Latest Global Evidence for CLABSI Prevention

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Disclosures

1. Disclosure of Relevant Financial Relationships

I have the following financial relationships to disclose:

- ❖I thank 3M for supporting my attendance at ACIPC 2023
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- ❖Associate Editor: *Infection, Disease & Health*

2. Disclosure of Off-Label and/or investigative Uses

I will not discuss off label use and/or investigational use in my presentation.

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Learning Objectives

By the end of the session, learners will be able to:

- Distinguish between CLABSI and CRBSI
- Discuss the latest evidence for CLABSI prevention
- Describe the 4E model of implementation

CLABSI

Surveillance definition, useful for tracking institutional and national trends.

Laboratory-confirmed bloodstream infection in a patient with a central venous catheter in place for >48 hours before the date on which blood was drawn for culture, if no other source of bacteremia or fungemia is identified.

No requirement for signs and symptoms of infection.

:. Probably overestimates the true incidence of CVAD-associated infection.

CRBSI

Clinical definition, used for diagnosis and treatment.

Laboratory-confirmed bloodstream infection in a patient with a central venous catheter in place for >48 hours before the date on which blood was drawn for culture, if no other source of bacteremia or fungemia is identified.

AND signs and symptoms of infection (e.g., fever, elevated white cell count, and erythema at the catheter exit site)

AND confirmation of the catheter as the sources of infection (tip cultures, matched blood cultures)

:. More accurate but not practical for surveillance

Guidelines for the prevention of intravascular catheter-related infections

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Bethesda, Maryland; Norwood, Worcester, Boston, Massachusetts; Staten Island, New York, Seattle, Washington; Milwaukee, Wisconsin; Baltimore, Maryland; Rhode Island; Atlanta, Georgia; Houston, Texas, Omaha, Nebraska; and Ann Arbor, Michigan

 (Am J Infect Control 2011;39:S1-S34.)

These guidelines have been developed for healthcare personnel who insert intravascular catheters and for persons responsible for surveillance and control of infections in hospital, outpatient, and home healthcare settings. This report was prepared by a working group comprising members from professional organizations representing the disciplines of critical care medicine, infectious diseases, healthcare infection control, surgery, anesthesiology, interventional radiology, pulmonary medicine, pediatric medicine, and nursing. The working group was led by the Society of Critical Care Medicine (SCCM), in collaboration with the Infectious Diseases Society of America (IDSA), Society for Healthcare Epidemiology of America (SHEA), Surgical Infection Society (SIS), American College of Chest Physicians (ACCP), American Thoracic Society (ATS), American Society of Critical Care Anesthesiologists (ASCCA), Association for Professionals in Infection Control and Epidemiology

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Potential conflicts of interest. N.P. O'G. served as a board member for the ABIM Subspecialty Board for Critical Care Medicine. M.A. is an employee of the Infusion Nurses Society. Honoraria from 3M, Becton Dickinson, Smiths Medical. L.A.B. is a consultant for Institute of Healthcare Improvement, Board membership for Theradoc, Medline. Honoraria from APIC, Clorox. E.P.D. consulting from Merck, Baxter, Ortho-McNeil, Targanta, Schering-Plough, Optimer, Cadence, Cardinal, BDGeneOhm, WebEx, Cerebrio, and Tyco. Grant support through the NIH. Payment for lecture from Merck. Payment for development of educational presentation from Medscape. Travel and meeting expenses paid for by ASHP, IDSA, ASM, American College of Surgeons, NQF, SHEA/CDC, HHS, Trauma Shock Inflammation and Sepsis Meeting (Munich), University of Minnesota. J.G. Honoria from Ethicon. S.O.H. provides research support from Angiotech; Honoraria from Angiotech, Merck. L.A.M provides research support from Astellas, Theravance, Pfizer; Consulting for Ash Access, Cadence, CorMedix, Catheter Connections, Carefusion, Sage, Bard, Teleflex; Payment for manuscript preparation from Catheter Connections. I.I.R. provides research support from Cubist, Enzon, and Basilea;Consulting for Clorox; Stock Equity or Options in Great Lakes Pharmaceuticalsand Inventive Protocol; Speakers Bureau for Cook, Inc.; Royalty income (patents owned by MD Anderson on which Dr. Raad in an inventor: American Medical Systems, Cook, Inc., Cook urological, Teleflex, TyRx, Medtronic, Biomet, Great Lakes Pharmaceuticals. A.R. consulting income from Eisai Pharmaceuticals, Discovery Laboratories. M.E.R. provides research support from Molnlycke, Cardinal Healthcare Foundation, Sanofi-Pasteur, 3M, and Cubist; Consulting from Semprus; Honorarium for lectures from 3M, Carefusion, Baxter and Becton Dickinson. Previously served on Board of Directors for Society for Healthcare Epidemiology of America. All other authors: no conflicts.

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The contents of this special supplement were developed completely under the auspices of the Centers for Disease Control and Prevention (CDC). Publication of the CDC "Guidelines for the Prevention of Intravascular Catheter-Related Infections" in *American Journal of Infection Control* was made possible by an educational grant from CareFusion Corporation.

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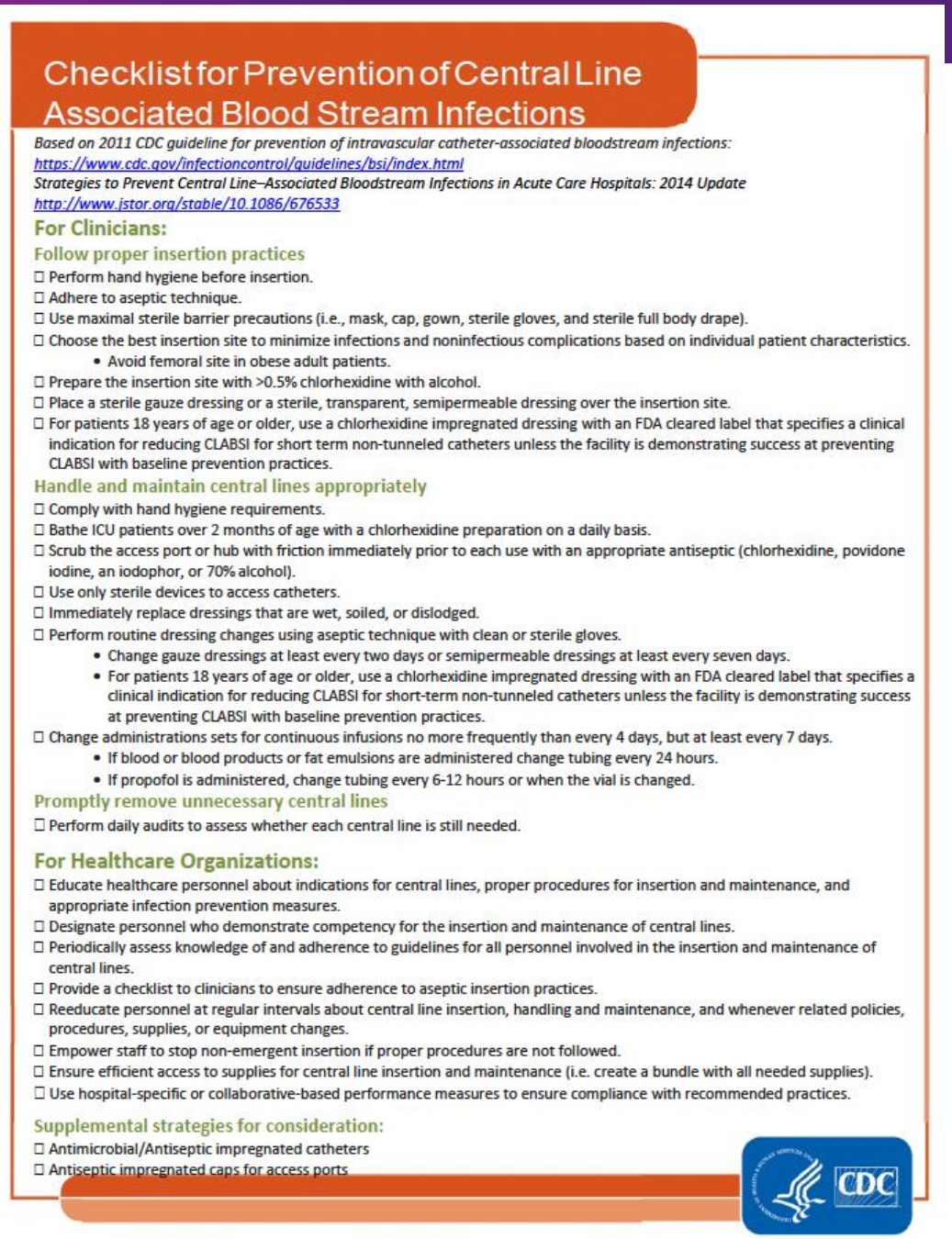
Centers for Disease Control and Prevention

