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Best-evidenced practice for minimising catheter-related bloodstream infections:

skin antisepsis and flushing of vascular access devices

Contents

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Foreword

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Most patients in hospital will have some form of intravenous (IV) catheter in situ to facilitate the administration of IV therapy (Helm et al, 2015). Although relatively easy to insert and care for, vascular access devices (VADs) do not come without risks, and catheter-related bloodstream infections (CRBSIs) account for up to 20% of healthcare-associated infections (National Biofilms Innovation Centre, 2022). CRBSIs are a significant cause of morbidity and mortality, and this is reflected in increased length of patient stay in hospital and a high economic burden, with an approximate annual cost to NHS hospitals of over £2.7 billion (Clare and Rowley, 2021). However, many CRBSIs can be considered preventable (Clare and Rowley, 2021), and it is widely accepted that the use and implementation of evidence-based best-practice strategies within healthcare organisations can contribute to the reduction of avoidable CRBSIs.

Clinically effective infection prevention and control are essential features of patient protection. Therefore, practitioners need to understand how adhering to evidence-based best practice can improve patient care and reduce the number of preventable infections related to vascular access. Nationally and internationally, comprehensive evidence-based recommendations for preventing CRBSIs and other healthcare-associated infections (HCAIs) are available in the form of the epic3 guidelines (Loveday et al, 2014); Standards for Infusion Therapy (Royal College of Nursing, 2016) and Infusion Therapy Standards of Practice (Gorski et al, 2021).

The key pillars of best practice for minimising CRBSIs are hand hygiene, asepsis (including skin antisepsis) and VAD care and maintenance. As part of this, the evidence-based guidelines recommend the following:

- Antisepsis (decontamination/preparation) with 2% chlorhexidine gluconate in 70% isopropyl alcohol, applied with friction and allowed to air dry as part of the skin preparation for insertion and maintenance of VADs
- Regular flushing of VADs with 0.9% sodium chloride following a pulsatile (push-pause) technique, as an effective method to prevent CRBSIs caused by biofilm formation
- Strict adherence to aseptic technique.

Aseptic technique remains among the most common and important clinical competencies for healthcare practitioners. However, standardisation of terms and practices, such as implementing the Aseptic Non Touch Technique (ANTT) Clinical Practice Framework, can help to reduce variation in practice standards and improve staff adherence (Clare and Rowley, 2021).

The following article will explore how incorporating evidence-based best-practice guidelines into local policies and routine clinical practice can enhance patient safety and minimise the risk of patients acquiring an CRBSI during an episode of care.

References

Clare S, Rowley S. Best practice skin antisepsis for insertion of peripheral catheters. Br J Nurs. 2021;30(1):8–14. https://doi.org/10.12968/bjon.2021.30.1.8

Gorski LA, Hadaway L, Hagle M et al. Infusion therapy standards of practice. J Infus Nurs. 2021;44(S1):S1–S224. https://doi.org/10.1097/NAN.0000000000000396

Helm RE, Klausner JD, Klemperer JD, Flint L, Huang E. Accepted but unacceptable. J Infus Nurs. 2015;38(3):189-203. https://doi.org/10.1097/NAN.0000000000000100

Loveday HP, Wilson JA, Pratt RJ et al. epic3: National evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. J Hosp Infect. 2014;86(1): S1–S70. https://doi.org/10.1016/S0195-6701(13)60012-2

National Biofilms Innovation Centre. Reducing biofilm formation. 2022. https://tinyurl.com/3c3jskpc (accessed 5 June 2022)

Royal College of Nursing. Standards for infusion therapy. 4th edn. 2016. www.rcn.org.uk/clinical-topics/Infection-prevention-and-control/Standards-for-infusion-therapy (accessed 26 September 2022)

Preventing intravenous catheter-related bloodstream infections (CRBSIs)

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Healthcare-associated infections (HCAIs) are a cause of preventable harm that presents both a clinical and an economic burden in the UK and around the world. In the UK, it has been estimated that more than 80% of HCAIs are not present on hospital admission and, therefore, occur during a patient's stay in hospital (European Centre for Disease Prevention and Control, 2013). In the US, up to 90% of patients admitted to hospital have an intravenous (IV) catheter inserted (Helm et al, 2015), often via a peripheral or central vein (NHS Clinical Evaluation Team, 2018). Patient care often requires insertion of an IV device, whether to administer fluids, parenteral nutrition or blood products or to monitor progress. However, vascular access via these routes is one of the main causes of healthcare-associated bloodstream infections (HCAIs). According to what the author believes to be the most recently available data, about 40% of bloodstream infections in Europe are attributable to the use of IV catheters (European Centre for Disease Prevention and Control, 2013), and it can only be imagined how this may have risen since, given the development of the COVID-19 pandemic over the past few years.

This article outlines some of the literature surrounding catheter-related bloodstream infections (CRBSIs), delves into their clinical challenges and demonstrates their burden on national economic health. It then explores how to achieve good clinical outcomes using national and international guidance and evidence-based practice for the care and maintenance of vascular access devices (VADs). Existing literature focuses on some of the relevant aspects of this issue separately. This article brings these fragments together to present a clearer picture of the situation and lay out a number of solutions to prevent CRBSIs.

Current burden

In 2016–2017, there were an estimated 834 000 HCAIs in English hospitals alone, which was not only a figure close to treble that previously reported by the National Institute for Health and Care Excellence (NICE) (Guest et al, 2020), but also one that led to 28 500 patient deaths and the use of 7.1 million hospital bed days in the same 2016–2017 period (Guest et al, 2020). According to the most recent data for England, CRBSIs account for about 10–20% of HCAIs in the UK (National Biofilms Innovation Centre, 2022), and up to 70% are considered preventable (Clare and Rowley, 2021).

Specific examples of progress include a 2-year programme to reduce infection rates related to central venous access in intensive care, reported by Bion et al (2013). However, since 2020, while official government data have been lacking, anecdotal evidence indicates that some hospitals have noted a rise in CRBSIs, as resources have been sparse, and the use of IV therapy and vascular access devices (VADs) have played a central role in treating patients with COVID-19 (Barton, 2022).

Morbidity and mortality

CRBSIs are a significant cause of morbidity, mortality and increased length of stay in hospital, particularly in the intensive care unit (ICU) (Olaechea et al, 2013; Ferroni et al, 2014).

An older systematic review of 39 studies published between 1984 and 2012 across 14 geographical regions around the world placed the overall CRBSI rate between 0.38 and 4.58 per 1000 catheter days (Dreesen et al, 2013). More recent data specific to the UK place the CRBSI rate on the lower end of this range, at 0.38 episodes per 1000 catheter days (Bond et al, 2022). In 2009, a review performed on available data of intensive care units in four European countries (UK, France, Italy and Germany) estimated between 8400 and 14400 CRBSI episodes per year (Tacconelli et al, 2009), while, in the US, about 250 000 bloodstream infections are acquired every year, reported to be the third leading cause of hospital-acquired infection (Gahlot et al, 2014).

While researchers widely agree on the impact of CRBSIs on mortality, statements regarding this appear widely unreferenced across the literature, although a recent review in the UK reported 0.01 CRBSI deaths per 1000 catheter days (Bond et al, 2022). Across Europe, mortality ranges from 1000 to 1584 deaths per year (Tacconelli et al, 2009), with attributable mortality in Spain, for example, estimated to be 9.4% (Olaechea et al, 2013). In 2004, Wisplinghoff et al (2004) found that, over a 7-year observation period, the crude mortality rate of blood stream infections was 27%.

Economic burden

HCAIs are estimated to cost the NHS in England about £2.7 billion per year (Clare and Rowley, 2021). For a European example, the cost of CRBSIs in Italy varies greatly (€4080—€14 800 per patient) but averages at €5575 (Mandolfo et al, 2019). In the US,

CRBSIs cost more than 2 billion a year, based on an average cost of care of $45 000 per patient (Rupp and Karnatak, 2018).

