

PREVENTING INTRAVASCULAR DEVICE (IVD)-RELATED BLOODSTREAM INFECTIONS (BSIs) QUESTIONS AND ANSWERS

I-Care Steps

Protect your patients and reduce the occurrence of BSIs by following the I-Care Steps when managing intravascular devices.

- I** **IVD Management**
- C** **Clean** your hands.
- A** **Access:** use alcoholic chlorhexidine to prepare the insertion site and use sterile alcohol swabs to clean injection ports before accessing.
- R** **Review** the need for the IVD on a daily basis and remove when no longer required.
- E** **Educate** everyone about I-Care – staff, patients and carers.

Since the launch of the I-Care eToolkit there have been a number of questions from hospitals in relation to intravascular device (IVD) management. The responses will be incorporated into the next version of the Recommended Practices. Until that time the questions and answers will be included in this document to ensure sharing of information and consistency of practice in relation to IVD insertion and management.

Question 1:

Staff have questioned if we are going the way of disposable blood tourniquets as they feel these are not cleaned - are you aware if this is the practice at other facilities, I know that cleaning of these items probably is poorly complied with?

Answer 1:

In 2002, Bernath reported there were no studies which compared reused tourniquets with fresh tourniquets in relation to lowering infection rates.¹ The author did identify four articles which used surrogate outcomes (the presence of blood or microorganisms on tourniquets), but no studies were found linking contamination with infection.

More recent studies however, suggest that tourniquets may play a role in transmission of methicillin resistant *Staphylococcus aureus* (MRSA).^{3, 4} Rates of MRSA positivity have ranged from 5% to 58% when portions of tourniquets were microbiologically sampled and cultured; low rates of compliance with cleaning was also reported (35.5%).^{3, 4, 5, 6} A high proportion of tourniquets were also blood stained (2.8% to 37.5%).^{2, 4}

Two methods of contamination have been suggested – (1) contamination of the tourniquet by the HCP's hands (not directly from the patient's skin) and (2) re-inoculation of the HCP's hands from the contaminated tourniquet thus allowing transmission to patients or other surfaces.^{3, 5}

Whilst the role contaminated tourniquets may have in subsequent infection is difficult to establish, disease transmission may be theoretically possible. Consequently, the following measures are recommended:

1. Hand hygiene should be regarded as the most important method by which the spread of organisms can be reduced.⁵
2. Where possible, patients should be supplied with their own tourniquets, either reusable or disposable. Labelling of tourniquets with patient names may help in restricting use to a single patient. Reusable tourniquets should be reprocessed according to the manufacturer's instructions, when no longer required.
3. Tourniquets not assigned to a specific patient should either be disposable (single-use only) or if reusable, cleaned with alcohol-impregnated wipes after each use.
4. Blood-stained tourniquets should be discarded immediately.
5. Ample supplies of new tourniquets should be readily available for staff use.

Two types of tourniquets are currently available on Queensland Health Standing Offer Arrangement (SOA) 728 – reusable (Terumo Venosafe) and disposable latex free (Becton Dickinson {BD}).

References:

1. Australia. Monash University. Bernath V. *Tourniquets in phlebotomy*. [online]. February 2006 [cited 12 March 2006]. Available from <http://www.med.monash.edu.au/healthservices/cce> (Internet access required)
2. Rourke C, Bates C, Read R. Poor hospital infection control practice in venepuncture and the use of tourniquets. *Journal of Hospital Infection* 2001; 49: 59-61.
3. Fellowes C, Kerstein R, Clark J, Azadian B. MRSA on tourniquets and keyboards. *Journal of Hospital Infection* 2006; 64(1): 87-88.
4. Sacar S, Turgut H, Kaleli I, Cevahir N, Asan, Sacar M, Tekin K. Poor hospital infection control practice in hand hygiene, glove utilization, and usage of tourniquets. *American Journal of Infection Control* 2006; 34(9): 606-609.
5. Leitch A, McCormick, Gunn I, Gillespie T. Reducing the potential for phlebotomy tourniquets to act as a reservoir for methicillin-resistant *Staphylococcus aureus*. *Journal of Hospital Infection* 2006; 63: 428 - 431.
6. Ormerod J, Williams J, Lewis J, Dawson S. Risk of MRSA transmission from tourniquets. *Journal of Hospital Infection* 2006; 64(3): 300-301.