2011 Guidelines (O'Grady)

- Education, training and staffing
- Selection of catheters and sites
- Hand hygiene & aseptic technique
- Maximal sterile barrier precautions
- Skin preparation
- Catheter site dressing regimens
- Patient cleansing
- Catheter securement devices
- Antimicrobial/Antiseptic impregnated catheters and cuffs
- Antibiotic lock prophylaxis, antimicrobial catheter flush, catheter lock
- Replacement of catheters, administration sets, needleless connectors
- Performance improvement (bundles, compliance, documentation)
- CLABSI surveillance



Checklist for Prevention of Central Line Associated Blood Stream Infections

Based on 2011 CDC guideline for prevention of intravascular catheter-associated bloodstream infections:
https://www.cdc.gov/infectioncontrol/guidelines/bsi/index.html
Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals: 2014 Update
http://www.jstor.org/stable/10.1086/676533

For Clinicians:

Follow proper insertion practices

- ☐ Perform hand hygiene before insertion.
- ☐ Adhere to aseptic technique.
- ☐ Use maximal sterile barrier precautions (i.e., mask, cap, gown, sterile gloves, and sterile full body drape).
- ☐ Choose the best insertion site to minimize infections and noninfectious complications based on individual patient characteristics.
  - Avoid femoral site in obese adult patients.
- ☐ Prepare the insertion site with >0.5% chlorhexidine with alcohol.
- ☐ Place a sterile gauze dressing or a sterile, transparent, semipermeable dressing over the insertion site.
- ☐ For patients 18 years of age or older, use a chlorhexidine impregnated dressing with an FDA cleared label that specifies a clinical indication for reducing CLABSI for short term non-tunneled catheters unless the facility is demonstrating success at preventing CLABSI with baseline prevention practices.

Handle and maintain central lines appropriately

- ☐ Comply with hand hygiene requirements.
- ☐ Bathe ICU patients over 2 months of age with a chlorhexidine preparation on a daily basis.
- ☐ Scrub the access port or hub with friction immediately prior to each use with an appropriate antiseptic (chlorhexidine, povidone iodine, an iodophor, or 70% alcohol).
- ☐ Use only sterile devices to access catheters.
- ☐ Immediately replace dressings that are wet, soiled, or dislodged.
- ☐ Perform routine dressing changes using aseptic technique with clean or sterile gloves.
  - Change gauze dressings at least every two days or semipermeable dressings at least every seven days.
  - For patients 18 years of age or older, use a chlorhexidine impregnated dressing with an FDA cleared label that specifies a clinical indication for reducing CLABSI for short-term non-tunneled catheters unless the facility is demonstrating success at preventing CLABSI with baseline prevention practices.
- ☐ Change administrations sets for continuous infusions no more frequently than every 4 days, but at least every 7 days.
  - If blood or blood products or fat emulsions are administered change tubing every 24 hours.
  - If propofol is administered, change tubing every 6-12 hours or when the vial is changed.

Promptly remove unnecessary central lines

- ☐ Perform daily audits to assess whether each central line is still needed.

For Healthcare Organizations:

- ☐ Educate healthcare personnel about indications for central lines, proper procedures for insertion and maintenance, and appropriate infection prevention measures.
- ☐ Designate personnel who demonstrate competency for the insertion and maintenance of central lines.
- ☐ Periodically assess knowledge of and adherence to guidelines for all personnel involved in the insertion and maintenance of central lines.
- ☐ Provide a checklist to clinicians to ensure adherence to aseptic insertion practices.
- ☐ Reeducate personnel at regular intervals about central line insertion, handling and maintenance, and whenever related policies, procedures, supplies, or equipment changes.
- ☐ Empower staff to stop non-emergent insertion if proper procedures are not followed.
- ☐ Ensure efficient access to supplies for central line insertion and maintenance (i.e. create a bundle with all needed supplies).
- ☐ Use hospital-specific or collaborative-based performance measures to ensure compliance with recommended practices.

Supplemental strategies for consideration:

- ☐ Antimicrobial/Antiseptic impregnated catheters
- ☐ Antiseptic impregnated caps for access ports

CDC

2011 CDC CLABSI Checklist

cdc.gov

For Clinicians

- Insertion
- Maintenance
- Removal

For Healthcare Organisations

Supplemental Strategies

Antimicrobial/antiseptic impregnated catheters
Antiseptic impregnated caps for access ports

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY JULY 2014, VOL. 35, NO. 7

SHEA/IDSA PRACTICE RECOMMENDATION

Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals: 2014 Update

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PURPOSE

Previously published guidelines are available that provide comprehensive recommendations for detecting and preventing healthcare-associated infections (HAIs). The intent of this document is to highlight practical recommendations in a concise format designed to assist acute care hospitals in implementing and prioritizing their central line–associated bloodstream infection (CLABSI) prevention efforts. This document updates "Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals,"[1] published in 2008. This expert guidance document is sponsored by the Society for Healthcare Epidemiology of America (SHEA) and is the product of a collaborative effort led by SHEA, the Infectious Diseases Society of America (IDSA), the American Hospital Association (AHA), the Association for Professionals in Infection Control and Epidemiology (APIC), and The Joint Commission, with major contributions from representatives of a number of organizations and societies with content expertise. The list of endorsing and supporting organizations is presented in the introduction to the 2014 updates.[2]

SECTION 1: RATIONALE AND STATEMENTS OF CONCERN

I. Patients at risk for CLABSIs in acute care facilities
   A. Intensive care unit (ICU) population: the risk of CLABSI in ICU patients is high. Reasons for this include the frequent insertion of multiple catheters, the use of specific types of catheters that are almost exclusively inserted in ICU patients and associated with substantial risk (eg, pulmonary artery catheters with catheter introducers), and the fact that catheters are frequently placed in emergency circumstances, repeatedly accessed each day, and often needed for extended periods of time.[3,4]
   B. Non-ICU population: although the primary focus of attention over the last 2 decades has been the ICU setting, the majority of CLABSIs occur in hospital units outside the ICU or in outpatients.[5-10]
   C. Infection prevention and control efforts should include other vulnerable populations, such as patients receiving hemodialysis through catheters,[11] intraoperative patients,[12] and oncology patients.
   D. Besides central venous catheters (CVCs), peripheral arterial catheters also carry a risk of infection.[3]

II. Outcomes associated with hospital-acquired CLABSI
   A. Increased length of hospital stay.[13-17]
   B. Increased cost (the non-inflation-adjusted attributable cost of CLABSIs has been found to vary from $3,700 to $39,000 per episode[14,17-19]).