Sources of contamination

A CRBSI is defined as the presence of bacteraemia originating from an intravenous catheter (Gahlot et al, 2014). Several sources of contamination can lead to a CRBSI. According to epic3 guidelines, the source of most CRBSIs are the microorganisms that colonise catheter hubs, as well as the skin adjacent to the insertion site (Loveday et al, 2014).

Central venous catheters (CVCs)—also referred to as central venous access devices (CVADs)—in particular pose a greater risk infection than any other medical device, and they are known as the main source of bacteraemia and septicaemia in hospitalised patients (Gahlot et al, 2014). For example, the relative risk for CRBSI is up to 64 times greater with CVCs than with peripheral venous catheters (PVCs) (Gahlot et al, 2014). The most likely primary source of CVC-related infection depends on how long the device is in situ: in short-term use (less than 10 days) this is colonisation by cutaneous organisms along the external surface of the catheter, while in long-term use (more than 10 days) it is intraluminal spread from the hub (Gahlot et al, 2014).

The tip of the catheter and cutaneous tract may be colonised with skin flora, or the lumen may be colonised because of being extrinsically contaminated prior to insertion. Less commonly, the internal surface of the lumen may also be contaminated either because of contaminated infusate or medication or because of haematogenous seeding from another more distant infected site (Gahlot et al, 2014). Common endogenous infectious agents include the patient not washing their hands following toileting or touching their skin and then touching the IV site or hub (Lavery, 2010). Exogenous infectious agents that are relatively common include transfer from the hands of a healthcare practitioner, highlighting the importance of hand hygiene (*Box 1*), or contact with other patients (Lavery, 2010). However, according to Gahlot et al (2014), 60% of CRBSIs were caused by microorganisms from the patient's skin itself.

Box 1. Best practice for hand hygiene before and after contact with catheter or insertion site

- Wash hands with non-antimicrobial liquid soap and water when:
  - Hands are visibly soiled or dirty
  - Potentially contaminated with blood or body fluids
  - Caring for patients with vomiting or diarrhoeal illnesses
  - Caring for a patient with a suspected or known gastrointestinal infection, e.g. norovirus or a spore-forming organism (such as *Clostridioides difficile*)
- In all other cases and for routine hand hygiene during care, use alcohol-based hand rubs (which should be available for staff as near to point of care as possible)

Source: Loveday et al (2014)

Common microorganisms that reside on the skin (and may be transferred from either the patient or the health professional's hands) include *Staphylococcus epidermidis* and *Staphylococcus aureus* (Lavery, 2010). *Enterococcus* spp, *Pseudomonas* spp, *Serratia* spp and *Enterobactor* spp may also originate in the bowel flora and be transferred via the patient's hands or equipment (Lavery, 2010). However, according to epic3 guidelines, coagulase-negative staphylococci, mainly *S. epidermidis*, are the most common causes of CRBSI, followed by other microorganisms such as *S. aureus*, *Candida* spp and *enterococci* (Loveday et al, 2014).

In addition, biofilm forms a slimy coating around the lumen, to which bacteria can then easily adhere, entering the bloodstream from the point of the VAD insertion through the skin or contaminated parts of the catheter (Caguioa et al, 2012). Resistance to antibiotic therapy due to biofilm formation also has an important role in development of bacteraemia (Gahlot et al, 2014).

Best practice strategies

Hand hygiene

Hand hygiene has been confirmed to be an important factor in infection prevention (World Health Organization (WHO), 2009), while also being the easiest. Best practice for hand hygiene is summarised in *Box 1*. Once hands are decontaminated, clean and non-sterile gloves must be worn before coming into contact with the catheter or closed system (Loveday et al, 2014).

Aseptic Non Touch Technique

The Aseptic Non Touch Technique (ANTT) Clinical Practice Framework (*Figure 1*) was developed in response to a lack of standardisation of a safe aseptic technique and a common language for education, research and clinical practice, resulting in variability in practice standards and concerns for patient safety (Rowley and Clare, 2020; ANTT, 2021).

ANTT is recognised as best practice for vascular access by NICE (2012), the Association for Vascular Access (Rowley and Clare, 2019) and the Infusion Nursing Society (Gorski et al, 2021). It is one of the most commonly performed infection prevention strategies, used by 88% of NHS Trusts in England as their single standard aseptic technique (Rowley and Clare, 2020).

ANTT is intended for use with any invasive procedure that involves risk of infection to the patient. The aim is to always maintain asepsis, and this is achieved through a concept termed Key-Part and Key-Site Protection. This involves the integration of standard precautions, sterile supplies, non-touch technique and aseptic fields, as well as following the principal practice rule that Key-Parts must only come into contact with other aseptic Key-Parts and Key-Sites (ANTT, 2021).

Skin antisepsis of insertion site

Importantly, disinfection of the skin prior to invasive medical procedures can serve as an effective measure for the prevention

	Surgical-ANTT	Standard-ANTT
1. ANTT risk assessment		
2. Environmental management	■ Environmental risks removed or avoided ■ Working areas/surfaces disinfected ■ Staff activity strictly controlled	■ Environmental risks removed or avoided ■ Work surfaces cleaned or disinfected
3. Decontamination and protection	■ Hand cleaning or surgical hand scrub ■ Sterilised gloves worn ■ Suitable mouth/eye protection ■ Sterilised gown, if full barrier precautions ■ Scrubbing of intravenous hubs, etc	■ Hand cleaning ■ Typically, non-sterilised gloves worn; sterilised gloves worn if Key-Parts or Key-Sites must be touched ■ Personal protective equipment (PPE) worn ■ Scrubbing of intravenous hubs, etc
4. Aseptic field selection and management	■ Critical Aseptic Field (sterilised drapes) ■ Key-Parts are protected within a large Critical Aseptic Field ■ Only sterilised equipment can be placed in a Critical Aseptic Field; sterilised gloves are required to maintain asepsis (the main aseptic field is managed critically)	■ Micro Critical Aseptic Fields (caps, covers etc) ■ Key-Parts protected with Micro Critical Aseptic Fields contained in General Aseptic Field (disinfected or disposable tray) ■ With Key-Parts protected by Micro Critical Aseptic Field, essential but non-sterilised equipment may be placed in the General Aseptic Field (managed generally)
5. Non-touch technique	■ Non-touch technique is desirable ■ Even when wearing sterile gloves, Key-Parts and Key-Sites are not touched unless necessary to do so	■ Non-touch technique is essential
6. Preventing cross infection	■ Prevent cross infection	■ Prevent cross infection

Figure 1. Aseptic Non Touch Technique (ANTT) practice development framework (used with permission from Stephen Rowley, ANTT)

of microbial contamination. In fact, as the risk of infection is known to increase with the density of the microorganisms around the insertion site, antisepsis (decontamination/preparation) of the insertion site is among the most important measures in preventing CRBSI (Loveday et al, 2014; Gorski et al, 2021).

The epic3 guidelines recommend precautions during catheter insertion (Loveday et al, 2014). The access site should be decontaminated with 2% chlorhexidine gluconate in 70% alcohol (or povidone iondine in cases of sensitivity) applied with friction and allowed to air dry (Loveday et al, 2014).

A cross-hatching back-and-forth technique has been shown to be 10-times more effective at reducing bacterial load than a circlular approach (McDonald et al, 2001). It enables maximum contact between the skin and antiseptic preparation, encouraging the solution to make its way to the skin's deeper cell layers (Silva, 2014).

Maintenance of vascular access devices

Appropriate care and maintenance of VADs are essential for preventing CRBSIs, because components such as the hub and lumen can harbour sources of infection. Infection risk can be minimised through use of ANTT (Lee and Terry, 2021). Other important principles of care include maintaining a closed IV system with minimal connections, maintaining the patency and correct positioning of the catheter, and preventing damage to the device and associated equipment (Lee and Terry, 2021).

