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DOCUMENT CONTROL PAGE

Title:	Central Venous Catheters (CVCs): Guidelines for their management in children
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Contents

1. Introduction

This document provides guidance around the care of Central Venous Catheters (CVCs) for all paediatric patients within the Royal Manchester Children's Hospital and Managed Clinical Services.

This document does not cover midlines or intrathecal devices. **Please refer to Appendix 11 and 12 for further information regarding haemodialysis CVCs**.

The MAGiC (Manchester Access Group in Children) service can be contacted for advice and troubleshooting of CVCs Monday to Friday, 08.00-16.00. The team can be accessed through contacting 'MAGiC' on Vocera. The on-call anaesthetist/surgeon should be contacted for advice needed urgently out of hours.

2. Purpose

The purpose of this guideline is to ensure that documented best practice is available in relation to the use, maintenance and removal of CVCs within the Trust. It aims to ensure that standard practice is followed to ensure patient safety and applies to all appropriately trained clinical staff.

3. Roles and Responsibilities

Director of Nursing / Head of Nursing

It is the responsibility of the Director of Nursing/ Deputy Director of Nursing/ Head of Nursing:

- To ensure approval and ratification of this clinical guideline goes through the appropriate professional forum.
- To ensure appropriate dissemination and implementation of this clinical guideline across the Hospital/ MCS.

Lead Nurses/Modern Matrons

It is the responsibility of the Lead Nurses/Modern Matrons:

- To ensure all clinical staff within their clinical areas are aware of this clinical guideline.
- To ensure the operational implementation of this clinical guideline within their clinical areas.
- To ensure all clinical staff are appropriately trained to competently adhere to the clinical guideline.

Ward Manager

It is the responsibility of the Ward Manager:

- To promote awareness of the clinical guideline within their department/ward area.
- To ensure operational implementation of the clinical guideline within their department/ward area.
- To identify and support ongoing training to ensure competent adherence of the clinical guideline.

Clinical/Nursing Staff

It is the responsibility of all clinical staff involved in patient assessment:

- To competently assess CVCs when accessed and/or daily (for inpatients), documenting clearly the outcome of their assessment on the patient's LDA with a VIP assessment
- To understand and apply all aspects of CVC care documented within this guideline.
- To ensure knowledge and competencies are kept up to date and to contact the relevant team for any advice in regard to CVC care if a problem occurs.

Doctors/Non-Medical Prescribers

It is the responsibility of doctors and/or non-medical prescribers to:

- Ensure a thorough assessment of the CVC when concerns are identified/ reported.
- Ensure the care of CVCs in children within the hospital is delivered to the standard of this guideline.
- Ensure prompt referral to the relevant speciality when further support is required

4. Training and Competency Assessment

All nursing staff and allied health professionals who access CVCs must be trained to do so and must undergo a competency assessment before practicing unsupervised.

- The paediatric IV therapy study day must be attended before accessing CVCs. This session provides the theory behind administration of IV drugs and how to safely access CVC devices.
- Staff must then undergo practice under the direct supervision of competent members of staff until deemed appropriate to be signed off as competent. The relevant pages within the IV assessment pack must be completed as evidence of competency.
- All competent staff members must complete a paediatric IV therapy update every three years. In addition, all staff should have an annual aseptic non touch technique (ANTT) assessment – please refer to the Trust ANTT Policy (2018) for further guidance.
- New recruits who are already IV competent from a previous Trust should discuss their level of competency with their line manager who will decide what training is appropriate for that staff member.
- No staff member should access CVCs unless they have received training and competency assessment in line with this guideline.

5. Types of CVCs

A CVC is a vascular access device that is inserted into the central venous system with the tip sitting in the superior/ inferior vena cava or right atrium. Catheters are available in single or multiple lumens. All CVCs are inserted in an appropriate setting (theatre, radiology or critical care) using strict sterile precautions. This guideline covers:

- **Tunnelled Cuffed Central Venous Catheters (TC-CVCs**) – these are commonly referred to by their brand names e.g. Hickman, Broviac, Proline, Powerline
- Peripherally Inserted Central Catheters (PICCs)

- **Totally Implanted Vascular Access Devices (TIVADs)** – usually referred to as Ports or 'Portacaths' (brand name) and are accessed by the use of a non-coring needle known as a 'Gripper'.
- **Non-Tunnelled Temporary CVCs** – may be referred to as short-term lines, 'neck' lines, femoral lines or Vascaths.

Central venous access devices will be collectively called CVCs throughout this guideline unless specified otherwise.

The duration and type of therapy that a CVC is needed for will impact on the type of device required. **For further information around each device, refer to Appendix 1**.

6. Care of a CVC

6.1 Dressings and Anti-reflux Needle-free Connectors (Neutron device)

Excellent standards of CVC care should be adhered to at all times in order to reduce the incidence of catheter-related blood stream infections (CRBSIs) and exit site infections. Strict ANTT procedures will reduce the risk of infection if it is applied in all aspects of ongoing CVC care – please refer to the Trust ANTT Policy (2018) **and Appendix 10**.

Dressings

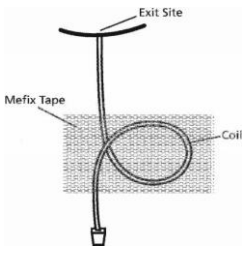
All CVCs that are external and routinely accessed must have a dressing in situ (apart from TC-CVCs that have been in situ for longer than 6 weeks). The purpose of the dressing is to secure the line and prevent dislodgement as well as reducing the risk of infection. Dressings must be changed every seven days - or sooner if the dressing is soiled or is no longer intact. **Please refer to Appendix 2 for a step-by-step guide to changing a CVC dressing**.

The dressings required for CVCs as recommended by NICE guidelines (NICE, 2015) are **Tegaderm CHG or Tegaderm IV Advanced Antimicrobial dressings**. These dressings allow for greater observation of the exit site and provide antiseptic coverage which reduces the likelihood of a CRBSI.

Tegaderm IV Advanced or IV 3000 dressings should be used for TIVADs, in patients less than two months old and for any patient identified as having a chlorhexidine allergy.

Safety Loops

It is recommended that TC-CVCs with a very long external segment should have an appropriate length 'safety loop' at some point in the length of the external section of catheter in order to minimise the risk of dislodgement or removal. Examples of appropriate 'safety loops' are shown below.



PICCs and non-tunnelled temporary catheters do not have an internal cuff and rely on securement either by the use of sutures or a securement device. They are also not subcutaneously tunnelled, therefore they are not suitable for looping and any attempt to do so may cause dislodgement of the line.

After six weeks and if the exit site is healed, a dressing *may* no longer be required for a TC-CVC as the catheter should be secured by the tissue ingrowth to the cuff.

Anti-reflux Needle-free Connectors (NFCs)

All CVCs should have a needle-free connector attached to the end at all times. These devices provide a closed access system and reduce the risk of infection. Currently, the MAGiC services' preferred device is the '**Neutron** Needle-free Neutral Displacement Connector' (ICU Medical UK) device which is used to prevent blood reflux and reduce the incidence of microbial contamination. **All devices must be changed every seven days or sooner if they become contaminated. Refer to Appendix 3**. If unavailable, suitable anti-reflux alternatives are the 'Bionector-TKO To-Keep-Open' (Vygon UK) and the 'NeutroX Neutraclear needle-free connector with anti-reflux valve' (BD UK).

NB. The Neutron NFC is NOT compatible with glass syringes such as prefilled emergency drug glass syringes. Refer to appendix 17.

It is recognised that some patient groups may be at high risk of CVC infections and that using a barrier at the end of the needle-free connector may be beneficial, such as 'Curos Disinfecting Caps' or Parafilm. The manufacturer of Curos Caps applies caution to these caps as a potential choking hazard, however, does not recommend a lower age limit. It is recommended, based on "Policy Statement—Prevention of Choking Among Children" from the American Academy of Paediatrics (2010) that Curos Caps should not be used in children under four years of age.

For children under the age of four years – a suitable alternative to Curos caps for protecting the end of needleless connectors is Parafilm however caution should be applied as Parafilm can be picked off and chewed. Please refer to Appendix 11 for its use.

Octenisan wash

Octenisan wash should be commenced in all hospitalised patients who have an external CVC. Octenisan should be used for whole body washing (incl. hair washing and showering). This should be continued whilst the patient is admitted to help prevent line infections. Please consult the MAGiC team prior to discharge. Oilatum Plus or SkinSan may be used as an alternative to Octenisan if previous sensitivity to Octenisan has been seen.

For patients at increased risk of infection, such as those having a Bone Marrow or Stem Cell Transplant, they should be discharged home with an antimicrobial wash to reduce the risk of line infections once they are no longer an inpatient.

6.2 Maintaining Patency

In order to maintain optimal CVC function, they require regular and adequate flushing of 0.9% Sodium Chloride. When not in use, all lumens of CVCs should have regular flushes depending on which CVC type to maintain patency. **Refer to Appendices 4 and 5 on how to flush a CVC and for the flushing regimes when a CVC is not in use**.

Blood aspiration is required to confirm CVC patency before every use as it is important to establish that the tip of the CVC is within the central venous system before anything is infused through the catheter. A small free flow 'flashback' of blood into a pre-filled 0.9% Sodium Chloride flush is an acceptable way of checking CVC patency. This can then be flushed back into the system if the syringe has not been disconnected**. If a CVC does not aspirate or is showing resistance when flushing, please refer to Appendix 6**.

N.B. When accessing a CVC, a 10mL IV syringe should be used at all times. Using smaller syringes on CVCs can cause an increase in pressure which can cause venous damage and catheter rupture. Most clinical areas within RMCH use the 'BD Posiflush SP 5mL' or 'Polyflush 5ml' pre-filled 0.9% Sodium Chloride syringes. These are suitable for use on all CVCs as although the content is only 5mL's, the diameter of the syringe bore is of a 10mL syringe.

TauroLock (Taurolidine and Citrate 4%) can be used as a line lock for:

- Primary prophylaxis for CVCs for patients on long term parenteral nutrition (i.e., patients who are anticipated to require parenteral nutrition for >28 days), and patients who require or have recently had a Bone Marrow or Stem Cell Transplant.
- Secondary prophylaxis for CVCs for patients who have had previous significant line infections. It is instilled into the device lumens between treatments in order to make the internal flow passages resistant to clot formation and hostile to bacterial and fungal growth.

