SUPPLEMENT ARTICLE: SHEA/IDSA PRACTICE RECOMMENDATION

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

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PURPOSE

Previously published guidelines are available that provide comprehensive recommendations for detecting and preventing healthcare-associated infections. 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. Refer to the Society for Healthcare Epidemiology of America/Infectious Diseases Society of America "Compendium of Strategies to Prevent Healthcare-Associated Infections" Executive Summary and Introduction and accompanying editorial for additional discussion.

SECTION 1: RATIONALE AND STATEMENTS OF CONCERN

1. 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, arterial catheters), and the fact that catheters are frequently placed in emergency circumstances, repeatedly accessed each day, and often needed for extended periods.[1,2]

   b. Non-ICU population: Although the primary focus of attention over the past 2 decades has been the ICU setting, recent data suggest that the greatest numbers of patients with central lines are in hospital units outside the ICU, where there is a substantial risk of CLABSI.[3-5]

2. Outcomes associated with hospital-acquired CLABSI

   a. Increased length of hospital stay[6-10]

   b. Increased cost; the non–inflation-adjusted attributable cost of CLABSIs has been found to vary from $3,700 to $29,000 per episode[7,10,11]

3. Independent risk factors for CLABSI (in 2 or more published studies)[12-14]

Note: femoral catheterization was found to be an independent risk factor in 1 study.[15]

   a. Factors associated with increased risk
   i. Prolonged hospitalization before catheterization
   ii. Prolonged duration of catheterization
   iii. Heavy microbial colonization at the insertion site
   iv. Heavy microbial colonization of the catheter hub
   v. Internal jugular catheterization

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vi. Neutropenia

vii. Prematurity (ie, birth at an early gestational age)

viii. Total parenteral nutrition

ix. Substandard care of the catheter (eg, excessive manipulation of the catheter or reduced nurse-to-patient ratio)

b. Factors associated with reduced risk

i. Female sex

SECTION 2: STRATEGIES TO DETECT CLABSI

1. Surveillance protocol and definitions

a. Use consistent surveillance methods and definitions to allow comparison with benchmark data

b. Refer to the *NHSN Manual: Patient Safety Component Protocol*[16] for information on the appropriate surveillance methodology, including information about blood specimen collection, and for surveillance definitions of CLABSI. The relevant sections of the manual are "Identifying Healthcare-associated Infections (HAI) in NHSN," "Device-Associated Module: Methodology," and "Device-Associated Module: Central Line-Associated Bloodstream Infection (CLABSI) Event."

SECTION 3: STRATEGIES TO PREVENT CLABSI

1. Existing guidelines and recommendations

a. Several governmental, public health, and professional organizations have published evidence-based guidelines and/or implementation aids regarding the prevention of CLABSI, including the following:

i. The Healthcare Infection Control Practices Advisory Committee[17]

ii. The Institute for Healthcare Improvement[18] and

iii. Making Health Care Safer, Agency for Healthcare Research and Quality[19]

b. The recommendations in this document focus on central venous catheters (CVCs) unless noted otherwise.

i. These recommendations are not stratified on the basis of the type of catheter (eg, tunneled, implanted, cuffed, noncuffed catheter, or dialysis catheter).

ii. These recommendations may not be applicable for prevention of bloodstream infections with other intravascular devices.

2. Infrastructure requirements

a. An adequately staffed infection prevention and control program responsible for identifying patients with CLABSI

b. Information technology to collect and calculate catheter-days as a denominator for computing rates of CLABSI and patient-days to allow calculation of CVC utilization; catheter-days from information systems should be validated against a manual method.

c. Resources to provide appropriate education and training

d. Adequate laboratory support for timely processing of specimens and reporting of results

3. Practical implementation

a. Educate physicians, nurses, and other healthcare personnel about guidelines to prevent CLABSI (eg, with online and paper versions). These guidelines should be easily accessible.

b. Develop and implement a catheter insertion checklist. Educate nurses, physicians, and other healthcare personnel involved in catheter insertion, regarding the use of the catheter insertion checklist.

c. Educate healthcare personnel about the insertion and maintenance of catheters.[20] One method is to require healthcare personnel to complete an educational program including a posteducation test to ensure their knowledge and competency before being allowed to insert CVCs.

d. Establish catheter insertion kits/carts containing all necessary items for insertion.