When bacteria manage to adhere to the surface of the catheter, this can facilitate the formation and growth of attached bacterial communities called biofilms (National Biofilms Innovation Centre, 2022). Bacterial biofilms lead to survival advantages, such as potential virulence, pathogenesis of infection and resistance to antibiotics; the persistence of staphylococcal infections is an example of this (Høiby et al, 2011; Brandwein et al, 2016). The flushing of IV catheters following a push-pause (pulsatile) flushing technique is an effective method in reducing catheter bacterial colonisation to prevent CRBSIs (Ferroni et al, 2014).

The skin's microbiome also plays a role in bacterial infection and impacts the way a biofilm community behaves (Percival et al, 2012). For example, moist skin harbours different bacterial species than does dry skin; therefore, a specific bacteria's ability to exploit the skin's barrier is partially dependent on its microbiota (Brandwein et al, 2016). Cleaning the exit site with 2% chlorhexidine in 70% alcohol and allowing to air dry on a regular basis and the use of a sterile, transparent semi-permeable polyurethane dressing to cover the intravascular insertion site (changed every 7 days or sooner if needed with the use of ANTT and skin asepsis) can help minimising CRBSI originated at insertion site, as they provide a barrier to external contaminants (while still allowing moisture vapour and skin breathability) (Loveday et al, 2014).

Care bundles approach

The care bundle approach consists of implementing a group of individual evidence-based best practice interventions for a variety of clinical purposes, including infection prevention. Care bundles for intravascular devices would aim to reduce the number of IV devices in situ and prevent infections in those devices that are needed. However, implementation of care bundles requires careful multidisciplinary team planning and consensus.

As the name suggests, care 'bundles' should never be broken up and used in an ad-hoc way. They are created intentionally to be used together to improve patient outcomes using a standardised approach based on robust evidence and guidelines, such as epic3 and INS 2021 (Loveday et al, 2014; Gorski et al, 2021). The use of care bundles helps healthcare professionals to standardise best evidenced practice while reducing variability or guesswork in the provision of care (Clare and Rowley, 2021).

An example of a successful care bundle for vascular access was the HANDS quality improvement project carried out at King's College Hospital NHS Foundation Trust (Caguioa et al, 2012). The HANDS mnemonic used as part of this Trust-wide initiative stands is expanded in *Box 2*.

Box 2. HANDS

H	Hand hygiene
A	Antisepsis (using 2% chlorhexidine gluconate in 70% isopropyl alcohol)
N	Non-touch technique
D	Date on a clear IV film dressing, daily inspections and documentation
S	Scrubbing the hub for 15 seconds, allowing it to dry

Another initiative that has been successfully applied to IV management is the Department of Health and Social Care's high-impact interventions from the Saving Lives programme, which was launched to help healthcare organisations ensure that robust infection-prevention measures are embedded across their acute trusts (Aziz, 2009; Coghill, 2009). In particular, high-impact intervention number 1 is the central venous catheter bundle (DHSC, 2007a). High-impact intervention number 2 is the peripheral IV cannula care bundle (DHSC, 2007b), which has been shown to improve peripheral IV cannula care, resulting in reduced rates of meticillin-resistant *Staphylococcus aureus* (MRSA) bacteraemia rates (Aziz, 2009). The actions outlined in these care bundles are concerned with insertion and ongoing care. Insertion actions cover aspects such as catheter type and insertion site, hand hygiene, personal protective equipment, skin preparation, dressing choice, safe disposal of sharps and appropriate documentation (DHSC, 2007a; 2007b). Ongoing care actions include appropriate hand hygiene procedure before and after every patient contact; ensuring intravenous devices are still clinically indicated; at least daily inspection of the catheter site for signs of infection; use of an intact, dry, adherent transparent dressing; use of aseptic technique during catheter access; administration set replacement at appropriate intervals (i.e., blood products immediately, parenteral nutrition after 24 hours, others after 72 hours); and appropriate rather than routine catheter replacement (DHSC, 2007a; 2007b). Each action in the bundle is important, but infection reduction occurs when all actions are performed every time for every patient.

Reducing vascular access device infection by best-evidenced practices

Some additional best practices for reducing VAD infection, facilitating catheter maintenance and, therefore, improving clinical outcomes include the following:

- Using a VAD with the minimum number of ports or lumens needed for the care of the patient (Loveday et al, 2014)
- Using a designated single-lumen catheter to administer lipid-based solutions (Loveday et al, 2014)
- Consideration of a chlorhexidine-impregnated sponge dressing (Loveday et al, 2014)
- Consideration of daily cleansing with chlorhexidine in adult patients with a CVC (Loveday et al, 2014)
- Correct positioning and securement of IV cannulas to reduce risk of mechanical phlebitis or infection (Higginson, 2015).

Skin antisepsis with a single-use applicator or wipes

The epic3 guidelines advise decontamination of the skin at the insertion site with a single-use application of 2% chlorhexidine gluconate in 70% isopropyl alcohol (or povidone iodine in alcohol

for patients with sensitivity to chlorhexidine) (Loveday et al, 2014). While fibre-based wipes impregnated with chlorhexidine/isopropyl alcohol solution can be used with effective non-touch technique, they bring the health professional's fingers closer to a Key-Site and introduce more vulnerability to human factors. They also increase variability in terms of the volume of solution each wipe contains, the way that they are held (e.g., folded, open or scrunched up) and interpretations of method of use (Clare and Rowley, 2021). To date, BD ChloraPrep™ single-use applicators (*Figure 2*) are the only applicator-shaped product licensed to use for this purpose by the Medicines and Healthcare products Regulatory Agency (MHRA) (Clare and Rowley, 2021).

Flushing and locking

Best-evidenced practice advocates flushing of the device after any IV drug administration (to prevent any mixing of incompatible medicines or solutions) and at regular intervals to promote and maintain patency (Ferroni et al, 2014). An IV flush is administered normally with 0.9% sodium chloride. The correct techniques of pulsatile flush and positive pressure disconnection should be used (Royal College of Nursing (RCN), 2016; Gorski et al, 2021). Peripheral IV cannulas must be removed or effectively flushed at the end of an IV procedure, particularly where anaesthetic or sedative drugs have been administered and between each new drug (NHS England, 2017). Otherwise, residue of these drugs can later be introduced to the patient's circulation and cause muscle paralysis, unconsciousness and respiratory and cardiac arrest (NHS England, 2017).

Flushing and locking are strongly associated with intraluminal occlusion following build-up of fibrin and/or infusion fluid deposits or a mixture of incompatible medications and solutions (Goossens, 2015). Regarding the appropriate lock solution for occlusion prevention, the Italian group for VADs (GAVeCeLT) highlights that this is based on proper flushing technique and locking with saline. For infection prevention, lock solution should include substances with antibacterial and antibiofilm activity, such as citrate and/or taurolidine, and, furthermore, evidence does not support the use of the heparin lock in non-dialysis catheters (Pittiruti et al, 2016).

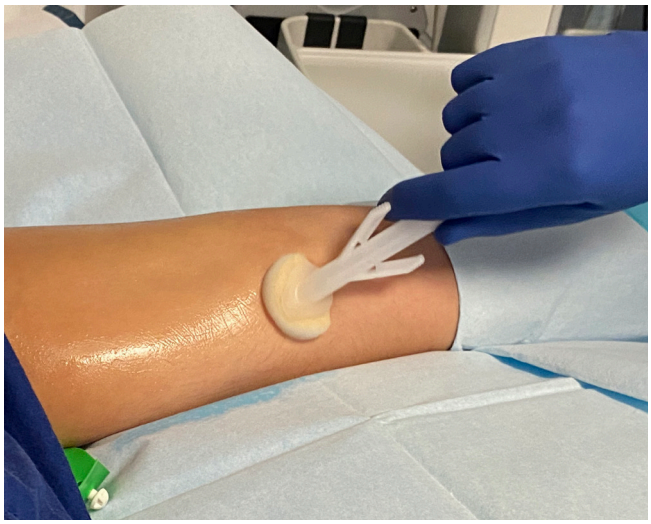
Appropriate flushing with the correct solution and technique also helps to remove potential nesting material for microorganisms and can reduce the risk of chemical phlebitis (Ferroni et al, 2014). This is pertinent, because phlebitis has been cited to be the most common IV complication, occurring in up to 96% of patients, according to data from 1985 (Niël-Weise et al, 2010).

