Health Protection Scotland

NHS National Services Scotland

Targeted literature review:

What are the key infection prevention and control recommendations to inform a neonatal central venous catheter (CVC) quality improvement tool?

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HPS ICT Document Information Grid	
Purpose:	To present a review of the evidence to inform the content of HAI related quality improvement tools for NHSScotland. This supports the functions of HPS in developing effective guidance, good practice and a competent workforce and translating knowledge to improve health outcomes.
Target audience:	All NHSScotland staff involved in neonatal patient care activities where interventions can lead to HAI, particularly those interventions that can cause bloodstream infections such as line insertion. Infection prevention and control teams in NHS boards and other settings. Partner organisations particularly Healthcare Improvement Scotland and National Education for Scotland to ensure consistent information across similar improvement documentation.
Description:	Literature critique summary and presentation of key recommendations to inform HAI quality improvement tools, based around a framework that evaluates these against the health impact contribution and expert opinion/practical application.
Update/review schedule:	Every three years; however if significant new evidence or other implications for practice are published updates will be undertaken.
Cross reference:	Standard Infection Control Precautions in the National Infection Prevention and Control Manual. http://www.nipcm.hps.scot.nhs.uk/ Data on HAI incidence and prevalence and process compliance data. Implementation support from Healthcare Improvement Scotland and/or others, education and training support from National Education Scotland. http://www.nes.scot.nhs.uk/education-and-training.aspx The Maternity and Children Quality Improvement Collaborative (MCQIC) measurement plan is part of the Scottish Patient Safety Programme (SPSP) and contains tools for monitoring compliance with CVC insertion and maintenance bundles.

	http://www.scottishpatientsafetyprogramme.scot.nhs.uk/programmes/mcqic/neonatal-care

Contents

1. Executive summary

The Scottish National HAI Prevalence Survey (2011 and 2016) both identified a burden of HAI in the neonatal population that requires a focus on prevention of sepsis and bloodstream infections in this population.[1;2] Central vascular catheters (CVCs) are the leading cause of device-related bacteraemia or catheter related bloodstream infections (CRBSI) which are a major cause of morbidity, increased severity of patient illness and prolonged hospital stays.

Critical care aspects related to CVC insertion therefore include surgical hand antisepsis, aseptic technique and maximal sterile barrier precautions, use of antisepsis at site of insertion to minimise the risk of microbial seeding at the external surface of the CVC as it is inserted and use of sterile dressings. A review of the content against the currently available guidelines and evidence has now been undertaken to ensure that the key recommendations are still the most important for optimal insertion of CVCs and subsequent safety of neonates with CVCs.

The recommendations result from review of the scientific evidence and the process of assessing these within an expert opinion framework. The key recommendations and their scientific grade of evidence for a neonatal CVC insertion and maintenance quality improvement tool now are:

Insertion

- Ensure that surgical hand antisepsis is performed immediately before donning maximal sterile barrier precautions (e.g. gloves and gown) (Category 1B)
- Ensure that maximal sterile barrier precautions are used by healthcare workers; including headwear, fluid-resistant surgical mask (FRSM), sterile gown and sterile gloves (Category 1B)
- Ensure that maximal sterile barrier precautions are used by applying a sterile body drape (Category 1B)
- Ensure that aseptic technique is maintained throughout insertion of CVCs (Category 1B)
- Ensure that a single-use application of an appropriate antiseptic is used for skin preparation of the insertion site, and allowed to dry, before CVC insertion (Category 1A)

- Final recommendation – no recommendation on optimum catheter insertion site in neonates can be made (No recommendation)
- Ensure that a sterile, transparent, semi-permeable dressing is used to cover the catheter site (Category 1B)
- Chlorhexidine-impregnated dressings to cover the catheter site should be avoided in patients susceptible to skin irritation (Category 1B)

Maintenance

- Ensure that the need for the CVC in situ is reviewed and recorded on a daily basis. (Category 1A)
- Ensure that the CVC dressing is intact. (Category 1B)
- Ensure that the CVC dressing is changed if it becomes damp, loose or visibly soiled. (Category 1B)
- Ensure that a single-use application of an appropriate antiseptic is used for cleaning the insertion site during dressing changes. (Category 1A)
- Ensure that hand hygiene is performed immediately before accessing the line/site (WHO Moment 2). (Category 1A)
- Ensure that a single-use antiseptic containing 70% isopropyl alcohol is used to clean the access hub prior to accessing – rub the access hub for at least 15 seconds ('scrub the hub') (Category 1B)

To find out more information on the categories of these recommendations see Appendix 2.

