



**衛生防護中心**  
Centre for Health Protection

# **Recommendations on Prevention of Intravascular Catheter Associated Bloodstream Infection**

Version 3.0

**Scientific Committee on Infection Control, and  
Infection Control Branch, Centre for Health  
Protection, Department of Health**



衛生防護中心乃衛生署  
轄下執行疾病預防  
及控制的專業架構  
The Centre for Health  
Protection is a  
professional arm of the  
Department of Health for  
disease prevention  
and control

**December 2024**

## Membership (2024)

Chairperson : Dr. YUNG Wai Hung, Raymond, M.H.  
Members : Dr. CHEN Hong  
Ms. CHING Tai Yin, Patricia, M.H.  
Dr. CHOI Kin Wing  
Dr. FUNG Sau Chun, Kitty  
Dr. HO Pak Leung, J.P.  
Prof. HUI Shu Cheong, David, B.B.S.  
Ms LAI Wai Man, Yvette  
Dr. LAI Wai Man, Raymond  
Dr. LAM Tin Keung, Edman  
Prof. LI Yuguo  
Prof. Margaret IP  
Dr. NG Kwok Po, Eddy  
Dr NG Sheung Chun  
Dr. QUE Tak Lun  
Dr. SETO Wing Hong, S.B.S.  
Dr. TAI Lai Bun  
Secretary : Dr. LOW Hon Kei, Kelvin

## Correspondence

Address : Scientific Committee on Infection Control Secretariat  
G/F Infection Control Branch,  
Centre for Health Protection, 147C Argyle Street, Kowloon,  
Hong Kong  
Telephone : 2125 2916  
Fax : 3523 0515  
E-mail : [sc\\_chairman@dh.gov.hk](mailto:sc_chairman@dh.gov.hk)

## **Background**

The Scientific Committee on Infection Control (SCIC) endeavours to prevent healthcare associated infections including Intravascular Catheter Associated Bloodstream Infection. The recommendations provided by SCIC serve as guidance for the hospital colleagues in the formulation of strategies, programmes and plans for the prevention of intravascular catheter associated bloodstream infection.

## **Acknowledgements**

The SCIC would like to express the most sincere thanks to the following parties for their dedication and valuable contribution to the preparation of the “Recommendations on Prevention of Intravascular Catheter Associated Bloodstream Infection”.

### **I. Guidelines review group (3rd edition)**

#### **i. External reviewers:**

Dr. Anucha Apisarnthanarak, MD.  
Professor in Infectious Diseases, Faculty of Medicine, Thammasat University Hospital, Thailand.

Prof. Victor D. Rosenthal, MD, PhD  
Research Associate Professor, Department of Public Health Sciences, University of Miami Miller School of Medicine.  
Founder and Chief Scientific Officer, International Nosocomial Infection Control Consortium (INICC), Miami, U.S.

#### **ii. Internal reviewers:**

Dr. CHEN Hong (Head, ICB)  
Dr. LUI, Leo (AC, ICB)  
Dr. LOW Hon Kei, Kelvin (SMO, ICB)  
Dr. SHING Suet Ying, Bianca (MO, ICB)  
Dr. YUEN Wing Sze (MO, ICB)  
Mr. NG Ngai Ming, Anthony (SNO, ICB)  
Ms. TSANG Yuen Ki, Candy (APN, ICB)  
Mr. YIP Ka Chun, Jeff (NO, ICB)  
Ms. WONG Lai Man, Shirley (APN, ICB)  
Ms. KWOK Ka Ling (APN, ICB)

## **II. Guidelines review group (2nd edition)**

### **i. External reviewer:**

Dr. Anucha Apisarnthanarak, MD.  
Professor in Infectious Diseases  
Faculty of Medicine  
Thammasat University Hospital  
Thailand

### **ii. Internal reviewers:**

Dr. WONG Tin Yau, Andrew (Head, ICB)  
Dr. CHEN Hong (AC, ICB)  
Dr. LEE Wai Yan, Joyce (MO, ICB)  
Ms. LEUNG Suk Yee, Jane (APN, ICB)  
Ms. FU Kit Yee (APN, ICB)  
Ms. TSANG Yuen Ki, Candy (APN, ICB)

## **III. Ex-members of guideline development group (1st edition)**

### **i. Recommendations development work group**

Dr. Ada WONG (MO, EHS, DH)  
Dr. Lisa YIP (MO, EHS, DH)  
Ms. CHOW Sin Cheung (NO, ICT, RTSKH)  
Ms. FONG Oi Wah (NO, PHSB, CHP)  
Ms. HO Yuk Yin (APN, ICT, TWH)  
Mr. KAN Chun Hoi (SNO, ICT, TMH)  
Ms. Stella KWOK (SNO, HKBH)  
Ms. Joan LAU (NO, EHS, DH)  
Ms. LEUNG Fung Yee (DOM, ICU, PMH and YCH)  
Mr. LEUNG Tsz Kin (APN, ICT, PWH)  
Ms. Amy LUK (SNO, HKBH)  
Ms. Amy SIT (NS, ICT, TPH)  
Ms. TAM Oi Yi, Catherine (NO, ICT, PYNEH)  
Mr. TSOI Wai Lun (NS, ICT, UCH)  
Ms. Susanna WONG (NO, EHS, DH)  
Ms. Babbitt WOUN (APN, ICT, TMH)  
Mr. YU Man Kit (APN, ICT, QEH)