However, Hadaway (2006) made the important point that correct technique is only a part of the puzzle, with the technology of catheter flushing also playing an essential role. The flush solution, along with the source of the solution and the design of the syringe, mechanical pumps, needle-free injection systems and catheter, combine with appropriate technique to achieve effective catheter flushing (Hadaway, 2006). The use of syringes with at least a 10 ml are recommended for long-term CVCs, as well as in cases where catheters and ports are not designed to withstand the high pressure of power injection (Goossens, 2015). Guidelines recommend a flushing volume of at least twice that of the catheter and add-on devices, but a flush volume of 20 ml is recommended after an infusion of more viscous products, such as blood components (Goossens, 2015).

Pre-filled syringes

Pre-filled 0.9% sodium chloride syringes may provide a cost-effective, time-efficient and more standardised alternative to manually drawing up a syringe for flushing, as demonstrated in an assessment of paediatric intensive care (Ceylan et al, 2021). They produce less waste and reduce the risk of needlestick injuries and contamination, as well as the risks of labelling confusion and potential errors, which may lead to patient harm. Using separate products to prepare an IV flush increases the number of steps, products and sometimes people involved and, thus, increases the risk of human error (Lee and Terry, 2021). Pre-filled syringes are registered as medical devices. However, the use of a saline ampule to flush a device is categorised as prescription only medicine. Therefore, moving from manually flushing to using a pre-filled syringe simplifies the overall process by negating the need for a prescription.

Lee and Terry (2021) described how, when manually drawing up an IV flush, each ampoule of sodium chloride 0.9% is classified as a prescription only medication (PoM) and requires a separate prescription, patient-specific direction or patient group directive. A pre-filled syringe is not defined or classified as a medicine but as a CE-marked medical device. Medical devices are classified into four classes according to increasing levels of risk (MHRA, 2021a). In the UK, pre-filled syringes for the purpose of flushing



Gema Munoz-Mozas

Figure 2. BD ChloraPrep™ single-use applicator

a medical device, such as a catheter or a port, are class II or class III (MHRA, 2021b). Unlike other pre-filled saline syringes that are classified as class IIa CE devices, BD PosiFlush™ Pre-Filled Syringes are classified as class III medical devices, meeting more-stringent mandatory requirements (Official Journal of the European Union, 2017).

Conclusion

The placing of IV catheters is integral to patient care. However, it is not without risks, and every precaution should be taken to reduce and prevent the occurrence of CRBSIs. Hand hygiene, aseptic technique and full-barrier precautions (where and when necessary) should always be used. The skin should be properly disinfected prior to insertion, and the catheter should be appropriately secured, monitored and maintained following evidence-based practice guidelines. Unnecessary catheters should be removed (or not placed to begin with). Quality improvement interventions can support the management of CVCs and PVCs to ensure correct maintenance and timely removal (Loveday et al, 2014). Regular education and assessment of health professionals in their competence and regular adherence to CRBSI prevention best-evidenced practices are also paramount to achieving reduced infection and good patient outcomes.

References

Aseptic Non Touch Technique. ANTT procedure guidelines: hospital & home care. 2021. www.antt.org/resources.html (accessed 6 October 2022)

Aziz A. Improving peripheral IV cannula care: implementing high-impact interventions. Br J Nurs. 2009;18(2):1242–1246. https://doi.org/10.12968/bjon.2009.18.20.45116

Badia-Cebada L, Peñafiel J, Saliba P et al. Trends in the epidemiology of catheter-related bloodstream infections; towards a paradigm shift, Spain, 2007 to 2019. Euro Surveill. 2022;27(19):2100610. https://doi.org/10.2807/1560-7917.ES.2022.27.19.2100610

Barton A. Resetting best practice in IV therapy and vascular access. Br J Nurs. 2022;31(2):S3. https://doi.org/10.12968/bjon.2022.31.2.S3

Bion J, Richardson A, Hibbert P et al. 'Matching Michigan': a 2-year stepped interventional programme to minimise central venous catheter-blood stream infections in intensive care units in England. BMJ Qual Saf. 2013;22(2):110–123. https://doi.org/10.1136/bmjqs-2012-001325

Bond A, Kopczynska M, Conley T et al. Long term survival following fungal catheter related blood stream infection for patients with intestinal failure receiving home parenteral support. J Parenter Enteral Nutr. 2022. https://doi.org/10.1002/jpen.2451

Brandwein M, Steinberg D, Meshner S. Microbial biofilms and the human microbiome. Npj Biofilms Microbiomes. 2016; 2(3). https://doi.org/10.1038/s41522-016-0004-z

Ceylan G, Topal S, Turgut N, Ozdamar N, Oruc Y, Agin H, Devrim I. Assessment of potential differences between pre-filled and manually prepared syringe use during vascular access device management in a pediatric intensive care unit. J Vasc Access. 2021:11297298211015500. https://doi.org/10.1177/11297298211015500

Clare S, Rowley S. Best practice skin antisepsis for insertion of peripheral catheters. Br J Nurs. 2021;30(1):8–14. https://doi.org/10.12968/bjon.2021.30.1.8

Coghill E. Using high-impact interventions to reduce infection risk by standardising good practice. Nurs Times. 2009;105(28)14–16

Department of Health and Social Care. High impact intervention no 1: central venous catheter care bundle. 2007a. https://tinyurl.com/mtt2274s (accessed 17 October 2022)

Department of Health and Social Care. High impact intervention no 2: peripheral intravenous cannula care bundle. 2007a. https://tinyurl.com/mr43xytk (accessed 17 October 2022)

Dreesen M, Foulon V, Spriet I et al. Epidemiology of catheter-related infections in adult patients receiving home parenteral nutrition: a systematic review. Clin Nutr. 2013;32(1):16–26. https://10.1016/j.clnu.2012.08.004

European Centre for Disease Prevention and Control. Surveillance report: point prevalence survey of healthcare-associated infections and antimicrobial use in European acute care hospitals 2011-2012. 2013. https://tinyurl.com/2p97kpvv (accessed 2 June 2022)

Ferroni A, Gaudin F, Guiffant G et al. Pulsative flushing as a strategy to prevent bacterial colonization of vascular access devices. Med Devices (Auckl). 2014;7:379–383. https://doi.org/10.2147/MDER.S71217

Goossens GA. Flushing and locking of venous catheters: available evidence and evidence deficit. Nurs Res Pract. 2015;2015:985686. https://doi.org/10.1155/2015/985686

Gorski LA, Hadaway L, Hagle M et al. Infusion therapy standards of practice. J Infus Nurs. 2021;44(S1):S1–S224. https://doi.org/10.1097/NAN.0000000000000396

Guest JF, Keating T, Gould D, Wigglesworth N. Modelling the annual NHS costs and outcomes attributable to healthcare-associated infections in England. BMJ Open. 2020;10:e033367. https://doi.org/10.1136/bmjopen-2019-033367

Hadaway L. Technology of flushing vascular access devices. J Infus Nurs. 2006;29(3):137–145. https://doi.org/10.1097/00129804-200605000-00003

Helm RE, Klausner JD, Klemperer JD, Flint L, Huang E. Accepted but unacceptable. J Infus Nurs. 2015;38(3):189–203. https://doi.org/10.1097/NAN.0000000000000100

Higginson R. IV cannula securement: protecting the patient from infection. Br J Nurs. 2015;24(Suppl 8):S23–S28. https://doi.org/10.12968/bjon.2015.24.Sup8.S23

