VASCULAR ACCESS CATHETERS: (HAEMODIALYSIS/APHERESIS CATHETERS) INSERTION AND MANAGEMENT - SCH

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- This business rule relates to the insertion and management of haemodialysis and apheresis catheters at Sydney Children's Hospital, Randwick.
- This document is intended for guidance of clinical staff inserting and managing non-tunnelled temporary haemodialysis / apheresis catheters (e.g. vascath) and tunnelled haemodialysis / apheresis catheters (e.g. permcath) for haemodialysis, plasmapheresis or peripheral blood stem cell harvest at Sydney Children's Hospital Randwick.
- **Temporary non-tunnelled and tunnelled haemodialysis / apheresis catheters should only be used for haemodialysis, plasmapheresis or peripheral blood stem cell collection. They should not be accessed for other purposes unless expressly ordered by the treating physician.**
- Temporary non-tunnelled and tunnelled haemodialysis / apheresis catheters should not be placed on the side of a proposed permanent dialysis access.
- Temporary non-tunnelled haemodialysis / apheresis catheters should be inserted under ultrasound guidance.
- Tunnelled haemodialysis / apheresis catheters are generally inserted in operating theatres.
- Preferred site for temporary non-tunnelled and tunnelled haemodialysis / apheresis catheters is the right internal jugular vein.

Approved by:	SCHN Policy, Procedure and Guideline Committee	
Date Effective:	1st April 2020	**Review Period**: 3 years
Team Leader:	Clinical Nurse Consultant	**Area/Dept**: SCH Nephrology

- Due to the large bore size of the haemodialysis / apheresis catheter a higher concentration of heparin is required, see document.
- All adverse events relating to temporary non tunnelled and tunnelled haemodialysis / apheresis catheters should be reported in IIMS.
- Note: All Procedure are as per CVAD principles and guidelines including the use of ANTT unless variations as per this guideline.
- All accredited Medical Officers or Registered Nurses who have been deemed competent in CVAD care and management are able to care for these catheters.

CHANGE SUMMARY

- Document due for mandatory review.
- Document expanded to include tunnelled haemodialysis / apheresis catheters.
- *Staphylococcus aureus* nasal carriage protocol updated as per new guidelines.
- Tissue plasminogen activator (Alteplase) locks included into protocol.
- Procedure for removal of temporary vascular access catheters included.
- References updated.

READ ACKNOWLEDGEMENT

- This document should be read by all SCH staff that care for children who require insertion of a temporary non-tunnelled haemodialysis / apheresis catheter.
  - Members of Department of Anaesthesia
  - Members of Department of Nephrology
  - Medical teams utilizing vascular access catheters for their patients.
  - Nursing staff Nephrology, Neurology, Oncology wards and CICU

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1 Introduction

Central venous catheters may be used if acute dialysis or apheresis is required. Ideally haemodialysis should be performed via an AV fistula because of a lower risk of infection related death compared with central venous line access. However the child must have suitable vascular structure for the formation of an ateriovenous (AV) fistula and there must be sufficient time for the AV Fistula to mature post-surgery.

Central venous lines for haemodialysis / apheresis can be non-tunnelled (eg Vascath) and used for acute short term haemodialysis / apheresis tunnelled / cuffed (eg Permcath used for longer term haemodialysis / apheresis.

In general if a catheter is to be used for more than 2 weeks a tunnelled (cuffed) catheter should be used [1, 4] due to the lower risk of infection.

Note: Both temporary non-cuffed and cuffed haemodialysis / apheresis catheters should only be used for haemodialysis, plasmapheresis or Peripheral Blood Stem Cell Collection; they should not be accessed for other purposes unless expressly ordered by treating physician.

2 Size

Intraluminal obstruction and trauma will be minimised by the correct choice of catheter size. The catheter required is dependent on the size of the child; it needs to be large enough for sufficient blood flow to ensure adequate dialysis [4]. Table 1 provides a guide for temporary haemodialysis / apheresis catheter selection, choice of catheter is limited by the catheters available [4]. The physician attending to the procedure has the final decision as to correct size and length for the individual child. Available catheters are listed in appendix 1.