It is advised that the key recommendations listed here are considered for application into practice as supported by quality improvement tools including care bundles.

Note: this review identifies the resulting key evidence based recommendations and does not aim to identify all the elements of a checklist or standard operating procedure covering CVC insertion or management.

Note

All medical and nursing staff involved in the use of all medical devices and medicinal products containing chlorhexidine should be aware of the risk of an anaphylactic reaction due to chlorhexidine allergy. The full details of the alert are available from the following web link

http://www.mhra.gov.uk/Publications/Safetywarnings/MedicalDeviceAlerts/CON197918

2. Aim of the review

To review the extant scientific literature to ensure that the key recommendations included within a quality improvement tool are the most critical in ensuring safe insertion and maintenance of CVCs and subsequent safety of neonatal patients.

2.1 Out of scope for this review

This literature review does not address any issues specific to:

Emergency insertion of CVCs;

Anti-microbial impregnated catheters;

Multiple lumen CVCs;

Paediatric patients i.e. not explicitly described as neonatal;

Prophylactic use of antimicrobials.

2.2 Assumptions

There are a number of aspects related to healthcare delivery that were not within the remit of this review as it is clear that they are the responsibility of other professionals. These include that:

- Staff are appropriately trained and competent in all aspects of the insertion and management of CVCs preferably using an approved educational package.
- The overall approach to the delivery of healthcare is supported by patient safety and improvement approaches and organisational readiness e.g. MCQIC SPSP.

3. Results

The recommendations presented are based on review of the current evidence using the existing recommendations for insertion and maintenance of CVCs in adults in Appendix 1 as a basis for the question set. The methodology for the review is described within Appendix 2 and the specific search strategy in Appendix 3.

3.1 Insertion

3.1.1 Final recommendation - Ensure that surgical hand antisepsis is performed immediately before donning maximal sterile barrier precautions (e.g. gloves and gown) (Category 1B)

Surgical hand antisepsis is recommended to reduce the possibility of cross-transmission of skin microorganisms during a surgical procedure via a breach in the sterile gloves.[3] The surgical hand antisepsis technique aims not only to remove transient microorganisms but to reduce resident microorganisms.[4-11] The use of alcohol based hand rub (ABHR) products for surgical hand antisepsis is as effective as a traditional surgical hand antisepsis, it is important to note however that products should be specifically labelled as suitable for this use.[5] A standardised application technique has not been universally accepted as yet,[3;5;6;8-11] though the HPS National Infection Prevention and Control Manual provides a recommended technique at appendix 3.[12]

There is a consensus of evidence that hand hygiene should be performed before carrying out a clean/aseptic procedure such as inserting an invasive device as these are considered high risk and therefore a maximum reduction of microbial counts on the hands is necessary.[3;7;8]

Given the reduction in SSIs related to this intervention and the fact that surgical hand antisepsis is routinely accepted and applied with other sterile maximal barrier precautions, this practice should be applied, with the most appropriate time being immediately before donning sterile maximal barrier precautions (e.g. gloves and gown).[3;7;8] Local policies and procedures should be referred to with respect to surgical hand antisepsis in ward areas.

3.1.2 Final recommendation - Ensure that maximal sterile barrier precautions are used by healthcare workers; including headwear, fluid-resistant surgical mask (FRSM), sterile gown and sterile gloves (Category 1B)

3.1.3 Final recommendation - Ensure that maximal sterile barrier precautions are used by applying a sterile body drape (Category 1B)

The use of maximal sterile barrier precautions for insertion of CVCs has been recommended in national and international evidence based guidance.[3;7;8] Maximal sterile barrier precautions are defined by the Centers for Disease Control and Prevention (CDC) as 'wearing a sterile gown, sterile gloves, cap and using a full body drape (similar to the drapes used in the operating room) during the placement of CVC'.[8] This recommendation is based on a body of evidence which demonstrates a considerable reduction in both catheter and skin colonisation and CRBSIs when maximal sterile barrier precautions are applied for CVC insertion.[7;8;13] There is a consensus of evidence that maximal sterile barrier precautions should be adhered to in addition to aseptic technique. For clarity of action, the recommendation has been separated to reflect the two aspects of care activity required to ensure maximal sterile barrier precautions have been used.