III. Independent risk factors for CLABSI (in at least 2 published studies)[20-25]
   A. Factors associated with increased risk.
      1. Prolonged hospitalization before catheterization
      2. Prolonged duration of catheterization
      3. Heavy microbial colonization at the insertion site
      4. Heavy microbial colonization of the catheter hub
      5. Internal jugular catheterization
      6. Femoral catheterization in adults

Affiliations: 1. Washington University School of Medicine, St. Louis, Missouri; 2. Bern University Hospital and University of Bern, Bern, Switzerland; 3. Warren Alpert Medical School of Brown University and Rhode Island Hospital, Providence, Rhode Island; 4. St. John Hospital and Medical Center and Wayne State University School of Medicine, Detroit, Michigan; 5. Lynn Hadaway Associates, Inc., Milner, Georgia; 6. Centers for Disease Control and Prevention, Atlanta, Georgia; 7. National Institutes of Health, Bethesda, Maryland; 8. University of Rochester Medical Center, Rochester, New York; 9. University of Nebraska Medical Center, Omaha, Nebraska; 10. Boston Children's Hospital and Harvard Medical School, Boston, Massachusetts; 11. Johns Hopkins University School of Medicine, Baltimore, Maryland; 12. Brigham and Women's Hospital and Harvard Medical School, Boston, Massachusetts; a. These authors contributed equally to this article.

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The Society for Healthcare Epidemiology of America

2014 update (Marschall)

Implementation strategies

- Engage: Increased *accountability* for HAI prevention (multidisciplinary teams, IPC programs, safety culture, champions)
- Educate: Staff, patient, family
- Execute: Standardise care processes
- Evaluate: Quality improvement collaboratives set goals, process & outcome measures

NHSN
NATIONAL HEALTHCARE SAFETY NETWORK

January 2023

National Healthcare Safety Network (NHSN)

Patient Safety Component Manual

Table of Contents

Please Note: The NHSN Patient Safety Component Manual is updated annually based on subject matter expert review and user feedback. Over time, certain chapters have been retired or moved to other components. To avoid confusion, the chapters in the PSC manual do not shift to account for these changes; therefore, chapters 8 and 13 are not listed in the Table of Contents or included in this document.

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

National Healthcare Safety Network (NHSN)

CDC's National Healthcare Safety Network is the nation's most widely used healthcare-associated infection tracking system. NHSN provides facilities, states, regions, and the nation with data needed to identify problem areas, measure progress of prevention efforts, and ultimately eliminate healthcare-associated infections.

In addition, NHSN allows healthcare facilities to track blood safety errors and important healthcare process measures such as healthcare personnel influenza vaccine status and infection control adherence rates.

Updated annually

- Definitions
- Criteria for diagnosis
- Blood specimen collection
- Linking CVAD use to BSI events
- Calculating and reporting CLABSI rates

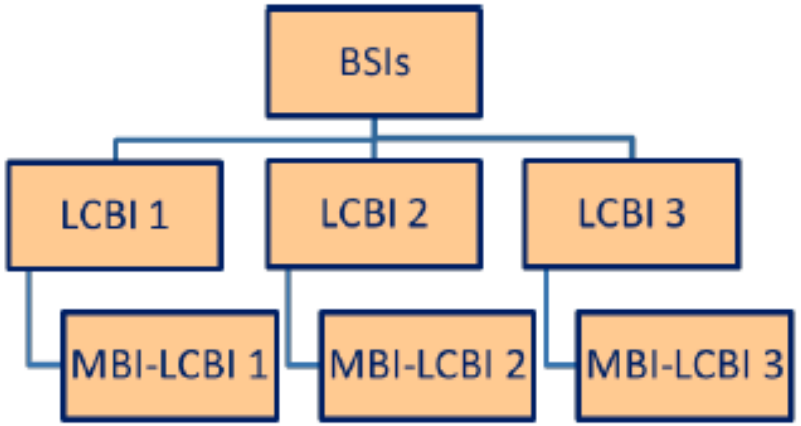
NHSN Definitions: BSI, CLABSI, MBI

Definitions Specific to Bloodstream Infection (BSI) / Central Line Associated Bloodstream Infection (CLABSI) Surveillance:

Primary bloodstream infection (BSI): A Laboratory Confirmed Bloodstream Infection (LCBI) that is not secondary to an infection at another body site (see Appendix: Secondary BSI Guide and CDC/NHSN Surveillance Definitions for Specific Types of Infection [Ch-17], urinary tract infection (UTI) [Ch-7], pneumonia (PNEU) [Ch-6], and surgical site infection (SSI) [Ch- 9].

Laboratory Confirmed Bloodstream Infection (LCBIs) Hierarchy; Types of LCBIs

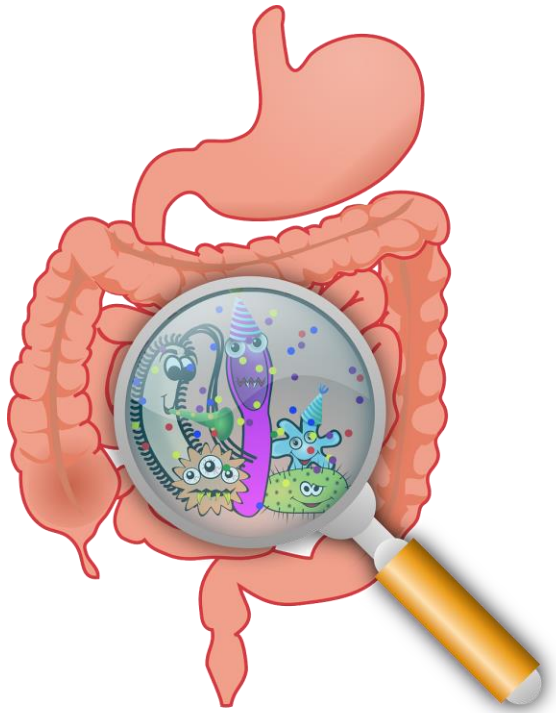
(see Table 1 and Table 2):



Secondary BSI: A BSI that is thought to be seeded from a site-specific infection at another body site (see Appendix: Secondary BSI Guide and CDC/NHSN Surveillance Definitions for Specific Types of Infection, UTI, PNEU, and SSI).

Mucosal Barrier Injury Laboratory-Confirmed Bloodstream Infection (MBI-LCBI)

- Definition of MBI-LCBI introduced by NHSN in 2013
- An MBI-LCBI is a subset of the LCBI criteria; therefore, a BSI event must fully meet an LCBI criterion before evaluating for the corresponding MBI-LCBI criterion.
- Accounts for the translocation of gastrointestinal tract organisms in at risk patients
- Patients with a CVAD AND compromised mucosal barrier who develop BSI (specific list of intestinal microorganisms) are now classified as MBI-LCBSI, not CLABSI.