Table 1:

Weight of child	Size of catheter:
< 5 kg	6.5 French dual lumen
5 to 10 kg	6.5 or 8 French dual lumen
10 to 20 kg	8 French dual lumen
20 to 40 kg	9 or 11 French dual lumen
> 40 kg	12.5 French dual lumen

Table adapted from KDOQI, Clinical Practice Recommendations 8: Vascular Access in Pediatric Patients [4].

3 Preferred Site

Where possible; temporary haemodialysis / apheresis catheters should not be placed on the side of a proposed permanent dialysis access. Haemodialysis / apheresis catheters should be inserted under ultrasound guidance [1, 5 & 6]; ultrasound can be used to assess the

suitability of the vein prior to catheter placement [6]. Temporary haemodialysis / apheresis catheter tip should be positioned in the superior vena cava [5]. When catheters are inserted in the supine position it should be noted that the catheter tip will move when the patient sits up [6].

The preferred site for insertion is the right internal jugular vein [1] with the distal tip of the catheter placed in the superior vena cava. Other sites in order of preference are: right external jugular vein; left internal and external jugular veins; subclavian veins – these sites should only be used when there is no other upper extremity options available; and the femoral veins – should only be used in bed bound patients [5 & 6].

4 Preparation of the patient

- Where possible/practicable Doppler studies should be attended prior to arranging insertion of catheter.
- Obtain nasal swabs from patient and family to check for *Staphylococcus aureus* nasal carriage.(Haemodialysis patients only)
- A single dose of Cefazolin 25mg/kg/dose, to a maximum of 1g, should be given pre insertion of catheter.

5 Insertion Procedure

5.1 Non tunnelled catheters:

Particular attention should be paid to the following:

1. Verification of venous placement of the guide wire MUST occur prior to dilation and placement of the Vascath. This may be done by careful Ultrasound imaging of the guide wire passing down the vein. Alternatively an IV cannula may be passed down the guide wire into the vessel, the guide wire removed, and the cannula transduced as venous.
2. Vascaths are very large and stiff catheters. Guide wire kinking or vessel perforation can occur both during passage of the dilator and final passage of the Vascath. Consideration should be given to the use of Image Intensifier Screening during insertion.
3. In any patient under General Anaesthesia, correct catheter tip position must be confirmed radiologically prior to emergence from Anaesthesia.
4. When placed by members of the Department of Anaesthesia the proceduralist must be a Senior Medical Officer with Category A Paediatric Accreditation and extensive experience in central venous catheter placement in the patient's age group.
5. Position of catheter must be reviewed by the nephrologist / team prior to first use. This may be review of Image Intensifier films or other films taken in theatres at the time of insertion, or by erect chest X-ray[1] at the discretion of the treating medical officer. Note: the catheter tip will move when the patient sits up [6].

5.2 Tunnelled catheters

Tunnelled catheters are generally placed in operating theatres.

6 Infection prevention

6.1 General principles

Catheter related infection is a major cause of morbidity in haemodialysis patients. Non-tunnelled temporary haemodialysis / apheresis catheters should be avoided where possible as the risk of infection is greater than with tunnelled catheters. Aseptic Non Touch technique (ANTT) should be used whenever the haemodialysis / apheresis catheter is manipulated, connected or disconnected [2, 8]. The use of antimicrobial locks has been shown to reduce the incidence of infection; however, the risk of spill over has been identified [6], although with low doses this should be minimal. The use of topical antimicrobials at the catheter exit site [2, 3] and eradication of nasal staphylococcal carriage have been advocated to reduce the incidence of systemic infection [1]. Nasal swabs should be obtained from all patients before insertion of non-tunnelled haemodialysis catheters.

6.2 Dressing

The exit site dressings should be attended at each haemodialysis /apheresis session. If the dressing becomes loose, wet, or soiled the dressing should be changed earlier [2]. The site should be cleaned with chlorhexidine 2% [2]; the exit site should be covered with a Tegaderm™ CHG IV dressing (chlorhexidine gluconate) or Kendall ™ AMD antimicrobial fenestrated foam dressing, and covered with tegaderm.

6.3 Staphylococcus aureus nasal carriage protocol

If *Staphylococcus aureus* is cultured from nasal swabs, eradication of nasal carriage should be attempted using the "5 day decolonisation plan". This consists of nasal mupirocin and a body wash, as per SCH.i.15 *Multiresistant Staphylococcus Aureus (MRSA)* In Hospital: Screening, Reduction of Microbiological Load ("Decolonisation") And Isolation guideline [13].