### **ii. Infection Control Branch core-working group**

Dr. WONG Tin Yau, Andrew (Deputising Head)  
Dr. YUNG Wai Hung, Raymond (Head)  
Dr. CHUANG Wai Man, Vivien (AC)  
Dr. TSANG Kay Yan (MO)  
Mr. LEE Kai Yip, Ralph (OH)

Ms. CHAN Toi Lan (NO)  
Ms. CHAN Wai Fong (APN)  
Ms. LEUNG Suk Yee, Jane (APN)  
Ms. LUNG Wan Tin (APN)  
Ms. CHAN Mei Mei, Cindy (RN)  
Ms. YUEN Woon Wah, Maggie (RN)

**iii. External Consultation Parties**

Dr Victor D. Rosenthal, MD, CIC, MSc. Chairman, International  
Nosocomial Infection Control Consortium (INICC)  
Members of Central Committee on Infectious Diseases and Emergency  
Response, Hospital Authority  
Chairman, Infection Control Committee, Department of Health  
Representatives from private hospitals

## Contents

Introduction .....	7
Recommendations on Prevention of Intravascular Catheter Associated Bloodstream Infection .....	7
1 Education, Quality Assurance and Surveillance .....	7
2 General Aspects .....	8
2.1 Hand hygiene .....	8
2.2 Use aseptic technique for catheter insertion and catheter site care .....	8
2.3 Catheter and site care .....	8
3 Care of Specific Catheters.....	9
3.1 Central venous catheters (CVCs), including peripherally inserted central venous catheters (PICCs), haemodialysis (HD) and pulmonary artery catheters (PACs) .....	9
3.2 Peripheral venous catheters .....	11
3.3 Peripheral arterial catheters .....	12
3.4 Pressure monitoring systems .....	12
3.5 Umbilical catheters.....	12
4 Maintenance of Administration Sets .....	12
5 Care of Infusate, IV Medication and Admixture .....	13
6 Needleless Intravascular Catheter Systems .....	14
7 Special Considerations for the Prevention of CABSI .....	14
References .....	16
Appendix I: Visual Infusion Phlebitis (VIP) Scale .....	21
Appendix II: Checklist of Recommendations for Various Catheters .....	22

## Introduction

Use of vascular catheters has become an indispensable part of modern medicine practice. They are widely used in healthcare settings. Their use may put patients at risk for local and systemic infectious complications such as local site infection or bloodstream infection. (1)

2. The causes of Catheter Associated Bloodstream Infection (CABSI) include migration of micro-organisms from the skin at the insertion site into the cutaneous tract of the catheter, contamination of the catheter hub as well as other less common sources. This guideline provides healthcare professionals with background information and recommendations to reduce the incidence of CABSI and emphasizes strategies on minimizing these hazards when using different intravascular catheters. Regarding the specific recommendations on haemodialysis catheter care, please refer to “[Infection Control Guidelines on Nephrology Services in Hong Kong](#)” for details.

## Recommendations on Prevention of Intravascular Catheter Associated Bloodstream Infection

Prevention of CABSI depends on integrating best practices to reduce the risk of infection and incorporating a culture to support implementation. Both technical and behavioral components of prevention strategies are important. The key elements for successful implementation include active engagement of frontline, senior leaders and other stakeholders; training of healthcare workers on indications, insertion, and maintenance of devices; regular assessment of competencies using standardized checklist; providing feedback to healthcare workers on their performance; setting clear and achievable goals by multidisciplinary team; conducting surveillance to facilitate understanding of gaps and ways of further improvement. (2)

### 1 Education, Quality Assurance and Surveillance

- 1.1 Develop educational programs regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of intravascular catheters, and appropriate infection control measures to prevent CABSI. (3–5)
- 1.2 Re-educate and train healthcare workers when an institution changes components of the infusion system that requires a change in practice (eg, when an institution’s change of the needleless connector requires a change in nursing practice). (2)
- 1.3 Ensure persons who insert or manage intravascular catheters are

trained and competent for the procedure. (3)

- 1.4 Well-organized surveillance program that can monitor and evaluate the performance of care is one of the tools for the prevention of the CABSI. (4) Both process and outcome measures on the care of intravascular catheter should be monitored. For the infection rate, it is preferable to express it by an incidence density such as “CABSI per 1000 catheter days”. (6, 7)

## 2 General Aspects

### 2.1 Hand hygiene

Perform hand hygiene procedures, either by washing hands with soap and water or with alcohol-based hand rubs (ABHR), before and after inserting, accessing, dressing catheters and palpating catheter insertion sites. (3,8–10)

### 2.2 Use aseptic technique for catheter insertion and catheter site care

2.2.1 Prepare skin with an antiseptic, e.g. 70% alcohol for peripheral venous catheter insertion, 2% chlorhexidine in alcohol for CVC and peripheral arterial catheter insertion and dressing changes. (2,3,9,11,12)

2.2.2 No recommendation can be made for the safety or efficacy of chlorhexidine in infants aged <2 months. (2,3)

2.2.3 For CVC insertion and dressing changes, apply repeated up and down, back and forth strokes for at least 30 seconds starting at the insertion site and working outward to the periphery. (12,13).