Høiby N, Ciofu O, Johansen HK et al. The clinical impact of bacterial biofilms. Int J Oral Sci. 2011;3(2):55–65. https://doi.org/10.4248/IJOS11026

Lavery I. Infection control in IV therapy: a review of the chain of infection. Br J Nurs. 2010;19(Supp 9):S6–S14. https://doi.org/10.12968/bjon.2010.19.Sup9.79305

Lee PT, Terry J. Changing practice to using pre-filled syringes for flushing IV cannulas. Br J Nurs. 2021;30(14):S14–S22. https://doi.org/10.12968/bjon.2021.30.14.S14

Loveday HP, Wilson JA, Pratt RJ et al. epic3 : National evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. J Hosp Infect. 2014;86(1):S1–S70. https://doi.org/10.1016/S0195-6701(13)60012-2

Mandolfo S, Maggio M, Forneris G, Galli F. Cost analysis of haemodialysis catheter related bloodstream infection through the DRG system, on behalf of Project Group of Vascular Access of Italian Society of Nephrology [article in Italian]. G Ital Nefrol. 2019;36(1)

Medicines and Healthcare products Regulatory Agency. Regulating medical devices in the UK. 2020. https://tinyurl.com/bddu6jet (accessed 2 June 2022)

Medicines and Healthcare products Regulatory Agency. Chapter 2: classification. Section 5 – Classification of general medical devices. 2021a. https://tinyurl.com/4w45v2yj (accessed 2 June 2022)

Medicines and Healthcare products Regulatory Agency. Borderlines between medical devices and medicinal products in Great Britain. 2021b. https://tinyurl.com/2jbdk8r8 (accessed 14 June 2022)

National Biofilms Innovation Centre. Reducing biofilm formation. 2022. https://tinyurl.com/3c3jskpc (accessed 6 October 2022)

NHS England. Confirming removal or flushing of lines and cannuale after procedures. 2017. https://tinyurl.com/2p9u3adh (accessed 6 October 2022)

National Institute for Health and Care Excellence. Healthcare associated infections: prevention and control in primary and community care (updated 2017). 2012. https://www.nice.org.uk/guidance/cg139 (accessed 6 October 2022)

Niël-Weise BS, Stijnen T, van den Broek PJ. Should in-line filters be used in peripheral intravenous catheters to prevent infusion-related phlebitis? A systematic review of randomized trials. Anesth Analg. 2010;110(6):1624–1629. https://doi.org/10.1213/ANE.0b013e3181da8342

NHS Clinical Evaluation Team. Clinical review: safety peripheral intravenous cannula. 2018. https://tinyurl.com/muzuv2yx (accessed 6 October 2022)

NHS England. National infection prevention and control for manual England. 2022. https://tinyurl.com/2p89ewbu (accessed 6 October 2022)

Official Journal of the European Union. Regulation (EU) 2017/745 of the European Parliament and of the Council of 5 April 2017 on medical devices. 2017. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R0745&from=EN (accessed 7 March 2023)

Olaechea PM, Palomar M, Alvarez-Lerma F et al. Morbidity and mortality associated with primary and catheter-related bloodstream infections in critically ill patients. Rev Esp Quimioter. 2013;26(1):21–29

Pittiruti M, Bertoglio S, Scoppettuolo G et al. Evidence-based criteria for the choice and the clinical use of the most appropriate lock solutions for central venous catheters (excluding dialysis catheters): a GAVeCeLT consensus. J Vasc Access. 2016;17(6):453–464. https://doi.org/10.5301/jva.5000576

Rowley S, Clare S. Standardizing the critical clinical competency of aseptic, sterile, and clean techniques with a single international standard: Aseptic Non Touch Technique (ANTT®). JAVA. 2019;24(4)

Rowley S, Clare S. How widely has ANTT been adopted in NHS hospitals and community care organisations in England and Scotland. Br J Nurs. 2020;29(16):924–932. https://doi.org/ 10.12968/bjon.2020.29.16.924

Royal College of Nursing. Standards for infusion therapy. 4th edn. 2016. www.rcn.org.uk/clinical-topics/Infection-prevention-and-control/Standards-for-infusion-therapy (accessed 26 September 2022)

Rupp ME, Karnatak R. Intravascular catheter-related bloodstream infections. Infect Dis Clin N Am. 2018;32:765–787. https://doi.org/10.1016/j.idc.2018.06.002

Silva P. The right skin preparation technique: a literature review. J Perioper Pract. 2014; 24(12):283–285. https://doi.org/10.1177/175045891402401204

Tacconelli E, Smith G, Hieke K, Lafuma A, Bastide P. Epidemiology, medical outcomes and costs of catheter-related bloodstream infections in intensive care units of four European countries: literature – and registry-based estimates. J Hosp Infect. 2009;72(2):97–103. https://doi.org/10.1016/j.jhin.2008.12.012

Wisplinghoff H, Bischoff T, Tallent SM, Seifert H, Wenzel RP, Edmond MB. Nosocomial bloodstream infections in US hospitals: analysis of 24,179 cases from a prospective nationwide surveillance study. Clin Infect Dis. 2004;39(3):309–317. https://doi.org/10.1086/421946World Health Organization. WHO guidelines on hand hygiene in health care. 2009. www.who.int/publications/i/item/9789241597906

Case studies

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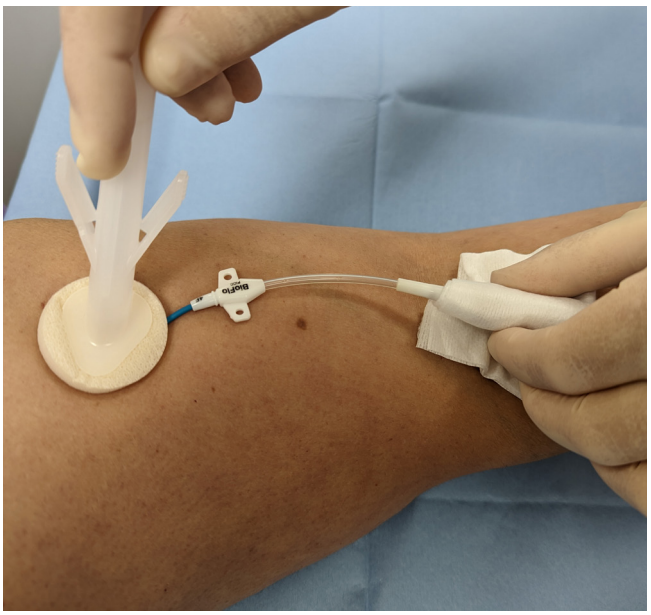
Intravenous (IV) access, both peripheral and central, is an integral part of the patient care pathways for diagnosing and treating cancer. Patients receiving systemic anticancer treatment (SACT) are at risk for developing infections, which may lead to hospitalisation, disruptions in treatment schedules and even death (Centers for Disease Control and Prevention, 2021). However, infection rates can be reduced and general patient outcomes improved with the evidence-based standardisation of IV practice, and the adoption of the appropriate equipment, such as peripheral IV cannulas, flushing solutions and sterile IV dressings (Easterlow et al, 2010).

Cancer treatment frequently involves the use of central venous catheters (CVCs)—also referred to as central venous access devices (CVADs)—which can represent a lifeline for patients when used to administer all kinds of IV medications, including chemotherapy, blood products and parenteral nutrition. They can also be used to obtain blood samples, which can improve the patient's quality of life by reducing the need for peripheral stabs from regular venepunctures (Taxbro and Chopra, 2021). CVCs are relatively easy to insert and care for; however, they are associated with potential complications throughout their insertion and maintenance.