Separate procedure document or link to the following:

- Nasal mupirocin
  - 2% mupirocin nasal ointment applied inside each nostril, twice a day for 5 days
  - If on an antibiotic for MSSA or MRSA therapy, the "5 day decolonisation" should coincide with the last 5 days of antibiotic treatment
- Body wash
  - Suitable body wash is a chlorhexidine-based wash like Microshield 2 ™ or Microshield 4 ™ which is 2% or 4% chlorhexidine gluconate wash; or bleach baths.
  - If however the child has eczema, then Oilatum Plus® (benzalkonium chloride 6% and triclosan 2% in liquid paraffin) should be used instead.

- Apply the antiseptic body wash in the bath or shower daily for the same 5 days as nasal mupirocin.
- Take care to wash hair, under the arms, inguinal region and in any skin folds.
- Allow the antiseptic to remain on the skin for at least 5 minutes before washing off.

- Alternatively use a bleach bath.
  - Older child or adult: Add to a full bath tub of water (150-180 L), ½ of a cup (125 mL) of ~ 4% bleach. *This is normal household bleach and should be the unperfumed, unscented variety.
  - The child or adult can spend a normal time in the bath, generally 5-10 minutes. The bleach baths are given daily for 5 days
  - Do not immerse the child's head under the water. Tip: For young children, wet scalp areas and behind ears using a small / facial towel or flannelette. Older kids – tip head back and drench scalp/head area with the bleach bath water, take care to avoid eyes
  - Once the bath is finished, partially dry the skin by patting it with a towel. Do not rub the skin and don't dry completely.
  - Use moisturiser after the bath as the bleach bath can be drying. Using moisturiser from a pump pack will decrease the chance of contamination of the moisturiser with Staphylococcus aureus; moisturiser such as "QV Skin Lotion" which is readily available from chemists and not greasy.
  - Newborns or very small infant: Add 1 ml of ~ 4% bleach* to 1 L of water in a spray bottle. Spray on skin. AVOID head area (including avoid eyes, face and scalp). Leave for 5 – 10 minutes. Either, rinse and dry off or just dry off. Follow daily for 5 days
  - Use bleach baths for the same 5 days as nasal mupirocin.

6.3 Risk of infection

The risk of infection is greater when using a non-tunnelled haemodialysis / apheresis catheter.

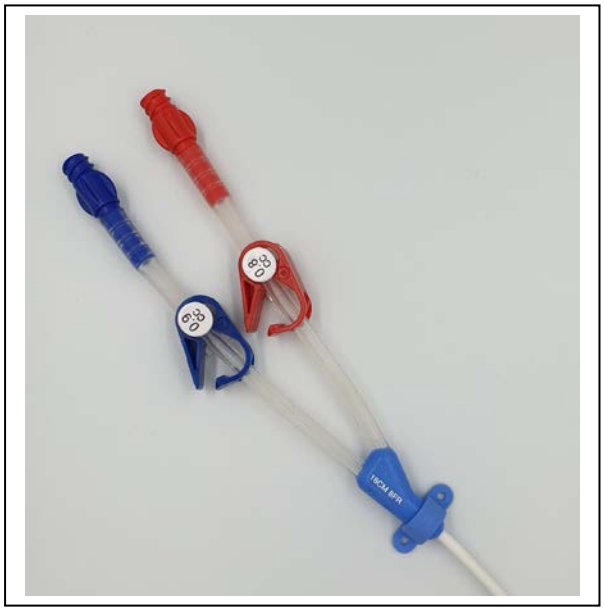
The risk of infection varies with the site of the non-tunnelled catheter. Oliver et al (2000) list the incidence of bacteraemia in terms of site of placement and length of time since placement [14], showing that femoral placement has a greater incidence of infection as compared to internal jugular placement. See appendix 2, table 3.

Bacteraemia may result from catheter exit site infection or luminal contamination. Oliver et al (2000) observed that bacteraemia quickly follows the identification of a catheter exit site infection [14], showing that 22.2% of patients with an identified exit site infection will have bacteraemia by day 7. See appendix 2, table 4.

