

Benchmarking Central Venous Catheter Blood Stream Infections in Adult Critical Care

Network Guidance

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Contact	Claire Horsfield, Network Manager & Lead Nurse Claire.horsfield4@nhs.net
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Background and Rationale

The impact of HCAs on morbidity, mortality, length of stay and cost is well documented¹; as such many interventions have been developed to reduce HCAI incidence.

A 2-year programme which started in April 2009 was called “Matching Michigan” in reference to an earlier American study which demonstrated a large reduction in catheter related BSI using a range of technical and behavioural interventions². The Matching Michigan study observed a 60% reduction in CVC-BSI rates in adult ICUs after the intervention. This was adopted in the UK and demonstrated a reduction in CVC BSI³ and following this conclusion the Infection in Critical Care Quality Improvement Programme (ICCQIP) was developed.

The NHSE Adult Critical Care Service Specification⁴ stipulates that units should participate in ICCQIP and publish central venous catheter-related blood stream infection rates. Whilst many units have implemented strategies to minimise Health Care Associated Infections (HCAs), in relation to CVC BSIs, many are unable to demonstrate the effectiveness of these interventions and there is no comparative data to provide assurance to individual Trusts, commissioners or the Network Clinical Advisory Board.

Within the Network regular audits are undertaken to benchmark and promote best practice in relation to CVC management. Whilst this provides assurance of the processes, there is a lack of comparative outcome data in terms of CVC related blood stream infections. By applying a standard definition for diagnosing CVC BSIs and submitting data to the network, this will enable benchmarking of infection rates and will provide assurance.

Abbreviations and Definitions

Central venous catheter (CVC) - a vascular catheter that ends close to or in the great vessels (femoral, subclavian, jugular, aorta etc.); this includes peripherally inserted central catheters. CVCs can be short or long term. Common names (not exclusive) are PICC, CVC, portocath, tesio, hickman, etc.

Central venous catheter bloodstream infection (CVC BSI) - a bloodstream infection thought to be related to/associated with a central venous catheter

Infection in Critical Care Quality Improvement Programme (ICCQIP) - a clinician-led collaboration of professional organisations in intensive care, healthcare epidemiology, microbiology and infection prevention and control hosted by Public Health England.

¹ Eber MR, Laxminarayan R, Perencevich EN, Malani A. Clinical and economic outcomes attributable to health care-associated sepsis and pneumonia. *Arch Intern Med* 2010 Feb 22;170(4):347-53

² Pronovost P, Needham D, Berenholtz S, Sinopoli D, Chu H, Cosgrove S, et al. An intervention to decrease catheter-related bloodstream infections in the ICU. *N Engl J Med* 2006 Dec 28;355(26):2725-32.

³ Bion J, Richardson A, Hibbert P, Beer J, Abrusci T, McCutcheon M, 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 Feb;22(2):110-23.

⁴ NHSE Adult Critical Care Service Specification: <https://www.england.nhs.uk/wp-content/uploads/2019/05/220502S-adult-critical-care-service-specification.pdf>

Aims and Objectives

A small number of units in the Critical Care Network submit data via the ICCQIP, which is considered to be the gold standard. The reason for this is the time required to collect the comprehensive data set and lack of time allocated to clinicians to complete this. As such, this guidance has been developed to ensure all units are collecting CVC BSI data using the same criteria and allowing regional benchmarking. By applying ICCQIP definitions it avoids any additional burden for units already engaged with the national programme. It is also a starting point for those considering joining the initiative.

The overall aim of this document is to provide a standard definition for critical care units in the network to determine if a blood stream infection is related to /associated with the presence of a CVC.

Following agreement and implementation of this guidance, each unit will seek to introduce a process to apply the CVC BSI definition which will facilitate monthly data collection and submission to the network including;

The total number of CVC BSI's

The total number of CVC days

This will enable regional benchmarking of CVC BSI rates and will drive improvement, link to existing benchmarking data and will support compliance with commissioning and professional standards.

Criteria to determine CVC BSI

Step 1	Step 2	Step 3
<p>Evidence of a positive blood culture taken either:</p> <ul style="list-style-type: none"> 48 hours or more after CVC insertion <p>OR</p> <ul style="list-style-type: none"> within 48 hours of a CVC being removed 	<p>Has a pathogen been cultured from at least one blood culture bottle? (Appendix 1)</p> <p>OR</p> <p>Has a common skin commensal (Appendix2) been cultured from 2 blood cultures drawn on separate occasions and taken within a 48hr period</p> <p>AND</p> <p>The patient has at least ONE symptom of fever >38°C, chills or hypotension?</p>	<p>Is it likely that the patients' signs, symptoms and positive blood results, including pathogen cultured from blood, are related to the CVC and NOT an infection from another site?</p> <p><i>If unclear additional information to support diagnosis:</i></p> <p>I) quantitative CVC culture 103 CFU/ml or semi-quantitative CVC culture > 15 CFU</p> <p>II) quantitative blood culture ratio CVC blood sample/peripheral blood sample > 5</p> <p>III) differential delay of positivity of blood cultures: CVC blood sample culture positive 2 hours or more before peripheral blood culture (blood samples drawn at the same time)</p> <p>IV) positive culture with the same micro-organism from pus from insertion site</p> <p>V) symptoms improve within 48hr of removal of CVC</p> <p>Confirms diagnosis of CVC BSI</p>

Exclusions:

Repeat positive blood cultures taken within 7 days where the same organism(s) has/have been identified

NOTE: Subsequent positive blood cultures of a different species for the same patient should be reported as a new episode unless they are cultured within the same bottle/set
Treatment and management of identified CVC BSI's should follow local protocols.