TauroLock should be instilled slowly (not more than 1 mL per second in children over two years of age and in infants and children less than two years of age not more than 1 mL per 5 seconds) into the access device in a quantity sufficient to fill the lumen completely. Unless otherwise stated by the MAGiC team, a **dose of 1mL should be used**. The solution must be withdrawn from the catheter prior to initiating the next treatment.

For patients with Dialysis lines, an alternative to Taurolock for Prophylaxis of line infections is Taurolock HEP500, to be instilled with the volume as stated on each lumen.

6.3 Blood sampling

Blood samples can be taken from all CVCs with the exception of a 2fr PICC due to the internal volume space. It should however be considered prior to blood sampling through a CVC if obtaining blood peripherally would be more appropriate due to the increased risk of CVC occlusion and inaccurate blood test results from medication within the lumen. It should also be considered that excessive central venous blood sampling could compromise a patient's condition e.g., anaemia. **Refer to Appendix 7 on obtaining blood samples from CVCs.**

6.4 TIVAD Access

Only staff who have been assessed as competent in the IV assessment pack for the use of TIVADs should access these devices. TIVADs should always be accessed using a non-coring Gripper needle to prevent damage to the septum of the device. If the Gripper is staying insitu, it requires changing at least weekly. **Refer to Appendix 8 for a guide on inserting and removing Gripper needles.**

6.5 Monitoring and Documentation

All CVCs must be monitored closely and an appropriate IV care plan such as the 'Visual Inspection Phlebitis' (VIP) score should be utilised for all patients with a CVC in situ. The use of this tool will allow staff to recognise early signs of complications, as well as monitor when dressing and needle-free connector changes are due. VIP should be recorded on HIVE 12 hourly, including when the dressing and Needle-free connector has been changed.

N.B. VIP is an adult based tool, and its suggested actions should be used as guidance only. It is recommended that medical staff are contacted immediately if there are any concerns regarding a CVC or if it is scoring above zero on VIP.

Refer to Appendix 9 for further information on the correct use of the VIP tool.

6.6 Catheter Removal and Repair

All staff must continuously assess the need for a CVC and consider removing it if it is no longer needed. Some examples of when a CVC should be removed are:

- A proven and unresolved CRBSI
- End of treatment/therapy
- Faulty/broken device
- Thrombosis
- Occlusion that has not resolved with treatment

Non-tunnelled CVCs, including PICCs, may be removed on a ward area without the need for anaesthetic. This should only be done by an experienced and competent professional in order to maintain patient safety. Staff can refer to the RMCH 'Standard Operating Procedure for Healthcare Professionals: Procedure for Removing a Non-Tunnelled Central Venous Catheter (CVC) including the SecurAcath device (2020)' for more information and should complete a competency document for removal of these devices before undertaking this task.

Tunnelled CVC removal usually requires a general anaesthetic and removal in theatre by surgical/anaesthetic staff.

Occasionally, an external section of a TC-CVC may split or break off. Staff should ensure that any associated medical emergency is dealt with immediately (e.g., bleeding) and that the line is made safe promptly. The CVC should be clamped using blue clamps above and below the breakage over sterile gauze. Some TC-CVCs have bespoke repair kits and

should only be used by appropriately trained members of staff – usually medical staff or specialist nurses.

6.7 Complications

There are multiple possible complications that can result from the presence of a CVC. These include infection, dislodgement, accidental removal, occlusion and/or thrombosis, extravasation and air embolism. **Refer to Appendix 10 for the causes and management of these complications**.

Lines are also at risk of being contaminated by bodily fluids, increasing the risk of Line Infections. This is classified as Mild, Moderate and Gross. Refer to Appendices 11-12 for decontamination instructions.

6.8 Catheter Associated Skin Impairment (CASI)

Many paediatric patients relying on a CVC for treatment are complex and have conditions which impair on the skin surrounding a CVC exit site (e.g., nutritional deficiencies, haematology / oncology disorders), resulting in an increased likelihood of skin damage.

The following standard prevention techniques should be employed for all patients with a CVC as part of usual CVC maintenance as well as enhanced strategies for patient groups deemed high risk:

1. Use of medical adhesive remover for all dressing changes (Apeel® wipes/liquid sachet/spray)
2. Ensure the skin surrounding CVC exit site is always left to dry completely after cleaning during CVC care, prior to application of a new dressing

In addition, for the following patient groups, use a Sterile Barrier Film Applicator such as 'Medi Derma – S barrier film applicator', on skin surrounding the exit site prior to application of a new dressing:

- Graft versus host disease (GvHD)
- Patients < 2 months old
- Burns
- Severe eczema
- Congenital hyperinsulism (CHI)

CASI can be categorised into several different types. It is important that a CVC site is assessed at least daily and after identification of a suspected CASI type, appropriate strategies are put into place for the patient to manage and protect the skin from further damage. **Refer to Appendix 11 for management of CASI types.**

7. Equality Impact Assessment

Equality Impact Assessment Please record the decision whether the policy, service change or other key decision was assessed as relevant to the equality duty to: • Eliminate discrimination and eliminate harassment • Advance equality of opportunity • Advance good relations and attitudes between people			
Not relevant		Relevant	
Where the decision was NOT RELEVANT, please record the reason for the decision below...		Where the decision was RELEVANT, please record details of the outcome of the full impact assessment and summarise the actions that will be taken to eliminate or mitigate adverse impact, advance equality or justification for the impact.	
Please enter the EqIA registration Number:		2019-360	

8. Consultation, Approval and Ratification Process

The RMCH Polices and Guidelines Group have been consulted on the guideline as well as paediatric representatives from: surgical, anaesthetics, gastroenterology, critical care, IV therapy, tissue viability and Wythenshawe.

PMMC have approved the medicines-related components of this guideline.

Approval will be sought at the RMCH/MCS Quality and Safety Committee.

This guideline will be reviewed every three years by the RMCH/MCS Quality and Safety Committee.

9. Dissemination and Implementation

This guideline will be disseminated via the Clinical Effectiveness team and published on the Trust's Intranet site in the paediatric clinical handbook.

10. Future Plans

- Review CRBSI rates and methods of reduction.

11. References and Associated Trust Documents

References

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For Appendices 11-12:

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Associated Trust Documents

Aseptic Non-Touch Technique (ANTT) Policy: (2023)

MFT, RMCH, Central Venous Catheters – Information for schools and nurseries. TIG 71/12 (August 2012).

Managing Phlebitis and Extravasation in Paediatrics Policy (2019)

Standard Operating Procedure for Healthcare Professionals: Procedure for Removing a Non-Tunnelled Central Venous Catheter (CVC) including the SecurAcath device (2023)

12. Appendices

A1: Information on Vascular Access Devices

Tunnelled Cuffed Central Venous Catheters (TC-CVCs)

- Surgically tunnelled through subcutaneous tissue from the exit site on the anterior chest wall. This process of insertion as well as a small cuff on the CVC that embeds internally will improve stability and reduce the likelihood of infection.
- Option of a single lumen or double lumen.
- Can be used for all long-term IV therapy (e.g., chemotherapy, PN, antibiotics, blood sampling, and bone marrow transplant).
- Usually requires full general anaesthesia for insertion and removal.
- Cannot be fully submerged in water, therefore swimming and baths are not permitted.
- May not be a good option if therapy only requires access intermittently due to continuous risk of line infection and damage.
- Can damage the long-term patency of the central veins.
- Requires ongoing care when not in use including weekly flushes, dressing and needle free connector changes.

Peripherally Inserted Central Catheters (PICCs)

- Directly inserted into a peripheral vein, usually in the upper limb with the tip advanced into the central venous system.
- May be inserted using local anaesthesia but usually requires a general anaesthetic in young children.
- Can be removed easily without any need for anaesthetic.
- The insertion procedure carries less risk than other CVCs however they can be technically difficult to insert.
- Used for mid to long-term therapy, usually for a few months (e.g. antibiotics, antivirals, blood sampling, chemotherapy, TPN). PICCs can be used for as long as the device is operational – they do not need removing after a certain time period.
- Usually do not affect the patency of the central veins.
- Can be beneficial for children with poor/difficult peripheral venous access.
- Requires ongoing care when not in use including weekly flushes, dressing and needle free device changes.
- Cannot be fully submerged in water, therefore swimming and baths are not permitted.

Totally Implanted Vascular Access Devices (TIVADs)

- The device is implanted in the subcutaneous tissue of the antero-lateral chest wall with the catheter tunnelled to a large central vein.
- TIVADs are used for long term intermittent venous access. A good option for long term intermittent therapy (e.g., chemotherapy) and for conditions with intermittent access requirements (e.g., cystic fibrosis).
- Lowest risk of infection among all CVCs as there is no external portion when it is not in use.