7 Locking of haemodialysis / apheresis catheters

Haemodialysis / apheresis catheters can be locked using either heparin, tissue plasminogen activator (e.g. alteplase) or antibiotic heparin locks (e.g. Taurolock). Due to the large bore size of these catheters a higher concentration of heparin is required. The type of lock used is at the discretion of the consultant and will be dependent on the individual child's circumstances. All haemodialysis / apheresis catheters have the volume of the lumen documented on the on the extensions or clamp of the actual catheter. (See example following). (Note: red/brown is the arterial lumen; the venous lumen is blue.) Refer to CVAD policy for technique for locking catheters. Prior to locking both lumens need to be flushed with 0.9% sodium chloride. Clamps must be closed once the lock has been instilled. The lock volume used should be the exact volume documented on the catheter.

All catheter locks should be prescribed by the treating medical team including volume of the lock.



7.1 Heparin locks

Heparin is a high risk medication. It comes in multiple strengths and adverse events have occurred due to incorrect selection. It is essential that the correct strength is prescribed, dispensed and checked prior to administration.

Doses indicated below are for **each** lumen:

Patients more than and equal to 10kg (≥ 10 kg): **5000 units/mL** (use 5000units/mL ampoule)

Patients less than 10 kg (< 10kg), or when lower dose is indicated for an individual patient: **1000 units/mL** (use the 5000units/5mL ampoule)

7.2 Antibiotic locks

Due to the increased risk of systemic infection with non-tunnelled haemodialysis / apheresis catheters, these catheters may be locked with an antibiotic lock [3]. The goal is to kill the bacteria present in the biofilms that adhere to the catheter lumens whilst also salvaging the catheter. It is common to have this prescribed with systemic (IV) antibiotics. Options other than Taurolock are [8, 9, 10, 11, 12, 16 & 17]:

- gentamicin 1mg/mL in heparin 2500 units/mL
- ceftazidime 5mg/mL in heparin 5000 units/mL
- vancomycin 5mg/mL in heparin 5000 units/mL (1mL vancomycin 5mg/mL in sodium chloride 0.9% PLUS 1mL heparin 5000 units/mL. Resultant solution = 2mL)

The use of antibiotic locks will decrease the heparin concentration of each catheter lumen. Once the antibiotic has been prepared, heparin should be added so that there is a total volume of the combined catheter lumen volumes. (see vancomycin example above) Each catheter lumen should then be locked with the appropriate volume of the individual lumens. This is to be left indwelling until the next Haemodialysis / Apheresis session.

The preparation of antibiotics lock is quite complex – please contact Pharmacy and senior nurses in advance for administration advice.

7.3 Tissue plasminogen activator (Alteplase) locks:

Some patients at high risk of catheter thrombosis or infection may be considered for alteplase locks. Replacing one heparin dialysis catheter lock per week with tissue plasminogen activator (alteplase) has been shown to reduce catheter malfunction (hazards ratio 1.91 with heparin alone) and catheter-related bacteraemia (1.37 to 0.40 episodes per 1000 patient days) without an increase in adverse events, including bleeding [18].

Alteplase has been used in children with demonstrated effectiveness in reducing clot formation, need for urokinase/alteplase infusions and surgical replacement (small patient numbers, some dialysed twice per week, used after each session) [19]. Pharmacy keeps alteplase to use as locks (intraluminal route).
Medication name: Alteplase (Brand:Actilyse Cathflo 2mg vial)

Category: Special Access Scheme (SAS) Category A forms must be received by Pharmacy prior to dispensing.

Storage: Fridge (2-8^{o}C)

Prescribing on eMM: alteplase 2mg intraluminal (free text the dose by referring to Appendix 3)

Prescribing on hardcopy medication chart:

- Medication: alteplase 1mg/mL
- Dose: (volume required) into Lumen 1 & (volume required) into Lumen 2 and so forth (refer to Appendix 3)

Refer to Appendix 3 for administration instructions.

7.4 Removal of lock:

All lock solutions should be removed prior to use of catheter.

7.4.1 Action in case lock solution flushed into circulation:

The administration should be stopped immediately (if not fully administered).

Advise treating team or on call registrar that the lock solution has been inadvertently administered – specify lock solution and estimated volume given.

Depending on the clinical situation, medical officer may consider checking coagulation studies.

Observe patient for signs of bleeding and notify team immediately.

8 Rewiring of non-tunnelled haemodialysis / apheresis catheters

Non-tunnelled catheters with identified exit site or tunnel infections should not be rewired.