2.2.4 Antiseptics should be allowed to dry. (2,3,9,12)

2.2.5 Use clean gloves for peripheral intravascular catheter insertion; do not touch the insertion site after the application of skin antiseptics. Wear sterile gloves for the insertion of arterial and central venous catheters. (3,14)

### 2.3 Catheter and site care

2.3.1 Use sterile, transparent, semipermeable dressing or sterile gauze to cover the catheter site. (3,11,15,16)

2.3.2 A gauze dressing is preferred if the site is bleeding, oozing or the patient is diaphoretic. (2,3,9,11)

2.3.3 Replace dressing if it becomes damp, loosened, or visibly



soiled. (2,3,9,11)

2.3.4 Leave the transparent semipermeable membrane dressing applied to a peripheral cannula insertion site in situ for the life of the cannula, provided that the integrity of the dressing is retained. (9,17)

2.3.5 Evaluate the catheter insertion site at least daily by palpation to discern tenderness and by inspection if a transparent dressing is in use. (3,14) Assessment tools (e.g. Visual Infusion Phlebitis (VIP) scale in Appendix I) (18) can be used to evaluate the condition of catheter site and document the reason for removal. (19,20) Gauze and opaque dressings should not be removed if the patient has no clinical signs of infection (except for CVC, refer to 3.1.8). If the patient has local tenderness or other signs of possible CABSI, an opaque dressing should be removed and the site inspected. (3)

2.3.6 Remove the catheter when it is no longer necessary. (2,4,21)

2.3.7 Document in records the followings (19,22):

- insertion date and time
- indication of insertion
- site of insertion
- condition upon assessment
- removal date and time
- reason of removal

### 3 Care of Specific Catheters

3.1 Central venous catheters (CVCs), including peripherally inserted central venous catheters (PICCs), haemodialysis (HD) and pulmonary artery catheters (PACs)

The central line bundle approach is a group of evidence-based interventions for patients with central venous catheters that, when implemented together, result in better outcomes than when implemented individually. The central line bundle consists of 5 key components:

- a. Hand hygiene
- b. Maximal barrier precautions
- c. 2% Chlorhexidine skin antiseptics
- d. Optimal catheter site selection, with subclavian vein as the preferred site for non-tunneled catheters
- e. Daily review of line necessity, with prompt removal of unnecessary lines.

This is not intended to be a comprehensive list of all elements of care related to central venous catheters. Other elements of care, such as daily site care and selection of dressing material, are not excluded for any purpose other than to have a bundle that is focused. (2,23)

- 3.1.1 Use maximal sterile barrier precautions (including the use of all-inclusive procedure carts or kits such as cap, mask, sterile gloves, sterile gown, one large sterile drape, and other necessary supplies) for insertion of central venous catheter. (2,3,11,24)
- 3.1.2 Use new sterile gloves before handling the new catheter when guidewire exchanges are performed. (3)
- 3.1.3 Weigh the risks and benefits of placing a central venous catheter at a recommended site to reduce infectious complications against the risk for mechanical complications. (3)
  - a. Avoid using the femoral vein in adult patients, particularly in obese patients. (2,3)
  - b. A subclavian site is preferred to a jugular or femoral site in adult. (3,11)
  - c. Alternatively, PICCs can be used because of low risk of CABS. (25-27)
- 3.1.4 Prepare skin with antiseptic chlorhexidine 2% in 70% isopropyl alcohol which has been proven to provide better skin antisepsis than other antiseptic agents such as povidone-iodine solutions. (2,3,9,11,12,23)
- 3.1.5 For ultrasound guided insertion, use sterile sheath and sterile gel for ultrasound transducer. (24,28) Remove the ultrasound gel thoroughly before applying the dressing.
- 3.1.6 Minimal numbers of ports and lumens of central venous catheters essential for management of patients should be used. (3,11,29)
- 3.1.7 Designate a CVC line or one port of a multi-lumen CVC for exclusive use of parenteral nutrition. (9,11,12,30)
- 3.1.8 Replace gauze dressing every 2 days and transparent dressing every 7 days for short-term CVC. The risk of catheter dislodging should be weighed for changing of dressing in paediatric patients. (2,3,9,11,12)
- 3.1.9 For adult patients, use of chlorhexidine-impregnated dressings can be considered on the insertion site of short-term, non-tunnelled central venous catheters. (3,31)

- 3.1.10 Routine replacement of intravascular catheters is not necessary if they are functioning and have no evidence of causing local or systemic complications. (2,3,11)
- 3.1.11 Do not replace intravascular catheters over guidewire if CABSIs is suspected. (3,11)
- 3.1.12 Promptly remove the catheter when it is no longer essential. (2,3) When adherence to aseptic technique cannot be ensured (i.e. catheters inserted during a medical emergency), replace the catheter as soon as possible, i.e. within 48 hours. (3)
- 3.1.13 Use a sterile sleeve for all pulmonary artery catheters. (3)
- 3.1.14 Please refer to “[Infection Control Guidelines on Nephrology Services in Hong Kong](#)” for recommendations on haemodialysis catheter care.

## 3.2 Peripheral venous catheters

- 3.2.1 It is suggested to use the distal arm veins over the proximal section of the upper limb (cubital fossa or above) and to use upper limb over the lower limb for catheter insertion for both adults and pediatric patients. Sites other than the scalp veins should generally be prioritized over scalp veins for insertion of catheter in neonates. (14)
- 3.2.2 Veins should be selected on the non-dominant forearm if possible. The basilic or cephalic veins on the posterior (dorsal) forearm are the preferred site for catheterization. (32)
- 3.2.3 For adults, no need to replace catheters more frequently than every 72-96 hours. If sites for venous access are limited, catheter can be maintained for longer period but close monitoring of insertion site is necessary. For paediatric patients, only replace catheters when clinically indicated. (3)
- 3.2.4 Remove the peripheral intravascular catheter if there are signs of phlebitis or malfunctioning. (3)
- 3.2.5 Flush the peripheral intravascular lock or needle free device with normal saline daily (19) for maintaining the patency and lowering the overall catheter-related complications though they are not necessarily infection related. (9,11,33)
- 3.2.6 Efficacy of normal saline solution as an alternative to heparin solution for the maintenance of peripheral IV devices is to eliminate the risk of heparin-induced thrombocytopenia, thrombus, haemorrhage and medication incompatibility which can provide a safer therapy for patient as well as cost savings. (33–35) Therefore, normal saline flush is superior

and preferable.