Question 2:

What is the recommended storage time for intravenous infusions that are stored in warming cabinets?

Answer 2:

Information obtained from Baxter Healthcare Pty Ltd.¹

When stored for prolonged periods at temperatures above 30°C, the Baxter Viaflex Plastic Container may undergo loss of water vapour, resulting in an increase concentration of dissolved components. The sealed overpouch is designed to reduce water vapour loss and to extend shelf life of the product. Water vapour loss accelerates if the bag is prematurely removed from its overpouch.

Baxter Guidelines for Safe Warming and Storage of Viaflex Bags in UNOPENED pouches:

1. For normal therapeutic use, these solutions are warmed to temperatures between 34 - 40°C.
2. Microwave ovens must not be used for warming these products.
3. Thermostatically-controlled warming cabinets are suitable for warming of these solutions.
4. Once warmed, the solutions should be stored at the higher temperature until use (successive warming and cooling cycles may accelerate the rate of degradation of components). Do not remove the overpouch of any fluids being warmed.
5. The period for warming solutions in this manner should not exceed 14 days. Solutions that have been warmed for up to 14 days can be returned to room temperature storage. However, they should be used soon after; a limit of 30 to 60 days is suggested. Discard if not used.
6. Do not use containers of solutions that have a build-up of precipitates or glucose-based solutions that have discoloured. Avoid warming fluids containing pharmaceuticals for long periods.

Reference:

1. Baxter Healthcare Pty. Ltd. Clinical Information Sheet. Warming of Baxter's Parenteral and Irrigation Solutions. 31 August 2004.

Question 3:

I note you do not recommend routine blood collection via central lines. However where there is a need do you have a recommended procedure?

Answer 3:

Based on what has been ascertained from the literature, if blood must be collected from an intravascular catheter (excluding peripheral intravenous and haemodialysis catheters), the first few mL must be discarded prior to blood collection and the lumen flushed using a pulsatile action, with 0.9% normal saline post blood collection. The recommended volume of discard blood varies, with some authors recommending 10mL (e.g. Cancer Institute of New South Wales {NSW}), and others a smaller discard in accordance with the device type and length e.g. 4-5mL. The amount of discard blood should be sufficient to yield a non-contaminated sample.

Similar recommendations exist for the volume of flush solution including 10mL (Cancer Institute of NSW) and a volume based on the capacity of the catheter and add-on devices (i.e. the volume of flush should equal at least twice the volume of the catheter plus add-on devices). With regard to ports, it would appear that 20mL is recommended as the flush volume following blood withdrawal. However, with all types of catheters, manufacturer's recommendations should be followed.

If the lumen is not to be used, it should be locked with 0.9% normal saline using a positive pressure technique. If the catheter is locked with heparin, INR or APPT should not be collected from the catheter unless peripheral bloods cannot be taken. Coagulation studies can be taken if the catheter is locked with 0.9% normal saline. A blood collection tube holder ('vacutainer') should be used.

The Cancer Institute of NSW recommend cleaning the external surfaces of the access port with sterile alcohol wipes for 20 seconds x 3 times and allow to dry for 20 seconds. Either a sterile (sterile gloves) or non-touch (clean gloves) technique should be utilised when accessing any central venous catheter (CVC) lumen.