If it is considered appropriate to rewire a non-tunnelled catheter due to dysfunction, a single systemic antibiotic dose generally should be given immediately prior to the rewire procedure (Cefazolin 25mg/kg/dose, maximum 1g/dose). If rewiring for a suspected line infection appropriate systemic antibiotic treatment generally should be given for 48 to 72 hours prior to rewire [8].

9 Salvage/ rescue of infected non-tunnelled haemodialysis / apheresis catheters

Catheter salvage should not be attempted where there is an identified exit site or tunnel infection.

If it is considered appropriate to try and salvage a non-tunnelled catheter, systemic antibiotics appropriate to the organism cultured and antibiotic locks should be used [8 &15].

10 Removal of non-tunnelled haemodialysis / apheresis catheters

Given the risks of developing systemic infection **femoral lines should be removed after 7 days** and any non-tunnelled catheters with identified exit site infection should be removed

promptly [14]. Request for removal of any non-tunnelled haemodialysis / apheresis catheter must be documented by the treating team.

Catheter should be removed on non-dialysis days, or at least 4 hours following a haemodialysis session.

Procedure for Removal[20]:

> Note: Procedure performed by a Medical Officer or Registered Nurse who has been deemed competent through the accreditation process for CVAD removal.

Equipment:

- Sterile Field
- Stitch cutter (for removal of CVAD, if it has been secured with stitches)
- Sterile gauze square
- Occlusive dressing
- Personal Protective Equipment (PPE)
- Sterile scissors and specimen jar if catheter tip requires culture
- 2% chlorhexidine in 70% alcohol swab stick
- Non-sterile gloves

Procedure:

1. Attend baseline observations prior to commencing procedure.
2. Visually inspect the exit site, if infection is suspected discuss with medical staff if cultures required.
3. Apply PPE as necessary.
4. Ensure all lumens of the catheter are clamped.
5. Position patient supine with head slightly down (if tolerated).

Note: This is to increase the pressure in the large veins to above atmospheric pressure, which reduces the risk of air aspirating into the venous circulation.

6. Loosen dressing and lift securement device.
7. Remove sutures if necessary.
8. Clean any bloody debris and insertion site with 2% chlorhexidine in 70% alcohol swab stick and allow to dry.
9. Hold a gauze square over the insertion site with your non-dominant hand.
10. If the patient is able, ask them to take a deep breath and hold their breath. Then with your dominant hand, gently remove the catheter using a slow steady motion. If they are unable to hold their breath, then remove the catheter in the same manner at the beginning of expiration.

Note: Breath holding lessens the risk of air entering the exit tract and causing an air embolism.

11. Grasp the catheter not the hub, until completely removed.

If resistance is encountered, do not continue with removal, apply clear dressing and call medical team. Stay with the patient until reviewed by medical team.

12. Remove dressing with catheter and place onto the sterile field taking care not to contaminate the tip of the catheter if a tip culture required.

13. Once removed remind the patient to breath normally.

14. Continue to hold pressure using the sterile gauze over insertion site and apply pressure to stop bleeding. If uncuffed tunnelled CVC, maintain pressure at both sites for a minimum of 15 minutes post removal until bleeding stops at exit site on the chest.

15. Apply occlusive dressing. The site must be sealed with an occlusive dressing which remains insitu for at least 24 hours to reduce the risk of late air embolism.

16. Observe for the signs of complications and maintain supine bed rest (if possible) or semi-fowlers if supine is not tolerated, for a minimum of 60minutes.

17. Attend at least one set of observations during this 30minute period, as well as immediately prior to moving the patient back to the upright position.

18. Inspect the tip of the catheter to ensure it is intact. If catheter appears to be cut at the distal end, measure the catheter length and compare this to the CVAD insertion record. This will confirm if the catheter has been removed intact. If these values do not correlate and there is a possibility of part of the catheter remaining internally in the patient call for an urgent medical review.

Send tip to Microbiology if indicated. Cut approximately 2-3cm from the end of the catheter with sterile scissors and using sterile forceps place tip of catheter in the sterile specimen jar. Ensure Pathology request has been completed by medical team.

19. Document removal in the CVAD insertion/removal record on Powerchart and in the patient's progress notes. Noting the presence of an intact tip.