3.1.4 Final recommendation - Ensure that aseptic technique is maintained throughout insertion of CVCs (Category 1B)

Aseptic technique is a broad term for a number of actions which prevent cross-transmission of microorganisms. This includes factors such as sterility of equipment combined with a non-touch technique. This is also the basis of the aseptic non-touch technique (ANTT) which is advocated for use in some parts of the UK.[14] However there are a number of other activities which should also be considered as part of aseptic technique.[15] These include: preparation of a surface area which prevents 'touch' contamination of equipment; use of sterile equipment or effective decontamination of equipment prior to use; use of personal protective equipment (PPE), e.g. gloves; not touching critical parts that must remain sterile throughout the procedure; and appropriate hand hygiene.

The recommendation that aseptic technique should be used for insertion of a CVC is included within all the evidence based guidance identified during this review.[7;8;16]

Therefore the use of aseptic technique for insertion of any invasive device is crucial and although this is reflected throughout the other key recommendations the importance of maintaining asepsis throughout the procedure must be emphasised.

3.1.5 Final recommendation – Ensure that a single-use application of an appropriate antiseptic is used for skin preparation of the insertion site, and allowed to dry, before CVC insertion (Category 1A)

Infection can arise from migration of microorganisms normally present on the patient's skin. Antisepsis of the insertion site is therefore crucial in minimising the risk of microbial seeding of the external surface of the CVC as it is inserted and migration of these organisms down the lumen post–insertion; such migration can lead to biofilm formation, ultimately resulting in infection.[7;8;16-19] This risk increases with the density of the microbial contamination at the insertion site.[7]

Mitigation of this risk can involve the use of antiseptics such as chlorhexidine and povidone-iodine.[20] In adults chlorhexidine in 70% isopropyl alcohol is often used due to the quick antiseptic action of the alcohol combined with the residual antiseptic effect of the chlorhexidine.[21;22] Epic3 guidelines advise that skin should be decontaminated with a "single-use application of 2% chlorhexidine gluconate in 70% isopropyl alcohol (or povidone iodine in alcohol for patients with sensitivity to chlorhexidine)" prior to the insertion of a central venous access device.[7] CDC guidelines[8] recommend the use of >0.5% chlorhexidine in alcohol before insertion of CVCs and during dressing changes however, they also state that no recommendation on the safety or efficacy of chlorhexidine can be made for children <2 months of age. In neonates chlorhexidine products have been associated with skin irritation such as dermatitis and chemical burns as well as a risk for systemic absorption.[23] The SHEA 2014 guidelines state that the optimal choice of antiseptic agents for children under 2 months of age is unresolved and that the use of chlorhexidine specifically should be weighed against the risk of adverse effects, particularly in preterm infants.[23] Alternatives such as povidone iodine or alcohol may be used,[23] however, the CDC guidelines state that tincture of iodine must be avoided at the umbilical site due to potential adverse effects on the neonatal thyroid.[8]

The requirement that the skin antiseptic is allowed to dry is included as a recommendation within evidence based guidelines.[7;8] There is no specific evidence within the literature with regards to the method of application or the time that an antiseptic product is allowed to dry prior to insertion. However it is generally recommended that manufacturer's guidance is followed.[8]

There have been multiple reports in the literature of outbreaks of HAI associated with contaminated aqueous solutions of chlorhexidine.[24-28] Outbreaks of infection have also been associated with 70% and 95% ethanol used for skin decontamination as well as 70% isopropyl alcohol skin preparation pads, which may show a potential for this solution to become contaminated.[29-31] Therefore for the purposes of skin preparation prior to surgical procedures, the use of single use sterile containers antiseptic solutions should be considered best practice.