Question 4:

In rolling out the I-CARE initiative, we have had some queries from staff about best practice supported by research, in the area of inserting peripheral lines. The main queries relate to:

1. *Use of Persist Plus (chlorhexidine based antimicrobial) versus alcohol wipes - I understand the rationale re the duration of the IVD (ie for day procedures (less than 24hours) it is appropriate to use alcohol, but not for longer duration IVD's); however is there literature to support this?*
2. *A local procedure for PIVC insertion, states the practice of using a sterile field in the form of a dressing pack/insertion pack **OR** a pre-moistened alcoholic Chlorhexidine swab stick (Persist Plus). Is using a dressing pack/insertion pack a practice we should be adopting here instead of allowing staff to have the choice of one or the other? The CHRISP instruction clearly states that a sterile field is set up immediately prior to the procedure and that aseptic technique including sterile dressing pack with drape is used for dressing changes. Have you got research to support this practice (and the resultant decrease in BSI's), so I can encourage this practice in house?*

Answer 4:

1. There are a number of references to support the use of an antimicrobial solution that is broad spectrum and has long term microbacteriocidal action after application (e.g. chlorhexidine gluconate). In 1991, Maki et al reported that the rate of infections associated with central venous and arterial catheters could be significantly reduced if 2% aqueous chlorhexidine gluconate was routinely used for skin treatment prior to catheter insertion (compared to 10% povidone-iodine solution and 70% isopropyl alcohol).¹ In the study, the rate of infection for alcohol alone was 7.1 per 100 catheterisations, 9.3 infections per 100 catheterisations for povidone iodine, and 2.3 infections per 100 catheterisations for chlorhexidine. Proteinaceous solutions also have little effect on the antibacterial activity of chlorhexidine.

Whilst not specifically comparing alcohol with other antiseptics, Chaiyakunapruk et al undertook a meta-analysis comparing chlorhexidine with povidone-iodine solution for vascular catheter-site care, which demonstrated that the use of chlorhexidine gluconate solution for care of (short-term) catheter sites is significantly more effective than use of povidone-iodine solution for preventing vascular catheter-related infections (i.e. reduced the risk by approximately 50%).²

In 2003, the authors also reviewed pooled data from a number of recent randomized controlled trials to compare the clinical effectiveness and cost-effectiveness of substituting chlorhexidine for povidone-iodine when disinfecting catheter insertion sites. The study population included both central vascular and peripheral venous catheters. The authors concluded "the use of chlorhexidine for patients requiring short-term vascular

catheterisation, either central or peripheral catheters, would reduce the incidence of vascular catheter-related infection. It would also decrease health-care costs."³

In 2002, Hibbard et al, undertook a clinical study comparing the skin antiseptics and safety of a commercially available product ChlorPrep - 2% chlorhexidine gluconate (CHG) in 70% isopropyl alcohol (IPA), with 70% isopropyl alcohol and 2% aqueous chlorhexidine.⁴ In this study all products demonstrated immediate (10-minute) antimicrobial activity however, CHG + IPA, produced significantly better and more persistent antimicrobial activity. Additionally, at 24 hours, the IPA alone showed a decrease in antimicrobial activity and CHG + IPA did not.⁵

Other consolidated documents such as the Infusion Nursing Standards of Practice 2006, recommend antiseptic formulations containing a combination of alcohol (either ethyl or isopropyl) and chlorhexidine gluconate for access site preparation.

2. Infection in short-term catheters is most often due to microbes from the skin moving along the catheter surface where the catheter enters the skin. Experiments involving catheter placement suggested that microbes can move rapidly along the length of the catheter placed under the skin, perhaps by capillary action. A study examining catheter tips immediately after insertion demonstrated a contamination rate of 16% caused simply by passing through the skin. Because peripheral intravenous catheter (PIVC)-related bloodstream infection is a fairly infrequent event (compared with central venous access devices), studies have tended to measure either rates of phlebitis or levels of skin colonisation.

A number of guidelines related to intravascular device management state that proper hand washing technique, meticulous site care on insertion and with dressing changes including use of approved skin cleansing agents and aseptic technique, are considered the most important measures for preventing infections associated with short-term vascular access devices. Even though PIVC have a lower risk of infection, no medical device should ever be considered risk-free with regard to infection, especially if the device is implantable. The decision by CHRISP to recommend a sterile dressing pack including drape was based on studies which demonstrated that PIVC placed in emergency situations (where establishing access is more important than maintaining asepsis) were more likely to produce severe phlebitis, as was insertion by inexperienced personnel.^{6,7}

References:

