Central Line-Associated Bloodstream Infection Prevention

Last updated 2015
Objectives

• Describe the etiology and epidemiology of central line associated bloodstream infections (CLABSI)
• Identify risks associated with CLABSI
• Identify evidence-based practices for CLABSI prevention
• Describe the development of “bundles” and their impact on CLABSI prevention
• Review CLABSI surveillance methods
CLABSI Prevention Objectives

- U.S. Health and Human Services (HHS) HAI Action Plan 5-Year Targets
  - Reduce CLABSI by 50% (since 2009 baseline)
  - Achieve 100% compliance with CLIP
- Centers for Medicare and Medicaid Services (CMS) Value-Based Purchasing
  - All US hospitals reporting CLABSI via NHSN by Jan 2011
  - Annual payment update (2%) awarded for hospital participation
  - “Pay-for-performance” began 2013

HHS Action Plan for Prevention of Healthcare-Associated Infections
(http://www.health.gov/hai/prevent_hai.asp)
Central Line or Central Vascular Catheter

- Intravascular catheter that terminates at or close to the heart or one of the great vessels and is used for infusion, withdrawal of blood or hemodynamic monitoring*
  - Nontunneled CVCs (subclavian, jugular)
  - Tunneled CVCs (Broviac, Hickman, Groshong)
  - Dialysis catheter (Quinton)
  - Peripherally inserted central catheters (PICCs)
  - Implanted ports (Permacath)

- Used increasingly to provide long-term venous access in all care settings, including outpatient

* Note: midline catheters are not in this category
Pathogenesis of CLABSI

Common Mechanisms

• Extraluminal: Pathogens migrate along external surface of catheter
  – More common in early period following insertion, < 7 days
• Intraluminal: Hub contamination, migration along internal surface
  – More common >7 days, intraluminal colonization

Less Common Mechanisms

• Hematogenous seeding from another source
• Contaminated infusates
Biofilms

- Complex aggregation of microorganisms growing on a solid substrate
- Form on catheter surfaces
- Contribute to risk for CLABSI

Source: CDC
CLABSI Risk Factors

- Multiple catheters or multiple lumens
- Emergency insertion
- Prolonged duration of CVC
- Prolonged hospital stay prior to CVC insertion
- Excessive manipulation of the catheter
- Neutropenia
- Prematurity
- Total parenteral nutrition

*Dialysis patients have many of these risk factors.*
# Modifiable Factors Vary CLABSI Risk

<table>
<thead>
<tr>
<th>Modifiable Risk Factors</th>
<th>Higher CLABSI Risk</th>
<th>Lower CLABSI Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion circumstances</td>
<td>Emergency insertion</td>
<td>Elective insertion</td>
</tr>
<tr>
<td>Skill of inserter</td>
<td>General clinician</td>
<td>Specialized (e.g., PICC team)</td>
</tr>
<tr>
<td>Insertion site</td>
<td>Femoral</td>
<td>Subclavian</td>
</tr>
<tr>
<td>Skin antisepsis</td>
<td>Alcohol (and povidone iodine)</td>
<td>Chlorhexidine (lowest risk)</td>
</tr>
<tr>
<td>Catheter lumens</td>
<td>Multilumen</td>
<td>Single lumen</td>
</tr>
<tr>
<td>Duration of use</td>
<td>Temporary (non-tunneled) catheters (including PICC) left in place long-term</td>
<td>Dialysis fistula (lowest risk) or permanent (tunneled) catheter when long-term use expected</td>
</tr>
<tr>
<td>Barriers for insertion</td>
<td>Anything less than maximal</td>
<td>Maximal</td>
</tr>
</tbody>
</table>
What is a Bundle?

- Introduced by the Institute for Healthcare Improvement (IHI)
- Groups of practices with high-level clinical evidence of effectiveness
- When applied together, improvements synergistically greater
- Benefits of a bundle:
  - Treatment variation is minimized
  - Reliability is enhanced

The whole is greater than the sum of its parts!
IHI Bundle for Central Line Insertion Practices (CLIP)

Practices supported by high-level evidence:

- Hand hygiene
- Maximal barrier precautions
- Chlorhexidine skin antisepsis
- Optimal catheter site selection
- Daily review of line necessity

Empower nurses and others to “STOP THE LINE” if any of bundle components are missing.