Data Submission

Each month the network will collect data from each unit in the following format;

Unit:	(drop down list)
Month:	(drop down list)
Total No. of CVC line days	
Total No. of CVC BSIs	

Each unit to have an identified link person who will provide this information. Data to be submitted by the 4th of the following month.

An example data collection sheet for the CVC line days is provided in Appendix 3, but electronic patient records may be used to extract this information

Prevention of CVC BSI

The objectives of prevention are to reduce morbidity and mortality and reduce length of stay in ICU. There are many resources available to support best practice in relation to CVC insertion and on going care.

CVC Insertion Checklist

Local Safety Standards for Invasive Procedures (LocSSIPs) promote safe practice and reduce the risk of complications, with many units already using such checklists. The ICS and FICM have developed a CVC insertion checklist which is available for units to adapt if they do not currently have one, this can be found below and is accessible via this link: [CVC checklist oct23 2.pdf \(fcm.ac.uk\)](#)

CVC On-going care benchmark audit

The regional audit programme already exists which is used to provide benchmark data from all critical care units in the North East and Yorkshire (NEY). One of the audits relates to the care of CVCs and the best practice elements are assessed and presented via network forums. In addition to the regular audit, units have access to best practice tools to support improvement. Examples of the audit and improvement resources are available via the network website: [Benchmarking - SYBCCN.ORG](#)

Summary

This guideline provides a definition of CVC BSI that can be used to record and report the incidence on units. The collection and presentation of data at local unit and network forums will allow benchmarking and drive improvements in practice through collaboration. This approach is supporting compliance with ACC Service Specification Standards (DO5) and GPICS requirements.

Appendix 1- Recognised Pathogens

Pathogen	
ACHROMOBACTER SPECIES	GRAM POSITIVE BACILLI, NOT SPECIFIED /OTHER
ACINETOBACTER BAUMANNII	GRAM POSITIVE COCCI, NOT SPECIFIED /OTHER
ACINETOBACTER CALCOACETICUS	HAEMOPHILUS INFLUENZAE
ACINETOBACTER HAEMOLYTICUS	HAEMOPHILUS SP., NOT SPECIFIED /OTHER
ACINETOBACTER SP LWOFFI	HAEMOPHILUS PARAINFLUENZAE
ACINETOBACTER SP NOT SPECIFIED / OTHER	HAFNIA SPECIES
ACTINOMYCES SPECIES	HELICOBACTER PYLORI
AEROMONAS SPECIES	KLEBSIELLA SP., NOT SPECIFIED /OTHER
AGROBACTERIUM SPECIES	KLEBSIELLA OXYTOCA
ALCALIGENES SPECIES	KLEBSIELLA PNEUMONIAE
ANAEROBES, NOT SPECIFIED	LACTOBACILLUS SPECIES
OTHER ANAEROBES	LEGIONELLA SPECIES
ASPERGILLUS FUMIGATUS	LISTERIA MONOCYTOGENES
ASPERGILLUS NIGER	MORGANELLA SPECIES
ASPERGILLUS SP NOT SPECIFIED / OTHER	MORAXELLA CATHARRALIS
BACILLUS ANTHRACIS	MORAXELLA SP., NOT SPECIFIED /OTHER
BACTEROIDES FRAGILIS	MYCOBACTERIUM, ATYPICAL
BACTEROIDES SPECIES NOT SPECIFIED /OTHER	MYCOBACTERIUM TUBERCULOSIS COMPLEX
OTHER BACTERIA	MYCOPLASMA SPECIES
BURKHOLDERIA CEPACIA	NEISSERIA MENINGITIDIS
BURKHOLDERIA SPECIES	NEISSERIA SP., NOT SPECIFIED /OTHER
CAMPYLOBACTER SPECIES	NOCARDIA SPECIES
CANDIDA ALBICANS	OTHER PARASITES
CANDIDA GLABRATA	PASTEURELLA SPECIES
CANDIDA SP. NOT SPECIFIED /OTHER	PREVOTELLA SPECIES
CANDIDA PARAPSILOSIS	PROTEUS MIRABILIS
CANDIDA TROPICALIS	PROTEUS SP., NOT SPECIFIED /OTHER
CHLAMYDIA SPECIES	PROTEUS VULGARIS
CITROBACTER KOSERI (EX. DIVERSUS)	PROVIDENCIA SPECIES
CITROBACTER FREUNDII	PSEUDOMONAS AERUGINOSA
CITROBACTER SP NOT SPECIFIED /OTHER	PSEUDOMONADACEAE FAMILY, NOT SPECIFIED /OTHER
CLOSTRIDIUM DIFFICILE	SALMONELLA ENTERITIDIS
CLOSTRIDIUM OTHER	SALMONELLA SP., NOT SPECIFIED /OTHER
ENTEROBACTER AEROGENES	SALMONELLA TYPHIMURIUM
ENTEROBACTER AGGLOMERANS	SALMONELLA TYPHI OR PARATYPHI
ENTEROBACTER CLOACAE	SERRATIA LIQUEFACIENS
ENTEROBACTER GERGOVIAE	SERRATIA MARCESCENS
ENTEROBACTER SP., NOT SPECIFIED /OTHER	SERRATIA SP., NOT SPECIFIED /OTHER
ENTEROBACTER SAKAZAKII	SHIGELLA SPECIES
ENTEROCOCCUS FAECALIS	STAPHYLOCOCCUS AUREUS
ENTEROCOCCUS FAECIUM	STAPHYLOCOCCUS SP., OTHER
ENTEROCOCCUS SP NOT SPECIFIED /OTHER	STENOTROPHOMONAS MALTOPHILIA
ESCHERICHIA COLI	STREPTOCOCCUS AGALACTIAE
ENTEROBACTERIACEAE, NOT SPECIFIED/ OTHER	OTHER HAEMOL. STREPTOCOCCAE
FILAMENTS OTHER	STREPTOCOCCUS SP., NOT SPECIFIED /OTHER
FLAVOBACTERIUM SPECIES	STREPTOCOCCUS PNEUMONIAE
FUNGI, NOT SPECIFIED / OTHER	STREPTOCOCCUS PYOGENES
GARDNERELLA SPECIES	YEASTS, OTHER
OTHER GRAM- BACILLI, NON ENTEROBACTERIACIAEA	YERSINIA SPECIES
GRAM NEGATIVE COCCI, NOT SPECIFIED /OTHER	