### 3.3 Peripheral arterial catheters

- 3.3.1 A minimum of a cap, mask, sterile gloves and a small sterile fenestrated drape should be used during insertion. During axillary or femoral artery catheter insertion, maximal sterile barriers precautions should be used. (3)
- 3.3.2 For adults, use of the radial, brachial or dorsalis pedis sites is preferred over the femoral or axillary sites. For children, the brachial site should not be used. The radial, dorsalis pedis, and posterior tibial sites are preferred over the femoral or axillary sites. (3)
- 3.3.3 Do not routinely replace. Replace only when clinically indicated. (3)
- 3.3.4 Use disposable transducer assemblies when possible. (3)
- 3.3.5 Replace the transducers assemblies at least every 96 hours together with other components of the system, including the tubing, continuous-flush device and flush solution. (3)

### 3.4 Pressure monitoring systems

- 3.4.1 Keep all components of the system sterile. (3)
- 3.4.2 Use a closed (continuous) flushing system to maintain the patency of the system. (3)
- 3.4.3 Do not infuse the dextrose-containing solution or parenteral nutrition fluids through the system. (3)

### 3.5 Umbilical catheters

- 3.5.1 Avoid tincture of iodine for disinfection of umbilical insertion site in newborn infants. Other iodine-containing preparation, for example, povidone iodine, is acceptable. (3)

## 4 Maintenance of Administration Sets

- 4.1 Replace administration sets including extension tubings and add-on devices at least every 7 days, unless CABSIs is suspected or confirmed. (2,3,11,14,36,37,38)
- 4.2 Replace administration sets transfusing blood, blood products or lipid containing solutions after administration or within 24 hours. (3,11,14)

- 4.3 Disinfect IV injection port, stopcocks, needleless intravascular device or heparin-block with 70% alcohol, 2% chlorhexidine in alcohol or iodophor preparation before access. (2,3,9,11,12)
- 4.4 IV injection port: there have been reports of higher infection rate associated with the use of stopcocks. (39–43) When stopcocks are to be used, cap all stopcocks when not in use. (3)
- 4.5 Do not draw blood specimens through single-lumen peripheral or central venous catheters intended for infusions except when catheter-associated bacteremia is suspected. Dedicate a specific lumen from a multi-lumen for blood-letting. (44)
- 4.6 Maintain a closed infusion system.
  - 4.6.1 The closed infusion system has been shown to result in significant reduction in the incidence of CABSIs (3,45)
  - 4.6.2 The closed infusion system is defined as:
    - 1) the container of intravenous solution is fully collapsible (the residue after administration does not exceed 5% of the nominal volume), and hence does not require external air vent to allow the solution to empty AND
    - 2) the connecting administration set has no air-vent.

The whole infusion system is maintained closed to the external environment while infusing except for the situation listed in para 4.6.3.
  - 4.6.3 In the situation when intravenous solution or medication is delivered by a semi-rigid plastic or glass bottle, an air vent to empty the solution is allowed.
- 4.7 In-line filters: Do not use filters routinely for infection-control purposes. (9) There is no reliable evidence to support their efficacy in preventing BSI related to catheters, infusate or infusion system. They may become blocked, especially with certain solutions, e.g., dextran, lipids, mannitol, thereby increasing the number of line manipulations and decreasing the availability of administered drugs. However, they may have a role for parenteral nutrition solutions for reasons other than infection prevention. (9)

## 5 Care of Infusate, IV Medication and Admixture

- 5.1 Complete lipid-containing solutions within 24 hours of hanging the solution. For lipid emulsions alone, it should be completed within 12 hours, and at maximum within 24 hours. (46)
- 5.2 Use single-dose vial of parenteral additive and medication as far as possible. Do not combine the leftover content of single-use vials

for later use. (9,46)

- 5.3 Disinfect diaphragm of the multidose vials with 70% alcohol before insertion. Sterile device should be used. (46)
- 5.4 Discard multidose vial of parenteral additive and medication if contaminated. (46)
- 5.5 Do not use any parenteral fluid or admixture that has visible turbidity, containing particulate matter or container with leaks or cracks. Save and report the item for investigation. (46)
- 5.6 Do not adopt routine culture of parenteral fluids, as a check on sterility for infection preventive measure. (44)
- 5.7 Attach a distinctive supplementary label to each admixed parenteral fluid stating the additives and dosage, the date and time of compounding, the expiration time and the signature of the person who did the compounding. (44)

## **6 Needleless Intravascular Catheter Systems**

- 6.1 Scrub the access port with an appropriate antiseptic for at least 15 seconds and access the port only with sterile devices to minimize the risk of contamination. (2,3,9,11,47–49)
- 6.2 Replace caps or needleless connectors no more frequently than at 72-hour intervals unless clinically indicated or follow the manufacturers' recommendations. (3,9)
- 6.3 Replace needleless components at least as frequently as the administration set and ensure the components are compatible to minimize the leaks and breaks in the system. (3,9)