IHI CLABSI Bundle
IHI Bundle Component: Hand Hygiene

- Before and after palpating* catheter insertion sites
- Before and after inserting, replacing, accessing, repairing, or dressing a catheter
- When hands obviously soiled or contamination suspected
- Before and after invasive procedures
- Between patients
- Before donning and after removing gloves

* Note: palpation of insertion site should not be performed after application of antiseptic unless aseptic technique maintained
IHI Bundle Component: Maximal Barrier Precautions

- Wear cap, mask, sterile gown and sterile gloves
  - Applies to both the line inserter and immediate assistant
- Cover patient from head to toe with sterile drape with small opening for site of insertion
IHI Bundle Component: Chlorhexidine Skin Antisepsis

• Allow time to dry completely before puncturing site
IHI Bundle Component: Optimal Catheter Site Selection

- Subclavian vein the preferred site for non-tunneled catheters in adults
IHI Bundle Component: Daily review of Line Necessity

- Prompt removal of unnecessary lines
- Risk of infection increases with duration of line
- Examples of appropriate uses: receipt of TPN, chemotherapy, extended use of antibiotics, or hemodialysis
CDC Prevention Strategies

Core Strategies
- Higher levels of scientific evidence
- Demonstrated feasibility

Supplemental Strategies
- Some scientific evidence
- Variable levels of feasibility

- Standard practice
- Implement in addition to Core when infections persist or rates are high
CLABSI Core Prevention Strategies

- Remove unnecessary central lines
- Proper insertion practices (CLIP)
- Hand hygiene
- Skin antisepsis
- Lower risk insertion sites
- Hub and access port disinfection
- Educate on central line insertion and maintenance
CLABSI Supplemental Prevention Strategies

• Chlorhexidine bathing
• Antimicrobial-impregnated catheters
• Chlorhexidine-impregnated dressings
Considerations for Supplemental Prevention Strategies

• Chlorhexidine bathing:
  – Daily bathing with 2% chlorhexidine decreased BSI rate in ICU compared to soap and water

• Chlorhexidine dressings
  – Chlorhexidine dressings have been shown to decrease CLABSI rates in some studies, not in others
  – May be an option when core interventions have not decreased CLABSI rates to established goals
Considerations for **Supplemental** Prevention Strategies

**Antimicrobial catheters**

- May be appropriate for
  - Patient’s catheter expected to be used for >5 days **AND**
  - when Core strategies have not decreased CLABSI rates to established goals

- Studies show some supporting evidence for catheters with Minocycline-Rifampin and Chlorhexidine–Silver Sulfadiazine for adult patients

- Platinum-Silver catheters available but less evidence to support use
Measuring Prevention

Requires monitoring for

1. Compliance with practices known to reduce infections (Process measures)

2. Changes in infection rates (Outcome measures)

Gould C., Catheter-Associated Urinary Tract infection (CAUTI) Toolkit, CDC
CLABSI Prevention Process Measures

- Monitor for sustainability
- Central line insertion practices (CLIP)
- Hand hygiene
- Proportion of patients with central lines
- Duration of use
- Central line associated maintenance practices (CLAMP)

Ensuring prevention practices are being performed is itself a “core” prevention strategy.
Monitoring CLIP

When a patient develops a CLABSI, assess central line CLIP adherence
Monitoring Central Line Care and Maintenance

Observation examples

• How long has the line been in? Does the RN know?
• Observe technique in accessing the line
  – Hand hygiene before and after? Cleanse the port?
• Are dressing changes performed using sterile technique?
• Is the dressing transparent, dated, and less than 7 days old?
• How long has the tubing been up?
• Is there documentation of daily review of line necessity?
CLABSI Prevention Outcome Measure

- Perform surveillance for CLABSI using NHSN standardized definitions and methods
- Use central line days to calculate infection rates
  \[
  \frac{\text{# of CLABSI}}{\text{Central line days}} \times 1000
  \]
- Compare your CLABSI rates over time to assess prevention progress
- Make comparisons only with similar patient populations (e.g., same unit with same type of patients over time)
**CLABSI Surveillance Definition**

Patient with a central line must meet one of the following criterion

**LCBI 1**
- Patient of any age
- □ has a recognized pathogen cultured from one or more blood cultures
- □ Organism cultured from blood is not related to an infection at another site

**LCBI 2**
- Patient of any age
- □ has common skin commensals cultured from 2 or more blood cultures drawn on separate occasions
- □ has at least one of the following signs or symptoms:
  - □ Fever (>38°C), chills, or hypotension
  - □ Signs and symptoms and (+) lab results are not related to an infection at another site

**LCBI 3**
- Patient < 1 year of age
- □ has common skin commensals cultured from 2 or more blood cultures drawn on separate occasions
- □ has at least one of the following signs or symptoms:
  - □ Fever (>38°C core), hypothermia (<36°C core), apnea, or bradycardia
  - □ Signs and symptoms and (+) lab results are not related to an infection at another site

*All criteria occur within 7 day infection window period*

NHSN Patient Safety Module: Chapter 4 Device-Associated Module: BSI
Mucosal Barrier Injury BSI