SECTION 4: RECOMMENDATIONS FOR IMPLEMENTING PREVENTION AND MONITORING STRATEGIES

Recommendations for preventing and monitoring CLABSI are summarized in the following section. They are designed to assist acute care hospitals in prioritizing and implementing their CLABSI prevention efforts. Criteria for grading the strength of the recommendation and quality of evidence are described in the Table.

Note: Some of the following measures have been combined into a "prevention bundle" that focuses on catheter insertion (eg, measures B.2, B.3, B.5, B.6, and C.2).[22-24]

I. Basic practices for prevention and monitoring of CLABSI: recommended for all acute care hospitals

A. Before insertion

1. Educate healthcare personnel involved in the insertion, care, and maintenance of CVCs about CLABSI prevention (A-II).[20,25-28]

a. Include the indications for catheter use, appropriate insertion and maintenance, the risk of CLABSI, and general infection prevention strategies.

b. Ensure that all healthcare personnel involved in catheter insertion and maintenance complete an educational program regarding basic practices to prevent CLABSI before performing these duties.

c. Periodically assess healthcare personnel knowledge of and adherence to preventive measures.

d. Ensure that any healthcare professional who inserts a CVC undergoes a credentialing process (as established

table. Strength of Recommendation and Quality of Evidence

Category/grade	Definition
Strength of recommendation	
A	Good evidence to support a recommendation for use
B	Moderate evidence to support a recommendation for use
C	Poor evidence to support a recommendation
Quality of evidence	
I	Evidence from ≥1 properly randomized, controlled trial
II	Evidence from ≥1 well-designed clinical trial, without randomization; from cohort or case-control analytic studies (preferably from >1 center); from multiple time series; or from dramatic results of uncontrolled experiments
III	Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports from expert committees

note.   Adapted from the Canadian Task Force on the Periodic Health Examination.[21]

by the individual healthcare institution) to ensure their competency before they independently insert a CVC.

B. At insertion

1. Use a catheter checklist to ensure adherence to infection prevention practices at the time of CVC insertion (B-II).[23,29]
  a. Use a checklist to ensure and document compliance with aseptic technique.
    i. CVC insertion should be observed by a nurse, physician, or other healthcare personnel who has received appropriate education (see above), to ensure that aseptic technique is maintained.
  b. These healthcare personnel should be empowered to stop the procedure if breaches in aseptic technique are observed.

2. Perform hand hygiene before catheter insertion or manipulation (B-II).[30-33]
  a. Use an alcohol-based waterless product or antiseptic soap and water.
    i. Use of gloves does not obviate hand hygiene.

3. Avoid using the femoral vein for central venous access in adult patients (A-I).[15,34,35]
  a. Use of the femoral access site is associated with greater risk of infection and deep venous thrombosis in adults.
    i. Increased risk of infection with femoral catheters may be limited to overweight adult patients with a body mass index higher than 28.4.[36]
    ii. Femoral vein catheterization can be done without general anesthesia in children and has not been associated with an increased risk of infection in children.[37]
  b. Several nonrandomized studies show that the subclavian vein site is associated with a lower risk of CLABSI than is the internal jugular vein, but the risks and benefits

in light of potential infectious and noninfectious complications must be considered on an individual basis when determining which insertion site to use.
  c. The use of peripherally inserted CVCs is not an evidence-based strategy to reduce the risk of CLABSI.
    i. The risk of infection with peripherally inserted CVCs in ICU patients approaches that with CVCs placed in the subclavian or internal jugular veins.[38]

4. Use an all-inclusive catheter cart or kit (B-II).[23]
  a. A catheter cart or kit that contains all necessary components for aseptic catheter insertion is to be available and easily accessible in all units where CVCs are inserted.

5. Use maximal sterile barrier precautions during CVC insertion (A-I).[39-42]
  a. Use maximal sterile barrier precautions.
    i. A mask, cap, sterile gown, and sterile gloves are to be worn by all healthcare personnel involved in the catheter insertion procedure.
    ii. The patient is to be covered with a large sterile drape during catheter insertion.
  b. These measures must also be followed when exchanging a catheter over a guidewire.