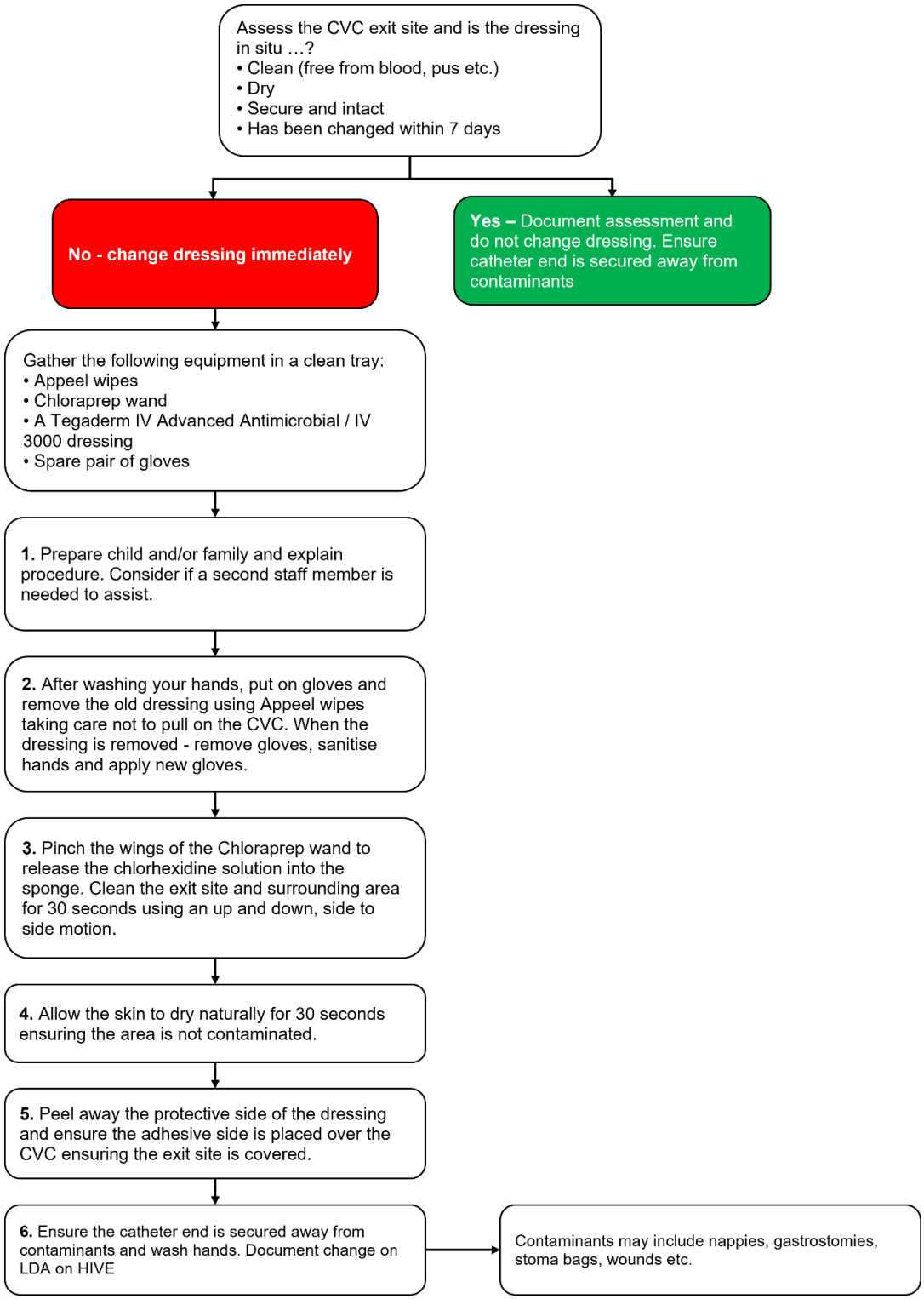
- An option in a child who is very active or likely to pull/damage an external line.
- When not in use, requires a flush to maintain patency every 8-12 weeks.
- Once the wound from initial insertion site is healed, patients are able to submerge in water when the TIVAD is de-accessed.
- Usually requires general anaesthesia for all insertions and removals.
- Accessing a TIVAD requires needle insertion so consider children who are needle phobic.
- Usually, single lumen only.
- Not a good option if the device needs continuous access because of erosion of the skin and increased risk of infection e.g., long term PN.
- Can damage the long-term patency of central veins and if a TIVAD becomes infected, it can be much harder to clear the infection in comparison to other CVCs.

Non-Tunnelled Temporary CVC

- Inserted percutaneously but without tunnelling or a cuff and the tip of the line lies centrally. The line is inserted directly into a central vein i.e. internal jugular, subclavian or femoral.
- Usually inserted at the bedside in paediatric critical care where a child needs multiple venous access points or in theatre.
- Useful for children who need continuous/frequent venous access for a short period of time especially in critically ill children. Indications may include multiple IV medications or fluids, central monitoring of pressures or short-term requirement of central access i.e., inotropes.
- Can be removed easily without any need for anaesthetic.
- Ideally should be in situ for no longer than 7-14 days.
- They are at a higher risk of infection and occlusion than other CVCs.

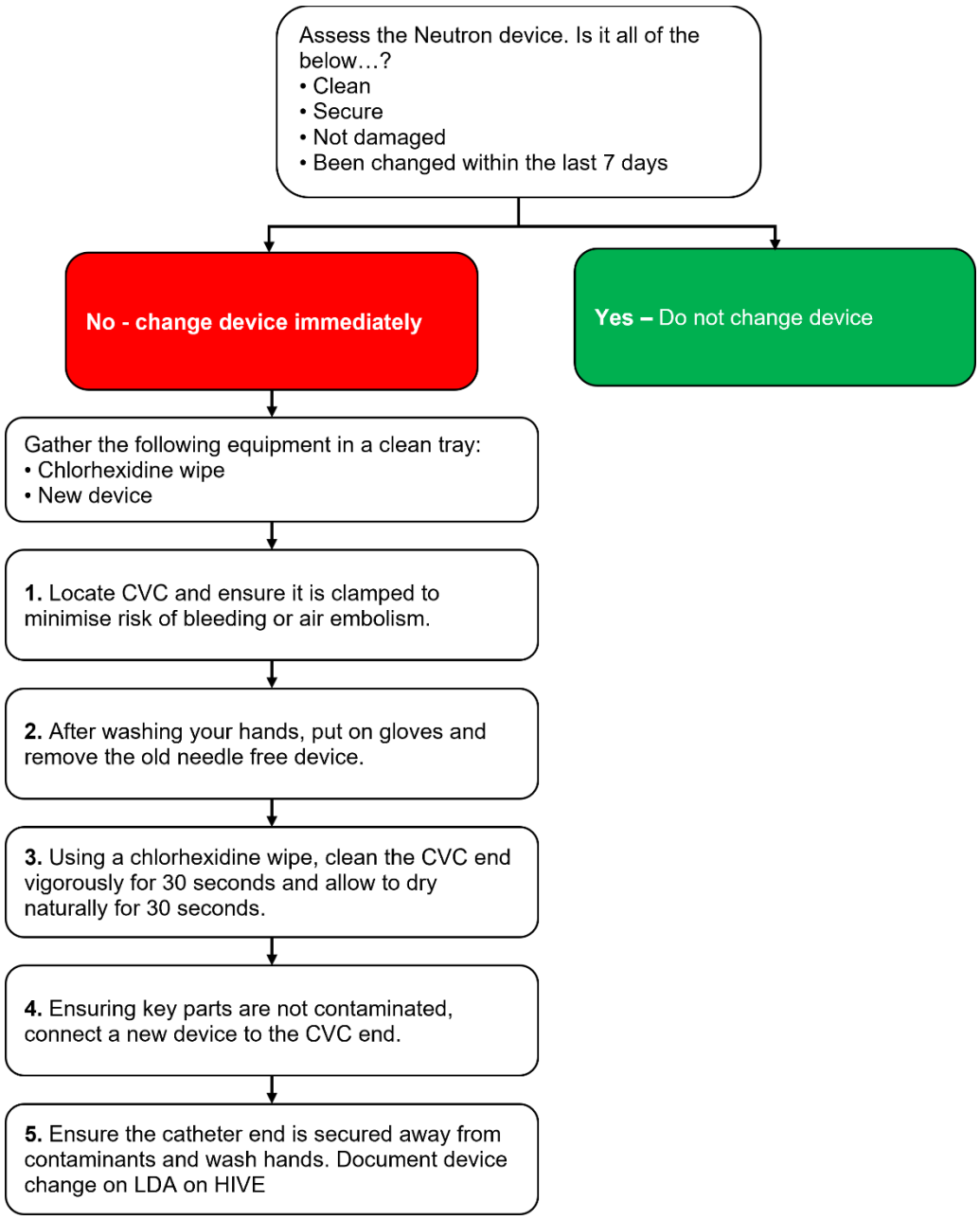
A2: Algorithm for Changing a CVC Dressing

N.B. This algorithm refers to dressing changes for PICCs, TC-CVCs and non-tunnelled temporary CVCs. For TIVADs – please refer to Appendix 8 (for changing gripper needle etc.)



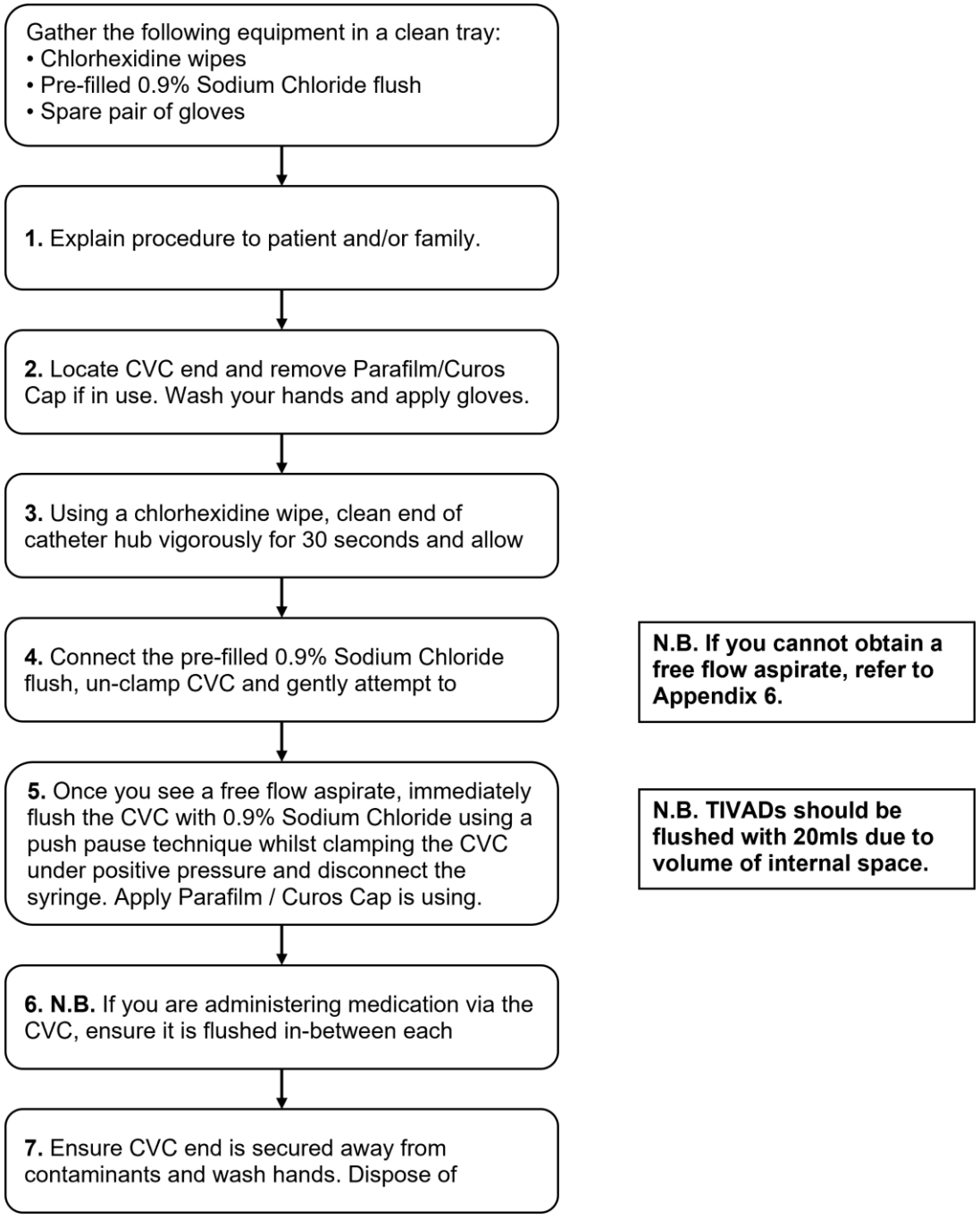
A3: Algorithm for Changing a Needle-free Connector Device

N.B. This algorithm refers to Neutron devices however the principle for changing any needle free connector device is the same.