Note

All medical and nursing staff involved in the use of all medical devices and medicinal products containing chlorhexidine should be aware of the risk of an anaphylactic reaction due to chlorhexidine allergy. The full details of the alert are available from the following web link

http://www.mhra.gov.uk/Publications/Safetywarnings/MedicalDeviceAlerts/CON197918

3.1.6 Final recommendation – no recommendation on optimum catheter insertion site in neonates can be made (No recommendation)

There is evidence to show that the density of skin flora is associated with increased risk of CRBSIs.[8] This is due to colonisation of the catheter tip or lumen and resultant migration of skin microorganisms along the internal or external catheter surface.[7] There have been studies which have therefore evaluated the differing risks associated with the choice of catheter insertion site. In neonates the upper or lower limbs, umbilical cord or the scalp can be used as CVC insertion sites. The evidence for optimum insertion site in neonates is limited, heterogeneous and at times conflicting. One RCT determined that when the catheter is situated in the upper limb the risk of complications was significantly lower when using the axillary vein compared to more distal sites such as the anticubital fossa.[32] The

2011 CDC guidance states that in paediatric patients femoral sites have an equivalent risk of infection as non-femoral sites,[8] however, in neonates this reduced risk has not been demonstrated and one study has found that femoral sites had a higher rate of complications than non-femoral sites (greater and lesser saphenous veins of the lower limbs or basilica or cephalic veins of the upper limb).[33] When comparing upper limb to lower limb insertion one study found no difference in risk of CRBSI,[34] one study did report a difference in CRBSI per 1000 catheter days (6.4 and 3.4 per 1000 catheter days for upper and lower limb insertion, respectively) but didn't state if this was significant, the study did demonstrate that there was no difference in rates of CRBSI using scalp insertion compared to upper or lower limb insertion.[35] Broviac catheters surgically placed in the groin have been show to have a lower risk of CRBSI than those placed in the neck;[36] it has also been shown that of catheters surgically placed in the neck, internal jugular catheters had a greater risk of CRBSI than those in the subclavian vein.[37]
A retrospective cohort found no significant differences in CRBSI per 1000 catheter days between neonates given a UVC only, PICC only or UVC followed by a PICC.[38] There are a number of potential limitations and confounding factors when comparing these studies which discussed in section 4.

There is insufficient evidence to inform a recommendation on optimum catheter insertion site in neonates to reduce infection risk. There are a number of factors which should be taken into account with respect to site selection and these include patient comfort, risk of mechanical complications, the ease by which asepsis can be maintained during the procedure, risk of mechanical complications, distance from open wounds and the skill of staff undertaking the procedure.[7;8] The requirement for a clinical risk assessment should always be emphasised.

3.1.7 Final recommendation - Ensure that a sterile, transparent, semi-permeable dressing is used to cover the catheter site (Category 1B)

The DH High Impact Intervention includes an action that 'a sterile, semi-permeable, transparent dressing is used allowing observation of insertion site'.[16] This is based on evidence presented within the epic3 guidelines which concludes that 'a sterile, transparent, semi-permeable polyurethane dressing should be used to cover the catheter insertion site'

or that 'if the insertion site is bleeding or oozing, a sterile gauze dressing is preferable to a transparent, semi-permeable dressing'.[7] The current recommendation within the CDC guidelines states 'use either sterile gauze or sterile, transparent, semi-permeable dressing to cover the catheter site'.[8]

However, although, the use of a transparent dressing is recommended, there is no supporting evidence provided. It has been reported that the rates of colonisation found in catheters dressed with either gauze or semi-permeable transparent dressings are comparable.[8] In addition, a Cochrane review (updated in 2011) concluded that the uncertainty regarding the effect of different CVC dressings on the risk of infection meant that the choice of dressing should be based on patient preference and/or cost.[39]

A sterile dressing provides protection of the insertion site following insertion of a CVC;[7;8;39] transparent dressings provide the added value of enabling viewing of the insertion site and could result in improved outcome.

3.1.8 Final recommendation – Chlorhexidine-impregnated dressings to cover the catheter site should be avoided in patients susceptible to skin irritation (Category 1B)

In NHSScotland chlorhexidine-impregnated sponge or gel dressings are recommended to cover catheter insertion sites in adult patients.[40] The dressings are designed to continually release chlorhexidine at the CVC insertion site for the local reduction and inhibition of bacterial skin colonisation and are associated with reduction in CRBSI rates.[7;41-43] The evidence for clinical benefit is less clear in neonatal patients; a 2016 systematic review found that chlorhexidine dressings posed a risk of skin irritation (contact dermatitis) but did not significantly reduce rates of CRBSI despite a moderate reduction in catheter colonisation.[44] The potential benefits of chlorhexidine based dressings should be balanced against the risk of adverse effects, particularly in preterm neonates.[23;45]

3.2 Maintenance

3.2.1 Final recommendation - Ensure that the need for the CVC in situ is reviewed and recorded on a daily basis. (Category 1A)

Longer catheter dwell times are associated with increasing risk of CRBSI;[46;47] therefore, CVCs should be removed when no longer clinically indicated.[46-48] This requires regular

evaluation of the ongoing clinical need for catheterisation.[7] The Department of Health (DH) High Impact Intervention incorporates a recommendation that the catheter is removed if no longer required or alternatively, the decision not to remove is recorded and records are kept including date, location, and name of healthcare worker.[16] Assessment and removal of non-essential CVCs is also a highly graded recommendation within Centers for Disease Control and Prevention (CDC) guidelines.[8] Accurate record keeping regarding the clinical need for catheterisation should be maintained and updated on a daily basis.