1. Maki D, Ringer M, Alvarado C. Prospective randomised trial of povidone-iodine, alcohol, and chlorhexidine for prevention of infection associated with central venous and arterial catheters. *The Lancet* 1991; 338(8763): 339-344.
2. Chaiyakunapruk N, Veenstra D, Lipsky B, Saint S. Chlorhexidine Compared with Povidone-Iodine Solution for Vascular Catheter-Site Care: A Meta-Analysis. *Ann Intern Med* 2002; 136: 792-801.
3. Chaiyakunapruk N, Veenstra D, Lipsky B, Sullivan S, Saint S. Vascular catheter site care: the clinical and economic benefits of chlorhexidine gluconate compared with povidone iodine. *Clin Infect Dis* 2003; 37: 764-771.
4. Hibbard J, Mulberry G, Brady A. A Clinical Study Comparing the Skin Antisepsis and Safety of ChlorPrep, 70% Isopropyl Alcohol, and 2% Aqueous Chlorhexidine. *Journal of Infusion Nursing* 2002; 25(4): 244-249.
5. Infusion Nurses Standards of Practice. *Journal of Infusion Nursing* 2006; 29(1) (Supplement): S1-S62.
6. Maki DG, Ringer M. Risk factors for infusion-related phlebitis with small peripheral venous catheters. A randomized, controlled trial. *Ann Intern Med* 1991; 114: 845-854.
7. Widmer A. Intravenous-Related Infection. In Wenzel R, ed. *Prevention and Control of Nosocomial Infection*. 3rd ed. Baltimore: Williams & Wilkins, 1997: 771-805.

Question 5:

Can you help me? The Director of Medicine is really interested in not using the cubital fossa for IV devices. Is anyone doing anything about it, are there references, do you know what's going on? Do you know where I could get some information so support his concerns?

Answer 5:

CHRISP is not aware of what individual hospitals practices are in relation to catheterisation of the cubital fossa. However, a number of references and guidelines recommend against this practice for the following reasons:

1. Generally, site selection should be routinely initiated in the distal areas of the upper extremities; subsequent cannulation should be made proximal to the previously cannulated site to avoid 'using up' all available veins (one of the other risks associated with inserting a PIVC below the level of a prior venipuncture is 'leaky vein syndrome' which will cause fluids infusing through the PIVC to leak out of the skin at prior insertion sites).

2. When selecting a site for peripheral intravenous venous catheterisation (PIVC), the healthcare professional (HCP) should avoid areas of flexion.
3. The antecubital fossa and metacarpal veins should be avoided if a vesicant has to be peripherally delivered due to the difficulty in detecting infiltration at these sites of flexion.
4. Median antecubital veins should be avoided in case a peripherally inserted central catheter (PICC) is required.
5. Arm veins, particularly the cephalic, antecubital fossa and basilic veins, should not be used for PIVC in patients with developing end stage renal disease (ESRD) or patients with conditions likely to lead to ESRD (particularly if preservation of upper-extremity veins is needed for fistula or graft implantation).
6. The antecubital fossa veins are not good for prolonged IV therapy and it is best to avoid this site as the veins are short and are at a joint where the median nerve and brachial artery may be injured.
7. Generally antecubital fossa veins should be reserved for emergency procedures if a large bore catheter and/or short-term infusion is required.

Question 6:

After prepping an area with alcoholic chlorhexidine, clinicians generally re-palpate the vein prior to inserting a cannula - which of course contaminates the area. Is it OK for them to prep their fingers/gloves with the same solution (the same Persist-Plus swab) so they are not contaminating the area?

Answer 6:

It is not acceptable to attempt to disinfect gloved or ungloved fingertips in order to re-palpate the vein prior to PIVC insertion. Firstly, despite skin disinfection, bacteria present in the deeper layers of the skin may be released by manipulation of the skin when identifying the vein or other landmarks. Secondly, glove perforations have been shown to be relatively frequent (7.1% following surgical operations) and consequently bacteria from the operator's hand may also contribute to contamination of the site. Thirdly, alcohol can degrade glove integrity which will increase their permeability. What is preferable is for the operator to use sterile gloves if they need to touch the access site after application of the skin antiseptic.

