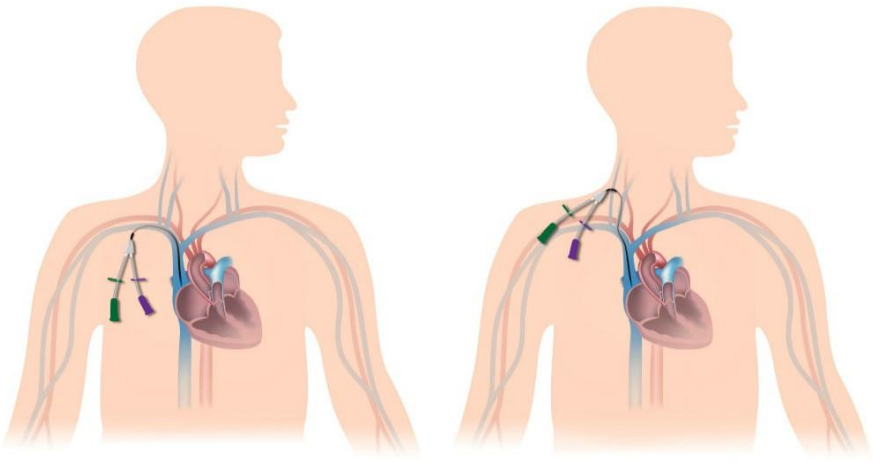
Central venous access devices (CVAD) are catheters placed in venous system with a tip localised in a great vessel - SVC or IVC, close to heart or at heart (upper right atrium).

4. ROLES AND RESPONSIBILITIES

(see Vascular Access UHL Policy B13/2010)

5. Types of CVAD

5.1 Non tunnelled central venous catheter - Centrally inserted central catheter (CVC or CICC) is defined as a device with its tip positioned in the superior or inferior vena cava or the upper right atrium, usually via the internal jugular, subclavian or femoral veins; usually inserted in critical care setting or pre-operatively in a theatre. The catheter can be a single or multi-lumen; usual use is up to 10 - 14 days. This type of centrally inserted CVAD is not suitable for long term use, and patients with centrally inserted CVC should not be discharged home. (1)



Pic 1: Non- tunnelled central venous catheter

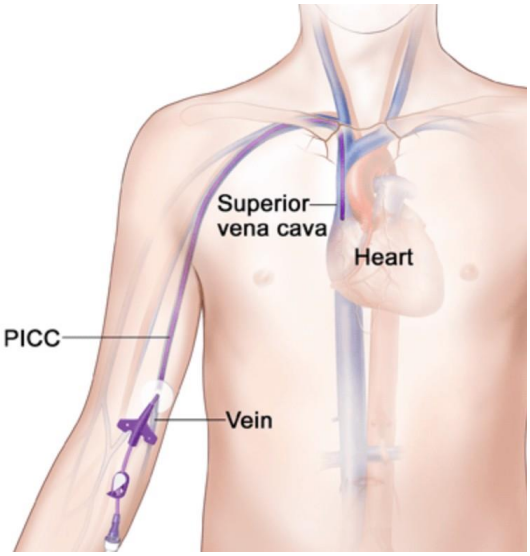
5.2 Peripherally inserted central catheter (PICC) is defined as a device that is inserted into a peripheral vein, and advanced until the catheter tip terminates in central position which is:

- the junction of the superior vena cava and the right atrium (SVC - RA junction) for the catheters inserted in the upper limb (usually basilic or brachial vein)
- or inferior vena cava for a **peripherally inserted central catheter via lower limb veins, usually femoral (FICC),** with its tip position at IVC-RA junction (inferior vena cava - right atrium junction) or below the level of renal veins (projection at L1). The central position is considered if tip is localised at IVC - above the level of L5 (a decision about a line suitability for PN use).
- usual use is mid - long term with duration of 2 - 12 weeks or longer (length of use is not clearly limited).

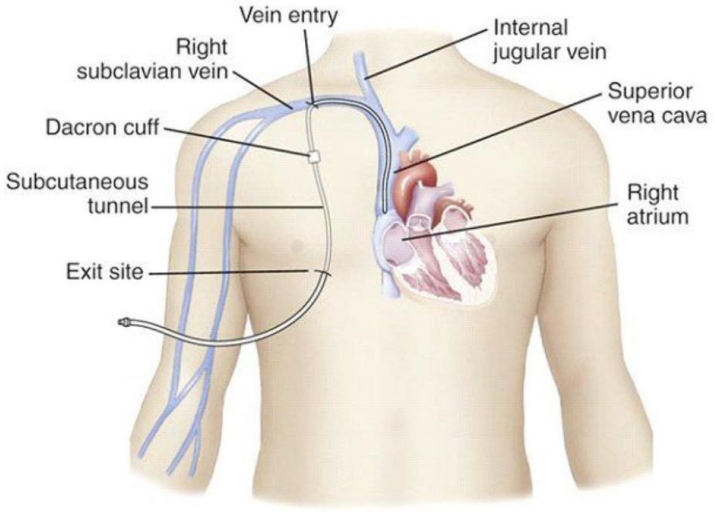
5.3 Umbilical catheter (UVC). A central catheter inserted into the umbilical vein of neonate with appropriate use for a therapy duration of ≤ 14 days. Insertion after ≥ 5 days after birth is inappropriate; consider transition to alternative vascular access from 8 days after UVC placement. It is appropriate for non-peripherally compatible infusiates, but has a risk of catheter tip moving - small target of safe positioning. (1)

5.4 VasCath. Specialised CVAD used for dialysis, plasma exchange or plasmapheresis.

5.5 Tunnelled non-cuffed - PICC line inserted via subcutaneous tunnel which reduces the risk of infection and dislodgement of the line; usual use is mid - long term with duration of 2 - 12 weeks or longer (length of use is not clearly limited).



Pic 2: PICC line,



Pic 3: Tunnelled cuffed CVAD

5.6 Tunnelled cuffed CVAD (Hickman™, Broviac™). Surgically implanted with subcutaneous tunnel from skin entry site to the vein; there is a small cuff around the line lying in the tunnel allowing subcutaneous tissue granulate into the cuff. This creates mechanical barrier to infectious agents and stabilises line position preventing its dislodgement. It is used as long term access > 1 month.

5.7 Implanted port. Surgically placed under the skin of the chest wall; the port is connected to the catheter tunnelled beneath the skin which is inserted to the vein, usually jugular vein. An access to the port is provided with special needle via skin. It is used for long term intermittent access. Not suitable for neonates and small infants due to risk of dislodgment with fast growth and difficulties to accommodate the chamber under the skin.

Table 1: CVAD TYPES

CENTRAL VENOUS ACCESS DEVICES	ACRONYM	Other common names
Centrally inserted Central Catheter	CICC	Central line, CVC
Peripherally Inserted Central Catheter	PICC	Picc line
Umbilical Venous Catheter	UVC	Umbilical line
Tunnelled PICC; tunnelled CICC	T-PICC; T-CICC	Tunnelled line
Tunnelled cuffed CICC	TC-CICC	Hickman™, Broviac™
Totally Implanted Venous Access Device	Port	Port-a-cath™
Dialysis catheter / large bore cuffed CICC	LB-CICC	Vascath ™, Permcath™
OTHER VASCULAR ACCESS DEVICES		
Peripheral Vascular Access Device	PVAD	Peripheral line
Midline catheter	MDC	Short long line
Arterial catheter	Arterial catheter	Arterial catheter

6. INDICATION AND SELECTION OF APPROPRIATE DEVICE

6.1 Indications of CVAD

- Administration of irritant, vesicant or hyperosmolar drugs / fluids; e.g. TPN, concentrated drugs, inotropes (pH < 5 or > 9, Osmolarity > 600 mOsm/L); multiple infusions requirement (>2 non- compatible or > 3 compatible)
- Long term access for frequent or prolonged use, e.g. chemotherapy, antibiotics, haemodialysis (duration of iv access > 7 - 14 days)
- Daily blood sampling, difficult intravenous access
- Monitoring of central venous pressure

6.2 Selecting the most appropriate device

6.2.1 Vascular access devices must only be inserted where there are sound clinical reasons, and the type of device selected should take into account the patients clinical needs.

- Estimated duration of treatment
- Therapeutic dose (need for central venous access)
- Medical history, e.g. cardiac anomalies, need for recurrent iv access in the future, haem - onc disorders; complications in the past - thrombosis, difficult iv access
- Patient age, weight & size

6.2.2 Use a CVAD with **the minimum number of ports or lumens** essential for the management of the patient.

✴ Multiple concurrent central lines are associated with increased rates of infection. (CI) (5,6,7)

6.2.3 Use a CVAD with the smallest diameter acceptable for required indication.

- Catheter-to-vein ratio ≤ 45% for peripherally inserted venous access,
- PICC; catheter-to-vein ratio ≤ 40% for non tunnelled CVAD, tunnelled CVAD, totally implanted venous devices. (3)
    - The vein diameter in mm (without tourniquet use) measured with an ultrasound is equal to the recommended Fr gauge of the catheter. For example: For a 3mm vein = 3Fr CVAD; for a 4mm vein use a 4Fr CVAD.

✴ Using bigger size of the catheter than recommended increases the risk of thrombosis. (3, 7)

6.2.4 If the CVAD is suspected as a source of infection catheter exchange via placing a guide wire through the existing catheter is NOT acceptable.

6.2.5 In high risk patients, peripherally inserted or tunnelled, cuffed central catheters are preferred compare to temporary or un-cuffed catheters. (C I) (5)

6.2.6 Subcutaneous indwelling venous ports should be reserved for chronic intermittent therapy in patients immunocompetent at the time of insertion. (B I) (5)

6.2.7 Antimicrobial-impregnated catheters should be considered for CVC insertion in all high-risk patients. (B I) (5)

✴ This statement is valid for short term non tunnelled catheter, and is not useful for long term catheters - antimicrobial impregnation of long term catheters doesn't prevent infection. (2, 8, 9)

Table 2: Rough orientation - sizes of central venous catheters.

Age	Kg	Size guide	Length for IJ / Fem
< 6 months	< 2 kg	4 Fr	5 cm
	2 - 4 kg	4.5 Fr	6 cm / 8cm
	4 - 10 kg	4.5 - 5 Fr	6 cm / 8 - 12cm
> 6 months - 5 years	10 - 20 kg	4.5 - 5.5 Fr	6 cm / 12cm
	16 - 40 kg	5.5 - 7 Fr	12 cm
> 5 years	> 40kg	7 Fr	15 cm

✴ Children with congenital heart conditions might need smaller size of catheters compare to standard population.

7. INSERTION OF CENTRAL VENOUS ACCESS DEVICE

All devices must be inserted and cared for using the relevant care bundles.