One serious complication of CVC use is catheter-related bloodstream infections (CRBSIs), which can increase morbidity, leading to prolonged hospitalisation and critical use of hospital resources (Akhtar and Lee, 2021). Early-onset CRBSIs are commonly caused by skin pathogens, and so a cornerstone of a CRBSI prevention is skin antisepsis at the time of CVC insertion. Appropriate antisepsis (decontamination/preparation) of the site for CVC insertion can prevent the transmission of such skin pathogens during insertion, while reducing the burden of bacteria on the CVC exit site (Loveday et al, 2014).

Evidence-based practice for the prevention of a CRBSIs and other healthcare-associated infections recommends skin antisepsis prior to insertion of a vascular-access device (VAD) using a 2% chlorhexidine gluconate and 70% isopropyl alcohol solution. This is recommended in guidelines such as epic3 (Loveday et al, 2014), the Standards for Infusion Therapy (Royal College of Nursing, 2016) and the Infusion Therapy Standards of Practice (Gorski et al, 2021). A strong evidenced-backed product such as BD ChloraPrep™ (*Figure 1*) has a combination of 2% chlorhexidine gluconate in 70% isopropyl alcohol that provides broad-spectrum rapid-action antisepsis, while the applicators facilitate a sterile, single-use application that eliminates direct hand-to-patient contact, helping to reduce cross-contamination and maintaining sterile conditions (BD, 2021). The BD ChloraPrep™ applicator's circular head allows precise antisepsis of the required area, and the sponge head helps to apply gentle friction in back-and-forth motion to penetrate the skin layers (BD, 2021). BD ChloraPrep's rapid-acting, persistent and broad-spectrum characteristics and proven applicator system (Florman and Nichols, 2007) make it a vital part of the policy and protocol for insertion, care and maintenance of CVCs in specialist cancer centres such as the Royal Marsden. Meanwhile, the use of BD PosiFlush™ Prefilled Saline Syringe (*Figure 2*), a prefilled normal saline (0.9% sodium choride) syringe, is established practice for the flushing regime of VADs in many NHS Trusts.

The following five case studies present examples from personal experience of clinical practice that illustrate how and why clinicians in oncology and other disciplines use BD ChloraPrep™ and BD PosiFlush™ Prefilled Saline Syringe in both adult and paediatric patients.



Colin Fairhurst

Figure 1. BD ChloraPrep™

Case study 1 (Andy)

Gema Munoz-Mozas

Andy was a 65-year-old man being treated for metastatic colorectal cancer at the Royal Marsden NHS Foundation Trust specialist cancer service, which provides state-of-the-art treatment to over 60 000 patients each year.

Andy had a peripherally inserted central catheter (PICC) placed at the onset of his chemotherapy treatment to facilitate IV treatment. While in situ, PICCs require regular maintenance to minimise associated risks. This consists of a weekly dressing change to minimise infection and a weekly flush to maintain patency, if not in constant use. For ambulatory patients, weekly PICC maintenance can be carried out either in the hospital outpatient department or at home by a district nurse or family member trained to do so. Patients, relatives, carers and less-experienced nurses involved in PICC care (flushing and dressing) can watch a video on the Royal Marsden website as an aide memoir.

Initially, Andy decided to have his weekly PICC maintenance at the hospital's nurse-led clinic for the maintenance of CVCs. At the clinic, Andy's PICC dressing change and catheter flushing procedures were performed by a nursing associate (NA), who, having completed the relevant competences and undergone supervised practise, could carry out weekly catheter maintenance and access PICC for blood sampling.

In line with hospital policy, the PICC dressing change was performed under Aseptic Non Touch Technique (ANTT) using a dressing pack and sterile gloves. After removal of the old dressing, the skin around the entry site and the PICC was cleaned with a 3 ml BD ChloraPrep™ applicator, using back-and-forth strokes for 30 seconds and allowing the area to air dry completely before applying the new dressing. As clarified in a recent article on skin antisepsis (Clare and Rowley, 2020), BD ChloraPrep™ applicator facilitated a sterile, single-use application that eliminates direct hand-to-patient contact, which help reduce cross-contamination and maintaining ANTT. Its circular head allowed precise antisepsis around the catheter, and the sponge head helped to apply gentle friction in back-and-forth strokes to penetrate the skin layers.

Gema Munoz-Mozas

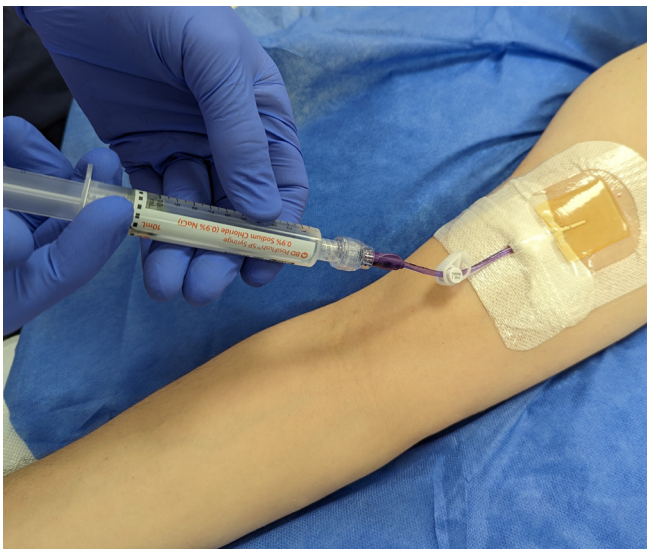


Figure 2. BD PosiFlush™ Prefilled Saline Syringe

Once the new dressing was applied, the NA continued to clean the catheter hub and change the needle-free connector. Finally, the catheter lumen was flushed with 10 ml of normal saline (0.9% sodium chloride) with a pre-filled saline syringe (BD PosiFlush™ Prefilled Saline Syringe). This involved flushing 1 ml at a time, following a push-pause technique, with positive pressure disconnection to ensure catheter patency. The classification of these syringes as medical devices enables NAs and other non-registered members of the clinical team to support nursing staff with the care and maintenance of PICCs and other CVCs, within local policies and procedures. Using pre-filled syringes can save time and minimise the risk of contamination of the solution (Ceylan et al, 2021).

The use of pre-filled 0.9% sodium chloride syringes facilitates home maintenance of PICCs for patients. When Andy did not need to attend hospital, his PICC maintenance could be performed by a family member. Patients and relatives could access the necessary equipment and training from the day-case unit or outpatient department. Home PICC maintenance is extremely beneficial, not just to providers, but also to patients, who may avoid unnecessary hospital attendance and so benefit from more quality time at home and a reduced risk of hospital-acquired infections. Many patients and relatives have commented on the convenience of having their PICC maintenance at home and how easy they found using the ChloraPrep™ and BD PosiFlush™ Prefilled Saline Syringe 'sticks'.

Case study 2 (Gail)

Simon Clare

Gail was as a 48-year-old woman being treated for bladder cancer with folinic acid, fluorouracil and oxaliplatin (FOLOX). She was admitted for a replacement PICC, primarily for continuous cytotoxic intravenous medication via infusion pump in the home-care setting. Her first PICC developed a reaction thought to be related to a sutureless securement device (SSD) anchoring the PICC. The device was removed, but this resulted in displacement of the PICC and incorrect positioning in the vessel (superior vena cava). Now unsafe, the PICC was removed, awaiting replacement, which resulted in a delayed start for the chemotherapy.

A second PICC placement was attempted by a nurse-led CVC placement team, and a line attempt was made in Gail's left arm. Skin antisepsis was undertaken using a 2% chlorhexidine gluconate and 70% isopropyl alcohol solution (ChloraPrep™). A BD ChloraPrep™ 10 ml applicator was selected, using manufacturer's recommendations, as per best practice guidance for CVC placement (Loveday et al, 2014) and to comply with

local policy for the use of ANTT. The BD ChloraPrep™ applicator allowed improved non-touch technique and helped facilitate good Key-Part and Key-Site Protection, in line with ANTT (Clare and Rowley, 2021).