MBI-LCBI 1	MBI-LCBI 2	MBI-LCBI 3
Patient of **any age** fully meets LCBI 1 criterion	Patient of **any age** fully meets LCBI 2 criterion	Patient **≤1 year of age** fully meets LCBI 3 criterion
with at least **one** blood specimen	with at least **two matching** blood specimens	
with **ONLY intestinal organisms** from the NHSN MBI organism list*	with **ONLY Viridans Group *Streptococcus and/*or *Rothia spp.*** alone but no other organisms†	
identified by culture or non-culture based microbiologic testing method	identified by culture	

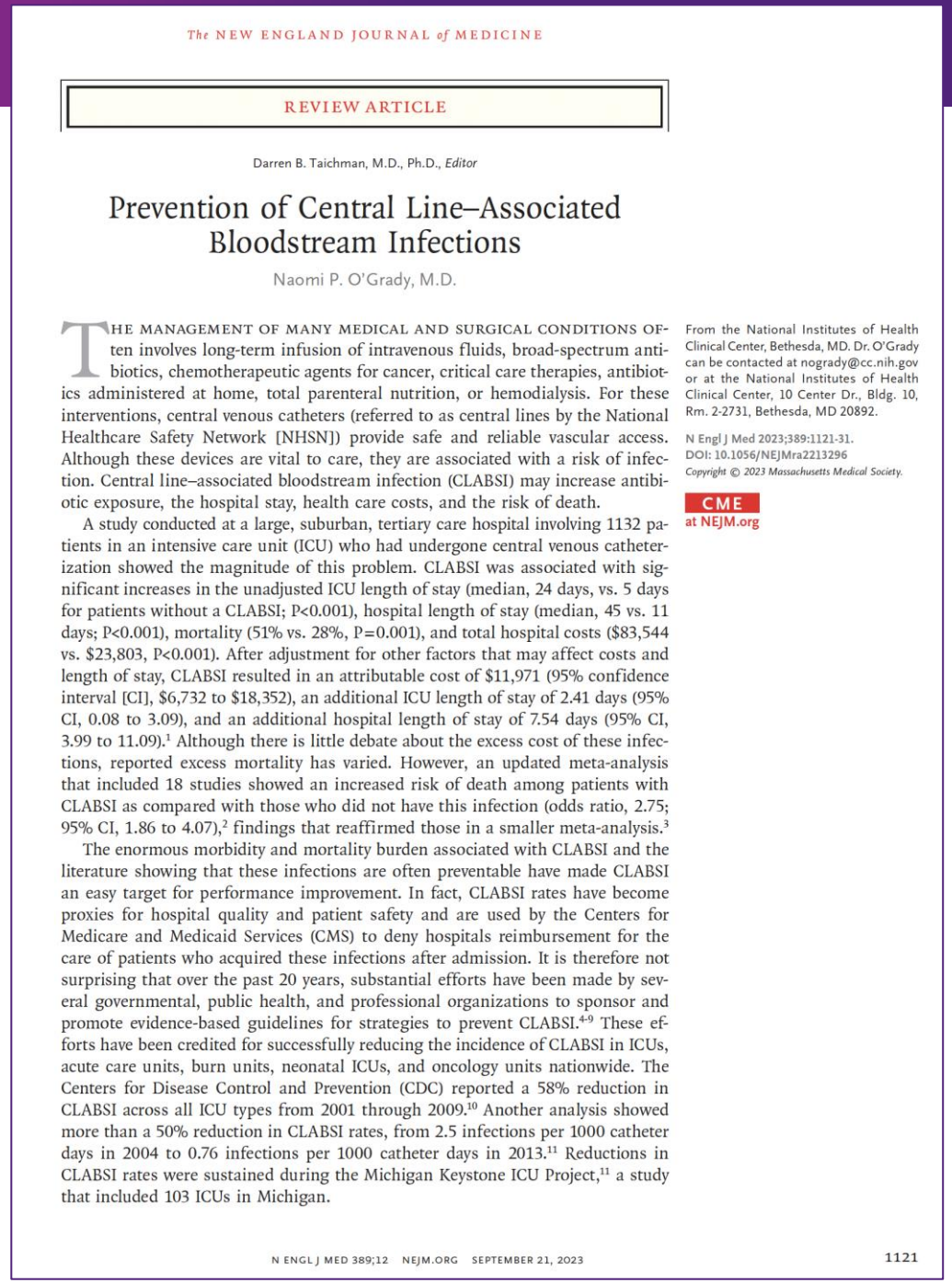
AND

Patient meets at least *one* of the following:

1. Is an allogeneic hematopoietic stem cell transplant recipient within the past year with **one of the following** documented during same hospitalization as positive blood specimen:
   a. Grade III or IV gastrointestinal graft versus host disease [GI GVHD]
   OR
   b. ≥1-liter diarrhea in a 24-hour period (or ≥20 mL/kg in a 24-hour period for patients <18 years of age) with onset on or within the 7 calendar days before the date the positive blood specimen was collected.

   OR

2. Is neutropenic, defined as at least two separate days with ANC‡ and/or WBC values <500 cells/mm³ collected within a 7-day time period which includes the collection date of the positive blood specimen, the 3 calendar days before and the 3 calendar days after (See Table 5).



The NEW ENGLAND JOURNAL of MEDICINE

REVIEW ARTICLE

Darren B. Taichman, M.D., Ph.D., *Editor*

Prevention of Central Line–Associated Bloodstream Infections

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CME at NEJM.org

THE MANAGEMENT OF MANY MEDICAL AND SURGICAL CONDITIONS often involves long-term infusion of intravenous fluids, broad-spectrum antibiotics, chemotherapeutic agents for cancer, critical care therapies, antibiotics administered at home, total parenteral nutrition, or hemodialysis. For these interventions, central venous catheters (referred to as central lines by the National Healthcare Safety Network [NHSN]) provide safe and reliable vascular access. Although these devices are vital to care, they are associated with a risk of infection. Central line–associated bloodstream infection (CLABSI) may increase antibiotic exposure, the hospital stay, health care costs, and the risk of death.

A study conducted at a large, suburban, tertiary care hospital involving 1132 patients in an intensive care unit (ICU) who had undergone central venous catheterization showed the magnitude of this problem. CLABSI was associated with significant increases in the unadjusted ICU length of stay (median, 24 days, vs. 5 days for patients without a CLABSI; P<0.001), hospital length of stay (median, 45 vs. 11 days; P<0.001), mortality (51% vs. 28%, P=0.001), and total hospital costs ($83,544 vs. $23,803, P<0.001). After adjustment for other factors that may affect costs and length of stay, CLABSI resulted in an attributable cost of $11,971 (95% confidence interval [CI], $6,732 to $18,352), an additional ICU length of stay of 2.41 days (95% CI, 0.08 to 3.09), and an additional hospital length of stay of 7.54 days (95% CI, 3.99 to 11.09).[1] Although there is little debate about the excess cost of these infections, reported excess mortality has varied. However, an updated meta-analysis that included 18 studies showed an increased risk of death among patients with CLABSI as compared with those who did not have this infection (odds ratio, 2.75; 95% CI, 1.86 to 4.07),[2] findings that reaffirmed those in a smaller meta-analysis.[3]

The enormous morbidity and mortality burden associated with CLABSI and the literature showing that these infections are often preventable have made CLABSI an easy target for performance improvement. In fact, CLABSI rates have become proxies for hospital quality and patient safety and are used by the Centers for Medicare and Medicaid Services (CMS) to deny hospitals reimbursement for the care of patients who acquired these infections after admission. It is therefore not surprising that over the past 20 years, substantial efforts have been made by several governmental, public health, and professional organizations to sponsor and promote evidence-based guidelines for strategies to prevent CLABSI.[4-9] These efforts have been credited for successfully reducing the incidence of CLABSI in ICUs, acute care units, burn units, neonatal ICUs, and oncology units nationwide. The Centers for Disease Control and Prevention (CDC) reported a 58% reduction in CLABSI across all ICU types from 2001 through 2009.[10] Another analysis showed more than a 50% reduction in CLABSI rates, from 2.5 infections per 1000 catheter days in 2004 to 0.76 infections per 1000 catheter days in 2013.[11] Reductions in CLABSI rates were sustained during the Michigan Keystone ICU Project,[11] a study that included 103 ICUs in Michigan.