There is mixed evidence on the subject of UVC dwell time, a retrospective cohort found a higher risk of complications associated with increased UVC dwell time compared to PICCs and suggested replacing UVC before day 4 for a PICC,[49] whereas an RCT found that UVCs could remain in situ up to and beyond the CDCs recommended maximum of 14 days without a statistically significant difference in rates of CRBSI compared to UVCs replaced with PICCs at day 7-10.[45;50] A recent retrospective cohort also found that there were no statistically significant differences in CRBSI in neonates catheterised with a UVC only, PICC only or UVC followed by PICC.[38] The potential limitations and confounding factors in these studies are discussed in section 4.

3.2.2 Final recommendation - Ensure that the CVC dressing is intact. (Category 1B) Final recommendation - Ensure that the CVC dressing is changed if it becomes damp, loose or visibly soiled. (Category 1B)

It is recommended that when short-term CVCs are used gauze dressings should be changed every 2 days and transparent dressings at least every 7 days.[8;23] However, neonatal skin, particularly in preterm infants, may be easily damaged or torn by removing adherent dressings which may also risk catheter dislodgement.[23;51;52] There is consensus that less frequent dressing changes may be more appropriate for neonatal patients and that dressings are replaced if damp, loosened, or visibly soiled as well as if there is fluid or bleeding at the insertion site or if an excessive portion of the catheter is exposed.[23;51-53]

3.2.3 Final recommendation - Ensure that a single-use application of an appropriate antiseptic is used for cleaning the insertion site during dressing changes. (Category 1A)

It is recommended that prior to a dressing being changed skin the site should be cleansed with a single-use application of 2% chlorhexidine gluconate in 70% isopropyl alcohol (or povidone iodine in alcohol for patients with sensitivity to chlorhexidine), allowing the antiseptic to air dry.[7;16] The Center for Disease Control (CDC) guidelines recommend skin is prepared with a preparation of >0.5% chlorhexidine with isopropyl alcohol before insertion of CVCs and during dressing changes, but state that tincture of iodine (an iodophor) or 70% isopropyl alcohol can be used as alternatives if chlorhexidine is not suitable for the patient.[8]

As described in section 4.1.5, chlorhexidine products may cause skin irritation such as dermatitis and chemical burns in neonates and the optimal choice of antiseptic agents for children under 2 months of age is unresolved.[23] Alternatives such as povidone iodine or alcohol may be used,[23] however, the CDC guidelines state that tincture of iodine must be avoided at the umbilical site due to potential adverse effects on the neonatal thyroid.[8] The use of chlorhexidine products for skin cleansing should be weighed against the risk of adverse effects, particularly in preterm infants.

As multiple outbreaks have been associated with multi-use antiseptic solution, single-use sterile antiseptic solution is considered best practice.[24-31]

3.2.4 Final recommendation - Ensure that hand hygiene is performed immediately before accessing the line/site (WHO Moment 2). (Category 1A)

This recommendation, and the importance of hand hygiene performance, is consistent with all current evidence, guidelines and the DH high impact intervention.[8;16] The World Health Organization (WHO) Guidelines on Hand Hygiene in Health Care (2009)[3] clearly describe the indications for hand hygiene and present these within the WHO ‘My 5 Moments for Hand Hygiene’ approach, including emphasising the importance of performing hand hygiene before clean/aseptic procedures to prevent HAI. These 5 Moments are widely promoted within NHSScotland and hand hygiene performance is measured against these Moments. Accessing the site has been emphasised as a key factor in acquiring infection

and therefore this moment is crucial to protect the patient at a vulnerable time.[8;16] In relation to the risk associated with CVC maintenance, the clearest indication for hand hygiene is Moment 2: 'before clean/aseptic procedures'.