7.1 Who may insert CVAD:

- it is required to be familiar with CVAD as there are differences in different types - read and understand a product information prior to use;
- knowledge of venous anatomy and ideally experience in ultrasound use are basics for successful insertion;
- it is the responsibility of the manager of the inserting practitioner to decide if the inserter has the necessary experience to insert a CVAD.

7.2 Consent

Consent is required for CVAD insertion, except if this would delay lifesaving interventions. The risks and benefits associated with CVAD insertion and use are to be explained to young person/ guardian/parents by the professional inserting the CVAD.

7.3 LocSSIP

Local safety standard for invasive procedures (LocSSIP) must be completed and filed in the patient's medical notes.

7.4.1 Purpose of LocSSIP is to ensure that there is adherence to correct insertion procedures.

7.4.2 A member of staff should be assigned to observe the procedure.

7.4.2 The procedure MUST be stopped and corrected (if safe to do so) if any element of aseptic technique has been breached. Compliance with maximal barrier precautions is a shared clinical responsibility.

7.4.3 Local Safety Standards for Invasive Procedures (LocSSIP) Checklist: CVC/ PICC/ Midline Insertion can be found: **CVC, PICC, Midline, Central and Arterial Line(s) Standard Operating Procedure UHL Paediatric Intensive Care LocSSIP**

7.4 Device insertion site

7.5.1 Conventional access sites from most to least preferred include neck veins (e.g. internal jugular), arm veins (e.g. brachial or basilic), femoral vein, and subclavian vein. (B I) [5]

7.5.2 Percutaneous CVC and PICC lines (including tunnelled) may be inserted either in PICU or theatres. Tunnelled cuffed and subcutaneously implanted CVADs are usually inserted in theatre.

7.5.3 The correct position should be confirmed by X-ray prior to use.

7.5.4 Considerations for specific groups of patients: congenital cardiac, chylothorax, single ventricle pathways, patients with potential need for dialysis or transplantation - damage (thrombotic or stenotic) of certain venous pathways can compromise treatment options and survival of these specific groups of patients. (E.g. use of upper extremity veins for access should be avoided in patients with potential future need for hemodialysis; preference for lower extremity CVAD are appropriate for patient with univentricular physiology to preserve upper extremity vein patency for stage 2 and 3 palliation). (C IIa) [5]

7.5 Ultrasound Imaging for CVAD insertion.

Two-dimensional (2-D) imaging ultrasound guidance is the preferred method for insertion of CVADs. It decreases number of attempts and controls the insertion process.

✳ Higher number of attempts is related to the increased risk of thrombosis.

7.6 General principles of insertion of central venous catheter.

Specific insertion techniques are outside of the scope of the document. Adequate analgesia and sedation for a patient; adequate monitoring of vital signs throughout the procedure must be performed.

7.6.1 Surgical aseptic technique and maximal barrier precautions must be maintained.

- Hand hygiene before and after assembling equipment, palpating for insertion site
- Wipe a surface of a trolley to be used for equipment with ChlorClean or Distel Wipe® and allow to dry.
- A disposable standard CVAD insertion pack should be used. (Exceptions may be made in an emergency situation where a pack is not immediately available). Break open sealed pre-filled Catheter Insertion Trolley/tray and prepare equipment.
- Maximal barrier precautions use, including a 60 seconds hand scrub with alcohol or disinfectant preparation, the use of a cap, mask, sterile gown, and sterile gloves (eye/face protection if there is a risk of splashing with body fluids) for the operator and those assisting in the procedure; after skin antisepsis the patient is covered with sterile drapes of adequate size to maintain sterility of the operating field and with a small opening for the site of insertion.
- The staff is to be kept to a minimum in the area where the procedure is being undertaken; observers are to wear a cap, apron and mask.
- Close curtains and minimise interruptions during procedure.

7.6.2 Skin antisepsis

- use surgical clippers not razors to remove hair
- for most of the paediatric population, 2% chlorhexidine and 70% alcohol, in a single use applicator is the optimal skin antisepsis for CVAD insertion
- if there is allergy or contraindication to chlorhexidine, use betadine
- full sterile drape when sterile field is prepared
- allow the skin to dry for 30 seconds

7.6.3 Equipment

- Lay out sterile equipment only once surgically scrubbed and gowned
- Do not open catheter pack until patient has been cleaned and correctly positioned for immediate central line insertion
- Create continuous sterile zone using sterile drapes and sterile trolley
- Use sterile Ultrasound probe cover
- Flush the catheter lumens with 0.9% sodium chloride and clamp - except distal lumen where guide wire comes out

7.6.4 Insert the line using Seldinger technique
(insertion technique differs with different type of lines and products)

- Visualise vessel and insert a needle +/- syringe (or cannula) into the blood vessel
- Aspirate - blood has to flow freely; do not flush if blood doesn't flow freely
- Remove the syringe (or cannula needle) and insert the guide-wire through the needle into the vessel
- Once the guide-wire is in the vessel remove the needle. Confirm the wire position with ultrasound. If uncertain, a transducer or blood gas can also be used to assist in the

determination of position.

- Dilate the blood vessel using a dilator over the guide-wire if required and then remove
- Insert the central line over the guide-wire, guide wire has to be under control at all times
- Remove the guide-wire, check if is intact
- Aspirate and flush all lumens with Sodium chloride 0.9% using start-stop technique, then clamp whist flushing
- Attach Bionectors®

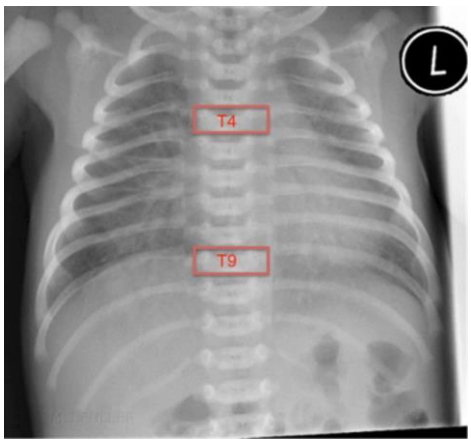
7.6.5 If surgical aseptic technique has been breached during the insertion of a vascular device then the procedure must be abandoned and re-started except when patient's life is at risk if no access is obtained. In this situation it should be clearly documented in the medical notes the reason for continuing with the procedure and the device must be removed and replaced when it is safe to do so.

7.6.6 Fixation and dressing

- Secure the line in place with a monofilament non-silk suture or securing device (e.g. GripLock, Stat-Lock)
- Cover with recommended dressing (see Dressing) - Ensure that the dressing is sealed around the CVC site. A sterile gauze dressing or Tegaderm™ pad can be used if the insertion site is oozing or bleeding. This should be changed after 24h.
- Consider using tissue adhesive (tissue glue) especially in PICC lines. Tissue adhesive reduces bleeding and protects the exit side by providing a barrier to microbes entering the blood stream.

7.6.7 Confirming tip position

- X-ray is to be performed prior to use. A transducer or blood gas can also be used to assist in the determination of position. X-ray is not necessary for femoral central lines unless they are going to be used for TPN (or other irritant solutions) where the tip must be in IVC - above L5 where IVC origin projects. CVCs inserted peri-operatively or in an urgent situation may be used prior to imaging provided the majority of the following criteria are met:
  - Uncomplicated insertion with no concerns re line placement
  - Ultrasound was used
  - Transduced pressure wave confirms placement in venous system
  - Free aspiration of blood from all lumens of CVAD
  - No pulsatile blood flow observed
- **If there is any doubt about CVAD position, an x-ray is to be done prior to use. If CVAD re-positioning is required the patient may require a second anaesthetic or sedation. It is highly recommended that the x-ray be performed whilst the patient is still anaesthetised.**
- **Optimal NEONATAL PICC line (<2 Fr) tip position is in the SVC (above T4) or IVC (below T9), but outside of cardiac silhouette on X-ray.**



Pic 3: Neonatal PICC line tip position (above T4 below T9)

✴ Pericardial tamponade, rare complication of peripherally inserted central catheters, with an incidence of 0.07 – 2%, T4, below T9)

associated with high mortality rate 75%; has been described in neonates with the catheter tip positioned within right atrium, inside the pericardial reflection on chest Xray. (10)

7.6.8 UVC - ideal position is at T8 - T9 - just below diaphragm, passing through the ductus venosus and at the junction of the inferior vena cava with the right atrium.

7.6.9 In children, a temporary catheter tip (CVC) should be positioned in the lower SVC from above the diaphragm, or above the iliac confluence from below. L5 is the anatomical landmark of the lower border of the IVC. (C IIa) (5)

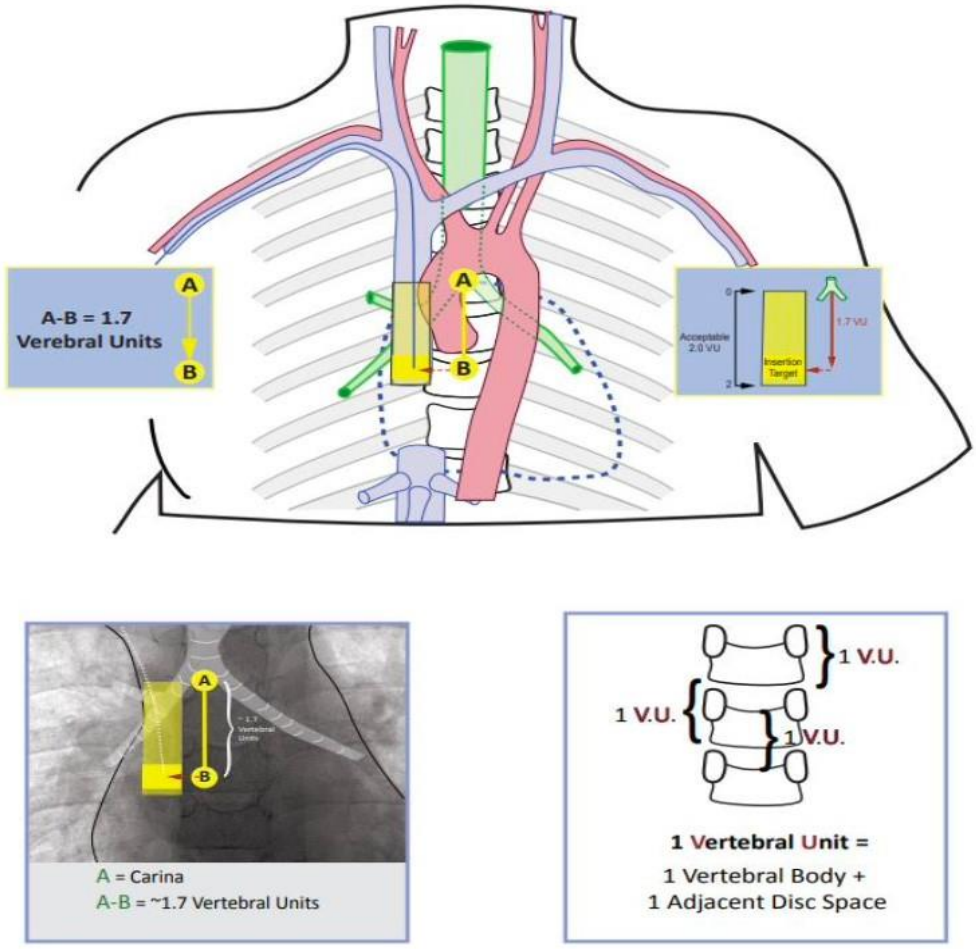
7.6.10 A long-term catheter tip should be positioned in the proximal cava near the cavoatrial junction. In a growing child, catheter tip location should be verified at least every 12 months. (B I) (5)

7.6.11 A catheter used for TPN must have a tip positioned in a central position which is at RA-SVC junction; or neonates/infants RA-IVC junction (T9) or below the renal veins in children (avoid L1).