National Institutes of Health

2023 review (O'Grady)

"CLABSI rates have become proxies for hospital quality and patient safety and are used … to deny hospitals reimbursement for the care of patients who acquired these infections after admission."

"This review focuses on the specific strategies for which there is high-quality evidence of reduced CLABSI rates and considers how changes in both definitions of CLABSI and public policy may have indirectly contributed to the reduction in these rates, *without having improved clinical outcomes*."

"Most CRBSIs now occur in non-ICU inpatient units and the outpatient setting"

Risk Factors for CLABSI (O'Grady 2023)

NON-MODIFIABLE

Patient factors

- ICU stay
- Immunocompromise
- Neutropenia
- Burns
- Malnutrition
- BMI >40
- Prolonged hospitalization before catheter insertion
- Prematurity in infants
- Limited venous access

MODIFIABLE

Provider factors

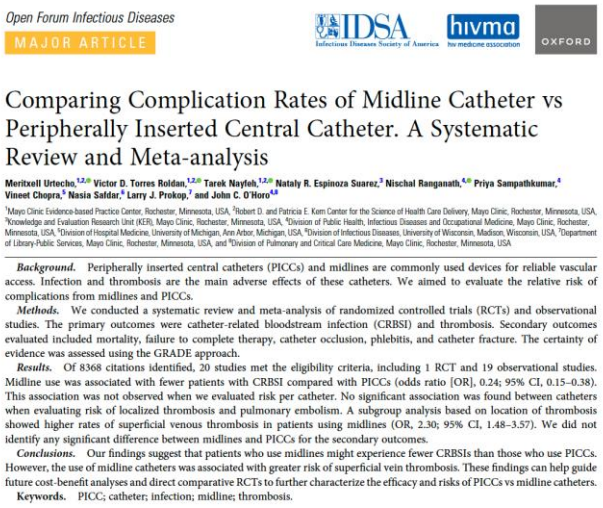
- Emergency catheter insertion
- Incomplete adherence to aseptic technique
- Multiple manipulations of the catheter
- Low nurse-to-patient ratio
- Failure to remove unnecessary catheter

Device factors

- Catheter material
- Catheter insertion site
- Number of lumens
- Indications for use (e.g., hemodialysis)

Catheter-associated bloodstream infection (CABSI)

Short-term peripheral catheters, peripherally inserted central catheters (PICCs), midline catheters, and peripheral arterial catheters also carry a risk of infection.



Open Forum Infectious Diseases
MAJOR ARTICLE

IDSA Infectious Diseases Society of America · hivma hiv medicine association · OXFORD

Comparing Complication Rates of Midline Catheter vs Peripherally Inserted Central Catheter. A Systematic Review and Meta-analysis

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Background. Peripherally inserted central catheters (PICCs) and midlines are commonly used devices for reliable vascular access. Infection and thrombosis are the main adverse effects of these catheters. We aimed to evaluate the relative risk of complications from midlines and PICCs.

Methods. We conducted a systematic review and meta-analysis of randomized controlled trials (RCTs) and observational studies. The primary outcomes were catheter-related bloodstream infection (CRBSI) and thrombosis. Secondary outcomes evaluated included mortality, failure to complete therapy, catheter occlusion, phlebitis, and catheter fracture. The certainty of evidence was assessed using the GRADE approach.

Results. Of 8368 citations identified, 20 studies met the eligibility criteria, including 1 RCT and 19 observational studies. Midline use was associated with fewer patients with CRBSI compared with PICCs (odds ratio [OR], 0.24; 95% CI, 0.15–0.38). This association was not observed when we evaluated risk per catheter. No significant association was found between catheters when evaluating risk of localized thrombosis and pulmonary embolism. A subgroup analysis based on location of thrombosis showed higher rates of superficial venous thrombosis in patients using midlines (OR, 2.30; 95% CI, 1.48–3.57). We did not identify any significant difference between midlines and PICCs for the secondary outcomes.

Conclusions. Our findings suggest that patients who use midlines might experience fewer CRBSIs than those who use PICCs. However, the use of midline catheters was associated with greater risk of superficial vein thrombosis. These findings can help guide future cost-benefit analyses and direct comparative RCTs to further characterize the efficacy and risks of PICCs vs midline catheters.

Keywords. PICC; catheter; infection; midline; thrombosis.

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Research Article

A Meta-Analysis of Incidence of Catheter-Related Bloodstream Infection with Midline Catheters and Peripherally Inserted Central Catheters

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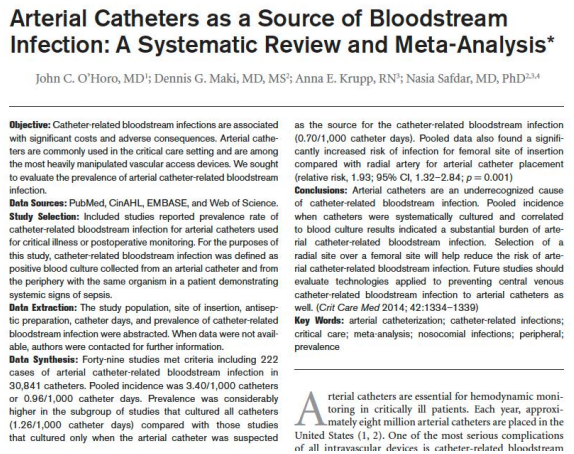

Arterial Catheters as a Source of Bloodstream Infection: A Systematic Review and Meta-Analysis*