## **7 Special Considerations for the Prevention of CABSIs**

- 7.1 There is no conclusive evidence to adopt any kinds of agents to be the lock solution for preventing CABSIs. (3)
- 7.2 Do not routinely use antibiotic lock solutions to prevent CABSIs. Use prophylactic antibiotic lock solution only in special situations, such as in treating a patient with a long-term cuffed or tunneled catheter, or port who has a history of multiple infections despite optimal maximal adherence to aseptic technique. (2,3,9,11)
- 7.3 The use of an antimicrobial- or antiseptic-impregnated catheter should be based on the need to enhance prevention of CABSIs after maximizing the adherence of infection control measures (educating personnel, using maximal sterile barrier precautions and using 2% Chlorhexidine skin antisepsis). (2,3,11,50,51)

- 7.4 When using antimicrobial- or antiseptic-impregnated catheters, monitor patients for untoward effects, such as anaphylaxis. (2,3,11)
- 7.5 Prophylactic antimicrobials: Do not administer intranasal or systemic antimicrobial prophylaxis routinely before insertion or during use of an intravascular catheter to prevent catheter colonization or bloodstream infection. (2,3,9,11)

December 2024

The copyright of this paper belongs to the Centre for Health Protection, Department of Health, Hong Kong Special Administrative Region. Contents of the paper may be freely quoted for educational, training and non-commercial uses provided that acknowledgement be made to the Centre for Health Protection, Department of Health, Hong Kong Special Administrative Region. No part of this paper may be used, modified or reproduced for purposes other than those stated above without prior permission obtained from the Centre.

## References

1. Farr BM. Nosocomial infections related to use of intravascular devices inserted for short-term vascular access. *Hospital epidemiology and infection control*. 3rd ed. Baltimore: Williams & Wilkins. 2004:231–40.
2. Buetti N, Marschall J, Drees M, Fakhri MG, Hadaway L, Maragakis LL, et al. Strategies to prevent central line-associated bloodstream infections in acute-care hospitals: 2022 Update. *Infect Control Hosp Epidemiol*. 2022 May;43(5):553-569.
3. Centers for Disease Control and Prevention. Guidelines for the prevention of intravascular catheter-related infections [Internet]. 2011 [updated October 2017]. Available from: <https://www.cdc.gov/hicpac/pdf/guidelines/bsi-guidelines-2011.pdf>
4. O’Grady NP, Alexander M, Dellinger EP, Gerberding JL, Heard SO, Maki DG, et al. Guidelines for the prevention of intravascular catheter-related infections. *Pediatrics*. 2002 Nov;110(5):e51.
5. Berenholtz SM, Pronovost PJ, Lipsett PA, Hobson D, Earsing K, Farley JE, et al. Eliminating catheter-related bloodstream infections in the intensive care unit. *Crit Care Med*. 2004 Oct;32(10):2014–20.
6. Maki DG, Kluger DM, Crnich CJ. The risk of bloodstream infection in adults with different intravascular devices: a systematic review of 200 published prospective studies. *Mayo Clin Proc*. 2006 Sep;81(9):1159–71.
7. Centers for Disease Control and Prevention. Bloodstream infection event (central line-associated bloodstream infection and non-central line-associated bloodstream infection). Device-associated Module BSI. 2024.
8. Centers for Disease Control and Prevention. Guideline for hand hygiene in health-care settings: recommendations of the healthcare infection control practices advisory committee and the HICPAC/SHEA/APIC/IDSA hand hygiene task force. *MMWR Recomm Rep*. 2002 Oct;51(RR-16):1-45, quiz CE1-4.
9. National Institute for Health and Care Excellence. Healthcare-associated infections: prevention and control in primary and community care. Clinical guideline. Clinical guideline [CG 139] [Internet]. 2012 [updated February 2017]. Available from: <https://www.nice.org.uk/guidance/cg139>
10. Pittet D. Improving compliance with hand hygiene in hospitals. *Infect Control Hosp Epidemiol*. 2000 Jun;21(6):381–6.
11. Loveday HP, Wilson JA, Pratt RJ, Golsorkhi M, Tingle A, Bak A, et al. epic3: national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. *J Hosp Infect*. 2014 Jan;86 Suppl 1:S1-70.
12. National Health Service. Guideline for interdisciplinary care and maintenance of long-term central venous catheters, in patients with cancer. 2013.
13. Department of Health, Australia. Guideline for percutaneous central venous catheters [Internet]. 2015. Available from: [https://www.health.qld.gov.au/\\_data/assets/pdf\\_file/0028/444493/icare-](https://www.health.qld.gov.au/_data/assets/pdf_file/0028/444493/icare-)