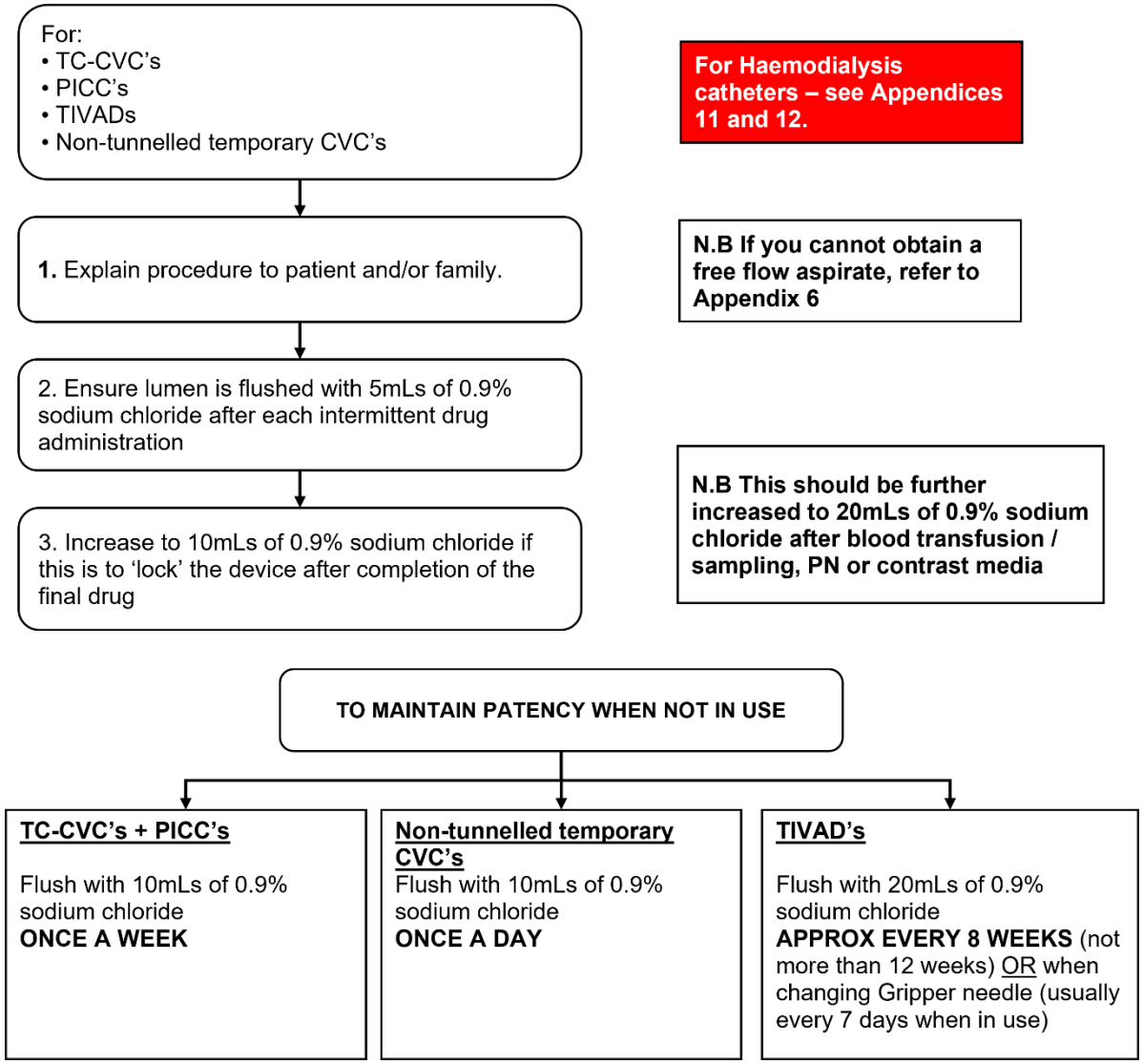
A4: Algorithm for Procedure of Flushing a CVC

N.B. CVCs should be flushed with 0.9% Sodium Chloride each time they are accessed to maintain patency. In addition, CVCs that aren't being accessed frequently must be flushed within certain timeframes to prevent line occlusion –see 'Algorithm 5 for CVC flushing regime'.



A5: Algorithm for CVC Flushing Regime – Device Specific

N.B. There may be exceptions to this algorithm for neonatal patients or those with fluid restrictions – please discuss these patients with the medical team.

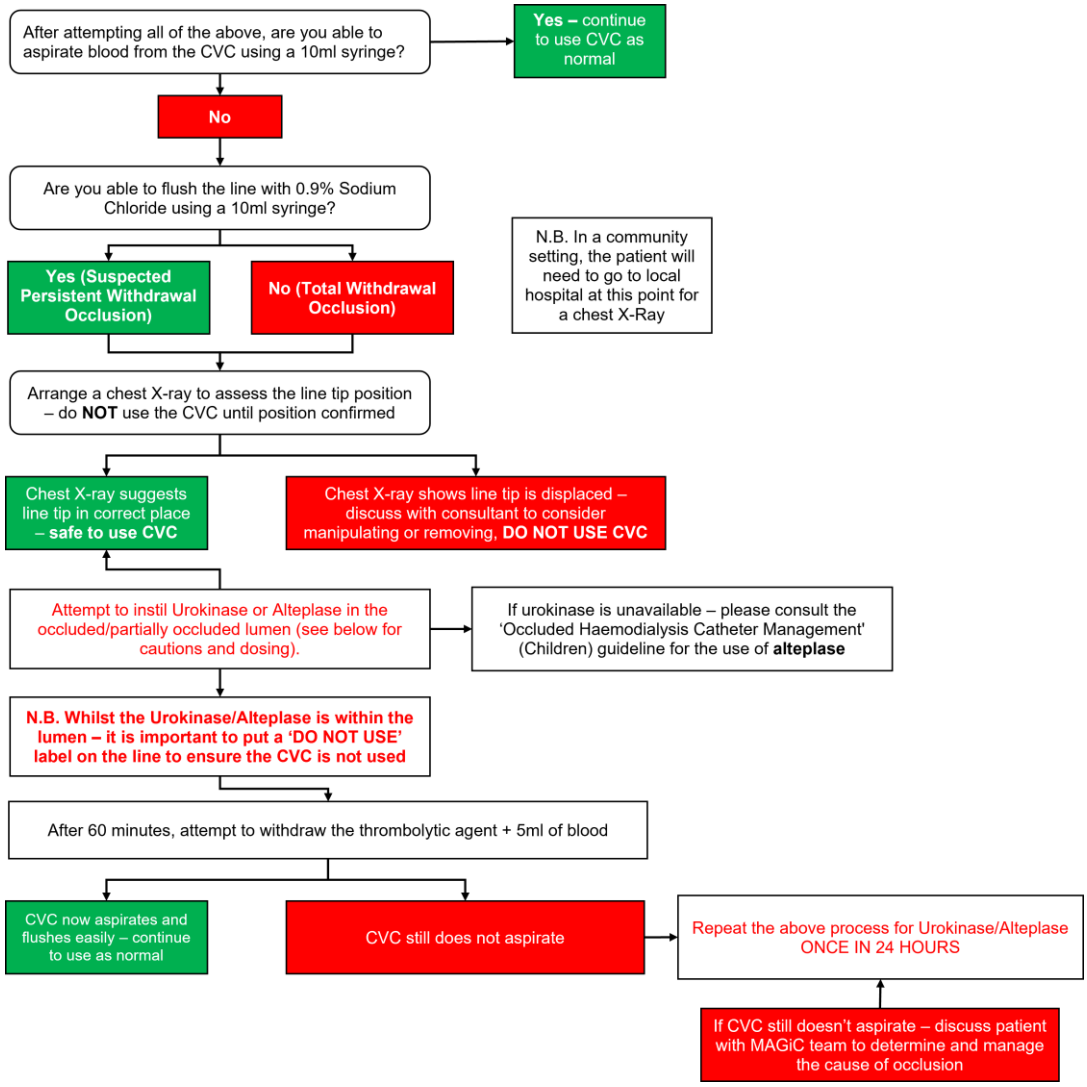


A6: Algorithm for CVC that Does Not Bleed Back

N.B. There may be exceptions to this algorithm for temporary non tunnelled CVCs – please seek local guidance from paediatric critical care. For long-term CVCs that have previously not bled back – please discuss patient with MAGiC team before commencing treatment.

If you are not able to get a freeflow aspiration of blood on accessing a CVC, you should initially attempt all of the following:

- Ensure there is no evidence of mechanical obstruction (e.g., line clamped, kinked or twisted – this could be under the dressing and thus changing the dressing may resolve the problem)
- Ask the patient to cough, move their arms or change position.
- Change the Neutron device.
- Attempt to flush the CVC with 2-3mls of 0.9% Sodium Chloride (do not force this if the line feels occluded)



Caution should be exercised in using a fibrinolytic agent 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
- are receiving warfarin therapy where INR > 1.3
- have had heparin administered on same day or APTT > 45
- have a platelet count < 80

Attempt to instil Urokinase 5000units/ml or Alteplase 1mg/ml and leave for 60 minutes (use a three-way tap if lumen occluded – consult MAGiC team for further advice).