Reference:

1. Centers for Disease Control and Prevention. Guidelines for the Prevention of Intravascular Catheter-Related Infections. *MMWR*, 2002; 51 (no. RR-10): 1-26.

Question 7:

With regard to haemodialysis catheters, should a surgical or clinical handwash be performed prior to donning sterile gloves, when accessing ports?

Answer 7:

Whilst a review of the literature related to hand hygiene and gloves for accessing and deaccessing haemodialysis catheters identified the need for hand hygiene, none specifically stated the type of hand wash. The US National Kidney Foundation (NKF) Kidney Disease Outcomes Initiative (K/DOQI) Clinical Practice Guidelines for Vascular Access¹ recommend "correct hand-washing, 'no-touch technique, and disposable clean gloves" for accessing catheters. The CARI (Caring for Australasians with Renal Impairment) Guidelines for Vascular Access² recommend accessing lines with a sterile technique. The US Infusion Nursing Standards of Practice 2006³, recommend "sterile technique should be used for all procedures related to haemodialysis access devices." There was nothing specific in the CDC or ePIC Guidelines.^{4,5}

In summary, a surgical scrub is only required for insertion of a catheter. If the dressing is changed as part of the circulation access procedure, it is recommended a clinical hand wash (60 seconds) be performed; if only access is being undertaken, a routine (10-15 seconds) hand wash would be sufficient.

References:

1. United States. National Kidney Foundation (NKF) Kidney Disease Outcomes Quality Initiative (K/DOQI). *Clinical Practice Guidelines and Clinical Practice Recommendations 2006 Updates*. [online] Copyright 2006 [cited 28 November 2006]. Available from: http://www.kidney.org/professionals/kdoqi/guideline_upHD_PD_VA/index.htm
2. Australia. Caring for Australasians with Renal Impairment (CARI) Guidelines. *Part 1 Dialysis Guidelines Vascular Access 2000*. [online] 4 October 2006 [cited 6 December 2006]. Available from: http://www.cari.org.au/dialysis_va_archives.php
3. Infusion Nurses Standards of Practice. *Journal of Infusion Nursing* 2006; 29(1) (Supplement): S1-S62.
4. Centers for Disease Control and Prevention. Guidelines for the Prevention of Intravascular Catheter-Related Infections. *MMWR* 2002; 51 (No. RR-10): 1-26.

5. Pratt R, Pellowe C, Wilson J, Loveday H, Harper P, Jones S, McDougall C, Wilcox M. epic2 National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England. *Journal of Hospital Infection* 2007; 65S: S1-S64. Available from: <http://www.epic.tvu.ac.uk/> (Internet Access Required)

Question 8:

The CHRISP guideline states that cannulas should be changed after 48 hours unless they are to be removed. Also lines should be left for 72 hours if for continuous infusion but further states that the lines should be changed with the cannula. Our practice has been to leave the cannula for 72 hours – change the intermittent lines after 24 hours and leave continuous lines for 72 hours. Is this acceptable?

Answer 8:

A recent systematic review has suggested that whilst the time *in situ* for a peripheral intravenous catheter (PIVC) is a known risk factor for developing thrombophlebitis, more clinical trials that provide stronger evidence are required in relation to elective replacement of PIVC.¹ Until such studies are undertaken, it was decided to recommend removing/replacing PIVC every 48 hours (unless removal at 72 hours is anticipated) due to the increased risk of phlebitis at 48 hours (10% to 18% risk of severe phlebitis) and by 72 hours (19% to 32%).² It is important to note, that the risk of phlebitis is also dependent on the patient (vulnerability to phlebitis), anatomic site, catheter size, personnel inserting the catheter, and the administration of highly phlebotogenic admixtures.^{1,2,3}

Whilst it is recognised there are cost savings if replacing the catheter and administration set simultaneously (i.e. at 72 hours), it is suggested that you ascertain the incidence of thrombophlebitis in PIVC with a dwell time of 72 hours and if within the range of 5% or less (as well as a low PIVC-related BSI rate), it would be acceptable to continue with your current recommendation. It is important to remind staff that PIVC may require more frequent changes if irritating medication(s) are being administered. PIVC should be inspected regularly for signs of complications including monitoring the former cannulation site for 48 hours after removal.