Appendix 2- Skin Commensals

Skin Commensals	
AEROCOCCUS SPECIES	COAGULASE-NEGATIVE STAPHYLOCOCCI, NOT SPECIFIED/OTHER
BACILLUS SPECIES, OTHER	STAPHYLOCOCCUS EPIDERMIDIS
CORYNEBACTERIUM SPECIES	STAPHYLOCOCCUS HAEMOLYTICUS
MICROCOCCUS SPECIES	STREPTOCOCCUS (VIRIDANS GROUP)
PROPIONIBACTERIUM SPECIES	

Appendix 3 –CVC Line Days Example

Date	No. of CVC Lines										Total
	Bed 1	Bed 2	Bed 3	Bed 4	Bed 5	Bed 6	Bed 7	Bed 8	Bed 9	Bed 10	
1st Jan 2025	1	0	2	1	0	2	0	0	2	0	8
2nd Jan 2025	1	0	2	1	0	2	0	0	2	0	8
3rd Jan 2025	1	0	2	1	0	2	0	0	2	0	8
4th Jan 2025	1	0	2	1	0	2	0	0	2	0	8
5th Jan 2025	0	1	2	0	1	2	0	1	2	0	9
6th Jan 2025	0	1	2	0	1	2	0	1	2	0	9
7th Jan 2025	0	1	2	0	1	2	0	1	2	0	9
8th Jan 2025	0	1	2	0	1	2	0	1	2	0	9
9th Jan 2025	0	1	2	0	1	2	0	1	2	0	9
10th Jan 2025	0	1	2	0	1	2	0	1	2	0	9
11th Jan 2025	0	1	2	0	1	2	0	1	2	0	9
12th Jan 2025	0	1	2	0	1	2	0	1	2	0	9
13th Jan 2025	0	1	2	0	1	2	0	1	2	0	9
14th Jan 2025	0	1	2	0	1	2	0	1	2	0	9
15th Jan 2025	0	1	0	0	1	0	0	1	0	0	3
16th Jan 2025	1	1	0	1	1	0	1	1	0	1	7
17th Jan 2025	1	1	0	1	1	0	1	1	0	1	7
18th Jan 2025	1	1	0	1	1	0	1	1	0	1	7
19th Jan 2025	1	1	0	1	1	0	1	1	0	1	7
20th Jan 2025	1	1	0	1	1	0	1	1	0	1	7
21st Jan 2025	1	1	0	1	1	0	1	1	0	1	7
22nd Jan 2025	0	0	1	0	0	1	1	0	1	1	5
23rd Jan 2025	0	0	1	0	0	1	1	0	1	1	5
24th Jan 2025	0	0	1	0	0	1	1	0	1	1	5
25th Jan 2025	0	0	1	0	0	1	1	0	1	1	5
26th Jan 2025	0	0	1	0	0	1	1	0	1	1	5
27th Jan 2025	0	0	1	0	0	1	1	0	1	1	5
28th Jan 2025	1	0	1	1	0	1	1	0	1	1	7
29th Jan 2025	2	0	1	2	0	1	1	0	1	1	9
30th Jan 2025	2	0	1	2	0	1	1	0	1	1	9
31st Jan 2025	2	0	1	2	0	1	1	0	1	1	9
Total											231