20. Advice the patient to keep dressing dry and intact for first 24hours post removal, the dressing can be removed 5-7 days post removal. If parents have any concerns at home post removal then parents can be advised to present to their closest emergency department or GP.

Note: Patient must be observed for a minimum of 1 hour post removal before being discharged home or in the care of the parent.

References

1. CARI guideline Insertion of catheters, 2012.
2. CARI guideline nursing care of central venous catheters, 2012.
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19. Gittins NS, Hunter-Blair YL, Matthews JN, et al. Comparison of alteplase and heparin in maintaining the patency of paediatric central venous haemodialysis lines: a randomized controlled trial. Arch Dis Child, 2007; 92(6): 499-501.
20. Practice guideline 2013-9037v5 Central Venous Access Devices.

Appendix 1:

Table 2: The following non-tunnelled catheters are currently available at SCH:

Catheter size	Location of stores
6.5 F x 7.5 cm	CICU
6.5 F x 10 cm	CICU
8 F x 10 cm	C 1 South
8F x 12 cm (Silicone)	**Order from TekMed – extra payment required for next day delivery, or 3 to 4 day delivery**
9 F x 12 cm	
9F x 15 cm	
8 F x 12.5 cm	CICU
11 F x 12.5 cm	C 1 South
11 F x 15 cm	**Order from Gambro, will require extra payment for next day delivery**
12 F x 12.5 cm (Curved extension)	C 1 South
12 F x 15 cm (Curved extension)	C 1 South

Table 3: The following tunnelled catheters are currently available at SCH:

Catheter size	Location
8 F x 18 cn Hemo-cath LT	C 1 South
10 F x 18 cm Split-cath LT 10 F x 24 cm Split-cath LT	C 1 South
12.5 F x 18 cm Hemo-cath LT 12.5 F x 24 cm Hemo-cath LT	C 1 South

Appendix 2:

Table 4: Incidence of bacteraemia

Table adapted from *Oliver et al 2000*.

Interval in weeks since placement of non-tunnelled haemodialysis catheter.	Incidence of bacteraemia	
	Internal jugular placement	Femoral placement
0 to 1	1.7%	3.1%
1 to2	4.6%	10.7%
2 to 3	5.4%	18.1%
3 to 4	10.3%	29.1%

Table 5: Probability of bacteraemia

Table adapted from *Oliver et al 2000*.

Number of days from onset of catheter exit site infection	Probability of bacteraemia
1	1.9%
2	13.4%
3	16.0%
5	18.8%
7	22.2%

Appendix 3:

Alteplase vial (Actilyse Cathflo 2mg powder for reconstitution)

Final concentration to use as a lock: 1mg/mL (ie require dilution)

Reconstitution instructions: Add 2.2mL water into 2mg vial to obtain 1mg/mL

Dose: The volume of reconstituted solution to be instilled in the central venous device should correspond to 110% of the internal lumen volume of the device (e.g. for a catheter of an internal volume of 1mL, the total Actilyse Cathflo dose would be 1.1mg in 1.1mL) – see table below. **Maximum for <10kg = 0.5mg/dose, and remaining volume to be made up with sodium chloride 0.9%**

Reference: https://www.medicines.org.uk/emc/product/4617/smpc#POSOLOGY

****Do not use 10mg vials from the after-hours cupboard as it is much more concentrated***

****Do not use NADs to administer alteplase – it must go directly onto the lumen and capped****

Example for patients less than 10kg (< 10kg)

8 Fr x 100 mm Gamcath	Internal Volume	Dose of alteplase to be taken out of 1mg/mL vial	Further dilution required with Sodium chloride 0.9%	Final volume to be placed in the line
RED lumen	0.8mL	0.5mg (=0.5mL)	0.38mL	0.88mL
BLUE lumen	0.82mL	0.5mg (=0.5mL)	0.4mL	0.9mL

Example for patients more than 10 kg (>10 kg)

11 Fr x 125 mm Vascath	Internal Volume	Dose of alteplase to be taken out of 1mg/mL vial	Further dilution required with Sodium chloride 0.9%	Final volume to be placed in the line
RED lumen	1.0mL	1.0mg (=1.0mL)	0.1mL	1.1mL
BLUE lumen	1.1mL	1.0mg (=1.0mL)	0.2mL	1.2mL

Please note;

Above examples only of volume, see locking volume for individual catheter.