References:

1. Idvall E, Gunningberg L. Evidence for elective replacement of peripheral intravenous catheter to prevent thrombophlebitis: a systematic review. *Journal of Advanced Nursing* 2006; 55(6): 715-722.
2. Maki D, Ringer M. Risk Factors for Infusion-related Phlebitis with Small Peripheral Venous Catheters. A Randomized Controlled Trial. *Annals of Internal Medicine* 1991; 114: 845-854.
3. White S. Peripheral Intravenous Therapy-Related Phlebitis Rates in an Adult Population. *Journal of Intravenous Nursing* 2001; 24(1): 19-24.

Question 9:

In the CHRISP recommendation it does not suggest what is the best method for placing the dressing (Tegaderm) on a PIVC site. I have had two staff ask where they should place the Tegaderm, just over the cannula or covering the junction on the cannula and bung. Are CHRISP recommending a method?

Answer 9:

A short-extension set should be used routinely with all PIVC to reduce complications associated with catheter movement (refer [Recommended Practices for PIVC](#)). The dressing should be placed over where the extension set is attached to the catheter hub as this secures it more effectively. The extension set is considered part of the PIVC when attached at the time of insertion and can remain *in situ* for the dwell time of the catheter.

Question 10:

The CHRISP Guidelines recommend using sterile gauze dressing only if there is a true contraindication to using transparent semi-permeable membrane (TSM) dressing on Central Venous Catheter (Including Peripherally Inserted Central Catheter) exit sites. The literature recommends the use of both dressings as suitable. Is this acceptable?

Answer 10:

This advice can be applied to: Percutaneous Central Venous Catheters and Peripherally Inserted Central Catheters:

There is currently no recommendation for the optimum dressing and frequency of change for central venous catheters. Until further evidence is available, the following dressings are recommended however, patient as well as environmental factors should be considered when selecting the most appropriate dressing:

- Transparent, semi-permeable, self-adhesive, (standard or hyperpermeable), polyurethane dressings (e.g. Smith & Nephew Opsite IV 3000™, 3M™ Tegaderm IV™). Benefits include protecting the site from extrinsic contamination, allowing continuous observation of the insertion site, and helping stabilise and secure the catheter.
 - Inspect the dressing on the exit site regularly AND replace semi-permeable dressings on insertion site according to manufacturer's recommendations OR every 7 days (if hyperpermeable) AND when the dressing becomes damp, loosened, no longer occlusive or adherent, soiled, if there is evidence of inflammation, or excessive accumulation of fluid (especially blood) under the dressing.
- Sterile gauze dressings secured with adhesive tape or semi-permeable dressing. Benefits include better adhesion on some patients, improved absorbency and helping secure the catheter.
 - Gauze dressings must be replaced every 24 hours (to allow daily site exit site observation) AND when the dressing becomes damp, loosened, no longer adherent, etc.
- If gauze is used in combination with a semi-permeable dressing, it is considered a gauze dressing and should be changed accordingly.

Question 11:

Use 0.9% Sodium Chloride NOT Heparinised Saline for Flushing and Locking IV Catheters.

Answer 11:

Heparin for flushing of catheter lumens is no more beneficial than flushing with normal saline alone.

The recommendation of CHRISP is that sterile 0.9% sodium chloride for injection be used to flush and lock catheter lumens with the exception of totally implantable central venous access ports and haemodialysis catheters or if the manufacturer recommends catheter lumens be locked with an alternate solution.