3.2.5 Final recommendation - Ensure that a single-use antiseptic containing 70% isopropyl alcohol is used to clean the access hub prior to accessing – rub the access hub for at least 15 seconds ('scrub the hub') (Category 1B)

There is substantial evidence that CVC access ports and hubs are generally contaminated and must be disinfected prior to access by HCWs.[8;16;54]

Needleless connectors were originally introduced to reduce the risk to staff from needlestick injuries.[55] Subsequent developments have resulted in numerous different designs of connectors which include split-septum devices, mechanical valve devices, and devices with positive fluid displacement. However, it is possible that complex designs of connectors may make them more likely to harbour bacteria. Indeed, there have been reports of increased CRBSIs which have been observed after their introduction and subsequently a focus on the importance of adequate and thorough decontamination of these needleless ports.[56-60]

The Department of Health (DH) High Impact Intervention therefore recommends that ports or hubs are cleaned with 2% chlorhexidine gluconate in 70% isopropyl alcohol prior to catheter access and that the lines should be flushed with sterile 0.9% sodium chloride when in frequent use.[16] The Center for Disease Control (CDC) guidelines recommend to 'minimize contamination risk by scrubbing the access port with an appropriate antiseptic (chlorhexidine, povidone iodine, an iodophor or 70% isopropyl alcohol) and accessing the port only with sterile devices'.[8]

The evidence for the use of 2% chlorhexidine gluconate in 70% isopropyl alcohol results mainly from studies where catheters are left in situ long term.[7] There is some debate on whether it is the method of cleaning or the choice of disinfectant which is the most important factor. Two microbiological studies which examined decontamination of different designs of needleless access hubs showed that 15 seconds of a scrubbing action with 70% isopropyl alcohol was as effective as 2% chlorhexidine in 70% isopropyl alcohol.[61;62] Despite being relatively small scale they have provided evidence that the duration of disinfectant contact along with the method of decontamination which is important. This is

of particular importance when considering the different designs of the needleless connector components.

Two studies were identified which supported the use of chlorhexidine in alcohol for cleaning catheters hubs and connectors before accessing neonatal CVCs.[63;64] No adverse effects were reported although it is unclear if these were recorded, it is possible that skin contact is minimal when chlorhexidine is used to 'scrub the hub' and so poses less risk of irritation.

Epidemiological evidence to support the inclusion of the 'scrub the hub' intervention for CVCs has been provided by a number of observational studies in adults; following introduction of this intervention within a number of ICUs, significant reductions were observed in the CRBSI rate, even within settings where the baseline rate was already low.[56;61;62] This has also been demonstrated in neonatal patients using 5% chlorhexidine gluconate in alcohol wipes.[63]

Other methods of hub decontamination, such as the use of antiseptic chambers, have also been described. However, despite some recent epidemiological and microbiological data, there is currently insufficient evidence to support routine use.[65;66]

4. Implications for research

Generally, there is a lack of high quality evidence to support recommendations for CVC insertion and maintenance that is specific to neonates. In particular, more research is required to determine the optimum antiseptic agent and concentration for skin antisepsis in neonates (particularly preterm infants) both before insertion and during dressing changes.

There are a number of potentially confounding factors associated with different insertion sites and catheter dwell times; the type of catheter required is intrinsically lined to patients factors that may increase or decrease risk of CRBSI e.g. an umbilical catheter is typically placed within the first week of birth when infants may be at a higher risk for infection. It is therefore difficult to compare outcomes in UVCs with PICCs, which may be in situ-longer and in older (more than 7 days old) infants. While most studies attempt to compare similar patient groups gestational age and dwell time (by standardising to infections per 1000 catheter days) are not always accounted for in study design or analysis.

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Appendix 1: Previous (Adult) recommendations for insertion and maintenance of CVCs

The following are final recommendations from the adult CVC insertion and maintenance QITs produced by HPS. These were used to inform the question set for developing an equivalent neonatal QIT.[40;67]