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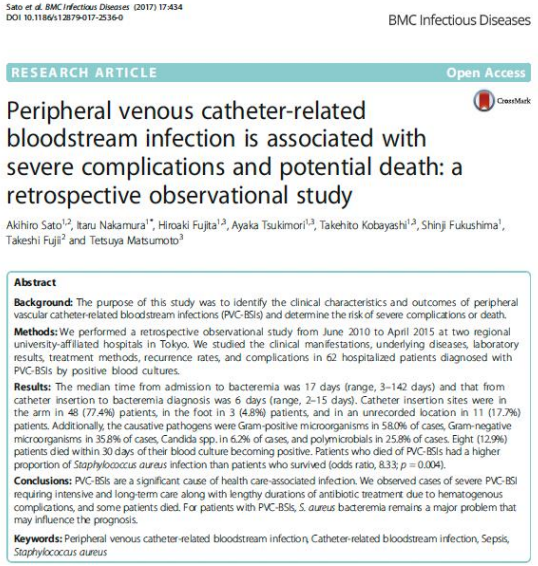
Objective: Catheter-related bloodstream infections are associated with significant costs and adverse consequences. Arterial catheters are commonly used in the critical care setting and are among the most heavily manipulated vascular access devices. We sought to evaluate the prevalence of arterial catheter-related bloodstream infection.
Data Sources: PubMed, CinAHL, EMBASE, and Web of Science.
Study Selection: Included studies reported prevalence rate of catheter-related bloodstream infection for arterial catheters used for critical illness or postoperative monitoring. For the purposes of this study, catheter-related bloodstream infection was defined as positive blood culture collected from an arterial catheter and from the periphery with the same organism in a patient demonstrating systemic signs of sepsis.
Data Extraction: The study population, site of insertion, antiseptic preparation, catheter days, and prevalence of catheter-related bloodstream infection were abstracted. When data were not available, authors were contacted for further information.
Data Synthesis: Forty-nine studies met criteria including 222 cases of arterial catheter-related bloodstream infection in 30,841 catheters. Pooled incidence was 3.40/1,000 catheters or 0.96/1,000 catheter days. Prevalence was considerably higher in the subgroup of studies that cultured all catheters (1.26/1,000 catheter days) compared with those studies that cultured only when the arterial catheter was suspected as the source for the catheter-related bloodstream infection (0.70/1,000 catheter days). Pooled data also found a significantly increased risk of infection for femoral site of insertion compared with radial artery for arterial catheter placement (relative risk, 1.93; 95% CI, 1.32–2.84; $p = 0.001$)
Conclusions: Arterial catheters are an underrecognized cause of catheter-related bloodstream infection. Pooled incidence when catheters were systematically cultured and correlated to blood culture results indicated a substantial burden of arterial catheter-related bloodstream infection. Selection of a radial site over a femoral site will help reduce the risk of arterial catheter-related bloodstream infection. Future studies should evaluate technologies applied to preventing central venous catheter-related bloodstream infection to arterial catheters as well. (*Crit Care Med* 2014; 42:1334–1339)

Key Words: arterial catheterization; catheter-related infections; critical care; meta-analysis; nosocomial infections; peripheral; prevalence

Arterial catheters are essential for hemodynamic monitoring in critically ill patients. Each year, approximately eight million arterial catheters are placed in the United States (1, 2). One of the most serious complications of all intravascular devices is catheter-related bloodstream



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BMC Infectious Diseases

RESEARCH ARTICLE Open Access

Peripheral venous catheter-related bloodstream infection is associated with severe complications and potential death: a retrospective observational study

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Abstract

Background: The purpose of this study was to identify the clinical characteristics and outcomes of peripheral vascular catheter-related bloodstream infections (PVC-BSIs) and determine the risk of severe complications or death.

Methods: We performed a retrospective observational study from June 2010 to April 2015 at two regional university-affiliated hospitals in Tokyo. We studied the clinical manifestations, underlying diseases, laboratory results, treatment methods, recurrence rates, and complications in 62 hospitalized patients diagnosed with PVC-BSIs by positive blood cultures.

Results: The median time from admission to bacteremia was 17 days (range, 3–142 days) and that from catheter insertion to bacteremia diagnosis was 6 days (range, 2–15 days). Catheter insertion sites were in the arm in 48 (77.4%) patients, in the foot in 3 (4.8%) patients, and in an unrecorded location in 11 (17.7%) patients. Additionally, the causative pathogens were Gram-positive microorganisms in 58.0% of cases, Gram-negative microorganisms in 35.8% of cases, Candida spp. in 6.2% of cases, and polymicrobials in 25.8% of cases. Eight (12.9%) patients died within 30 days of their blood culture becoming positive. Patients who died of PVC-BSIs had a higher proportion of *Staphylococcus aureus* infection than patients who survived (odds ratio, 8.33; $p = 0.004$).

Conclusions: PVC-BSIs are a significant cause of health care-associated infection. We observed cases of severe PVC-BSI requiring intensive and long-term care along with lengthy durations of antibiotic treatment due to hematogenous complications, and some patients died. For patients with PVC-BSIs, *S. aureus* bacteremia remains a major problem that may influence the prognosis.

Keywords: Peripheral venous catheter-related bloodstream infection, Catheter-related bloodstream infection, Sepsis, *Staphylococcus aureus*

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SHEA

SHEA/IDSA/APIC Practice Recommendation

Strategies to prevent central line-associated bloodstream infections in acute-care hospitals: 2022 Update

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Purpose

Previously published guidelines provide comprehensive recommendations for detecting and preventing healthcare-associated infections (HAIs). The intent of this document is to highlight practical recommendations in a concise format designed to assist acute-care hospitals in implementing and prioritizing their central line-associated bloodstream infection (CLABSI) prevention efforts. This document updates the *Strategies to Prevent Central Line-Associated Bloodstream Infections in Acute-Care Hospitals* published in 2014.[1] This expert guidance document is sponsored by the Society for Healthcare Epidemiology of America (SHEA). It is the product of a collaborative effort led by SHEA, the Infectious Diseases Society of America (IDSA), the Association for Professionals in Infection Control and Epidemiology (APIC), the American Hospital Association (AHA), and The Joint Commission, with major contributions from representatives of a number of organizations and societies with content expertise.

Summary of major changes

This section lists major changes from the *Strategies to Prevent Central Line-Associated Bloodstream Infections in Acute-Care Hospitals: 2014 Update*,[1] including recommendations that have been added, removed, or altered. Recommendations are categorized as essential practices that should be adopted by all acute-care hospitals (in 2014 these were "basic practices," renamed to highlight their importance as foundational for hospitals' HAI prevention programs) or additional approaches that can be considered for use in locations and/or populations within hospitals when CLABSIs are not controlled after implementation of essential practices (in 2014 these were "special approaches"). See Table 1 for a complete summary of the recommendations contained in this document.

Essential practices

- The subclavian vein is considered the preferable site for central venous catheter (CVC) insertion in the intensive care setting to reduce infectious complications. Previously, the primary recommendation was to avoid the femoral vein for access. Although this remains valid, it has been replaced by a positively formulated recommendation regarding the subclavian site.
- The recommendation to use ultrasound guidance for catheter insertion is backed by better evidence than was available previously; however, the procedure itself may jeopardize the strict observation of sterile technique.
- The use of chlorhexidine-containing dressings is now considered an "essential practice"; in the past, it was listed under special approaches that should only be employed if CLABSI rates remain high despite the implementation of basic practices.
- Routine replacement of administration sets not used for blood, blood products, or lipid formulations can be performed at

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2022 Update

"The intent of this document is to highlight **practical recommendations in a concise format** designed to assist acute-care hospitals in implementing and prioritizing their central line-associated bloodstream infection (CLABSI) prevention efforts."