7.6.12 The position of the RA is best estimated at a level 1.5 vertebral bodies below the carina on a chest radiograph. (13,14,15)

7.6.13 If a catheter is malpositioned, it should be promptly repositioned or replaced. (BIIa) (5)

7.6.14 The tip of a long-term hemodialysis catheter should be positioned within the right atrium. (B I) (5)



Pic 4: CVAD typ position in children - SVC-RA junction projection on CXR; © 2012 Cincinnati Children's Medical Center. Concept: Neil D Johnson MD, Illustrations: Glenn Miñano

The position of a catheter tip will vary widely with patient positioning, particularly in children, and should be evaluated with caution on any image. [16] It should be noted that upper limb PICCs in children move an average of 2.2 rib spaces with arm movement and so will not always remain in the optimum position. It is suggested therefore that, when inserted, the line is fixed so that the tip is optimally placed when the child's arm is positioned comfortably in a natural position (flexed elbow for neonates, arm by the side with slight elbow flexion for children) [17]

Considering that on chest x-ray the cavoatrial junction (CAJ) is usually 3 cm below the carina in the average adult patient, the "safe area" in adults would be the lower third of the SVC (1-3 cm below the carina) or the cavoatrial junction (3 cm below the carina) or the upper part of right atrium (3-5 cm below the carina).

7.7 Post procedure

- Dispose sharps safely and check the integrity and length of the guide wire to ensure it is intact. Operators and assistants must ensure that all guide wire(s) used are removed and that number of wires used and discarded is documented.
- Wipe reusable equipment; US probe to be cleaned with ChlorClean (avoid contact with alcohol - it damages US probes).
- Documentation - complete LocSSIP and file into the notes. The insertion of all CVADs is to be documented including; date, time, inserter, assistant, indication for CVAD, brand/type of the catheter, site of insertion, depth of catheter placement, exposed length of the catheter, confirmation of catheter site on CXR.
- Pre - packed central line insertion trolley is always be available on PICU. This should be checked and the trolley sealed at the start of every nursing shift. It is responsibility of the team inserting the line to ensure the trolley is restocked once procedure has finished.

8. CVAD INSERTION CARE BUNDLE

☑ **Appropriate planning**

- Appropriate indication, choice of CVAD and appropriate insertion site
- Consent
- LocSSIP - Local safety standard for invasive procedures must be followed and documented in medical notes
- Reduce personnel and noise exposure during procedure

☑ Routine decolonisation

☑ Surgical scrub with Chlorhexidine to prepare skin, surgical aseptic technique

☑ Maximal sterile barrier precautions for providers mask, hut, sterile gown) and patients (sterile drape with central opening)

☑ Pre-filled insertion trolley and Central line insertion pack

☑ Ultrasound guided insertion to maximise the attempt

In circumstances of resuscitation, where a patient's life is at risk and an urgent CVC placement is required, full adherence to the insertion bundle may not be possible. This situation has to be documented in notes and CVC should be replaced as soon as it is safe to do so.

9. COMPLICATIONS ASSOCIATED WITH CVAD INSERTION

Table 3: Complication associated with CVAD insertion

Complication	Symptoms & Actions
Bleeding, haematoma at insertion site	Apply pressure to vein insertion site until bleeding stops If bleeding continues or is excessive, notify medical team. Consider investigating coagulopathy.
Difficulty inserting catheter	Use ultrasound to pre-scan predicted difficult patients (age < 2y, <15kg, previous multiple or difficult CVADs – cystic fibrosis, home TPN or oncology patients). Have a clinician skilled with ultrasound guided venous access be present/ do these predicted difficult lines. Ensure a patent vein with diameter > 3x catheter diameter present, if possible. Seek assistance if >3 attempts (2 for neonates) to access a vein.
Malposition	Verify placement using X-ray, transducer waveform, and/or blood gas
Temporary nerve damage / pain	Using ultrasound guided insertion reduces nerve injury.
Dysrhythmias	May occur if catheter and/or wire enter heart. Withdraw catheter within SVC/IVC and observe. Verify position with x-ray/ ultrasound.
Arterial puncture	Verify placement with x-ray, transducer waveform and/or blood gas. If arterial, remove small bore catheters and apply pressure to insertion site. Large bore catheters may require surgical consult prior to removal.
Damage to blood vessels, heart or lungs	Use ultrasound guidance for insertion. If sudden haemodynamic instability or respiratory compromise, request urgent x-ray.
Air embolism	Always ensure needle and catheter is flushed, not open to air and is patent. Patient head down for neck lines.
Reaction to contrast	Contrast can cause reaction, and rarely anaphylaxis

10. MAINTENANCE. CVAD CARE BUNDLE

10.1 Review

- All inpatients with a CVAD in situ are to be reviewed daily by the multidisciplinary team, and every shift by the bedside nurse.
- For outpatients with a CVAD in situ, the device is to be reviewed at out-patient appointments.
- This includes; site assessment, review of how long the device has been in situ, the necessity for central venous access and consideration of alternative methods of treatment.
- CVADs no longer required are to be removed without delay. The longer a CVAD remains in situ the greater the risk of CVAD related complications.
- All children with a CVC (non tunnelled central venous catheter) in situ require 4-6 hourly observations (as PEWS score).
- In patients with PICC do not measure blood pressure on the arm where PICC line is inserted.

10.2 Educational framework

Prior to accessing a CVAD independently, staff are required to have completed all relevant sections of the Nursing Competency Framework (The Vascular access bundle) including Surgical Aseptic Technique, Aseptic Non Touch Technique UHL Guideline and Infection Prevention UHL Policy
Training opportunities and documented progress must be discussed every 6 - 12 months with a clinical supervisor. Training will address:

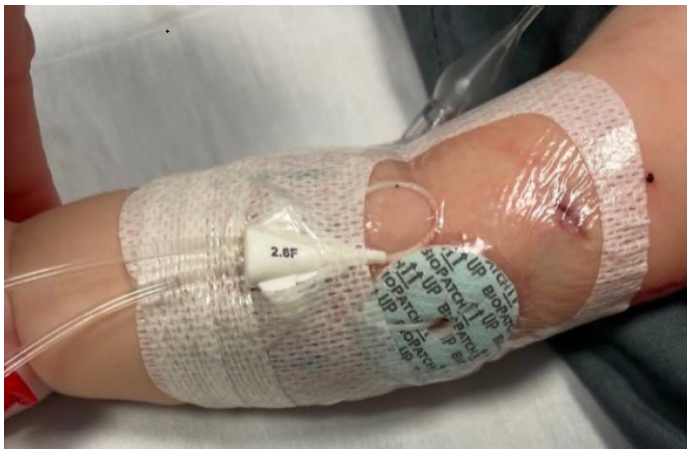
- Hand Hygiene, Surgical Aseptic Technique, Aseptic Non Touch Technique (ANTT)
- RAID and VIP (Phlebitis score) assessment
- How to access, flush and lock CVAD safely
- Appropriate use of dressing, Bionector© and tubing
- Daily ward round discussion and documentation

10.3 Dressing

- CVAD dressing provides a barrier to the external environment, and an additional securement reducing the risk of dislodgement.
- A clear, transparent, high moisture vapour transmission rate dressing must be used for CVADs. The recommended standard dressing is Tegaderm IV or Tegaderm IV Advanced™.
- Bleeding or oozing exit site after insertion is to be dressed with Tegaderm™ with pad or gauze dressing for 24 hours. Gauze dressings /Tegaderm™ with pad must be replaced with a transparent dressing within 24 hours to allow observation of the insertion site.
- In case of allergy, alternative dressing, e.g. Mepore™ IV, Polyskin™ or IV3000™ should be used.
- The dressing must be occlusive. Non-occlusive dressing must be changed as soon as possible.
- Replace every 7 days or upon removal of the device whichever is sooner. Dry intact dressings should **NOT** be routinely replaced sooner than after a week.
- CVAD can be secured with sutures (monofilament non-silk suture) or with suture-less adhesive device (e.g. GripLock, Stat-Lock). The insertion exit side may be secured with tissue adhesive. Tissue adhesive reduces bleeding and protects the exit side by providing a barrier to microbes entering the blood stream.
- Chlorhexidine dressing - Biopatch™ or Tegaderm CHG™ should be used at the exit side with aim to reduce the burden of skin flora. Chlorhexidine dressing:

- is not to be used over infected wounds, directly over burns, premature neonates or on patients with a known sensitivity to chlorhexidine
- should be applied once bleeding from insertion point stops
- has to be applied within 24h of line insertion to be effective
- should be changed every 7 days or when visibly soiled or non-occlusive
- is not to be used if CVAD is planned to be removed the next day after surgery (used during surgery only)

Pic 5: Tunnelled Femoral PICC, dressing Tegaderm™ with chlorhexidine pad (Tegaderm™ CHG 1660R)



Pic 6: Tunnelled PICC, dressing Tegaderm™ with Biopatch™

Biopatch sizes:

- ¾” with 1.5mm center hole for < 6Fr lines
- 1” disk with 4mm hole for 6-12 Fr lines

Correct application of Biopatch:

- Place Biopatch around catheter blue site up (“blue site to the sky”)
- Align radial slit with catheter (for easy removal)
- Ensure slit edges touch for maximum efficacy

Arterial catheter, usually secured with a monofilament non-silk suture, placed in central position - femoral artery, axillary artery is to be covered with chlorhexidine dressing. Peripheral arterial lines don't need a dressing with chlorhexidine.