6. Use a chlorhexidine-based antiseptic for skin preparation in patients older than 2 months of age (A-I).[43-46]
  a. Before catheter insertion, apply an alcoholic chlorhexidine solution containing a concentration of chlorhexidine gluconate greater than 0.5% to the insertion site.
    i. The antiseptic solution must be allowed to dry before making the skin puncture.
    ii. Chlorhexidine products are not approved by the US Food and Drug Administration for children younger

than 2 months of age; povidone-iodine can be used for children in this age group.

C. After insertion

1. Disinfect catheter hubs, needleless connectors, and injection ports before accessing the catheter (B-II).[47-49]
   a. Before accessing catheter hubs or injection ports, clean them with an alcoholic chlorhexidine preparation or 70% alcohol to reduce contamination.

2. Remove nonessential catheters (A-II).[50,51]
   a. Assess the need for continued intravascular access on a daily basis during multidisciplinary rounds. Remove catheters not required for patient care.

3. For nontunneled CVCs in adults and adolescents, change transparent dressings and perform site care with a chlorhexidine-based antiseptic every 5-7 days or more frequently if the dressing is soiled, loose, or damp; change gauze dressings every 2 days or more frequently if the dressing is soiled, loose, or damp (A-I).[52,53]

4. Replace administration sets not used for blood, blood products, or lipids at intervals not longer than 96 hours (A-II).[54]

5. Perform surveillance for CLABSI (B-II).[55]
   a. Measure unit-specific incidence of CLABSI (CLABSIs per 1,000 catheter-days) and report the data on a regular basis to the units, physician and nursing leadership, and hospital administrators overseeing the units.
   b. Compare CLABSI incidence with historical data for individual units and with national rates (ie, data from the National Healthcare Safety Network[56]).
   c. CLABSI has been documented in large numbers of non-ICU patients with CVCs. Surveillance for CLABSI in these settings requires additional resources.[4,5,57]

6. Use antimicrobial ointments for hemodialysis catheter insertion sites (A-I).[58-62]
   a. Povidone-iodine or polysporin ointment should be applied to hemodialysis catheter insertion sites in patients with a history of recurrent *Staphylococcus aureus* CLABSI.
   b. Mupirocin ointment should not be applied to the catheter insertion site due to the risks of mupirocin resistance and damage to polyurethane catheters.

D. Accountability

1. The hospital's chief executive officer and senior management are responsible for ensuring that the healthcare system supports an infection prevention and control program that effectively prevents the occurrence of CLABSI.

2. Senior management is accountable for ensuring that an adequate number of trained personnel are assigned to the infection prevention and control program.

3. Senior management is accountable for ensuring that healthcare personnel, including licensed and nonlicensed personnel, are competent to perform their job responsibilities.

4. Direct healthcare providers (such as physicians, nurses, aides, and therapists) and ancillary personnel (such as housekeeping and equipment-processing personnel) are responsible for ensuring that appropriate infection prevention and control practices are used at all times (including hand hygiene, standard and isolation precautions, cleaning and disinfection of equipment and the environment, aseptic technique when inserting and caring for CVCs, maximal barrier precautions, appropriate site selection, and daily assessment of the need for a CVC).

5. Hospital and unit leaders are responsible for holding personnel accountable for their actions.

6. The person who manages the infection prevention and control program is responsible for ensuring that an active program to identify CLABSIs is implemented, that data on CLABSIs are analyzed and regularly provided to those who can use the information to improve the quality of care (eg, unit staff, clinicians, and hospital administrators), and that evidence-based practices are incorporated into the program.

7. Individuals responsible for healthcare personnel and patient education are accountable for ensuring that appropriate training and educational programs to prevent CLABSIs are developed and provided to personnel, patients, and families.

8. Personnel from the infection prevention and control program, laboratory, and information technology departments are responsible for ensuring that systems are in place to support the surveillance program.

II. Special approaches for the prevention of CLABSI

Perform a CLABSI risk assessment. These special approaches are recommended for use in locations and/or populations within the hospital that have unacceptably high CLABSI rates despite implementation of the basic CLABSI prevention strategies listed above.