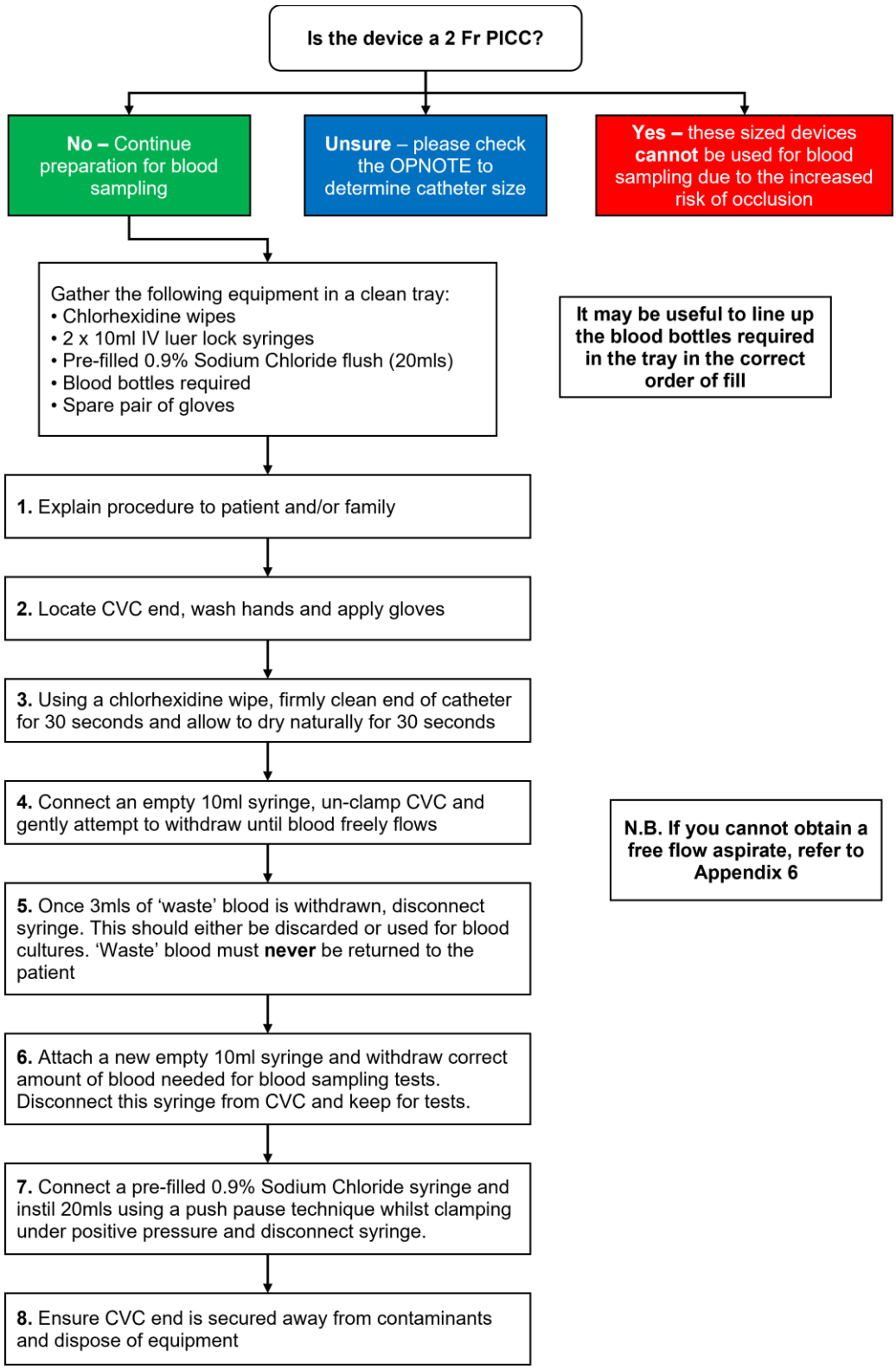
Dosing of Urokinase 5000units/ml or Alteplase 1mg/ml:

PICCs, Tunnelled / Non-tunnelled CVCs: > 1 year = 1 mL and < 1 year = 0.5 mL (each blocked lumen)

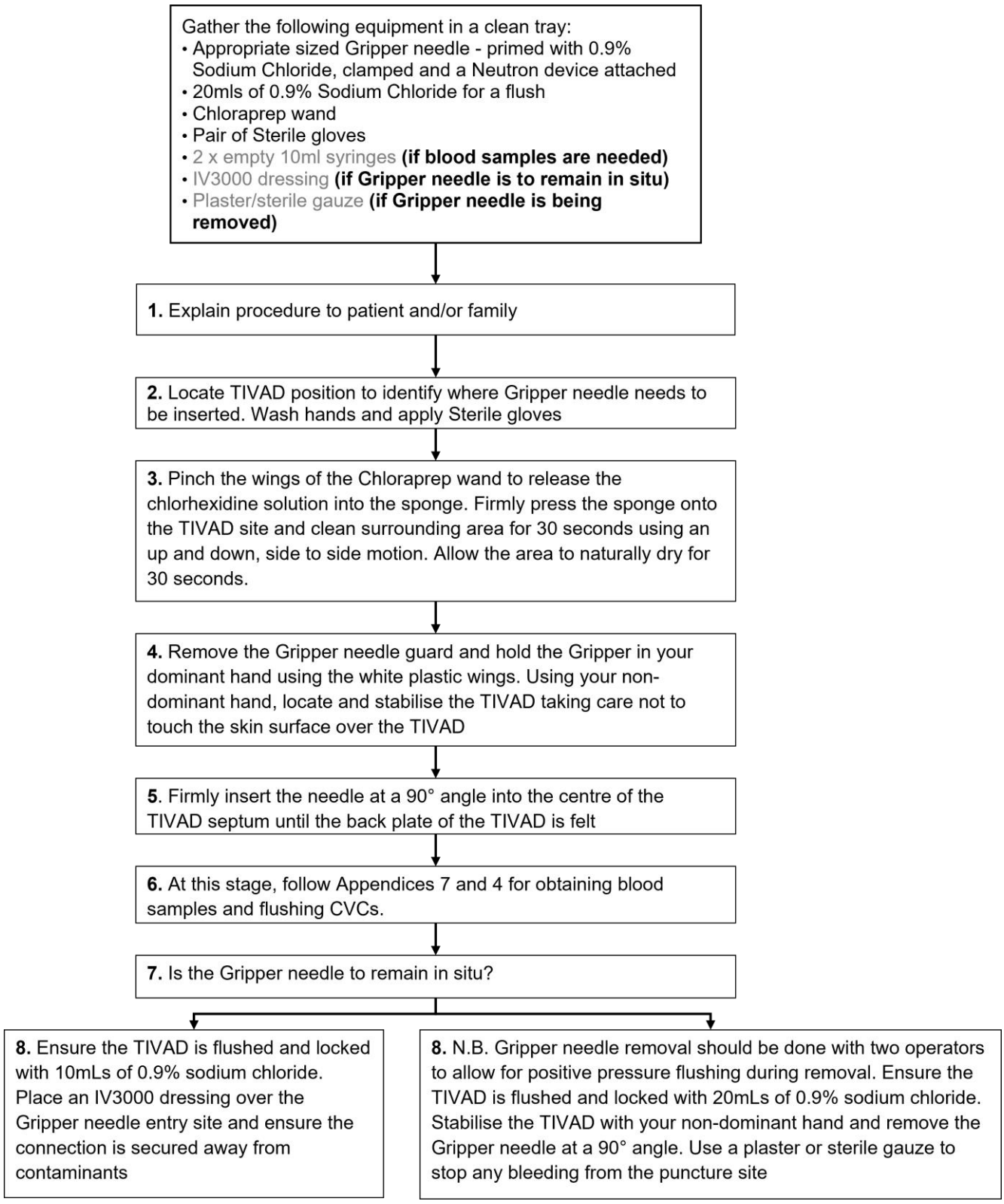
TIVADs/Ports: 1ml (some patients with ‘adult’ size ports may require larger doses – discuss with MAGiC team).

A7: Algorithm for Using a CVC to Obtain a Blood Sample

N.B. This algorithm is presuming a TIVAD is already accessed with a Gripper needle. Please refer to Appendix 8 for how to insert a Gripper needle.