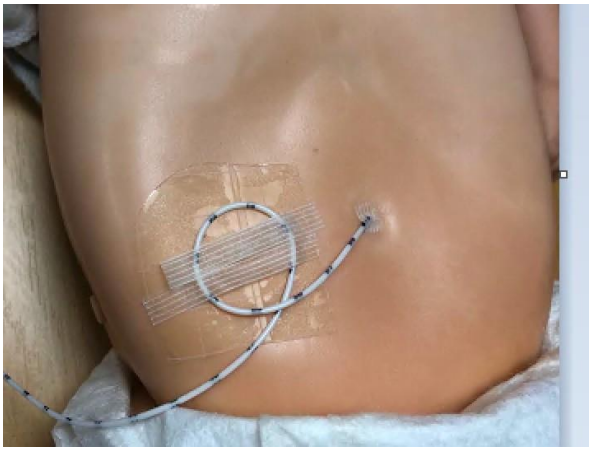
Hickman line: It is important that the initial dressing applied over the exit site in the operating theatre should remain in situ for 7days if possible, to allow the catheter cuff to become secure. Chlorhexidine dressing is to be applied after that. The dressing on the neck wound should be removed after 48 hours, leaving the steri-strips in situ until the wound has healed

Table 4: Recommended dressing for CVAD

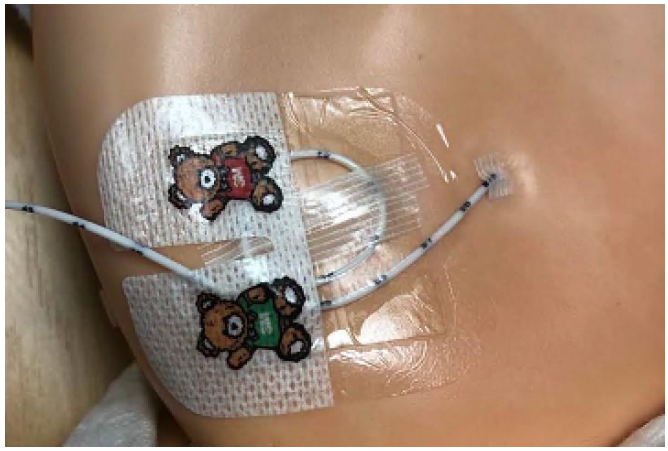
	Standard central line Central arterial line (Femoral, axillary) Midline (short long line) PICC/Hickman	**Peripheral arterial lines or Allergic to chlorhexidine (or premature)**
Neonates & small Infants	1660R (7x8.5cm) preferably or 1682 (5x5.7cm) + Biopatch, or 1681 (7x8cm) + Biopatch	1682 (5x5.7cm) or 1610 1681 (7x8cm)
Bigger infants & Children	1660R (7x8.5cm) preferably or 1681 (7x8cm) + Biopatch or 1689 (10x15.5cm) + Biopatch	1681 (7x8cm) 1689 (10x15.5cm)

Umbilical catheters

- Umbilical catheters are sutured to the umbilical stump
- Duoderm is applied to protect skin. The catheter are looped to prevent a traction at an insertion point and accidental dislodgement. The loop is secured with Steristrips and covered with Tegaderm. Record the external length of catheter to monitor migration.



Pic 7: Umbilical line securement - Duoderm + SteriStrips



Pic 8: Tegaderm™ 1610

Important consideration while performing dressing change:

- **Ensure the old dressing is peeled from distal end to avoid accidental CVAD removal. (**please see attachment page 39, “proximal” and “distal” are anatomical labels for a direction in relation to limbs; proximal is something localised closer to body centre, distal is something more distal from a centre; peeling a dressing from proximal end - closer to a body - carries a risk of a line/catheter being pulled out with a dressing, hence it is important to remove dressing from the end further away from a body)
- Ensure the old dressing is removed gently to prevent skin trauma**. Be cautious not to remove adhesive device securing the line while using adhesive remover wipes. Do not use adhesive remover fluid which is poured over the dressing - unless you plan changing adhesive device too.**
- **Ensure the skin preparation is completely dry before applying any dressing**

component. The adhesives in the dressing interact with wet skin preparation, potentially leading to skin complications.

- **Secure the CVAD and add on devices (e.g. three way taps and giving sets) away from potential sources of contamination such as nappies.**
- **If there are any concerns with the condition of the exit site or surrounding skin, refer to the appropriate teams for consultation and advice.**

10.4 Dressing change

- This procedure require a **surgical aseptic field** as key sites are exposed. Assess the need for additional support to ensure key sites remain protected at all times. Take into consideration the patient's age, developmental level and family participation.
- If the needle-less connector requires changing at the same time, this exposes a key site and sterile gloves and an aseptic field is required. Change Bionectors® every 3 days; weekly if not in use together with dressing change.

Equipment

- Dressing trolley cleaned with appropriate wipes (Chlorclean, Distel, Clinell)
- Sterile dressing pack with sterile gloves
- A pair of non-sterile gloves, disposable apron
- 2% Chlorhexidine gluconate in 70% isopropyl applicator

- Sterile dressing, the standard dressing is Tegaderm Advanced™ (with chlorhexidine pad or Biopatch™)
- Suture-less securement device (optional, only if planned to be changed)
- Microbiology wound swab if required. (If site is dry, include sterile water to moisten swab)
- Cavilon™ barrier swab stick (not to be used on infants <1 month of age)

Technique

- Explain procedure to patient and parents, ensuring privacy and comfort.
- Collect required equipment.
- Ensure surface has been cleaned with Clinell wipes before setting up a surgical aseptic field.
- Perform hand hygiene and using a non-touch technique open dressing pack onto work surface, touching only outside and corners. This is now your aseptic field. Open all other sterile items onto aseptic field using aseptic non-touch technique.
- Perform hand hygiene and don non-sterile gloves.
- Gently remove the old dressing starting from a distal end without touching the line or insertion / exit site, remove Biopatch™. If planning to change a suture-less securement device in situ, remove it carefully. Adhesive devices (e.g. Statlocks™, GripLock™) are to be removed with a 2% chlorhexidine and 70% alcohol skin preparation pad to assist with ease of removal. Minimise trauma and prevent skin breakdown.
- Assess the insertion site and surrounding skin, take precautions to prevent

dislodgement.

- In PICC lines - note the line marking (record and if there is a change of length of exposed catheter), hold the line and to peel the dressing upwards.
- Observe the external lumen of the catheter for kinks or damage.
- Site assessment is to include identifying signs and symptoms of infection which include; erythema, purulence, tenderness, haemo-serous ooze or any other abnormalities. Altered skin integrity includes; erythema, sheering or cuts in the skin, irritation, discomfort or any other abnormalities. Ask patient, (if possible), if there is any pain at the insertion / exit site or if they are experiencing any loss of function in their arm. If exudate, swelling, and redness noted: refer to the medical team & swab the site.
- Findings from the site and skin assessment may alter management from this point. Consider taking a clinical image and seeking advice from a senior member of staff.
- Remove gloves and repeat hand hygiene.
- Don sterile gloves.
- Securing the line with a piece of sterile gauze, scrub the line with chlorhexidine moving away from the patient and allow to air dry.
- Clean skin with chlorhexidine stick from the centre to the outer area in a circular motion, approximately 5-10cm. Repeat this three times and allow to completely air dry. Do not fan the area to speed up the drying process.
- Apply the Biopatch™ with the blue side facing upwards with the slit aligned with the catheter tubing.
- Apply Cavilon™ 2cm away from the exit site (not to be used on infants <1 month of age).
- For PICCs and tunnelled CVAD, replace the suture-less securement device (GripLock™). Before placing the CVAD into the GripLock™, ensure you are familiar with how the paper backing is removed. Once GripLock™ is attached to the line, remove the paper backing and place on the skin.
- Apply the dressing, ensuring is covers the Biopatch™, an appropriate portion of the catheter and surrounding skin.
- Safely dispose of equipment and rubbish.
- Perform hand hygiene.
- Document procedure

10.5 Accessing CVAD. Medication administration, flushing, priming lines, changing IV bags, blood sampling

- This procedure requires a **standard aseptic field** as key sites are exposed. Assess the need for additional support to ensure key sites remain protected at all times. Take into consideration the patient's age, developmental level and family participation.
- PN administration requires **surgical aseptic technique**.
- All access and ongoing care of CVADs must be provided using the principles of Aseptic non- Touch Technique (ANTT) to avoid the introduction of infectious agents. Access ports must be cleaned using 2% chlorhexidine gluconate (CHG) in 70% isopropyl alcohol (IPA) impregnated cloth using friction for 30 seconds, and allowed for 30 seconds to dry before use ('scrub the hub').
- If ANTT has been breached during the insertion of a vascular device then the procedure must be abandoned and re-started except when patient's life is at risk if no access is obtained. In this situation it should be clearly documented in the medical notes the

reason for continuing with the procedure and the device must be removed when the patient is stable.

Equipment

- Clean tray with medications as prescribed
- 2% Chlorhexidine in 70% isopropyl alcohol wipes
- Syringes (10 ml luerlock)
- Drawing up needles and red caps
- 0.9% sodium chloride flush or heparin flush

Technique

- Collect required equipment
- Perform hand hygiene
- Prepare equipment and work area
- Apply non-sterile gloves if wearing for personal protection
- Prepare medication using drawing up needles taking care to protect key parts
- Expose CVAD and needle-less connector (Bionector™)
- Assess insertion site and check position
- Perform hand hygiene
- Scrub access point vigorously with 2% chlorhexidine and 70% alcohol solution - 'Scrub the Hub' 30 seconds to scrub, 30 seconds to air dry completely
- Administer medications
- Flush the line with the appropriate flushing solution and volume to clear the CVAD
- Perform hand hygiene
- Document procedure

Accessing a needle-less connector (Bionector™)

- Prior to accessing a CVAD, the point of access must be scrubbed vigorously with friction using 2% chlorhexidine and 70% alcohol solution - 'Scrub the Hub' 30 seconds to scrub, 30 seconds to air dry completely
- Access the needle-less connector only with sterile devices

Priming lines/ infusion set changes

- Use a Bionector® on all lines except for CVP monitoring
- Change Bionectors® every 3 days (weekly if not in use together with dressing change)
- Use 2% CHG in 70% isopropyl alcohol cloth to 'Scrub the Hub' (30 seconds to scrub, 30 seconds to dry)
- CVAD lines are replaced using an aseptic non touch technique
- every 72 hours if used for medication and crystalloids

- every 24 hours if used lipid infusions* and Propofol
- if used for administration of blood products replace line(s) at the end of the infusion or 24 hourly.
- Change transducer sets every 72 hours
- Prevent occlusions by changing empty IV bags immediately; keep pumps above the level of a bed if possible (gravity helps to prevent back-flow and occlusion following that)
- If not in use, flush lines using **push - stop technique,** and lock the line or use continuous flush as indicated (see 8.6 Flushing and locking CVAD).
- Document date connector/tubing was changed and when next to be changed.