1. Bathe ICU patients older than 2 months of age with a chlorhexidine preparation on a daily basis (B-II).[63]
   a. Chlorhexidine products are not approved by the US Food and Drug Administration for children younger than 2 months of age but are used at some institutions for cleaning CVC insertion sites or as a sponge dressing for children in this age group.

b. A povidone-iodine preparation should be used to clean CVC insertion sites for children younger than 2 months of age, especially low-birth-weight neonates.

2. Use antiseptic- or antimicrobial-impregnated CVCs for adult patients (A-I).[64-70]

　　a. The risk of CLABSI is reduced with some currently marketed catheters impregnated with antiseptics (eg, chlorhexidine-silver sulfadiazine) or antimicrobials (eg, minocycline-rifampin). Consider the use of such catheters in the following circumstances:

　　　　i. Hospital units or patient populations have a CLABSI rate higher than the institutional goal, despite compliance with basic CLABSI prevention practices.

　　　　ii. Patients have limited venous access and a history of recurrent CLABSI.

　　　　iii. Patients are at heightened risk for severe sequelae from a CLABSI (eg, patients with recently implanted intravascular devices, such as a prosthetic heart valve or aortic graft).

　　b. These catheters are not approved by the US Food and Drug Administration for use in children.

　　　　i. Preliminary data suggest that antimicrobial-impregnated catheters appear to be safe and may hold promise for pediatric ICU patients.[71,72]

3. Use chlorhexidine-containing sponge dressings for CVCs in patients older than 2 months of age (B-I).[73-75]

　　a. Consider the addition of such a dressing in the following circumstances:

　　　　i. Hospital units or patient populations have a CLABSI rate higher than the institutional goal, despite compliance with an evidence-based prevention bundle.

　　　　ii. Patients have limited venous access and a history of recurrent CLABSI.

　　　　iii. Patients are at heightened risk for severe sequelae from a CLABSI (eg, patients with recently implanted intravascular devices, such as a prosthetic heart valve or aortic graft).

　　b. Do not use chlorhexidine-containing sponge dressings for low-birth-weight neonates.

4. Use antimicrobial locks for CVCs (A-I).[76-80]

　　a. Antibiotic locks are created by filling the lumen of the catheter with a supraphysiologic concentration of an antimicrobial solution and leaving the solution in place until the catheter hub is reaccessed. Such an approach can reduce the risk of CLABSI. Because of concerns regarding the potential for the emergence of resistance in exposed organisms and the potential for systemic toxicity from leakage of the lock solution into the bloodstream, use antimicrobial locks as a preventative strategy only for the following:

　　　　i. Prophylaxis for patients with limited venous access and a history of recurrent CLABSI.

　　　　ii. Patients who are at heightened risk for severe sequelae from a CLABSI (eg, patients with recently implanted intravascular devices such as a prosthetic heart valve or aortic graft).

III. 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 (A-I).[81-84]

　　a. Systemic antimicrobial prophylaxis is not recommended.

2. Do not routinely replace CVCs or arterial catheters (A-I).[85-87]

　　a. Routine catheter replacement is not recommended.

3. Do not routinely use positive-pressure needleless connectors with mechanical valves before a thorough assessment of risks, benefits, and education regarding proper use (B-II).[88-91]

　　a. Routine use of the currently marketed devices that are associated with an increased risk of CLABSI is not recommended.

IV. Unresolved issues

1. Nurse-to-patient ratio and use of float nurses in ICUs[92-94]

　　a. Observational studies suggest that there should be a nurse-to-patient ratio of at least 2 : 1 in ICUs where nurses are managing patients with CVCs and that the number of float nurses working in the ICU environment should be minimized. Formal recommendations await the results of interventional trials.

2. Intravenous therapy teams for reducing CLABSI rates[95]

　　a. Studies have shown that an intravenous therapy team responsible for insertion and maintenance of peripheral intravenous catheters reduces the risk of bloodstream infections.[96] However, few studies have been performed regarding the impact of intravenous therapy teams on CLABSI rates.

3. Surveillance of other types of catheters (eg, peripheral arterial catheters)[1,2]

　　a. Peripheral arterial catheters have not been included in most surveillance systems, although they are associated with a risk of bloodstream infection. Future surveillance systems may need to include bloodstream infections associated with these types of catheters.