Maintaining catheter patency is an important measure for all types of vascular access devices and is usually achieved through a combination of flushing and locking of the device. Flushing prevents mixing of incompatible medications or solutions and/or cleans the catheter lumen of blood or fibrin build-up. Locking prevents blood from backing up the catheter lumen when the device is not in use.¹

Heparinised saline has been used primarily due to the antithrombotic properties of heparin however, the efficacy of this practice is unproven. Additionally, complications such as heparin-induced thrombocytopenia (HIT), altered coagulation studies and bleeding have been reported, particularly if other general anticoagulant therapy is administered. Heparin is also incompatible with certain substances in solution e.g. gentamicin sulphate.

From a clinical perspective:

- The literature suggests the volume of flush or lock equal at least twice the volume of the catheter plus add-on devices (if used) – therefore 2-3mL is usually sufficient.
- The most important part of flushing and/or locking the catheter is the mechanical action of the procedure itself, designed to prevent backflow of blood into the catheter tip i.e. 'pulsatile' and 'positive pressure' flushing techniques.
- Some CVCs integrate valve technology which restricts blood backflow and air embolism by remaining closed when not in use therefore eliminating the need for heparin flushing to maintain patency

Reference:

1. Canada. Registered Nurses Association of Ontario. Nursing Best Practice Guideline. Care and Maintenance to Reduce Vascular Access Complications. [online] April 2005 [cited 13 September 2007]. Available from: http://www.rnao.org/Storage/11/570_BPG_Reduce_Vascular_Access_Complications.pdf (Internet Access Required)

Question 12:

Does PICC thrombosis occur more often in organ transplant patients?

Answer 12:

There is limited literature in relation to PICC use in organ transplant patients, most papers referred to stem cell or bone marrow transplant recipients. One paper (Tokars et al, 1999) evaluated risk factors for bloodstream infection (BSI) in 827 patients receiving home infusion therapy of which 11% had received a bone marrow or solid organ transplant. Saline and heparin were used as the flush solution (no other detail though) , however other complications were not included in the study. Another paper by Ng et al (1997), reported the success rate and complications associated with PICC including the applicability of PICCs in "high-risk" groups which included 52 multiorgan transplant patients (total 69 successful cannulations). Forty-five successfully completed their course, 6

died, 0 clotted, and 2 developed thrombus (overall, 25 PICC clotted and 15 developed thrombus). References 3 & 4 describe complications of PICC lines in oncology patients with solid tumours. The study, although small, identified a high rate of major complications (overall complication rate: 40.7 %; sepsis and thrombosis: 25%) compared with non-oncology patients (sepsis and thrombosis: 9%). Subsequent to this study, several changes were made to PICC management guidelines and the overall complication rate decreased significantly to 15.9%, however the non-infective complication rate did not change (heparin saline was used for flushing and locking PICCs; no changes were made to prophylactic anticoagulation as part of the interventions).

References:

- (1) Tokars J, Cookson S, McArthur M, Boyer C, McGreer A, Jarvis W. Prospective Evaluation of Risk Factors for Bloodstream Infection in Patients Receiving Home Infusion Therapy. *Annals of Internal Medicine* 1999; 131(5): 340-347.
- (2) Ng P, Ault M, Ellrodt A, Maldonado L. Peripherally Inserted Central Catheters in General Medicine. *Mayo Clin Proc* 1997; 72(3): 225-233.
- (3) Cheong K, Perry D, Karapetis C, Koczwara B. High rate of complications associated with peripherally inserted central venous catheters in patients with solid tumours. *Internal Medicine Journal* 2004; 34: 234-238.
- (4) Yap Y, Karapetis C, Lerosé S, Iyer S, Koczwara B. Reducing the risk of peripherally inserted central catheter line complications in the oncology setting. *European Journal of Cancer Care* 2006; 15: 342-347.
- (5) American Society of Health-System Pharmacists. ASHP Therapeutic Position Statement on the Institutional Use of 0.9% Sodium Chloride Injection to Maintain Patency of Peripheral Indwelling Intermittent Infusion Devices. *Am J Health-Syst Pharm* 2006; 63: 1273-5.
- (6) Pratt R, Pellowe C, Wilson J, Loveday H, Harper P, Jones S, et al. epic2 National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England. *Journal of Hospital Infection* 2007; 65S: S1-S64. Available from: <http://www.epic.tvu.ac.uk/>