- Society for Healthcare Epidemiology of America (SHEA)
- Infectious Diseases Society of America (IDSA)
- Association for Professionals in Infection Control and Epidemiology (APIC)
- American Hospital Association (AHA)
- The Joint Commission
- Centers for Disease Control and Prevention (CDC)

Summary of Recommendations to Prevent CLABSI

(Buetti 2022 ICHE)

- Recommendations
- Quality of evidence
  (high, moderate, low)
- Classification
  - essential practices
  - additional approaches
  - unresolved issues

Table 1. Summary of Recommendations to Prevent CLABSI

Essential Practices

Before insertion

1. Provide easy access to an evidence-based list of indications for CVC use to minimize unnecessary CVC placement (Quality of Evidence: LOW)
2. Require education and competency assessment of HCP involved in insertion, care, and maintenance of CVCs about CLABSI prevention (Quality of Evidence: MODERATE)[74–78]
3. Bathe ICU patients aged >2 months with a chlorhexidine preparation on a daily basis (Quality of Evidence: HIGH)[86–90]

At insertion

1. In ICU and non-ICU settings, a facility should have a process in place, such as a checklist, to ensure adherence to infection prevention practices at the time of CVC insertion (Quality of Evidence: MODERATE)[101]
2. Perform hand hygiene prior to catheter insertion or manipulation (Quality of Evidence: MODERATE)[102–107]
3. The subclavian site is preferred to reduce infectious complications when the catheter is placed in the ICU setting (Quality of Evidence: HIGH)[33,37,108–110]
4. Use an all-inclusive catheter cart or kit (Quality of Evidence: MODERATE)[118]
5. Use ultrasound guidance for catheter insertion (Quality of Evidence: HIGH)[119,120]
6. Use maximum sterile barrier precautions during CVC insertion (Quality of Evidence: MODERATE)[123–128]
7. Use an alcoholic chlorhexidine antiseptic for skin preparation (Quality of Evidence: HIGH)[42,129–134]

After insertion

1. Ensure appropriate nurse-to-patient ratio and limit use of float nurses in ICUs (Quality of Evidence: HIGH)[34,35]
2. Use chlorhexidine-containing dressings for CVCs in patients over 2 months of age (Quality of Evidence: HIGH)[45,135–142]
3. For non-tunneled CVCs in adults and children, change transparent dressings and perform site care with a chlorhexidine-based antiseptic at least every 7 days or immediately if the dressing is soiled, loose, or damp. Change gauze dressings every 2 days or earlier if the dressing is soiled, loose, or damp (Quality of Evidence: MODERATE)[145–148]
4. Disinfect catheter hubs, needleless connectors, and injection ports before accessing the catheter (Quality of Evidence: MODERATE)[150–154]
5. Remove nonessential catheters (Quality of Evidence: MODERATE)
6. Routine replacement of administration sets not used for blood, blood products, or lipid formulations can be performed at intervals up to 7 days (Quality of Evidence: HIGH)[164]
7. Perform surveillance for CLABSI in ICU and non-ICU settings (Quality of Evidence: HIGH)[13,165,166]

Additional Approaches

1. Use antiseptic- or antimicrobial-impregnated CVCs (Quality of Evidence: HIGH in adult patients[38,39,169–171] and Quality of Evidence: MODERATE in pediatric patients)[172,173]
2. Use antimicrobial lock therapy for long-term CVCs (Quality of Evidence: HIGH)[177–184]
3. Use recombinant tissue plasminogen activating factor (rt-PA) once weekly after hemodialysis in patients undergoing hemodialysis through a CVC (Quality of Evidence: HIGH)[192]
4. Utilize infusion or vascular access teams for reducing CLABSI rates (Quality of Evidence: LOW)[193,194]
5. Use antimicrobial ointments for hemodialysis catheter insertion sites (Quality of Evidence: HIGH)[197–201]
6. Use an antiseptic-containing hub/connector cap/port protector to cover connectors (Quality of Evidence: MODERATE)[202–208]

Approaches that Should Not Be Considered a Routine Part of CLABSI Prevention

1. Do not use antimicrobial prophylaxis for short-term or tunneled catheter insertion or while catheters are *in situ* (Quality of Evidence: HIGH)[209–213]
2. Do not routinely replace CVCs or arterial catheters (Quality of Evidence: HIGH)[214]

Unresolved Issues

1. Routine use of needleless connectors as a CLABSI prevention strategy before an assessment of risks, benefits, and education regarding proper use[215–219]
2. Surveillance of other types of catheters (eg, peripheral arterial or peripheral venous catheters)[11,21,22]
3. Standard, nonantimicrobial transparent dressings and CLABSI risk.
4. The impact of using chlorhexidine-based products on bacterial resistance to chlorhexidine
5. Sutureless securement
6. Impact of silver zeolite-impregnated umbilical catheters in preterm infants (applicable in countries where it is approved for use in children)[227]
7. Necessity of mechanical disinfection of a catheter hub, needleless connector, and injection port before accessing the catheter when antiseptic-containing caps are being used

Note. CLABSI, central line-associated bloodstream infection; CVC, central venous catheter; HCP, healthcare personnel; ICU, intensive care unit.

ESSENTIAL PRACTICES

"Should be adopted by all acute care hospitals"

ADDITIONAL APPROACHES

"Can be considered for use in locations and/or populations within hospitals when CLABSIs are not controlled after implementation of essential practices."

Essential Practices – Before CVC Insertion

Recommendation	Quality of Evidence
1. Provide easy access to an evidence-based list of indications for CVC use to minimize unnecessary CVC placement	LOW
2. Require education and competency assessment of HCP involved in insertion, care, and maintenance of CVCs about CLABSI prevention	MODERATE
3. Bathe ICU patients aged >2 months with a chlorhexidine preparation on a daily basis	HIGH

CVC: Central venous catheter; HCP: Health care practitioner; CLABSI: Central line associated bloodstream infection; ICU: Intensive care unit

Essential Practices – At Insertion

Recommendation	Quality of Evidence
1. In ICU and non-ICU settings, a facility should have a process in place, such as a checklist, to ensure adherence to infection prevention practices at the time of CVC insertion	MODERATE
2. Perform hand hygiene prior to catheter insertion or manipulation	MODERATE
3. The subclavian site is preferred to reduce infectious complications when the catheter is placed in the ICU setting	HIGH
4. Use an all-inclusive catheter cart or kit	MODERATE
5. Use ultrasound guidance for catheter insertion	HIGH
6. Use maximum sterile barrier precautions during CVC insertion	MODERATE
7. Use an alcoholic chlorhexidine antiseptic for skin preparation	HIGH

Essential Practices – After Insertion

Recommendation	Quality of Evidence
1. Ensure appropriate nurse-to-patient ratio and limit use of float nurses in ICUs	HIGH
2. Use chlorhexidine-containing dressings for CVCs in patients >2 months of age	HIGH
3. For non-tunneled CVCs in adults and children, change transparent dressings and perform site care with a chlorhexidine-based antiseptic at least every 7 days or immediately if the dressing is soiled, loose, or damp. Change gauze dressings every 2 days or earlier if the dressing is soiled, loose, or damp.	MODERATE
4. Disinfect catheter hubs, needleless connectors, and injection ports before accessing the catheter	MODERATE
5. Remove nonessential catheters	MODERATE
6. Routine replacement of administration sets not used for blood, blood products, or lipid formulations can be performed at intervals up to 7 days	HIGH
7. Perform surveillance for CLABSI in ICU and non-ICU settings	HIGH

Additional Approaches

Recommendation	Quality of Evidence
1. Use antiseptic- or antimicrobial-impregnated CVCs	HIGH (adults) MODERATE (paeds)
2. Use antimicrobial lock therapy for long-term CVCs	HIGH
3. Use recombinant tissue plasminogen activating factor (rt-PA) once weekly after hemodialysis in patients undergoing hemodialysis through a CVC	HIGH
4. Utilize infusion or vascular access teams for reducing CLABSI rates	LOW
5. Use antimicrobial ointments for hemodialysis catheter insertion sites	HIGH
6. Use an antiseptic-containing cap/port protector to cover connectors	MODERATE

Approaches that Should *Not* Be Considered a Routine Part of CLABSI Prevention

Recommendation	Quality of Evidence
1. **Do not** use antimicrobial prophylaxis for short-term or tunneled catheter insertion or while catheters are in situ	HIGH
2. **Do not** routinely replace CVCs or arterial catheters	HIGH