Blood sampling

- Blood sampling requires and aseptic non-touch technique.
- All CVADs >3Fr can be bled back for blood sampling if required. 2.6 Fr PICC line (MedComp) red lumen can be used for blood sampling done by trained staff.
- the sampling should be slow, avoid creating too high negative pressure - this leads to collapse of the lumen
- flush the catheter before sampling with Sodium chloride 0.9% 2x the volume of the catheter + add-on devices. After sampling flush the lumen with 5x the volume of the catheter + add-on devices.
- For CVADs with more than one lumen, use the largest lumen possible for blood sampling. If there is difficulty aspirating blood from the CVAD refer to the 'CVAD complications and management' section of this procedure.
- If vasoactive infusions are running, blood sampling should be done very carefully from more proximal lumen to avoid sampling of vasoactive agent.
- Verify blood tubes and volume required. Please refer to the procedure for patient identification procedures when blood sampling.

Equipment:

- Clean tray
- Request labels and blood tubes required
- 2% chlorhexidine and alcohol preparation pads
- 0.9% Sodium chloride flush and heparin lock if required

Technique:

- Collect required equipment
- Perform hand hygiene
- Prepare equipment and work area
- Perform hand hygiene and don non-sterile gloves
- Scrub the Hub using 2% chlorhexidine and 70% alcohol solution, 30 seconds to scrub, 30 seconds to air dry completely
- Clamp any lines not being accessed, unless there are vasoactive infusions running

- Attach a 10mL luerlock syringe to the needle-less connector and aspirate 5mL of waste blood. If drawing blood for coagulation studies, aspirate 10mls of blood. (in children < 10kg and neonates draw half the amount 2.5 ml and 5ml). Do not sample from a port for TPN.
- Luer-lock Vacutainer directly to Bionector and fill collection tubes with the required amount of blood
- If taking blood cultures, aspirate directly from a hub. Sterile gloves should be used as key parts of a line are exposed. Do not take waste blood before sampling for blood culture. Always use the first aspirated blood for blood culture.
- Return “waste blood’ for all children in PICU.
- Change Bionector after sampling
- Label the tubes and sign the request form as required
- Flush the line with 5-10mL (4 mL for neonates) 0.9% sodium chloride, using a pulsatile technique. Ensure all the blood components are flushed through the line.
- Lock the CVAD with heparin, if required.
- Dispose of equipment and rubbish.
- Perform hand hygiene.

Flushing and locking CVAD

Flush: 0.9% sodium chloride solution which is administered after blood sampling, medication administration or before a heparin lock.
Lock: Locking solution which is administered at the end of a treatment period. This can be either 0.9% sodium chloride or heparin, depending on the frequency of line access.

Both flushing and locking CVADs is to be done using **10mL syringes** or bigger**.**

✴ Smaller **syringes can create to high pressure and this can lead to line rupture.**

- Flush with start-stop flush technique. The technique used to create turbulent flow helping to prevent occlusion by removing fibrin deposits and drug precipitants.
- Leave a small amount (0.5-0.1mL) of flush/lock solution in the syringe at the end of the flushing sequence, this prevents blood refluxing back into the lumen of the CVAD.
- Clamp the CVAD under positive pressure when the final lock is being administered.
- The volume of flush (Sodium chloride 0.9%) should be twice the volume of the catheter and add-on 3-way tapes/extensions.
- Flush before/after blood sampling: flush the catheter before sampling with Sodium chloride 0.9% 2x the volume of the catheter + add-on devices. After sampling flush the lumen with 5x the volume of the catheter + add-on devices.
- If not in use, flush the lumen and clamp while still flushing. This prevents back flow of blood into a line and occlusion of the lumen.

Table 5: Flushing and locking CVAD				
PICC lines 1 – 2.6 Fr				
Standard occlusion risk	continuous flush 0.9%Sodium chloride run at 1ml/h			
High risk patients (cardiac, difficult access)	continuous Heparin 1unit/1ml in 0.9% Sodium chloride run at 1ml/h			
Prime volumes	Vygon Premicath 1.1Fr single lumen, 20cm: 0.09ml Vygon Nutriline 2Fr single lumen, 30cm: 0.12ml Vygon Nutriline Twinflow 2Fr double lumen, 30cm: 0.2ml per lumen (0.006ml per cm) MedComp 1.9Fr single lumen, 20cm: 0.17ml (0.004ml per cm) MedComp 2.6Fr double lumen, 20cm: 0.17ml per lumen (0.004ml per cm)			
MIDLINES 24 & 22 G (short long lines)				
Standard occlusion risk	continuous flush 0.9%Sodium chloride run at 1ml/h			
High risk patients (cardiac, difficult access)	continuous Heparin 1unit/ml in 0.9% Sodium chloride run at 1ml/h			
PICC≥ 3 Fr; HICKMAN & BROVIAC; VASCATH				
accessed more frequently than 24 hourly	flush and lock with 0.9% Sodium chloride			
accessed less frequently than 24 hourly,	at the end of each access the CVAD is to be flushed with 0.9% sodium chloride flush followed by a long-term heparin lock (concentration of Heparin 100 units/ml)			
High risk patients a CVAD accessed between 8 and 24 hourly	at the end of each access the CVAD is to be flushed with 0.9% sodium chloride followed by a short-term heparin lock (concentration of Heparin 10 units/ml)			
Note: A 0.9% sodium chloride flush should always be administered prior to the heparin lock.				
CVAD TYPE	MINIMUM FREQUENCY OF FLUSHING/ LOCKING	LONG TERM HEPARIN LOCK <10kg 100Units/ml	LONG TERM HEPARIN LOCK >10kg 100units/ml	SHORT TERM HEPARIN LOCK 10 units/ml
Prime volumes should be documented as per recommendation of a manufacturer; if unknown use weight as a guide.				
PICC ≧ 3Fr	7 days	1ml	2ml	2ml
HICKMAN/ BROVIAC	7 days	1ml	2ml	2ml
VASCATH	7 days	Volume on a catheter	Volume on a catheter	N/A
PORT	Every 4 - 6 weeks	4ml of 100units/ml (see Needling and Flushing Implanted and Central Venous Access Device - Port a Cath UHL Childrens Nursing Guideline C157/2016)		

- For PICC < 3Fr use continuous infusion of Sodium chloride 0.9% run at 1ml/h; if high risk of occlusion use continuous Heparin 1unit/ml in 0.9% Sodium chloride run at 1ml/h. (High risk patients: e.g. complex cardiac lesion expected to need multiple procedures in the future)
- Long term CVAD - PICC/Hickman, Haemodialysis catheters, implanted Port - if not in use, lock with Heparin.

- In high risk patients TauroLock can be considered. TauroLock - antibacterial solution which contains citrate as anticoagulant. The dwell time needs to be > 2h to achieve required effect. If catheter used intermittently (e.g. for antibiotics), use TauroLock once a day only. (see long term TPN guideline) Change the lock every 7 days if CVAD not in use.

Daily antiseptic bathing and linen change

- Daily Stellisept® bathing for all patients unless allergy or otherwise advised by Infection Prevention
- Octenisan® as a second line alternative in children
- Nasal Mupirocin TDS; or Naseptin QDS (alternative)
- Change linen daily

MAINTENANCE CARE BUNDLE

- ☑ Focus on Hand hygiene (5 moments of hand hygiene)
- ☑ CVAD competent nursing and medical staff (maintenance training for all providers)
- ☑ Daily ward round discussions - the need for CVAD to remain in situ must be reviewed at every ward round
- ☑ Dressing and site check - dressing change is 2 person surgical aseptic technique
- ☑ Scrub the hub
- ☑ Aseptic Non Touch Technique for accessing CVAD
- ☑ Standardised connector and tubing change, procedures, timing
- ☑ Occlusion prevention - correct flushing technique
- ☑ Daily antiseptic bathing and linen changes

11. CVAD complications

11.1 Complications post-insertion of CVAD

EVENT	RISKS & MANAGEMENT
Accidental removal	• Apply pressure to insertion site until bleeding stops • Cover the exit site with a sterile occlusive dressing (e.g. TegadermTM) • Notify medical team • Make arrangements for replacement of CVAD if required
Air embolus	Can occur due to: • An uncapped / unclamped line lumen • Accidental air injection • Vein exit site exposed during removal How to prevent that: • Do not allow air to enter the catheter • Ensure all lines are primed before attaching to the patient • Follow correct CVAD removal procedure • Ensure clamps are closed on lines. Symptoms: patient becomes acutely short of breath and distressed, cyanosis, tachycardia, decreased conscious level Treatment: • Call for help and commence resuscitation if cardio-respiratory compromise • Lie patient left side down with a head down position • Check the line for any obvious breaks, holes / disconnections • Clamp / cover exposed catheter end or between the leak (and damaged area) and the patient with the integral line clamp, atraumatic plastic clamp or metal clamp covered in gauze • Using surgical aseptic technique, scrub patient side of line with 2% chlorhexidine and 70% alcohol solution • Withdraw air and check for blood return • Flush with sterile 0.9% sodium chloride and clamp line • Using an aseptic non touch technique prime new lines and continue infusion • Document • Notify medical team
Tip malposition / migration	Migration in: Catheter length outside the body gets shorter, tip discovered in an unacceptable low position on CXR or ECHO Symptoms: Rarely tachycardia and palpitations due to migration into the right ventricle. Treatment: • Assess and document • Notify medical team; Catheter will need to be pulled back to an acceptable position with a sterile technique, re-secured, repeat CXR • Tunnelled cuffed and implanted ports need to be pulled back under a general anaesthetic in the operating theatre. Migration out: Catheter length outside the body gets longer, cuff protrudes from exit site, tip discovered in an unacceptable high position on CXR. Risk of extravasation and loss of therapeutic drug effect. Symptoms: Neck pain, rushing sound in ear when flushing, extravasation. Treatment: • Stop infusions and clamp • Secure catheter • Place firm pressure on any bleeding areas • Notify medical team. • Document.

Cardiac Tamponade	Cause: may occur within several hours of insertion due to accidental perforation of atrium by insertion needle or guide wire; catheter tip can cause the injury in premature neonates. Blood accumulates in the pericardial space around the heart and impairs cardiac function. Can be catastrophic and fatal. Rare, more common in neonates. Symptoms: cardiovascular instability and collapse. Treatment: medical emergency, pull crash call if cardiovascular instability Organise urgent ECHO.
Catheter damage or fracture - internal	CVAD catheter breaks inside the patient body and the broken end cannot be retrieved. Medical emergency as haemorrhage can occur the catheter may split and embolism of the internal portion can occur into the heart or lungs. Treatment: • Organise urgent emergency theatre • Any damaged line that requires removal should be sent to the manufacturer.
Catheter damage or fracture – external	CVAD catheter is damaged or broken outside the patient's body. Medical emergency as high risk of haemorrhage or venous air embolus. Treatment: Immediately clamp catheter between fracture and patient with integral line clamp, non - traumatic plastic clamp or metal clamp covered in gauze. • Place occlusive dressing over fracture site • Notify Medical team cuffed tunnelled central catheters can be repaired with the appropriate repair kit by trained staff. • Most lines will need removal and replacement. • Any damaged line that requires removal should be sent to the manufacturer.
Difficult to remove	• Reposition patient and reattempt removal • Ensure all sutures removed • If CVAD remains difficult to remove, stop • Notify medical team.