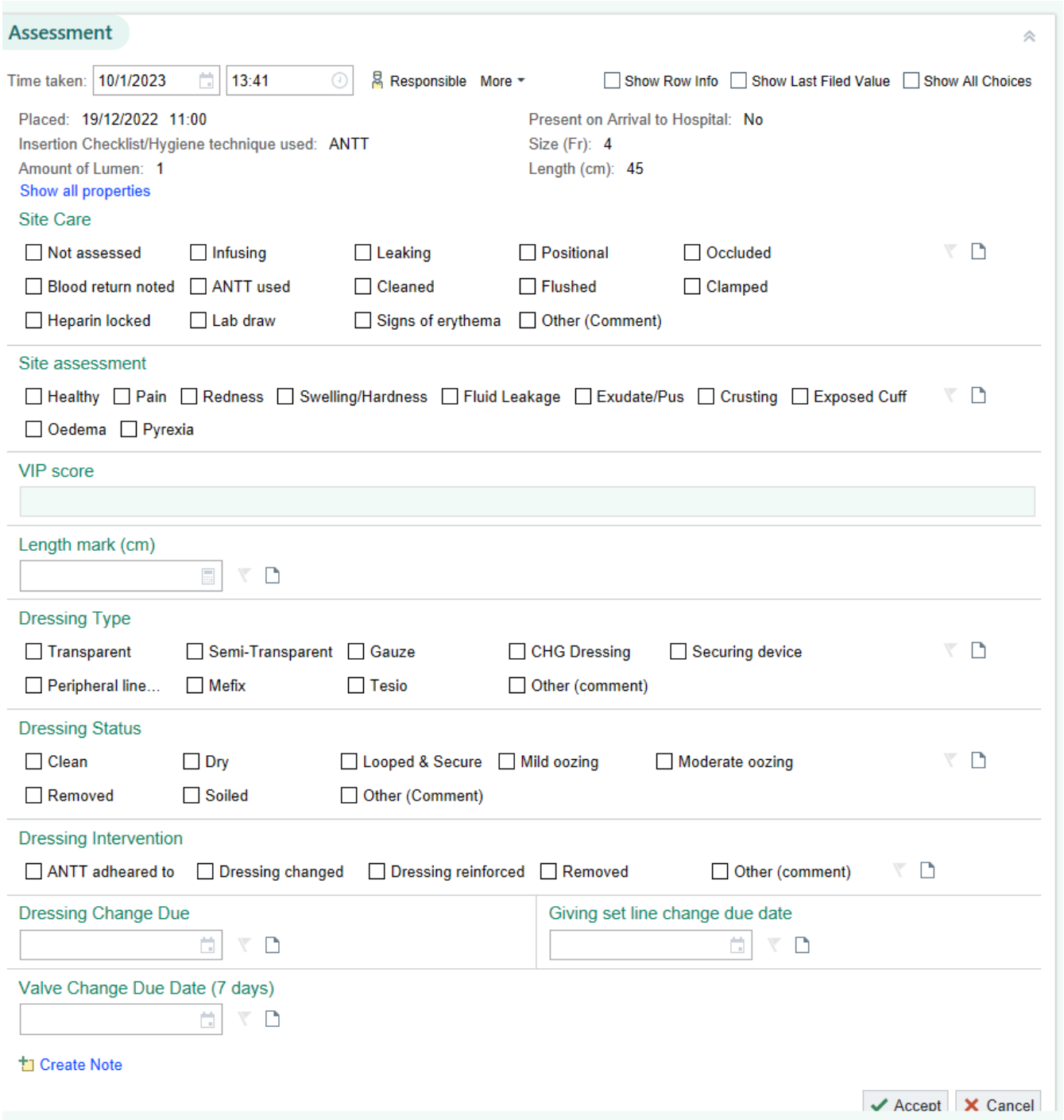


A8: Algorithm for Inserting and Removing a Gripper Needle for a TIVAD



A9: Information on Assessment Documentation on HIVE

Line assessment accessed through the LDA in HIVE

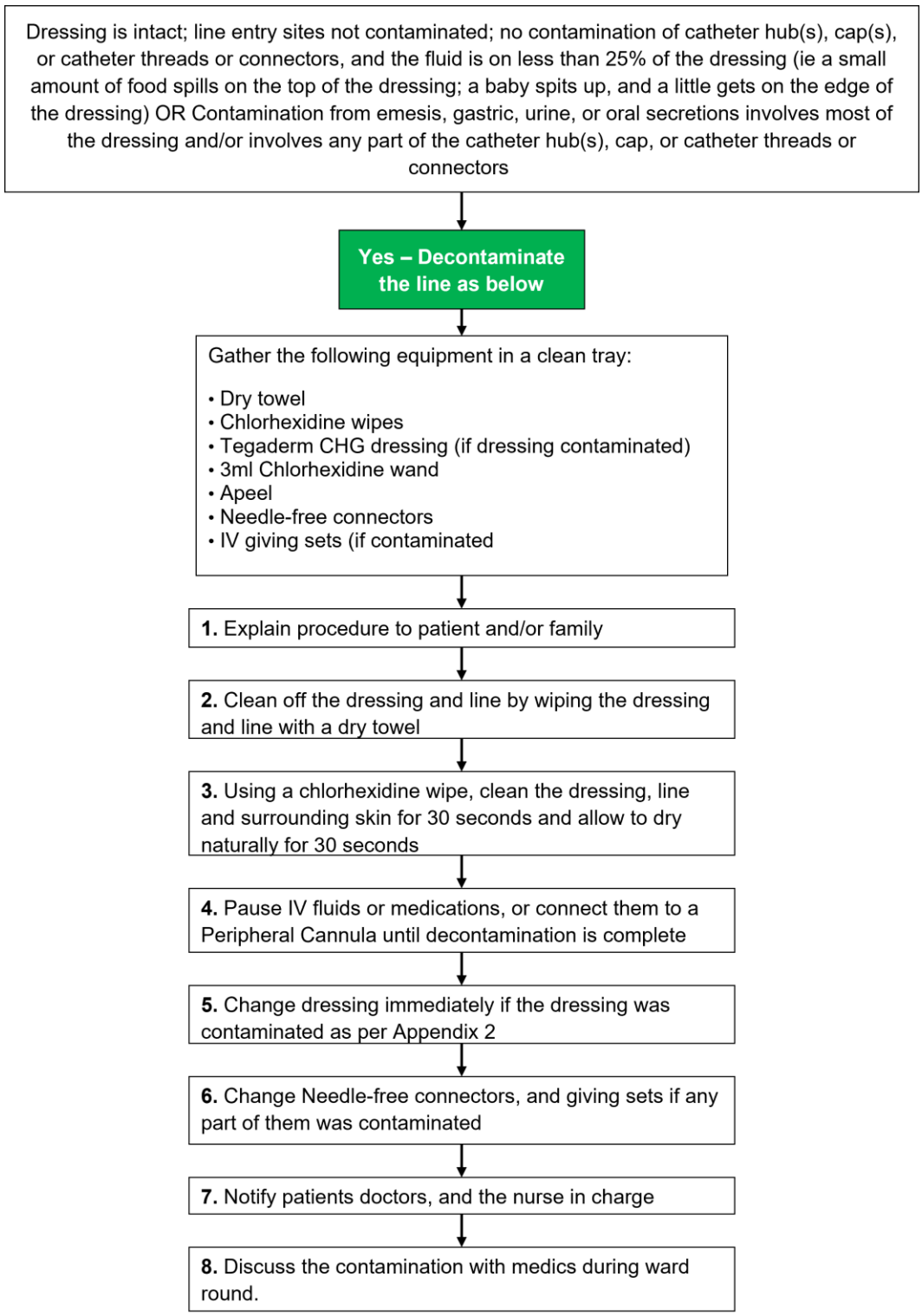


A10: Causes and Management of CVC Complications

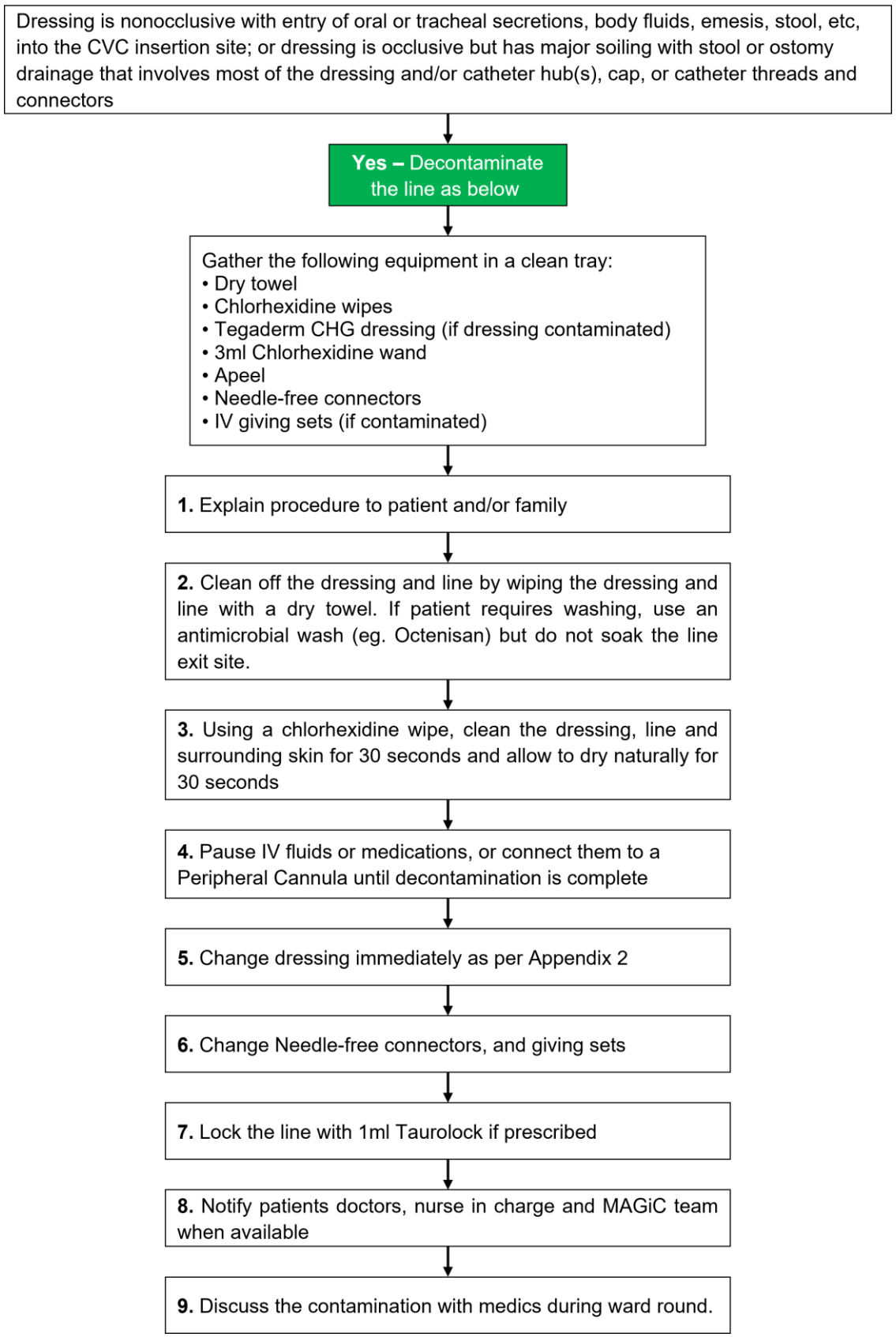
Complication	Possible Causes	Management
Infection	Usually either from contamination of the catheter hub or organisms on the patient's skin surface. Infection may also be due to bacterial translocation of organisms.	Patients with a suspected CRBSI should have the following: • Blood cultures from the CVC • Peripheral blood cultures • Swab of the exit site Depending on the clinical state of the patient and the organism grown will depend on which antibiotic regime is indicated or if the CVC needs to be removed.
Dislodgement/ Migration of CVC tip	If the CVC is not secured appropriately, it is possible for the catheter to move in and out the exit site and therefore the tip can become dislodged. Changes in intrathoracic pressure, coughing, sneezing and excessive vomiting can also lead to migration of the line tip.	Dislodgement may be suspected if: • The external length of the catheter changes • The cuff of a tunnelled line becomes visible at the exit site • Inability to aspirate or flush a CVC • Signs of extravasation or pain when flushing the CVC • Cardiac arrhythmias If any of these signs of dislodgement occur, a chest X-ray is needed to determine the line tip position.
Accidental removal	CVCs that have an external length of catheter are susceptible to accidental removal. This can be from pulling or catching on something – although securement devices and internal cuffs endeavour to prevent this, it is a recognised risk.	All staff and family members that care for children with a CVC should be aware of management of accidental removal as it can happen at any point. As soon as it is recognised that a CVC has accidentally come out, pressure must be applied, ideally with sterile gauze, at the exit site and the side of the neck (for tunnelled CVCs). This will stop bleeding and reduce the risk of infection at the exit site. An incident form should be completed, and a medical review requested.
Occlusion (partial or total) and/or thrombosis	• Mechanical occlusions such as clamps, kinking or twisting of the catheter. • Intraluminal occlusion • Extraluminal occlusion • Catheter related sheath • Line tip abutting vein wall	May be treatable with thrombolytic agent or line may need replacing / manipulating. Please see Appendix 6.
Extravasation	When the catheter tip displaces and is no longer in the vein. *See above causes for dislodgement/migration of CVC tip.* Extravasation can also occur due to needle displacement when accessing a TIVAD.	Stop the infusion immediately and notify doctor. *Refer to 'Managing Phlebitis and Extravasation in Paediatrics' policy.* Usually, a chest X-ray will be needed to determine the line tip position.