4. Estimating catheter-days for determining incidence density of CLABSI

a. Surveillance can be facilitated in settings with a limited workforce by estimating the number of catheter-days.[97,98]

SECTION 5: PERFORMANCE MEASURES

I. Internal reporting

These performance measures are intended to support internal hospital quality improvement efforts and do not necessarily address external reporting needs.

The process and outcome measures suggested here are derived from published guidelines, other relevant literature, and the opinion of the authors. Report process and outcome measures to senior hospital leadership, nursing leadership, and clinicians who care for patients at risk for CLABSI.

A. Process measures (in rank order from highest to lowest priority)

1. Compliance with CVC insertion guidelines as documented on an insertion checklist

a. Assess compliance with the checklist in all hospital settings where CVCs are inserted (eg, ICUs, emergency department, operating room, radiology, and general wards) and assign healthcare personnel familiar with catheter care to this task.

i. For an example of a central catheter checklist, see the Institute for Healthcare Improvement Web site.[99]

b. Measure the percentage of CVC insertion procedures in which compliance with appropriate hand hygiene, use of maximal sterile barrier precautions, and use of chlorhexidine-based cutaneous antisepsis of the insertion site is documented.

i. Numerator: number of CVC insertions that have documented the use of all 3 interventions (hand hygiene, maximal barrier precautions, and chlorhexidine-based cutaneous antiseptic use) performed at the time of CVC insertion.

ii. Denominator: number of all CVC insertions.

iii. Multiply by 100 so that the measure is expressed as a percentage.

2. Compliance with documentation of daily assessment regarding the need for continuing CVC access

a. Measure the percentage of patients with a CVC for whom there is documentation of daily assessment.

i. Numerator: number of patients with a CVC for whom there is documentation of daily assessment.

ii. Denominator: number of patients with a CVC.

iii. Multiply by 100 so that the measure is expressed as a percentage.

3. Compliance with cleaning of catheter hubs and injection ports before they are accessed

a. Assess compliance through observations of practice.

i. Numerator: number of times that a catheter hub or port is observed to be cleaned before being accessed.

ii. Denominator: number of times a catheter hub or port is observed to be accessed.

iii. Multiply by 100 so that the measure is expressed as a percentage.

4. Compliance with avoiding the femoral vein site for CVC insertion in adult patients

a. Perform point prevalence surveys or use information collected as part of the central line insertion checklist to determine the percentage of patients whose CVCs are in the femoral vein versus the subclavian or internal jugular veins.

b. Calculate the percentage of patients with a femoral vein catheter.

i. Numerator: number of patients with a CVC in the femoral vein.

ii. Denominator: total number of patients with a CVC in unit population being assessed.

iii. Multiply by 100 so that the measure is expressed as a percentage.

B. Outcome measures

1. CLABSI rate

a. Use National Healthcare Safety Network definitions.

i. Numerator: number of CLABSIs in each unit assessed (using National Healthcare Safety Network definitions).

ii. Denominator: total number of catheter-days in each unit assessed (using National Healthcare Safety Network definitions).

iii. Multiply by 1,000 so that the measure is expressed as number of CLABSIs per 1,000 catheter-days.

iv. Risk adjustment: stratify CLABSI rates by type of patient-care unit.[100-102]

(a) Report comparisons based on historical data and National Healthcare Safety Network data, if available.[56]

II. External reporting

There are many challenges in providing useful information to consumers and other stakeholders while preventing unintended adverse consequences of public reporting of healthcare-associated infections.[103] Recommendations for public reporting of healthcare-associated infections have been provided by the Healthcare Infection Control Practices Advisory Committee,[104] the Healthcare-Associated Infection Working Group of the Joint Public Policy Committee,[105] and the National Quality Forum.[106]

A. State and federal requirements

1. Hospitals in states that have mandatory reporting requirements for CLABSI must collect and report the data required by the state.

2. For information on state and federal requirements, contact your state or local health department.

B. External quality initiatives

1. Hospitals that participate in external quality initiatives or state programs must collect and report the data required by the initiative or the program.

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