Extravasation	• Accidental administration of drugs into the extra vascular tissue instead of into the vein. Tissue damage and necrosis can be extensive with some drugs (e.g. vesicant chemotherapy) and should be treated as a medical emergency.
	• Symptoms: pain, redness, swelling, visible leaking of drug via the skin tunnel
	• Treatment:
	  • Stop infusion
	  • Assess insertion site and document
	  • Notify medical team

Leaking the fluid out of exit site	• Consider 'Extravasation, assess and document • Notify medical team
Infection: local	Symptoms: redness, swelling, discharge, ooze, pain or tenderness at site. • Neutropenic patients may not develop symptoms of redness or discharge. Treatment: • May be treated with antibiotics and CVAD may be able to remain *in situ* • Swab site Note: Local site infections in an implanted port or above the cuff of tunnelled cuffed CVAD are difficult to treat and line removal is often required.

Infection: systemic	Symptoms: Pyrexia, hypotension, tachycardia, shock. Treatment: • If patient febrile (Temp > 38°C), take blood cultures. 2 sets (sequentially or within 12 hours) of blood cultures should be taken; one peripherally and one from the CVC. Sample from all lumens and clearly label each on the bottles. Note: Do NOT sample from lines with vasoactive infusions running. • Antibiotics should be started immediately, see sepsis guidelines Do not remove CVADs on the basis of fever alone. Use clinical judgment regarding removal of the CVAD. Consider evidence of infection elsewhere, non- infectious cause of fever, difficult line replacement.
Phlebitis	Irritation of the intima of the vein, may occur within 72 hours of insertion Symptoms: pain, erythema, warmth, a venous cord may be palpable Treatment: • Often can be treated with warmth and analgesia. • Do not remove CVAD.
Pneumothorax	Presence of air in the pleural space between the lungs and the chest wall. Can occur during CVAD insertion when the needle or guide wire used to access the vein inadvertently punctures the lung. This risk is reduced by using ultrasound. Symptoms: shortness of breath, reduced oxygen saturation, tachycardia, hypotension. It may also be discovered incidentally on a CXR. Treatment: if cardio respiratory compromise present pull crash call & commence resuscitation. Urgent chest decompression with a needle or a chest tube may be required. Small pneumothorax may resolve spontaneously.
Thrombosis (DVT)	Thrombosis occurs when a clot develops within the vein around the catheter and extends into central veins. More common if the catheter takes up > 1/3 of the vein diameter, the tip of the catheter is malpositioned high in the SVC or in patients with sepsis or cancer. Symptoms: May be asymptomatic or cause swelling, pain, tingling or numbness of arm, neck, face or legs. Surface vein collateral blood vessel formation may occur. It usually will not affect the patency of the catheter. Thrombosis can be confirmed by ultrasound. Treatment: • Referral to Haematology • DO NOT remove long term CVAD without consulting haematology – removal if patient is not anticoagulated may cause clot embolism. • It may be possible/ preferable to treat a thrombosis using anticoagulants without removing the catheter if the CVAD is functional and required. Re-insertion risks thrombus at a second site.

11.2 Mechanical dysfunction. Occlusion

- Catheter occlusion is one of the most frequent complications associated with CVADs use. Signs of a CVAD occlusion are resistance when flushing, sluggish flow, increased frequency of pump alarms, leaking at the insertion site, the inability to easily infuse fluid or aspirate blood. A CVAD can become partially or completely occluded and in some cases the occlusion will only occur when attempting to aspirate blood.
- All types of occlusion should be investigated and treated as soon as possible.
- The causes of CVAD occlusion can be due to; mechanical dysfunction, drug precipitate or a thrombotic blockage. Investigating the underlying cause is essential in the treatment and management of CVAD occlusions.

CAUSES	DIAGNOSIS AND TREATMENT
Kinks in catheter or add on devices such as the extension set or filters, tight sutures, closed clamp, a clogged needle- less connector	Assess the external portion of the CVAD and all add on devices for any kinks or blockages. Consider replacing add on devices (e.g. needle-less connector)
Tip of catheter abutting vessel wall.	Reposition patient and ask them to cough.
Damaged or fractured CVAD.	Assess the entire CVAD for any swelling, bulging, fracture or leaking. If any of these complications are identified, contact the medical team. In most cases the device will require removal and/or replacement. With certain devices such as silicone tunnelled cuffed central catheters, the damaged portion of the catheter may be repaired. Additional imaging may be required such as a linogram, which will assess the internal integrity of the device.
Tip malposition, internal kinking or pinch off syndrome.	Inspect and measure the external length of the CVAD and assess if the catheter has migrated. Consider a chest x-ray to ensure the tip of the catheter is in the correct position and to eliminate a mechanical obstruction.
Intraluminal thrombus	An intraluminal thrombus is the most common cause of CVAD occlusion. It occurs when there is a build-up of fibrin on the intraluminal surface of the CVAD. This type of thrombus may present as a partial or complete occlusion. If mechanical dysfunction is not expected to be the underlying cause of occlusion, alteplase can be instilled to restore catheter patency.

Fibrin tail	A fibrin tail is the result of blood components built up at the tip of the CVAD. This type of thrombotic occlusion acts as a one-way valve which permits fluids to be infused but blocks aspiration of blood. Administration of intraluminal alteplase may assist with lysis of the fibrin tail.
Fibrin sheath	A fibrin sheath may develop on the external surface of the CVAD and extend all the way down to the tip of the catheter creating a 'pocket'. If medication becomes trapped in the pocket, it may travel back up the external surface of the catheter causing tissue irritation and swelling. A linogram may assist with the diagnosis of this.
CVAD associated deep venous thrombosis	Deep venous thrombosis most commonly occurs at the insertion site, where endothelial damage and flow interruption are at their greatest. Thus, they can be totally missed if contrast is put through the catheter as in a linogram. Less commonly, they occur when the catheter tip irritates the vessel wall resulting in the tip of the CVAD adhering to the vein. CVAD associated DVT can present with line dysfunction, but can also present with signs of venous obstruction including; swelling of the distal limb, pain, or increased superficial collaterals. CVAD associated DVT may be occlusive or only partially occlusive and can embolise to cause pulmonary embolus or paradoxical emboli. Depending on the site of insertion of the CVAD, diagnosis may be made by ultrasound, but will often require CT or MR venography to show the true extent of the DVT.

11.3 Investigations to consider based on the issues

PRESENTATION	INVESTIGATIONS
CVAD no longer flushing or drawing back normally - Most probably due to an intraluminal clot, fibrin sheath or a malpositioned catheter tip	Administer alteplase If unsuccessful, CXR then linogram
Multiple doses of alteplase have been administered within a three-month period	Linogram CT or MR venogram
Pain with administration of fluid or medication - most likely due to a fracture, internal disconnection or tip migration	CXR and linogram after that
Line functioning but there is inflammation around the port or along the subcutaneous tract of the line Probably an infection but the CVAD may have fractured or disconnected	Ultrasound and consider CXR
Clinical signs of SVC obstruction +/- line functioning - Important to investigate early as percutaneous intervention is much easier while the SVC is still patent versus completely occluded	Linogram CT or MR venogram

11.4 Key messages for preventing CVAD occlusion:

- **Ensure all CVAD lumens are flushed and locked with the appropriate solution.**
- **When locking CVADs use a pulsatile technique, leaving a small volume (0.5-0.1mL) in the syringe.**
- **Assess CVAD patency and escalate management with any signs of occlusion.**

11.5 Unblocking CVAD with Alteplase

Alteplase is a Recombinant Tissue Plasminogen Activator (rtPA). It dissolves blood clots occluding central lines.

Indications: Partial or complete thrombotic occlusion of a central venous line despite the following measures:

- Patient repositioned with arms lifted up
- Ask patient to cough or perform Valsalva manoeuvre (squatting), if cooperates. Re-aspirate to see if successful
- Remove Bionector, scrub a hub, and try to aspirate directly from a hub using sterile syringe; try to flush gently
- A blocked line may be indicative of an infection. If it cannot be unblocked, consider removal and replacement of the line.

Contraindications: Any individual known to have an allergy to TPA. Caution should be exercised with patients who

- have any condition for which bleeding constitutes a significant hazard
- have had recent severe bleeding
- have had recent major trauma
- have active ulcerative GI disease
- have had a recent stroke
- If the patients' coagulation profile is known to be deranged, the Haematology team are to be contacted for advice regarding administration of Alteplase.

- Onset of action: Requires 2 to 4 hours dwell time. Alteplase must **be removed from the catheter** after dwell time. The catheter must be flushed well prior to infusing any other medications.

- If catheter patency is not restored, investigate for other causes of occlusion. The second dose of Alteplase can be considered. It can be administered immediately after attempting to remove the first dose. Consider a longer dwell time for subsequent dose of Alteplase. It can be left to dwell for up to 72 hours.

- Drug Information: Alteplase is available in a 2 mg vial sterile lyophilized powder. The 2mg vial is reconstituted with 2.2 ml of sterile water to make a 1 mg/ml concentration which is stable for 8 hours. Do not shake the vial, let stand or swirl. This solution should not be filtered and should be administered without further dilution.

Dosage: ALL DOSAGES OF Alteplase SHOULD BE ADMINISTERED USING a 10 ml **SYRINGE.** Alteplase should **not be administered** into **more than two lumens at once**.

For neonates and pre-terms, it is recommended that the concentration remain the same and that the volume infused be 110% of the catheter volume - please calculate the dose based on prime volume of catheter (see Table.5).