The inserting clinician failed to successfully position the PICC in Gail's left arm and moved to try on the right. On the second attempt, Gail noted the use of BD ChloraPrep™ and stated that she was allergic to the product, reporting a severe skin rash and local discomfort. The line placer informed the Gail that she had used BD ChloraPrep™ on the failed first attempt without issue, and she gave her consent to continue the procedure. No skin reaction was noted during or after insertion of the PICC.

BD ChloraPrep™ has a rapid-acting broad-spectrum antiseptic range and ability to keep fighting bacteria for at least 48 hours (BD, 2021). These were tangible benefits during maintenance of the CVC insertion site, in Key-Site Protection following dressing change and until subsequent dressing changes. There are reported observations of clinicians not allowing the skin to fully dry and applying a new dressing onto wet skin after removing old dressings and disinfecting the exit site with BD ChloraPrep™. This has been reported to cause skin irritation, which can be mistaken for an allergic reaction and lead the patient to think that they have an allergy to chlorhexidine. In our centre's general experience, very few true allergic reactions have ever been reported by the insertion team. Improved surveillance might better differentiate between later reported reactions, possibly associated with a delayed response to exposure to BD ChloraPrep™ at insertion, and local skin irritation caused by incorrect management at some later point during hospitalisation.

Staff training is an important consideration in the safe and correct use of BD ChloraPrep™ products and the correct use of adhesive dressings to avoid irritant contact dermatitis (ICD). It is worth noting that it can be difficult to differentiate between ICD and allergic contact dermatitis (ACD). Education and training should be multifaceted (such as with training videos and study days), allowing for different ways of learning, and monitored with audit. Local training in the benefits of using BD ChloraPrep™ correctly have been reinforced by adding simple instructions to the ANTT Clinical Practice Guideline for CVC insertion and maintenance. Education on its own is often limited to a single episode of training, the benefit of using the ANTT Clinical Practice Guideline is that it is embedded in a programme of audits and periodic competency reassessment. This makes sure that, as an integral part of good practice, skin antisepsis with BD ChloraPrep™ is consistently and accurately retrained and assessed.

Gail's case illustrates the importance of correct application of BD ChloraPrep™ and how good documentation and surveillance are vital in monitoring skin health during the repeated use skin-disinfection products. Care should be taken when recording ICD and ACD reactions, and staff should take steps to confirm true allergy versus temporary skin irritation.

Case study 3 (Beata)

Gema Munoz-Mozas

Beata was a 13-year-old teenage girl being treated for acute myeloid leukaemia. Although Beata had a dual-lumen skin-tunnelled catheter in situ, a peripheral intravenous cannula (PIVC) was required for the administration of contrast media for computed tomography (CT) scanning. However, Beata had needle-phobia, and so the lead vascular access nurse was contacted to insert the cannula, following ultrasound guidance and ANTT. After Beata and her mother gave their consent to the procedure, the nurse gathered and prepared all the equipment, including a cannulation pack, single-use tourniquet, skin-antisepsis product, appropriate cannula, PIVC dressing, 0.9% sodium chloride BD PosiFlush™ Prefilled Saline Syringe, sterile gel, sterile dressing to cover ultrasound probe and personal protective equipment.

Prior to PIVC insertion, a 4x5 cm area of skin underwent antisepsis with a 1.5 ml BD ChloraPrep™ Frepp applicator, with back-and-forth strokes for 30 seconds, and was allowed to air-dry. The vascular access team prefer to use BD ChloraPrep™ Frepp over single-use wipes, as the former is faster acting and provides the right volume to decontaminate the indicated area using ANTT (Clare and Rowley, 2021).

Following insertion, the PIVC was flushed with a 10 ml BD PosiFlush™ Prefilled Saline Syringe syringe, using a push-pause pulsatile technique, with positive pressure disconnection. Local policy recommends the use of pre-filled saline syringes, as they save time and minimise infection risk compared with manually drawn saline flushes (Ceylan et al, 2021). The Trust also permits competent non-registered members of staff to perform PIVC insertion, which is more cost-effective than depending on registered nurses.

In Beata's case, the team considered the use of BD ChloraPrep™ and BD PosiFlush™ Prefilled Saline Syringe to be essential for the prevention of VAD-associated infections, as well as increasing the quality of nursing care by saving time in the day-case and inpatient settings alike.

Case study 4 (Emma)

Colin Fairhurst

Emma, a 43-year-old woman diagnosed with acute lymphoblastic leukaemia, was scheduled for an allogenic stem-cell transplant and associated chemotherapy. To facilitate this, she attended the vascular access service at University Hospitals Plymouth NHS Trust for the insertion of a triple-lumen skin-tunnelled catheter. This was identified as the best VAD for her needs, because of its longevity, multiple points of access and decreased infection risk compared with other devices, such as PICCs.

This was Emma's second advanced VAD insertion, having previously received an apheresis line due to poor peripheral venous access, to facilitate the prior stem-cell harvest. She was yet to receive any treatment, and, therefore, no immunodeficiency had been identified prior to the insertion procedure.

Trust policy for skin disinfection prior to the insertion or removal of PICC lines is a 2% chlorhexidine gluconate and 70% isopropyl alcohol solution, BD ChloraPrep™. There is an exception for patient history of allergy or sensitivity to BD ChloraPrep™, where 10% povidone iodine is used instead. Emma had received BD ChloraPrep™ before, with no sign allergy or sensitivity, and so the vascular access team decided to use this product again for insertion. BD Chloraprep™ was used, in preference of other skin antisepsis options, due to the applicator's ability to effectively penetrate the layers of the epidermis, as well as the ability to eliminate direct hand-to-skin contact between the operator and patient (Clare and Rowley, 2021).

Insertion of a skin-tunnelled catheter first requires disinfection of a large area, including the neck and upper chest. Following the manufacturer's coverage recommendations, a 10.5 ml BD ChloraPrep™ applicator was selected as most suitable to cover an area of 25x30 cm (BD, 2022a).

The applicator was activated by pinching the wings to allow the antiseptic solution to properly load onto the sponge. To ensure proper release of the solution, the applicator was held on the skin against the anticipated site of insertion until the sponge pad became saturated. Then, a back-and-forth rubbing motion was undertaken for a minimum of 30 seconds, ensuring that the full area to be used was covered. The solution was then left to dry completely, prior to full-body draping, leaving the procedural area exposed for the procedure. Generally, drying time takes from 30 to 60 seconds, but local policy is not restrictive, as allowing the solution to fully dry is of paramount importance (Gunka et al, 2019). BD Chloraprep™ is effective against a wide variety of microorganisms and has a rapid onset of action (Florman and Nichols, 2007). Therefore, it was felt to be the best option for procedural and ongoing care skin asepsis in a patient anticipated to be immunocompromised during treatment.

It is the normal policy of the Trust's vascular access service to flush VADs using BD PosiFlush™ Prefilled Saline Syringes with 0.9% sodium chloride. Likewise, BD PosiFlush™ Prefilled Saline Syringes Sterile Pathway (SP) are used to prime all VADs prior to insertion and to check for correct patency once inserted. BD PosiFlush™ Prefilled Saline Syringe were used in preference of other options, such as vials or bags, due to the absence of requirement for a prescription in the local organisation. They are treated as a medical device and, therefore, can be used without prescription. The advantage of this is that flushes can be administered in a nurse-led clinic, where prescribers are not always available. Aside from the logistical advantages, the use of pre-filled syringes reduces the risk of microbial contamination through preparation error and administration error through correct labelling (National Patient Safety Agency, 2007) In Emma's case, three BD PosiFlush™ SP Prefilled Saline Syringes were used to check patency and/or ascertain venous location following the insertion of the skin-tunnelled catheter.

In this case, both BD ChloraPrep™ and BD PosiFlush™ Prefilled Saline Syringe proved simple to use and helped achieve a successful procedural outcome for the patient.