- [pcvc-guideline.pdf](#)
14. World Health Organization. Guidelines for the prevention of bloodstream infections and other infections associated with the use of intravascular catheters. Part I: peripheral catheters [Internet]. 2024. Available from: <https://www.who.int/publications/i/item/9789240093829>
  15. Australian Commission on Safety and Quality in Healthcare. Australian Guidelines for the prevention and control of infection in healthcare [Internet]. 2019 [updated April 2024]. Available from: <https://www.safetyandquality.gov.au/publications-and-resources/resource-library/australian-guidelines-prevention-and-control-infection-healthcare>
  16. Ullman AJ, Cooke ML, Mitchell M, Lin F, New K, Long DA, et al. Dressings and securement devices for central venous catheters (CVC). *Cochrane Database Syst Rev*. 2015 Sep;(9):CD010367.
  17. Salisbury NHS Foundation Trust. Arterial line management.
  18. Jackson A. Infection control: a battle in vein infusion phlebitis. *Nurs Times*. 1998 Jan;94(4):68-71.
  19. Nickel B, Gorski L, Kleidon T, Kyes A, DeVries M, Keogh S, et al. Infusion therapy standards of practice, 9th edition. *J Infus Nurs*. 2024 Jan;47(1S):S1-S285.
  20. Royal College of Nursing. Standards for infusion therapy, fourth edition [Internet]. 2016. Available from: <https://www.rcn.org.uk/clinical-topics/Infection-prevention-and-control-advice/Standards-for-infusion-therapy>
  21. Richet H, Hubert B, Nitemberg G, Andremont A, Buu-Hoi A, Ourbak P, et al. Prospective multicenter study of vascular-catheter-related complications and risk factors for positive central-catheter cultures in intensive care unit patients. *J Clin Microbiol*. 1990 Nov;28(11):2520-5.
  22. Hoskins A, Worth LJ, Malloy MJ, Smith M, Atkins S, Bennett N. Evaluating peripheral intravascular catheter insertion, maintenance and removal practices in small hospitals using a standardized audit tool. *Nurs Open*. 2022 May;9(3):1912-17.
  23. Institute for Healthcare Improvement, USA. How-to Guide: Prevent Central LineAssociated Bloodstream Infections (CLABSI). 2012.
  24. Franco-Sadud R, Schnobrich D, Mathews BK, Candotti C, Abdel-Ghani S, Perez MG, et al. Recommendations on the use of ultrasound guidance for central and peripheral vascular access in adults: a position statement of the society of hospital medicine. *J Hosp Med*. 2019 Sep;14(9):E1-22.
  25. Chopra V, O'Horo JC, Rogers MA, Maki DG, Safdar N. The risk of bloodstream infection associated with peripherally inserted central catheters compared with central venous catheters in adults: a systematic review and meta-analysis. *Infect Control Hosp Epidemiol*. 2013 Sep;34(9):908-18.
  26. Rosenthal VD, Yin R, Rodrigues C, Myatra SN, Divatia JV, Biswas SK, et al. Multinational prospective cohort study of incidence and risk factors for central line-associated bloodstream infections over 18 years in 281 ICUs of 9 Asian countries. *J Vasc Access*. 2024 Sep;25(5):1508-18.

27. Rosenthal VD, Yin R, Myatra SN, Memish ZA, Rodrigues C, Kharbanda M, et al. Multinational prospective study of incidence and risk factors for central-line-associated bloodstream infections in 728 intensive care units of 41 Asian, African, Eastern European, Latin American, and Middle Eastern countries over 24 years. *Infect Control Hosp Epidemiol*. 2023;44(11):1737-47.
28. AIUM Practice Parameter for the Use of Ultrasound to Guide Vascular Access Procedures. *J Ultrasound Med*. 2019 Mar;38(3):E4–18.
29. Dezfulian C, Lavelle J, Nallamotheu BK, Kaufman SR, Saint S. Rates of infection for single-lumen versus multilumen central venous catheters: a meta-analysis. *Crit Care Med*. 2003 Sep;31(9):2385–90.
30. Pittiruti M, Hamilton H, Biffi R, MacFie J, Pertkiewicz M, ESPEN. ESPEN guidelines on parenteral nutrition: central venous catheters (access, care, diagnosis and therapy of complications). *Clin Nutr*. 2009 Aug;28(4):365–77.
31. Puig-Asensio M, Marra AR, Childs CA, Kukla ME, Perencevich EN, Schweizer ML. Effectiveness of chlorhexidine dressings to prevent catheter-related bloodstream infections. Does one size fit all? A systematic literature review and meta-analysis. *Infect Control Hosp Epidemiol*. 2020 Dec;41(12):1388-95.
32. Queensland Health, Australia. Guideline for Peripheral Intravenous Catheter (PIVC) [Internet]. 2015. Available from: [https://www.health.qld.gov.au/\\_data/assets/pdf\\_file/0025/444490/icare-pivc-guideline.pdf](https://www.health.qld.gov.au/_data/assets/pdf_file/0025/444490/icare-pivc-guideline.pdf)
33. Goode CJ, Titler M, Rakel B, Ones DS, Kleiber C, Small S, et al. A meta-analysis of effects of heparin flush and saline flush: quality and cost implications. *Nurs Res*. 1991 Dec;40(6):324–30.
34. Campbell SG, Trojanowski J, Ackroyd-Stolarz SA. How often should peripheral intravenous catheters in ambulatory patients be flushed? *J Infus Nurs*. 2005 Dec;28(6):399–404.
35. LeDuc K. Efficacy of normal saline solution versus heparin solution for maintaining patency of peripheral intravenous catheters in children. *J Emerg Nurs*. 1997 Aug;23(4):306–9.
36. Gillies D, O’Riordan L, Wallen M, Morrison A, Rankin K, Nagy S. Optimal timing for intravenous administration set replacement. *Cochrane Database Syst Rev*. 2005 Oct;(4):CD003588.
37. Ullman AJ, Cooke ML, Gillies D, Marsh NM, Daud A, McGrail MR, et al. Optimal timing for intravascular administration set replacement. *Cochrane Database Syst Rev*. 2013 Sep;(9):CD003588.
38. Rickard CM, Marsh NM, Larsen EN, McGrail MR, Graves N, Runnegar N, et al. Effect of infusion set replacement intervals on catheter-related bloodstream infections (RSVP): a randomised, controlled, equivalence (central venous access device)-non-inferiority (peripheral arterial catheter) trial. *Lancet*. 2021 Apr;397(10283):1447-58.
39. Bouza E, Muñoz P, López-Rodríguez J, Jesús Pérez M, Rincón C, Martín Rabadán P, et al. A needleless closed system device (CLAVE) protects