Air embolism	A serious complication caused by the presence of air in the vascular system. This could occur during insertion or use of CVCs. Preventative measures should include removing all air from syringes and infusion sets before attaching to the patient as well as using clamps and needle free access devices.	Symptoms may include shortness of breath, altered conscious levels, chest pain and low cardiac output. If suspected – seek urgent medical assistance immediately. Turn the patient onto their left side and place them in the Trendelenberg (head down) position and administer oxygen.

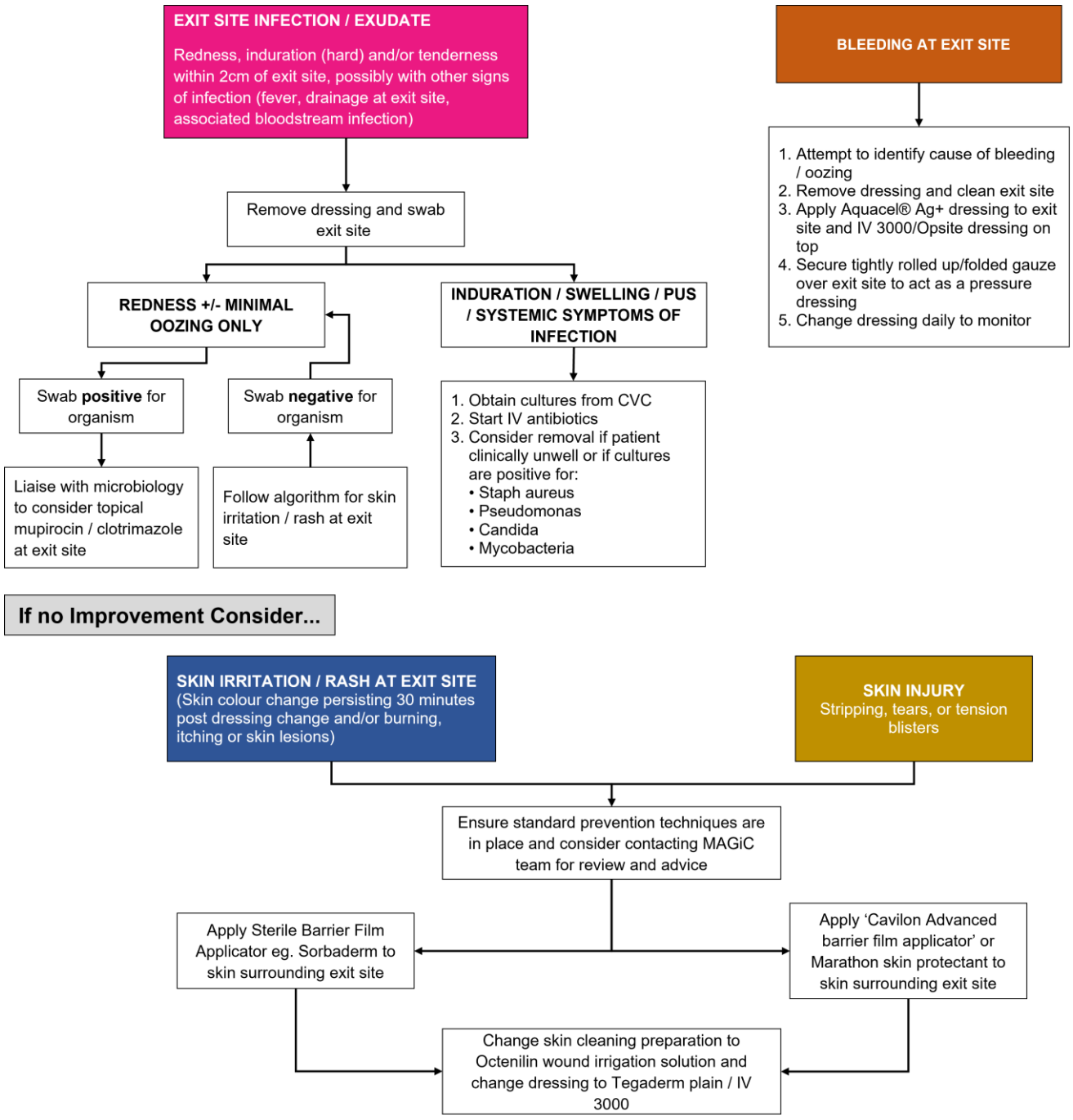
A11: Algorithm for Mild/Moderate Contamination with bodily fluids



A12: Algorithm for Gross Contamination with bodily fluids



A13: Management of CASI Types



These recommendations are based on an evidence-based algorithm from representatives of the World Congress of Vascular Access (2017). It is recognised that patients will have to be assessed and managed on an individual basis – please contact the MAGiC team for further advice.

A14: Needle-free connectors and Glass syringe compatibility

After introduction of the Neutron NFC, it was recently noted that this device is incompatible with some glass syringes. This was not initially highlighted by the manufacturer, but has since been updated on their product literature within the last year. The National Infusion and Vascular Access Society (NIVAS) UK has released a statement this year saying that not all needle free connectors are Aurum glass syringe prefilled emergency drug compatible, and that NIVAS is still working with MHRA and NHS to reach a solution.

The MHRA issued MDA/2004/005 to raise awareness of incompatibility between some needle-free connectors and Luer tips of pre-filled syringes. The MHRA continues to receive reports of damage to the needle-free connector and/or to the pre-filled syringe where force has been used to connect incompatible devices together. In some cases, fragments may block the syringe outflow. Such damage has resulted in a delay in administering therapy during the resuscitation of patients.

In 2011, The U.S. Food and Drug Administration (FDA) alerted the healthcare community about syringe connection problems when certain needleless glass syringes containing the cardiac drugs adenosine and amiodarone are used with particular types of intravenous (IV) access systems. They stated that the use of needleless pre-filled glass syringes in emergency situations should be avoided, if possible.

However, even if used with *compatible* NFCs, glass syringes still pose risks to patients due to the risk of nozzle fracture during connection or disconnection to NFCs: The consequences of nozzle fracture during emergency use include: loss of intravenous access, failure of critical drug administration and harm to the operator or patient from shattered glass fragments, which could potentially include intravenous administration of broken glass (https://associationofanaesthetists-publications.onlinelibrary.wiley.com/doi/full/10.1111/anae.13287 AAGBI 2015 correspondence).

It is rare in paediatrics to use the entire contents of a glass filled syringe in an emergency. Also, it is not always possible to know if a particular NFC is compatible with glass syringes or not. **Thus, we would recommend NOT to directly connect glass syringes to NFCs.** In an emergency we would suggest one of the following :

1. Decant the correct dose of drug to a plastic syringe using a 3-way tap, ensuring accurate dosing for children (preferred method)
2. Connect a short IV extension to the glass syringe, and then connect and disconnect the extension to the NFC when required
3. Remove the NFC and carefully connect directly to the catheter hub

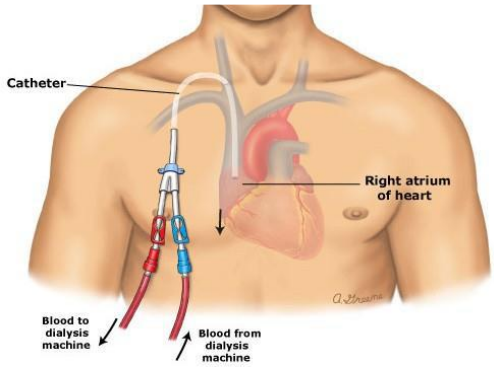
A15: The Management and Care of Paediatric Central Venous Catheters used for Extracorporeal Therapies

Originated / Modified By: Cora Lahart [1] and Alecia Gillett [2]
Designation: [1] and[2] Paediatric Haemodialysis Sister

Introduction

A bespoke CVC is a device used for extracorporeal therapies such as haemodialysis / haemodiafiltration, haemofiltration, lipid and plasma apheresis, extracorporeal photopheresis (ECP), peripheral blood stem cell collection (PBSC) and red cell. They have larger internal lumens than other CVCs and often have side holes to improve flow rates into and out of the catheter.

The tip of the CVC sits in either the right atrium, superior vena cava or the inferior vena cava depending on the device used and the patient's clinical situation. CVCs in the right atrium will usually provide higher flow rates than those positioned in the vena cava.



(Figure 1: Image showing catheter placement)

Method

During dialysis and extracorporeal therapies, blood is taken from the patient via the CVC, filtered and administered directly back through the CVC. The removal and re-administration of blood may be continuous if the patient has two lumens/two lines or will be cyclic if they only have a single lumen CVC i.e., an output cycle followed by an input cycle each lasting a set number of seconds.