Insertion

- Ensure that surgical scrub is performed immediately before donning maximal sterile barrier precautions (e.g. gloves and gown) (Category 1B)*
- Ensure that maximal sterile barrier precautions are used; including headwear, FRSM, sterile gown and sterile gloves for healthcare workers (Category 1B)
- Ensure that maximal sterile barrier precautions are used by applying a sterile body drape (Category 1B)
- Ensure that aseptic technique is maintained throughout insertion of CVCs (Category 1B)
- Ensure that a single-use application of 2% chlorhexidine in 70% isopropyl alcohol is used for skin preparation of the insertion site and allowed to dry, before CVC insertion (Category 1A)
- Ensure that the subclavian site is used if possible, or internal jugular vein (femoral site should be avoided where possible) (Category 1B)
- Ensure that a sterile, transparent, semi-permeable dressing is used to cover the catheter site (Category 1B)
- Consider using a chlorhexidine-impregnated sponge or gel dressing to cover the catheter site (Category 1A)

Maintenance

- Ensure that the need for the CVC in situ is reviewed and recorded on a daily basis (Category 1A)*
- Ensure that the CVC dressing is intact (Category 1B)
- Ensure that the CVC dressing has been changed in the last seven days (Category 1B)

- Ensure that a single-use application of 2% chlorhexidine gluconate in 70% isopropyl alcohol is used for cleaning the insertion site during dressing changes (Category 1A)
- Ensure that hand hygiene is performed immediately before accessing the line/site (WHO Moment 2) (Category 1A)
- Ensure that a single-use antiseptic containing 70% isopropyl alcohol is used to clean the access hub prior to accessing – rub the access hub for at least 15 seconds ('scrub the hub') (Category 1B)

Appendix 2: Literature review methodology

This targeted literature review was produced using a defined methodology as described below and in the National Infection Prevention and Control Manual: Development Process. The grading of recommendations for HPS QITs uses the HICPAC system rather than the SIGN50 system used for the NIPCM, this is described below.

Initial rapid search and review

The initial search rapid literature search was carried out to identify mandatory guidance, or recent national or international evidence based guidance which either agrees or refutes that the current key recommendations are the most important to ensure optimal PVC care:

- The main public health websites were searched to source any existing quality improvement tools
- Relevant guidance and quality improvement tools e.g. Department of Health (DH), Centers for Disease Control and Prevention (CDC) etc were reviewed
- Additional literature identified and sourced e.g. from the relevant Cochrane reviews.

The quality of evidence based guidance was assessed using the AGREE instrument and only guidance which achieved either a strongly recommend or recommend rating was included.

Targeted systematic review

As a result of initial rapid search and review, recommendations requiring a more in depth review were identified. This involved searching of relevant databases including OVID Medline, CINAHL, and EMBASE. All literature pertaining to recommendations where evidence was either conflicting or where new evidence was available were critically appraised using SIGN checklists and a 'considered judgement' process used to formulate recommendations based on the current evidence for presentation and discussion with the National Healthcare Associated Infection (HAI) Quality Improvement Tools Group in Scotland.

Grading of recommendations

Grading of the evidence is using the Healthcare Infection Control Practices Advisory Committee (HICPAC) method. In addition to the overall assessment of the evidence underpinning the recommendation, other factors are considered which affect the overall strength of the recommendation such as the health impact and expert opinion on the potential critical outcomes.

The HICPAC categories are as follows:

Category 1A – strong recommendation based on high to moderate quality evidence
Category 1B – strong recommendation based on low quality of evidence which suggest net clinical benefits or harms or an accepted practice (e.g. aseptic technique)
Category 1C – a mandatory recommendation
Category II – a weak recommendation which shows evidence of clinical benefit over harm
No recommendation – not sufficient evidence to recommend one way or another

Appendix 3: Search strategy

1. Exp neonate
2. exp Central Venous Catheters/ or exp Catheterization, Central Venous/ or exp central vascular catheter/ or exp catheterization, umbilical/
3. exp Infection/ or exp Cross Infection/ or exp Infection Control/
4. exp Chlorhexidine/ or exp Hand Disinfection/ or exp Povidone-Iodine/
5. exp Hand Hygiene/
6. surgical scrub*.mp
7. 4 or 5 or 6
8. personal protective equipment.mp
9. exp Gloves, Surgical/ or exp Gloves, Protective/
10. exp Protective Clothing/
11. 8 or 9 or 10
12. exp Asepsis/ or exp antisepsis
13. aseptic technique?.mp
14. non-touch technique?.mp
15. 12 or 13 or 14
16. infection$.mp.
17. exp Bacteremia or exp bacteraemia/
18. colonisation.mp.
19. 16 or 17 or 18
20. 3 or 7 or 11 or 15 or 19
21. 1 and 2 and 20