- from intravascular catheter tip and hub colonization: a prospective randomized study. *J Hosp Infect.* 2003 Aug;54(4):279–87.
40. Yébenes JC, Vidaur L, Serra-Prat M, Sirvent JM, Batlle J, Motje M, et al. Prevention of catheter-related bloodstream infection in critically ill patients using a disinfectable, needle-free connector: a randomized controlled trial. *Am J Infect Control.* 2004 Aug;32(5):291–5.
  41. Rosenthal VD, Udwardia FE, Kumar S, Poojary A, Sankar R, Orellano PW, et al. Clinical impact and cost-effectiveness of split-septum and single-use prefilled flushing device vs 3-way stopcock on central line-associated bloodstream infection rates in India: a randomized clinical trial conducted by the International Nosocomial Infection Control Consortium (INICC). *Am J Infect Control.* 2015 Oct;43(10):1040-5.
  42. Rosenthal VD. Impact of needle-free connectors compared with 3-way stopcocks on catheter-related bloodstream infection rates: A meta-analysis. *Am J Infect Control.* 2020 Mar;48(3):281-4.
  43. Rosenthal VD. Clinical impact of needle-free connector design: A systematic review of literature. *J Vasc Access.* 2020 Nov;21(6):847-53.
  44. Public Health Agency of Canada. Infection control guidelines for preventing infections associated with indwelling intravascular access devices. *Canada Communicable Disease Report – Supplement 1997, Volume: 23S8.* 1997.
  45. Maki DG, Rosenthal VD, Salomao R, Franzetti F, Rangel-Frausto MS. Impact of switching from an open to a closed infusion system on rates of central line-associated bloodstream infection: a meta-analysis of time-sequence cohort studies in 4 countries. *Infect Control Hosp Epidemiol.* 2011 Jan;32(1):50-8.
  46. Centers for Disease Control and Prevention. Guideline for the prevention of intravascular catheter-related infections. *MMWR Recomm Rep.* 2002 Aug;51(RR-10):1-29.
  47. World Health Organization. My 5 moments for hand hygiene: focus on caring for a patient with a central venous catheter [Internet] 2015. Available from: [https://cdn.who.int/media/docs/default-source/integrated-health-services-\(ihs\)/hand-hygiene/posters/hh15-centralcatheter-web-en1f13ed89bbc74cedacf8178bc1df923c.pdf?sfvrsn=b3d4a158\\_6](https://cdn.who.int/media/docs/default-source/integrated-health-services-(ihs)/hand-hygiene/posters/hh15-centralcatheter-web-en1f13ed89bbc74cedacf8178bc1df923c.pdf?sfvrsn=b3d4a158_6)
  48. Ling ML, Apisarnthanarak A, Jaggi N, Harrington G, Morikane K, Thu le TA, et al. APSIC guide for prevention of central line associated bloodstream infections (CLABSI). *Antimicrob Resist Infect Control.* 2016 May;5:16.
  49. Health Protection Scotland. National Services Scotland. Targeted literature review: what are the key infection prevention and control recommendations to inform a central vascular catheter (CVC) maintenance care quality improvement tool? 2014.
  50. Wang H, Tong H, Liu H, Wang Y, Wang R, Gao H, et al. Effectiveness of antimicrobial-coated central venous catheters for preventing catheter-related blood-stream infections with the implementation of bundles: a systematic review and network meta-analysis. *Ann Intensive Care.* 2018

Jun;8(1):71.

51. Chong HY, Lai NM, Apisarnthanarak A, Chaiyakunapruk N. Comparative Efficacy of Antimicrobial Central Venous Catheters in Reducing Catheter-Related Bloodstream Infections in Adults: Abridged Cochrane Systematic Review and Network Meta-Analysis. Clin Infect Dis. 2017 May;64(suppl\_2):S131-40.

## Appendix I: Visual Infusion Phlebitis (VIP) Scale

<b>Visual Infusion Phlebitis Score</b> IV site appears healthy	<b>0</b>	No signs of phlebitis <b>OBSERVE CANNULA</b>
One of the following is evident: • Slight pain at IV site • Redness near IV site	<b>1</b>	Possible first sign of phlebitis <b>OBSERVE CANNULA</b>
Two of the following are evident: • Pain • Erythema • Swelling	<b>2</b>	Early stage of phlebitis <b>RESITE THE CANNULA</b>
All of the following signs are evident: • Pain along the path of the cannula • Erythema • Induration	<b>3</b>	Medium stage of phlebitis <b>RESITE THE CANNULA</b> <b>CONSIDER TREATMENT</b>
All of the following signs evident and extensive: • Pain along the path of the cannula • Erythema • Induration • Palpable venous cord	<b>4</b>	Advanced stage of phlebitis or start of thrombophlebitis <b>RESITE THE CANNULA</b> <b>CONSIDER TREATMENT</b>
All of the following signs are evident and extensive: • Pain along the path of the cannula • Erythema • Induration • Palpable venous cord • Pyrexia	<b>5</b>	Advanced stage of thrombophlebitis <b>INITIATE TREATMENT</b> <b>RESITE THE CANNULA</b>

© Andrew Jackson 1997 Rotherham General Hospitals NHS Trust

Permission has been obtained from Mr. Andrew Jackson.