Case study 5 (Frank)

Colin Fairhurst

Frank was a 47-year-old man who had been diagnosed with infective endocarditis following a trans-oesophageal echo. A few days later, to facilitate his planned treatment of 6 weeks of intravenous antibiotics to be administered 4-hourly every day, he was referred to the vascular access service for insertion of long-term IV access. To facilitate this administration, the decision was made to place a PICC.

Frank's referral included a history of illegal intravenous drug use and details of the consequent difficulty the ward-based team had in finding suitable veins to obtain vascular access. His medical history also included infected abscesses in the left groin and methicillin-resistant *Staphylococcus aureus* (MRSA) colonisation.

First, Frank was administered suppression therapy for MRSA decolonisation. Following this and prior to PICC insertion, the skin antisepsis procedure was undertaken using a 2% chlorhexidine gluconate and 70% isopropyl alcohol solution, BD ChloraPrep™, in adherence to Trust policy (Loveday et al, 2014). Specifically, BD ChloraPrep™ applicators are selected for their single-use application. They have been demonstrated to reduce the risk of infectious complications (catheter colonisation and local infection) by 92% compared with 5% povidone iodine (PVI) 69% ethanol (Guenezan et al, 2021). A 3 ml BD ChloraPrep™ applicator was considered suitable to decontaminate an area sufficient for the intended PICC insertion procedure, as recommended by the manufacturer (BD, 2022b). It was applied using a back-and-forth motion for a minimum of 30 seconds and left to fully dry (Loveday et al, 2014). Staphylococcus aureus bacteraemia's have a mortality rate of 20–40% and are predominantly caused by VAD insertion (Ishikawa and Furukawa, 2021), and, therefore, the need to reduce this risk was of particular importance for this patient due to the history of MRSA colonisation.

In Frank's case, the use of BD ChloraPrep™ during the insertion procedure and for each subsequent dressing change episode participated in an uneventful period of treatment. The clinical challenges posed by the patients' presentation of MRSA colonisation meant the risk of infection was increased but, through correct antisepsis, no adverse events were noted, and the full course of treatment was successfully administered through the PICC.

References

Akhtar N, Lee L. Utilization and complications of central venous access devices in oncology patients. Current Oncology. 2021; 28(1):367–377. https://doi.org/10.3390/curroncol28010039

BD. BD ChloraPrep: summary of product characteristics. 2021. www.bd.com/en-uk/products/infection-prevention/chloraprep-patient-preoperative-skin-preparation/chloraprep-smpc-pil-msds (accessed 2 November 2022)

BD. Chloraprep 10.5ml applicator. 2022a. www.bd.com/en-uk/products/infection-prevention/chloraprep-patient-preoperative-skin-preparation/chloraprep-patient-preoperative-skin-preparation-product-line/chloraprep-105-ml-applicator (accessed 26 September 2022)

BD. Chloraprep 3ml applicator. 2022b. www.bd.com/en-uk/products/infection-prevention/chloraprep-patient-preoperative-skin-preparation/chloraprep-patient-preoperative-skin-preparation-product-line/chloraprep-3-ml-applicator (accessed 26 September 2022)

Centers for Disease Control and Prevention. Website. 2021. www.cdc.gov/cancer/preventinfections/providers.htm (accessed 26 September 2022)

Ceylan G, Topal S, Turgut N, Ozdamar N, Oruc Y, Agin H, Devrim I. Assessment of potential differences between pre-filled and manually prepared syringe use during vascular access device management in a pediatric intensive care unit. J Vasc Access. 2021:11297298211015500. https://doi.org/10.1177/11297298211015500

Clare S, Rowley S. Best practice skin antisepsis for insertion of peripheral catheters. Br J Nurs. 2021;30(1):8–14. https://doi.org/10.12968/bjon.2021.30.1.8

Caguioa J, Pilpil F, Greensitt C, Carnan D. HANDS: standardised intravascular practice based on evidence. Br J Nurs. 2012;21(14):S4–S11. https://doi.org/10.12968/bjon.2012.21.Sup14.S4

Easterlow D, Hoddinott P, Harrison S. Implementing and standardising the use of peripheral vascular access devices. J Clin Nurs. 2010;19(5–6):721–727. https://doi.org/10.1111/j.1365-2702.2009.03098.x

Florman S, Nichols RL. Current approaches for the prevention of surgical site infections. Am J Infect Dis. 2007; 3(1):51–61. https://doi.org/10.3844/ajidsp.2007.51.61

Gorski LA, Hadaway L, Hagle M et al. Infusion therapy standards of practice. J Infus Nurs. 2021;44(S1):S1–S224. https://doi.org/10.1097/NAN.0000000000000396

Guenezan J, Marjanovic N, Drugeon B, et al. Chlorhexidine plus alcohol versus povidone iodine plus alcohol, combined or not with innovative devices, for prevention of short-term peripheral venous catheter infection and failure (CLEAN 3 study): an investigator-initiated, open-label, single centre, randomised-controlled, two-by-two factorial trial [published correction appears in Lancet Infect Dis. 2021 Apr 6]. Lancet Infect Dis. 2021;21(7):1038–1048. https://doi.org/10.1016/S1473-3099(20)30738-6

Gunka V, Soltani P, Astrakianakis G, Martinez M, Albert A, Taylor J, Kavanagh T. Determination of ChloraPrep® drying time before neuraxial anesthesia in elective cesarean delivery: a prospective observational study. Int J Obstet Anesth. 2019;38:19–24. https://doi.org/10.1016/j.ijoa.2018.10.012

Ishikawa K, Furukawa K. Staphylococcus aureus bacteraemia due to central venous catheter infection: a clinical comparison of infections caused by methicillin-resistant and methicillin-susceptible strains. Cureus. 2021; 13(7):e16607. https://doi.org/10.7759/cureus.16607

Loveday HP, Wilson JA, Pratt RJ et al. Epic3: national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. J Hosp Infect. 2014;86(S1):S1–70. https://doi.org/10.1016/S0195-6701(13)60012-2

National Patient Safety Agency. Promoting safer use of injectable medicines. 2007. https://healthcareea.vctms.co.uk/assets/content/9652/4759/content/injectable.pdf (accessed 3 October 2022)

Royal College of Nursing. Standards for infusion therapy. 4th edn. 2016. www.rcn.org.uk/clinical-topics/Infection-prevention-and-control/Standards-for-infusion-therapy (accessed 26 September 2022)

Taxbro K, Chopra V. Appropriate vascular access for patients with cancer. Lancet. 2021; 398(10298):367–368. https://doi.org/10.1016/S0140-6736(21)00920-X

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Best practice infection prevention[1,2]

- 2% CHG in 70% IPA, for a rapid and persistent anti-bacterial activity[1,3]
- Sterile foam sponge helps control the solution flow while facilitating gentle back and forth application

BD ChloraPrep™ a proven and reliable solution

18+ years in use

50+ peer-reviewed publications

Over 4 billion applicators used

BD breakthrough sterilisation process raises the standard

Maintains the efficacy and purity of the antiseptic solution[4]

Less than a 1 in 1 million chance that a viable micro-organism can exist in a BD ChloraPrep™ applicator[4]

Sterility assurance level of 10-6. The same level required for injectable products[4]

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for product information

References

1. Loveday HP, Wilson JA, Pratt RJ, et al. epic3: national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. J Hosp Infect. 2014;86 Suppl 1:S1-S70. doi:10.1016/S0195-6701(13)60012-2, IVAD13 (Class C evidence) **2.** Standards for infusion therapy, The RCN IV Therapy Forum, Third edition, January 2010 **3.** Gorski LA. The 2016 Infusion Therapy Standards of Practice. Home Health Now. 2017;35(1):10-18. doi:10.1097/NHH.0000000000000481, IVAD14 (Class A evidence), IVAD15, IVAD23 (Class A evidence), IVAD24 **4.** Degala, et al. United States Patent 9,078,934. July 14, 2015.

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