During dialysis blood will always need to be withdrawn via the CVC therefore it is essential that full patency is maintained and that the CVC is checked for efficient blood withdrawal prior to use.

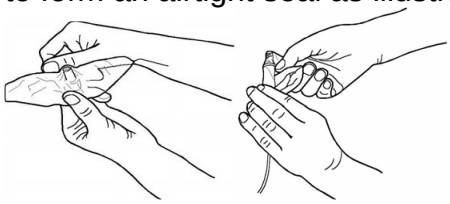
Complications

Withdrawal occlusion must be reported to medical staff and dealt with promptly so that the CVC can maintain its role in dialysis. If only one line/lumen of the dialysis CVC has full infusion and withdrawal patency, but the second line/lumen has withdrawal occlusion it may still be possible to use the device for dialysis, but improved patency of the compromised line/lumen must be pursued.

For full guidance on occlusion of these devices, refer to Appendix 12.

Exit Site Care

Dialysis CVC Exit Site Care - Additional Device Specific Information:

Action	Rationale
CVC dressings to be changed weekly or sooner if soiled.	To monitor for and reduce the risk of exit site infections
Principles of Aseptic Non-Touch Technique (ANTT) must be used for dressing changes	To reduce risk of infection
After removing the dressing, site must be cleaned with ChloraPrep or suitable alternative if allergic to Chlorhexidine	To minimise risk of exit site infections. NB: ChloraPrep cleaning is not effective unless it has air dried
If skin is broken, 0.9% Sodium Chloride and sterile gauze can be used for cleaning. Site must be dried before re-dressing	To minimise discomfort and protect skin integrity.
CHG (chlorhexidine gluconate) dressing should be applied over the exit site.	CHG dressing should be used to cover and protect exit sites as it acts as a barrier against external contamination and has an integrated gel pad containing an antiseptic agent.
If patient has a CHG allergy/reaction the CHG dressing the following should be used*:	
*Biopatch' (Chlorhexidine infused disk) should be placed around the line at the exit site.	To minimise risk of exit site infections
*'Biopatch' information	http://cmft-sp-wfe/sites/departments/paediatriccriticalcare/PublishingImages/Biopatch%20Video%20_1.mp4
*'Grip-Lok' line anchor should be placed around the hub and fixed to the skin	To anchor the line to reduce risk of line dislodgement
*IV 3000 dressing should be used to cover the exit site and Griplok	An IV 3000 dressing should be used as it has a greater moisture vapour transmission capability component than other film dressings available
Parafilm: Protect hubs by wrapping in parafilm. Wash hands Cut a 5cm square of parafilm. Wipe Tego bung and the hub of the CVC with a 2% Chlorhexidine/70% alcohol wipe (Clinell®) for 30 seconds to dry. Remove the paper backing and stretch the Parafilm over the hub. Mould the parafilm to form an airtight seal as illustrated below.  To remove, pull parafilm from hub. DO NOT USE SCISSORS. Clean bung prior to accessing line.	Evidence suggests that using a protective barrier around the hub and the connection of a central venous catheter is an effective preventative measure against contamination and infection. If this area is left contaminated or moist, sealing with Parafilm could create a breeding ground for Microorganisms. The seal should be airtight to prevent contamination.

Flushing Regime

Dialysis CVC Flushing Regime - Additional Device Specific Information:

Action	Rationale
The CVC must be checked for efficient blood withdrawal prior to use – withdrawal occlusion must be reported to medical staff and dealt with promptly	To achieve effective dialysis good blood flows need to be achieved via the CVC so full patency is essential Refer to Appendix 12
Extracorporeal CVCs must be locked with 1000units/ml Heparin or Alteplase, in a volume equal to that printed on the lumen	To maintain patency
2ml must be aspirated from the line prior to use.	To avoid line lock being flushed into the patient's systemic bloodstream
When not in use Extracorporeal CVCs will require a weekly flush regime. The lines should be aspirated, flushed with sodium chloride 0.9% and each lumen locked to the dead space volume stated on the line with heparin 1000units/ml.	To maintain patency
A needle free device known as a Tego or Bionector bung must be used on all extracorporeal therapies. These must be changed weekly.	Opening a CVC line intermittently increases the risk of infection, whereas accessing via a needle free device maintains a closed-circuit reducing infection risk.
Document Tego/Bionnector connector changes on VIP, Haemodialysis Prescription and in nursing notes	To monitor and reduce risk of infection
Tego Bung information	http://www.icumed.com/products/specialt y/renal-systems/tego-connector.aspx

Sampling

Dialysis CVC Blood Sampling - Additional Device Specific Information:

Action	Rationale
Aseptic Non-Touch Technique (ANTT) must be used when accessing the CVC	To reduce risk of infection
Attach a dry 10ml syringe to the CVC, remove 2ml from the line and discard	To remove line lock and check for clots.
Attach a new 10ml syringe, gently withdraw 5ml of blood and flush in and out of the CVC 5 times, before taking required blood sample amount. HAEMODIALYSIS PATIENTS ONLY	To eliminate contaminates To obtain non-diluted blood sample To reduce quantity of blood discarded Push and pull gently to reduce haemolysis
Flush line with 5ml 0.9% sodium chloride prior to commencing dialysis or locking line with appropriate anticoagulant.	To maintain line patency
**Please refer to trust ANTT policy*	

A16: Occluded Haemodialysis Catheter Management

N.B – The use of this appendix should be discussed with the dialysis nursing team and/or paediatric nephrology consultants before use.

Routine lumen line locks

Following completion of each dialysis session, the following procedure should be followed:

- Each catheter lumen must be flushed with 5mLs of 0.9% sodium chloride.
- Each catheter lumen should be locked with either heparin 1000unnits/mL or alteplase (see below).

Heparin 1000unit/mL line lock

Instil the exact volume of the catheter lumen with heparin 1000 units/mL. Aspirate and discard heparin before each dialysis session. This should be prescribed on the regular section of the drug chart.

Note: lumen volumes vary depending on line manufacturer and can be found detailed on the lumen.

Alteplase line lock

Instil the exact volume of the catheter lumen with Actilyse Cathflo (t-PA / alteplase) 2mg vials. Reconstitute with 2.2mL of water for injections to make a final concentration of 1mg/mL. Instil the exact volume of the catheter lumen (to a maximum dose of 2mg). This process must be completed on the two-day gap.

Suspected occlusions of Haemodialysis catheters

Early flow problems are often related to technical problems at the time of insertion. Common causes of early flow problems include:

- Catheter tip malposition
- Catheter tip mal-rotation (catheter tip abutting against vessel wall)
- Catheter located in the wrong vessel
- Catheter kinking

Delayed malfunction usually reflects thrombus either within the catheter or around the catheter tip. Thrombus may progress on to form fibrinous tissue surrounding the catheter – a fibrin sheath. The fibrin sheath often acts as a one-way valve, permitting infusion of fluid, but not aspiration of blood.

Other causes of delayed malfunction:

- Intraluminal clot or catheter-related thrombosis
- Intraluminal drug precipitate
- “Pinch-off”
- Suture constriction
- Catheter rupture

- Port needle dislodgement / malposition or fibrin in port reservoir

If there is a suspected occlusion, firstly check for any kinks in the catheter tubing or lumen. Also check whether the lumens are still clamped off and require unclamping. Dressings may be removed if necessary to examine the catheter tubing and lumens.

Management of suspected occlusion of Haemodialysis Catheters:

- Ask the patient to lie flat with their neck extended.
- Using a 5 mL luer lock syringe flush the catheter with 2mL of 0.9% sodium chloride.
- If possible, pull back into the syringe and check for any clots.

If flushing and pull back successful, continue with normal dialysis.

If unsuccessful, follow guidelines for total occlusion.

See page 33 for summary of occlusion management.

Investigations to be considered.

Patients with total or partial occlusion concerns who are requiring alteplase may require the following investigations:

- Chest radiograph to check position of line
- Echocardiogram to visualise clots at tip of line
- Linogram to establish any clots around catheter and position

Total occlusion of Haemodialysis catheters

1. Alteplase line lock (see below). Instil the exact volume of alteplase into the catheter lumen (to a maximum dose of 2mg) and leave for 1 to 2 hours.
2. Aspirate volume instilled and attempt dialysis.
3. If flow is poor on the machine or still difficult to aspirate and dialysis has been completed, instil the exact volume of alteplase in each lumen once again and leave until next haemodialysis session (long dwell).
4. If dialysis is not achieved, a medical review is required before deciding to omit a session of dialysis. Following medical review, the exact volume of alteplase may be instilled into each lumen and left until the next haemodialysis session.
5. If after the above regime the flows remain poor on the machine, the patient will need an alteplase infusion (see below).
6. If patient continues with access problems, consider alteplase line locks after each haemodialysis session. This will need to be prescribed on the drug chart.
7. All treatments for occlusion will be reviewed at the haemodialysis weekly review meeting.

Alteplase line lock for Haemodialysis Catheters

Use Actilyse Cathflo (t-PA/alteplase) 2mg vials.

Reconstitute with 2.2mL of water for injections to make a final concentration of 1mg/mL.

Instil the exact volume of the catheter lumen (to a maximum dose of 2mg) and leave for 1-2 hours or until the next dialysis session as per step 3 above.

Alteplase infusion for unblocking haemodialysis catheters

A dose of **0.01mg/kg/hr** should be infused through each lumen of the haemodialysis catheter for 4-6 hours. Make up a syringe for each catheter lumen using the following dosing table:

Patient Weight (kg)	Dose (mg) to be added to 10mL of 0.9% Sodium Chloride	Rate to be ran at (mL/hr)
10 to 19kg	0.2 x weight (kg)	0.5mL/hr
20 to 100kg	0.1 x weight (kg)	1mL/hr

Monitor Early Warning Score (EWS) every 30 minutes. Seek urgent medical review if the patient shows signs of bleeding or increasing EWS (e.g. Amber [score of 2-3] to Red [score of 4 or more]); stop the infusion in the interim.

Partial occlusion of Haemodialysis Catheters

1. Use Heparin 1000unit/mL line lock.
2. If patient continue to experience access problems, follow management of total occlusion guidance and consider alteplase line locks after each dialysis session.

Other medication

Consider aspirin, warfarin or other anti-platelet drugs if flow problems persist. Use of these medications must first be discussed with the Consultant Nephrologist.

Summary of Haemodialysis Catheter Occlusion Management