## Appendix II: Checklist of Recommendations for Various Catheters

	Central Venous Catheter	Peripheral Venous Catheter	Peripheral Arterial Catheter
<b>Insertion</b>			
Hand hygiene, gloves and attire	<input type="checkbox"/> Hand hygiene <input type="checkbox"/> Sterile gloves <input type="checkbox"/> Maximal sterile barrier precautions <sup>†</sup>	<input type="checkbox"/> Hand hygiene <input type="checkbox"/> Clean gloves	<input type="checkbox"/> Hand hygiene <input type="checkbox"/> Sterile gloves <input type="checkbox"/> Cap, mask, and a small sterile fenestrated drape <input type="checkbox"/> Maximal sterile barrier precautions <sup>†</sup> if axillary or femoral artery is used
Skin antisepsis	<input type="checkbox"/> 2% chlorhexidine in alcohol <input type="checkbox"/> Repeated strokes for at least 30 sec from insertion site to the periphery <input type="checkbox"/> Allow to dry	<input type="checkbox"/> 70% alcohol <input type="checkbox"/> Allow to dry	<input type="checkbox"/> 2% chlorhexidine in alcohol <input type="checkbox"/> Allow to dry
Site selection	<input type="checkbox"/> Choose the best insertion site to minimize infections and noninfectious complications: <u>Adult:</u> <ul style="list-style-type: none"> <li>• Avoid femoral vein, particularly in obese patients</li> <li>• Subclavian site is preferred</li> <li>• PICC is an alternative</li> </ul>	<input type="checkbox"/> Choose the best insertion site to minimize infections and noninfectious complications: <u>Adult &amp; Children:</u> <ul style="list-style-type: none"> <li>• Use upper limb over lower limb</li> <li>• Use distal arm veins over proximal section of the upper limb (cubital fossa or above)</li> <li>• Select veins on non-dominant forearm</li> <li>• Basilic or cephalic veins on</li> </ul>	<input type="checkbox"/> Choose the best insertion site to minimize infections and noninfectious complications: <u>Adult:</u> <ul style="list-style-type: none"> <li>• Use radial, brachial or dorsalis pedis sites</li> </ul> <u>Children:</u> <ul style="list-style-type: none"> <li>• Use radial, dorsalis pedis or posterior tibial sites</li> <li>• Avoid brachial site</li> </ul>

	Central Venous Catheter	Peripheral Venous Catheter	Peripheral Arterial Catheter
		the posterior (dorsal) forearm are preferred	
Dressing	<input type="checkbox"/> Choose the most suitable dressing: <ul style="list-style-type: none"> <li>• Use sterile, transparent, semipermeable dressing or sterile gauze to cover the catheter site.</li> <li>• Use sterile gauze if bleeding, oozing or profuse sweating</li> <li>• Consider the use of chlorhexidine-impregnated dressings on the insertion site of short-term, non-tunnelled central venous catheters for adult patients</li> </ul>	<input type="checkbox"/> Choose the most suitable dressing: <ul style="list-style-type: none"> <li>• Use sterile, transparent, semipermeable dressing or sterile gauze to cover the catheter site.</li> <li>• Use sterile gauze if bleeding, oozing or profuse sweating</li> </ul>	
Documentation	Record the details of insertion, including: <ul style="list-style-type: none"> <li><input type="checkbox"/> Date and time</li> <li><input type="checkbox"/> Indication</li> <li><input type="checkbox"/> Site</li> </ul>		
<b>Maintenance</b>			
Assessment	<input type="checkbox"/> Hand hygiene <input type="checkbox"/> Evaluate the catheter insertion site daily for sign(s) of phlebitis.		
Dressing change	<input type="checkbox"/> Prepare skin with an antiseptic, e.g. 2% chlorhexidine in alcohol <input type="checkbox"/> Replace gauze dressing every 2 days and transparent dressing every 7 days for short-term CVC.	<input type="checkbox"/> Transparent semipermeable membrane dressing: leave in situ for the life of the cannula, provided that the integrity of the dressing is retained	<input type="checkbox"/> Prepare skin with an antiseptic, e.g. 2% chlorhexidine in alcohol <input type="checkbox"/> Transparent semipermeable membrane dressing: leave in situ for the life of the cannula,

	<b>Central Venous Catheter</b>	<b>Peripheral Venous Catheter</b>	<b>Peripheral Arterial Catheter</b>
	<input type="checkbox"/> Replace any dressing if damp, loosened, or visibly soiled	<input type="checkbox"/> Replace any dressing if damp, loosened, or visibly soiled	provided that the integrity of the dressing is retained <input type="checkbox"/> Replace any dressing if damp, loosened, or visibly soiled
Removal	<input type="checkbox"/> Evaluate the catheter insertion site at least daily. Promptly remove if no longer needed <input type="checkbox"/> If aseptic technique cannot be ensured (i.e. inserted during emergency), replace ASAP, i.e. within 48 hours.	<input type="checkbox"/> Evaluate the catheter insertion site at least daily. Promptly remove if no longer needed <input type="checkbox"/> Remove if sign(s) of phlebitis or malfunctioning	<input type="checkbox"/> Evaluate the catheter insertion site at least daily. Promptly remove if no longer needed
Documentation of assessment/ removal	Records the details of assessment/ removal, including: <input type="checkbox"/> Condition of catheter site <input type="checkbox"/> Removal date and time <input type="checkbox"/> Reason of removal		

† Maximal sterile barrier precautions: cap, mask, sterile gloves, sterile gown and one large sterile drape