Type of Catheter	**Standard Central Venous Catheters and PICC Catheters**	**Tunneled Catheters (Broviacs Hickman)**	**Totally Implanted Devices (Infuse-a-ports)**
Volume of (Alteplase)	> 1 months and full term and < 10 Kg: 0.5 mg total volume 0.5 ml	> 1 month and full term and < 10 Kg: 0.5 mg total volume 0.5 ml	> 1 month and full term and < 10 Kg to be discussed case by case
	> 10 Kg: 1 mg total volume 1 ml	> 10 Kg: 2 mg total volume 2 ml	> 10 Kg: 2 mg total volume 2 ml

Equipment

- Vial of rtPA (Alteplase)
- Gloves
- 2 x 10 ml syringe
- Three way tap
- 2% CHG in 70% Alcohol Swab

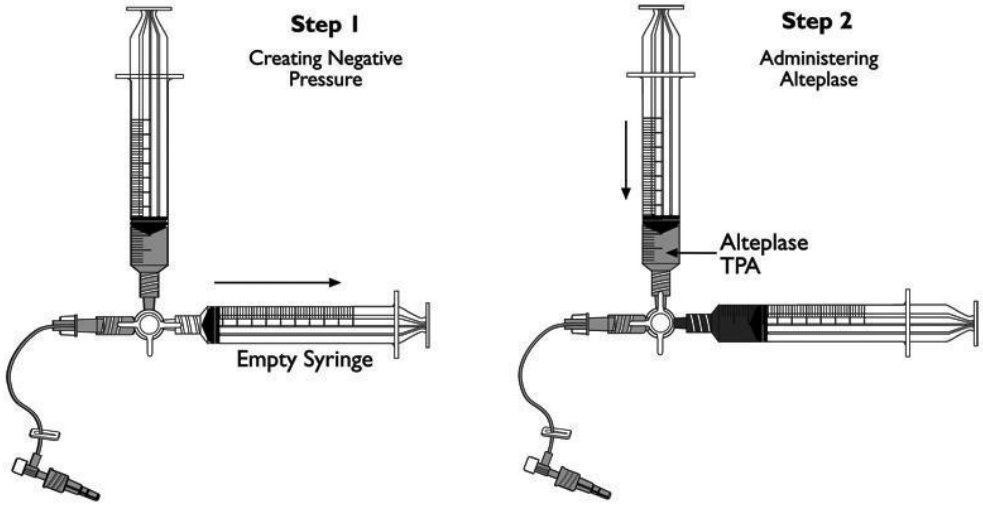
Procedure

- Maintain good hand hygiene before, during and after the procedure.
- Maintain ANTT throughout access of central line
- Attach the empty 10ml syringe to one end of the three-way tap and the syringe filled with Alteplase to the other port. Ensure that the port with the Alteplase is closed. See diagram below.
- Clamp the catheter if the catheter is open ended
- 'Scrub the hub' connection site and attach the three-way tap to the catheter
- Hold the empty syringe in a downward position so that aspirated air rises in the syringe.
- Pull back on the empty syringe plunger to the 8 ml or 9 ml marking and then close the 3-way tap. This creates negative pressure within the CVAD (vacuum effect). Release the plunger
- Open the 3-way tap to the Alteplase. Apply gentle pressure if required but DO NOT FORCE THE ALTEPLASE.

N.B Alteplase should ideally be instilled slowly, approximately over 1 minute, since this will

coat the walls of the catheter and prevent denature.

- Close the 3-way tap and label the site “Do not use rtPA in situ.“
- The Alteplase must stay in the catheter for 2 - 4 hours and then be aspirated out together with 4- 5 mls of blood to remove any remaining drug and/or clot.
- Flush with 10ml 0.9% Sodium Chloride and begin infusion or again flush with heparinised sodium chloride as per protocol, using pulsatile techniques if the line is not used immediately.
- This technique may be repeated once if there is sluggish or difficult blood return.
- Discuss further plans - line removal / replacement with Consultant if unsuccessful.
- Discard all bio-hazardous material appropriately.
- Document procedure in nursing notes.
- Complete Alteplase (rtPA) Insertion Record.



Pic 9: Unblocking a CVAD with Alteplase

Alteplase installation record			
Reason for instilation:			
Type of CVAD: CVC	Hickman/Broviac	PICC	other
Amount of drug instilled:			
Length of time left in situ:			
Result:			
Signature	Date	Time	
Second installation:			
Length of time left in situ:			
Result:			
Signature	Date	Time	

12. CVAD removal

CVAD is to be removed without delay once the multi-disciplinary team decides they are no longer required for patient care.

Lines should not be changed routinely, at the same time in percutaneously inserted non-tunnelled non-cuffed CVC the risk of CLABSI increases after 7 days. Based on further treatment needs and needs for iv access an appropriate vascular access device should be chosen to replace CVC.

Implanted devices (ports) and cuffed catheters are to remove in PICU or theatre under general anaesthesia, as surgical dissection and suturing is required.

Standard central lines, umbilical catheters, PICCs, tunnelled uncuffed PICCs are to be removed in PICU or in a ward.

Preparation:

- Prepare the child and family; consider comfort techniques and analgesia as required. Anaesthesia or sedation is rarely needed for standard central venous catheters, PICCs or umbilical catheters removal.
- The removal is to be performed by 1 or 2 personnel, considering patient age, developmental level and family participation.
- Review recent bloods, including coagulation studies, consider bleeding risk. Prior to removal of the cuffed CVAD, the patient must have a platelet count equal to or greater than 50.
- There is risk of air embolism during removal of internal jugular/subclavian non-tunnelled, non- cuffed CVC and large bore catheters. CVAD should only be removed when the patient is lying flat in bed preferably with the head of the bed tilted slightly down - the Trendelenburg position, or semi-Fowler position.

Pic 10: Semi-Fowler position

Pic 11: Trendelenburg position

Equipment

- Dressing pack
- 2% chlorhexidine and 70% alcohol solution
- Non sterile gloves
- Sterile gloves
- Stitch cutter
- Gauze- Sterile transparent semi permeable dressing
- Adhesive remover wipes may be required to remove tissue adhesive from the exit site

Technique

- Perform hand hygiene
- Clean stainless steel trolley with ChlorClean or Distel Wipe® and allow to dry
- Prepare equipment and aseptic field
- Using a surgical aseptic technique open required equipment
- Expose CVAD site and clamp all lines
- Don non sterile gloves
- Remove dressing and dispose
- Perform hand hygiene
- Don sterile gloves
- Clean insertion site using 2% chlorhexidine and 70% alcohol soaked gauze in a circular motion extending outwards.
- Remove any securing sutures or suture-less securement devices.
- If the patient is able to comply, ask them to take a deep breath and hold it. Remove catheter. For patients who can't hold their breath, if possible, remove on expiration.
- Using gauze, place firm pressure over site, gently using steady pressure pull the CVAD out.
    - For non-tunnelled CVADs, place firm pressure over insertion site with gauze until bleeding stops.
    - For tunnelled CVADs, place pressure **over vein insertion site** – until bleeding stops
- As catheter is about to exit, increase pressure on insertion site. If resistance is high at any point, stop and notify medical staff.
- If there are concerns about central line infection, consider sending a tip.
- Hold gauze over site until bleeding stops.
- Cover insertion site with a sterile Tegaderm with pad dressing, after removal bore catheters reinforce with pressure dressing.
- Following removal of bore catheters, the patient must rest in bed for 4 hours.
- Dispose of equipment safely, perform hand hygiene, and document. record in EMR

13. Midlines (short long lines)

- A midline is a catheter that is inserted into the deep arm veins (usually brachial or basilic) with its tip positioned not deeper than in axillary vein.
- A midline works in the same way as peripheral intravenous cannula, as the tip of the device remains in the peripheral vasculature. Therefore, only medication that is suitable to be given peripherally can be given through a midline.
- Midlines can be inserted outside the theatre environment or PICU, such as treatment rooms in the in-patient areas. Midline insertion must be conducted by a trained operator using

surgical aseptic technique and ideally using ultrasound guidance, and is to be secured with suture or suture-less device. Consider using chlorhexidine dressing for high risk patients.

- Maintenance: Dressing and suture-less securement devices are to be changed every seven days unless clinically indicated.
- Midline catheters are to be flushed and locked with 0.9% sodium chloride if they are not connected to a continuous infusion. In high risk patients (cardiac, difficult access) with 24G or 22G midlines consider continuous Heparin+Sodium chloride 1unit/1ml flush of 1ml/h.

14. Education and training requirements

Insertion training for all providers

- All staff performing or assisting with the procedure must receive appropriate training
- Training opportunities: Induction, Simulation training, Daily bedsite teaching
- Training will address:
  - Hand hygiene, aseptic non-touch technique (ANTT), surgical aseptic technique
  - Indications and principles of safe insertion of CVAD (including USS guidance as the gold standard) including manipulation with guide wires
  - Device fixation using non-silk suture or suture-less device
  - Safe disposal of sharps
  - Semipermeable transparent dressing
  - Use of smart-sites (Bionector©) and flushing technique
  - Documentation and care planning

Maintenance training for all providers

- All staff performing or assisting with access procedure must receive appropriate training
- Training opportunities and documented progress must be discussed every 6 - 12 months with a clinical supervisor
- Training will address:
  - Hand Hygiene, Aseptic non touch technique (ANTT), surgical aseptic technique
  - RAID and VIP (Phlebitis score) assessment
  - How to access, flush and lock CVAD safely
  - Appropriate use of dressing, Bionector© and tubing
  - Daily ward round Discussion and documentation

15. Monitoring Compliance

None

16. Supporting References

1. Ullman AJ, et all: The Michigan Appropriateness Guide for Intravenous Catheters in Pediatrics:miniMAGIC. Pediatrics 2020;145;S269.

2. Kolacek S, Puntis J, Hojsak I et al. ESPGAN/ESPEN/ESPR guidelines on pediatric parenteral nutrition: Venous access. Clinical nutrition 2018.1-13

3. Sharp R, Cummings M, Fielder A, Mikocka-Walus A, Grech C, Esterman A. The catheter to vein ratio and rates of symptomatic venous thromboembolism in patients with a peripherally inserted central catheter (PICC): a prospective cohort study. Int J Nurs Stud. 2015; 52(3):677–685

4. Insertion, management and removal of central venous access devices. The Royal Children's Hospital Melbourne, Australia, 2021.

5. Baskin KM, Mermel LA, Saad TF, et al; Venous Access: National Guideline and Registry Development (VANGUARD) Initiative Affected Persons Advisory Panel. Evidence-based strategies and recommendations for preservation of central venous access in children. JPEN J Parenter Enteral Nutr. 2019;43(5): 591–614

6. Clark-Christoff N, Watters VA, Sparks W, Snyder P, Grant JP. Use of triple-lumen subclavian catheters for administration of total parenteral nutrition. JPEN J Parenter Enteral Nutr. 1992;16(5):403- 407.

7. Spencer TR, Mahoney KJ. Reducing catheter-related thrombosis using a risk reduction tool centered on catheter to vessel ratio. J Thromb Thrombolysis. 2017;44(4):427-434.

8. Gilbert RE, Mok Q, Dwan K, et al. Impregnated central venous catheters for prevention of bloodstream infection in children (the CATCH trial): a randomised controlled trial. Lancet. 2016;387(10029):1732-1742.

9. Turnbull IR, Buckman SA, Horn CB, Bochicchio GV, Mazuski JE. Antibiotic-impregnated central venous catheters do not change antibiotic resistance patterns. Surg Infect (Larchmt). 2018;19(1): 40-47.

10. Hou A, Fu J. Pericardial effusion/cardiac tamponade induced by peripherally inserted central catheters in very low birth weight infants: A case report and literature review. Front Pediatr 2020;8:235.

11. Pittiruti M, Lamperti M. :ate cardiac tamponade in adults secondary to tip position in the right atrium: An urban legend? A systematic review of the literature. Journal of Cardiothoracic and Vascular Anesthesia 2015;29(2):491-5

12. Schutz JC, Patel AA, Clark TW et al. Relationship between chest port catheter tip position and port malfunction after interventional radiologic placement. J Vasc Interv Radiol 2004;15:581–587.