CLABSI Prevention Process Measures

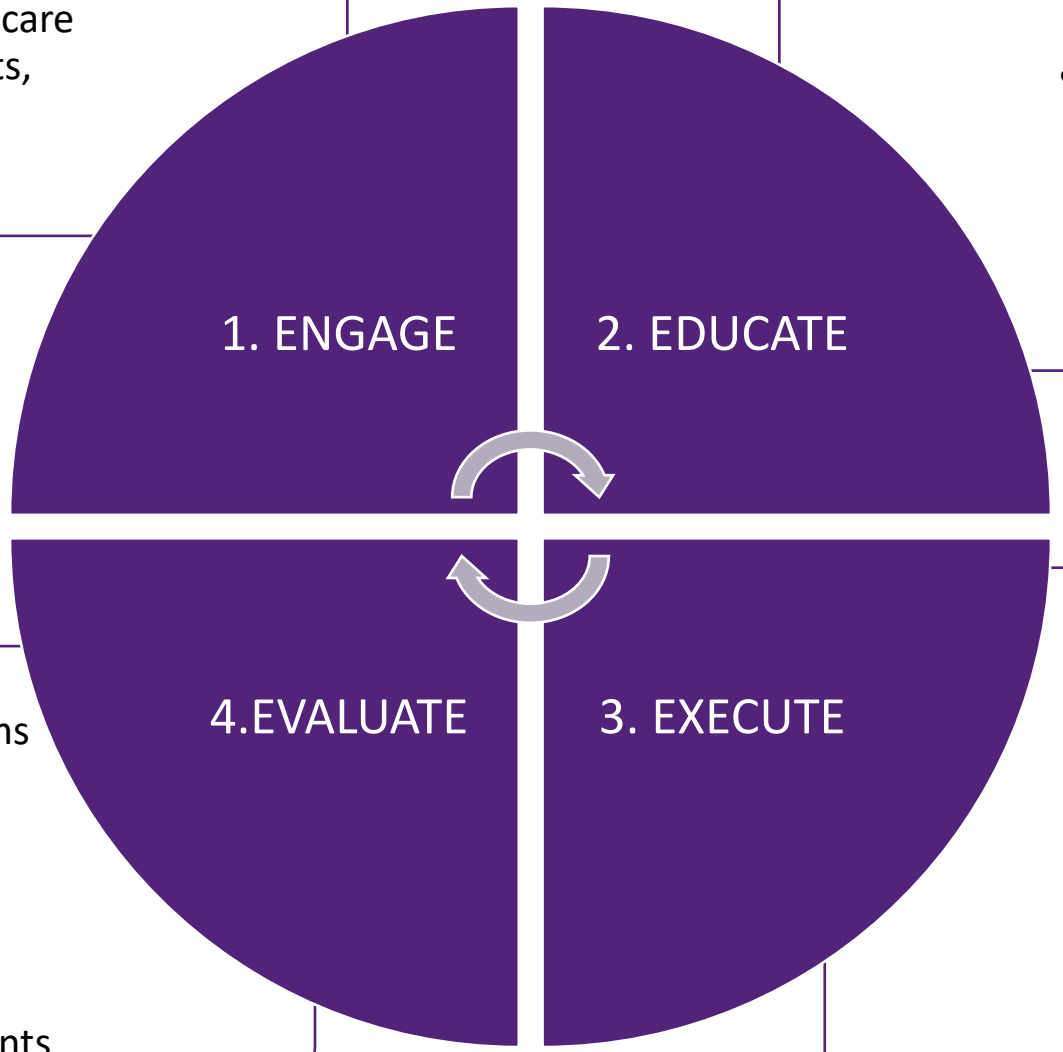
Assessing Compliance According to Practice	
Use of proper CVC insertion interventions: 1. Hand hygiene 2. Use of maximal sterile barrier precautions 3. Use of chlorhexidine-based cutaneous antisepsis	(Number of CVC insertions that have documented the use of all 3 interventions performed at the time of CVC insertion divided by number of all CVC insertions) ×100 = % properly performed procedures
Documentation of daily assessment regarding patient's need for continuing CVC access	(Number of CVC insertions with documentation of daily assessment divided by number of patients with CVC) ×100 = % of patients who received daily assessment for continuing need for CVC access
Assessing Compliance by Simulation	
Simulation of catheter maintenance to assess HCP competency	(Number of HCP properly simulating aseptic infusion of medications divided by number of HCP simulating the aseptic infusion of medications) ×100 = % of HCP competent in catheter maintenance
Assessing Device Utilization as a Surrogate for Patient Exposure Risk	
Standard utilization ratio (SUR)	Number of observed device days divided by number of predicted device days

CLABSI Prevention Outcome Measures

Assessing CLABSI Rate	
Using NHSN definitions	(Number of CLABSIs in each unit assessed with NHSN definitions divided by total number of catheter days in each unit assessed using NHSN definitions) ×1,000 = Number of CLABSIs per 1,000 catheter days
Risk Adjustment	
Report comparisons based on historic data and NHSN data, if available.	
By type of patient-care unit	Device standardized infection ratio (dSIR) = Observed CLABSI events divided by predicted CLABSI events based on actual device days
By the patient population level to reflect the care of the device, and interventions to reduce utilization	Population standardized infection ratio (pSIR) = Observed CLABSI events divided by predicted CLABSI events based on predicted device days

Implementation Strategies

(Buetti 2022 ICHE)



- Senior Leaders
- Stakeholders (Healthcare practitioners, Patients, Caregivers)
- Champions

- Healthcare practitioners
- Patients & Caregivers
- Indications for insertion, infection prevention, daily evaluation of CVC necessity

- Standardized competency assessment checklists for insertion and maintenance care
- Educate patients, caregivers, esp when transferred to another setting or home with CVC

- Clear goals
- Multidisciplinary teams
- Process measures (compliance audits)
- Outcome measures (CLABSI rates)
- Regular feedback
- Review all CLABSI events

Infection Prevention Champions

https://www.cdc.gov/hai/prevent/tap.html

Identify

Identify Potential Champions:

- ❑ Respected
- ❑ Effective Communicators
- ❑ Enthusiastic
- ❑ Committed
- ❑ Courageous
- ❑ Team Oriented
- ❑ Open to New Ideas
- ❑ Early Adopters

Train

Provide Resources:

- ❑ Facility specific data for action
  - Results of TAP Assessments
- ❑ Evidence/Guidelines on which the initiative is based
- ❑ Contact information for support personnel
- ❑ Facility protocols for promoting initiatives

Empower

Facilitate Success:

- ❑ Offer leadership support
- ❑ Make initiatives patient-centered
- ❑ Clearly define goals & timelines
- ❑ Encourage involvement from other staff
- ❑ Assist in making evidence actionable

Sustain

Continue Support:

- ❑ Align goals across leadership levels
- ❑ Conduct audits and provide feedback to personnel
- ❑ Offer ongoing opportunities to discuss concerns with personnel
- ❑ Ensure hand off at the end of an initiative

Unresolved Issues . . . (PhD, anyone?)

(Buetti 2022 ICHE)

1. Routine use of needleless connectors as a CLABSI prevention strategy before an assessment of risks, benefits, and education regarding proper use
2. Surveillance of other types of catheters (eg, peripheral arterial or peripheral venous catheters)
3. Standard, nonantimicrobial transparent dressings and CLABSI risk.
4. The impact of using chlorhexidine-based products on bacterial resistance to chlorhexidine
5. Sutureless securement products
6. Impact of silver zeolite-impregnated umbilical catheters in preterm infants (applicable in countries where it is approved for use in children)
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Thank you

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