13. Jimenez M, Baskin KM, Cahill AM et al. The elusive cavoatrial junction: anatomic and biometric study of the superior vena cava (abstract). Pediatr Radiol 2005;35 [Suppl 1]:S59

14. Baskin KM, Jimenez RM, Cahill AM, Jawad AF, Towbin RB. Cavoatrial junction and central venous anatomy: implications for central venous access tip position. J Vasc Interv Radiol. 2008;19(3):359-365.

15. Yoon SZ, Shin JH, Hahn S (2005) Usefulness of the carina as a radiographic landmark for central venous catheter placement in paediatric patients. Br J Anaesth 2005; 95:514–517

16. Barnacle A, Arthurs O, Roebuck D, Hiorns M. Malfunctioning central venous catheters in children: a diagnostic approach. Padiatr Radiol 2008;38:363-378.

17. Connolly B, Amaral J, Walsh S, Temple M, Chait P, Stephens D. Influence of arm movement on central tip location of peripherally inserted central catheters (PICCs). Pediatr Radiol 2006; 36: 845–50

18. Mid Yorkshire Hospitals NHS Trust 2019. Perpherally inserted central catheter (PICC) line care; weekly dressing change of a PICC line. https://www.youtube.com/watch?v=QXLkr26j-YY

17. Key Words

Broviac, Care bundle, Central line, Central venous access, Dressing, Hickman, PICC, Vascular

The Trust recognises the diversity of the local community it serves. Our aim therefore is to provide a safe environment free from discrimination and treat all individuals fairly with dignity and appropriately according to their needs.

As part of its development, this policy and its impact on equality have been reviewed and no detriment was identified.

CONTACT AND REVIEW	
Guideline Lead (Name and Title) **Julia Vujcikova - Consultant**	**Executive Lead** **Chief Nurse**
Details of Changes made during review: 2024 Complete overhaul of original document	

Appendix 1: Central line associated blood stream infection (CLABSI)

BLOODSTREAM INFECTION (BSI)	
ADULTS *meets one of the following criteria:*	**Paediatrics(<13yrs)** *meets one of the following*
a) A recognised pathogen from at least one blood culture	a) A recognised pathogen from at least one blood culture
b) A common skin microorganism* from 2 blood cultures drawn on separate occasions and taken within a 48hr period **AND** The patient has at least ONE symptom of fever >38 C, chills or hypotension	b) A common skin microorganism* from 2 blood cultures drawn on separate occasions and taken within a 48hr period **AND** The patient has at least TWO symptoms of paediatric SIRS : fever >38.5 C <36 C, tachycardia (bradycardia for <1yr), elevated respiratory rate, elevated/depressed leukocytes

Neonates(<28days) *meets one of the following criteria:*	
	a) A recognised pathogen from at least one blood culture or CSF
OR	b) A common skin microorganism* is cultured from blood or catheter tip AND patient has ONE of: C-reactive protein >2.0 mg/dL, immature/total neutrophil ratio (I/T ratio) >0.2, leukocytes <5/nL, platelets <100/nL
AND	At least TWO of temperature >38 or <36.5 °C or temperature instability, tachycardia or bradycardia, apnoea, extended recapillarisation time, metabolic acidosis, hyperglycaemia, other sign of BSI such as apathy

*coagulase-negative staphylococci, Micrococcus sp., Propionibacterium acnes, Bacillus sp., Corynebacterium sp

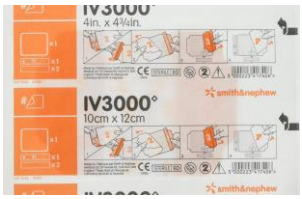
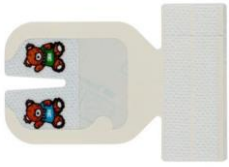
CENTRAL LINE ASSOCIATED BLOODSTREAM INFECTION **A. CENTRAL LINE- ASSOCIATED BSI (CLABSI)** *meets the following criteria:*	
	a) One of the criteria for bloodstream infection
AND	b) The presence of one or more central venous catheters at the time of the positive blood culture, or CVC removed within 48 hours before positive blood cultures.
AND	c) The signs and symptoms, and the positive laboratory results, including pathogen cultured from the blood, are not primarily related to an infection at another site
B. CATHETER-RELATED BSI (CRBSI) meets the following criteria:	
	a) One of the criteria for bloodstream infection
AND	b) The presence of one or more central venous catheters at the time of the blood culture, or CVC removed within 48 hrs before cultures
AND	c) One of the following*: I) quantitative CVC culture 10^3 CFU/ml or semi-quantitative CVC culture > 15 CFU II) quantitative blood culture ratio CVC blood sample/peripheral blood sample> 5 III) differential delay of positivity of blood cultures: CVC blood sample culture positive 2 hours or more before peripheral blood culture (blood samples drawn at the same time) IV) positive culture with the same micro-organism from pus from insertion site V) symptoms improve within 48hr of removal of CVC *ECDC definition

Appendix 2: Appropriate device selection

EXPECTED NEED FOR IV ACCESS	0 - 7 days	8 - 14 days	15 - 90 days (or more)	> 60 - 90 days
Peripheral iv cannula				
Midline catheter	- Preferred vein upper arm basilic vein - PICC preferred if home care required (lower failure rate)			
Central venous catheter (non-tunnelled)	- Preferred in critically ill - If haemodynamic monitoring required - Not suitable for home care			
PICC Peripherally inserted central catheter		- Preferred to midline if blood sampling required		
Tunnelled PICC (non-cuffed)				
Tunnelled cuffed CVAD (Hickman, Broviac)				Frequent use (> 1x a week)
Port				Intermittent use (< 1x a week)

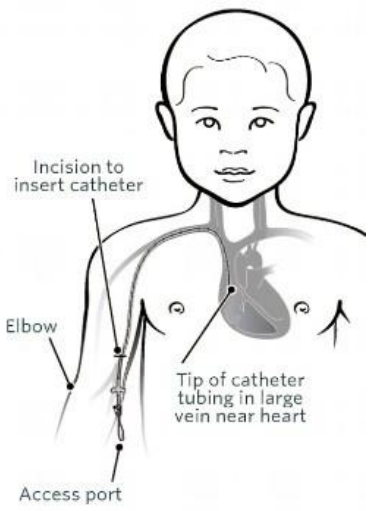
Appendix 3: Dressing

STANDARD CENTRAL LINE DRESSING; CENTRAL ARTERIAL LINE (femoral or axillary); MIDLINE (short long line in high risk patients) PICC/ HICKMAN/BROVIAC™; VASCATH,			
TEGADERM™ IV ADVANCED SECUREMENT DRESSING SIZES			
1660R	1682	1681	1689
7 x 8.5 cm with CHG	5 x 5.7 cm	7 x 8 cm	10 x 15.5 cm
			
1657R	Biopatch	Biopatch	Biopatch
11.5 x 8.5 cm with CHG	¾” with 1.5mm center hole for < 6Fr lines	¾” with 1.5mm center hole for < 6Fr lines	1” disk with 4mm hole for 6-12 Fr lines
			

CHLORHEXIDINE SENSITIVITY / ALLERGY; PREMATURE NEONATE PERIPHERAL ARTERIAL CATHETERS MIDLINE (short long line in low risk patients)			
TEGADERM™ IV ADVANCED SECUREMENT DRESSING SIZES			
Tegaderm Allergy	1682 or 1610	1681	1689
Mepore or IV3000	5 x 5.7 cm	7 x 8 cm	10 x 15.5 cm
 	 		

Appendix 4: PICC line care

(Name of a patient) has PICC line inserted in right brachial vein *(Vygon 4Fr 60cm)* - trimmed to *XY*cm, exposed length of catheter is *XY* cm; the procedure was done on *(date)*.



It is possible to take blood samples from PICC, however it is very important to flush the line after sampling with 10mls of 0.9% Sodium chloride (larger flush as usually after drugs administration).

Please avoid running blood products if possible (*it increases a risk of catheter associated thrombosis).*

The line is not suitable for CT contrast administration (*high pressure can cause a rupture of PICC*).

1) Please look after PICC as per care bundle for Central venous acces PICU (C112/2016)

2) **Change dressing every 7 days** under aseptic conditions – surgical sterile technique, sterile gloves and apply Chlorhexidine dressing (Biopatch or Tegaderm CHG with Chlorhexidine pad).

3) The line is not stitched, it is secured with GripLock – please **DON'T USE Apeel** for dressing change. *It removes securing device too. Use Apeel only if you plan to change securing device (GripLock) too.*

4) Change Bionector every 3 days under aseptic conditions; if used for TPN change Bionector daily. If PICC is not in use, change with dressing every 7 days.

5) Use **syringes 10ml and bigger** to administer medications and flush. *Smaller syringes create excessive pressure and can damage the PICC.*

6) Flush before and after each drug administration.

7) Use **start - stop flush** technique, **clamp while still flushing**. (*It prevents back flow of blood into the tip of the line = occlusion).*

8) On the end of the flush the syringe should still contain at least 1ml of 0.9% Sodium Chloride (*emptying a syringe creates negative pressure and back flow and back flow of blood into a tip of the line = occlusion).*

9) The volume of the flush should be at least 3mls (approximately 2x volume of catheter + volume of 3way taps or additional equipment).

10) If you flush the line after Propofol, blood product or TPN use at least 5mls (approximately 5x volume of catheter + volume of 3way taps or additional equipment).

11) Infusion pumps attached to PICC must be above the level of the bed. (*Gravity helps to prevent back flow of blood into the line; doing so helps preventing a blockade.)*

Thank you very much for following the instructions.

PICC dressing

Tegaderm with chlorhexidine pad (7x8.5cm)
3M ™Tegaderm™CHG IV Securement Dressing 1660R (7x8.5cm)

Tegaderm 1681 (7x8cm) or 1689 (10x15.5cm) + Biopatch
3M ™Tegaderm™IV Advanced Securement Dressing 1681 or 1689

BIOPATCH ¾" with 1.5mm center hole for < 6Fr PICC
Place Biopatch around catheter blue site up
("blue site to the sky")
Align radial slit with catheter for easy removal

Chlorhexidine dressing (Tegaderm CHG or Biopatch) should be applied :
* once bleeding from insertion point stops
* within 24h of line insertion to be effective

If allergic to chlorhexidine, use
3M ™Tegaderm™ 1681/1689 without chlorhexidine
NO Biopatch

PICC dressing

Dressing change every 7 days (or when soiled, non-occlusive)
- under aseptic conditions, non-touch technique
- sterile gloves, apply chlorhexidine

DO NOT use APEEL to remove old dressing as it removes a securing device of PICC too.

Peel dressing from a DISTAL end (further end of dressing from a patient).
Record the exposed length of a catheter.

Change BIONECTOR every 3 days under aseptic conditions.
Change daily if on TPN.