- Resulted from need or more specific BSI definition in oncology patients
  - Misclassification of BSI resulting from translocation of intestinal organisms inflates CLABSI rates
- Pertains only to patients who are post allogeneic hematopoietic stem cell transplant or severely neutropenic (definitions provided in protocol)
- Review three criteria as applicable to your facility
  - Table 3: MBI-LCBI Eligible Enterobacteriaceae
  - Table 4: Examples Illustrating MBI-LCBI Criteria for Neutropenia
Mucosal Barrier Injury BSI - continued

- CLABSI reporting in NHSN requires facilities to indicate if MBI–LCBI or LCBI conditions are met
  - Both MBI-LCBI & LCBI must be reported as part of the NHSN monthly reporting plan for BSI reporting

NHSN Patient Safety Module: Chapter 4 Device-Associated Module: BSI
CLABSI Surveillance Clarifications

• Timeframe for determining CLABSI due to common commensals
  – Blood cultures have been collected on the same or consecutive days
  Example: Blood cultures positive for common commensal organism (e.g., S. epi) collected on Mon-Tues meets LCBI 2; cultures collected on Mon-Wed are too far apart

• Extensive clarifications for determining primary vs. secondary BSI
  – Provides specific scenarios to consider when determining if a BSI is primary or secondary to another site of infection and therefore not a CLABSI

NHSN Patient Safety Module: Chapter 4 Device-Associated Module: BSI
CLABSI Surveillance Clarifications -continued

- For BSI to be considered a CLABSI, a central line must be
  - In place for >2 days on the date of the event (date device placed = day one)
  AND
  - Still in place on day of event -or- in place on the day prior to the event

- The CLABSI event date is defined as the day the first element used to meet the surveillance definition occurs within the seven-day window period *

*2015 NHSN Updated Definition
NHSN Patient Safety Module: Chapter 4 Device-Associated Module: BSI
CLABSI Location Attribution

• A CLABSI is attributed to the location of the patient on the day of event
  – Defined as the date that the first element used to meet the LCBI criterion occurred
• If the date of event for a CLABSI is the day of transfer or discharge, or the next day, the infection is attributed to the transferring location

NHSN Patient Safety Module: Chapter 4 Device-Associated Module: BSI
CLABSI Cannot Re-Occur in the Same Patient within a 14-Day Timeframe

• The date of the CLABSI event is considered day 1
• A new CLABSI is not reported until 14 days have elapsed
• If a new pathogen is identified in the blood within the 14 day timeframe, it should be added to the CLABSI already reported
  — Refer to the CLABSI protocol for more details

NHSN Patient Safety Module: Chapter 4 Device-Associated Module: BSI
CLABSI Infection Window Period

• Defined as the 7-days during which all site-specific infection criteria must be met

• Includes the **first** positive blood culture was obtained, **3 calendar days before** and **3 calendar days after**
How do I apply the CLABSI surveillance concepts?

Let’s look at some examples...
CLABSI Infection Window Period

<table>
<thead>
<tr>
<th>Infection Window Period:</th>
<th>3 days before first positive diagnostic test</th>
<th>FIRST POSITIVE DIAGNOSTIC TEST</th>
<th>3 days after first positive diagnostic test</th>
</tr>
</thead>
</table>

- For CLABSI, the first diagnostic test is a positive blood culture
## Infection Window Period – Definitions

<table>
<thead>
<tr>
<th>Diagnostic Test for possible CLABSI</th>
<th>Localized Sign or Symptom for Possible CLABSI (ONLY used with 2 blood commensals)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Positive blood culture with a pathogen —OR—</td>
<td>• Fever</td>
</tr>
<tr>
<td>• 2 positive blood cultures with common commensals</td>
<td>• Chills</td>
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<td></td>
<td>• Hypotension</td>
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NHSN Patient Safety Module, Chapter 2
### CLABSI Event Date

Date the first element used to meet the definition for the first time

<table>
<thead>
<tr>
<th>HOSPITAL DAY</th>
<th>INFECTION WINDOW PERIOD</th>
<th>HOSPITAL DAY</th>
<th>INFECTION WINDOW PERIOD</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Blood Culture +\textit{Staph A}</td>
<td>1</td>
<td>Central Line inserted</td>
</tr>
<tr>
<td>2</td>
<td>\textit{Staph A}</td>
<td>2</td>
<td>Fever 38.8C</td>
</tr>
<tr>
<td>3</td>
<td>\textit{Blood Culture + Staph epi}</td>
<td>3</td>
<td>\textit{Blood Culture + Staph epi}</td>
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<tr>
<td>4</td>
<td>\textit{Staph epi}</td>
<td>4</td>
<td>\textit{Blood Culture + Staph epi}</td>
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<td>18</td>
<td>\textit{Blood Culture + Staph epi}</td>
</tr>
<tr>
<td>BSI-POA</td>
<td>\textit{Date of Event =2 Pathogen= Staph A}</td>
<td></td>
<td>\textit{CLABSI-HAI Date of Event =3 Pathogen= Staph epi}</td>
</tr>
</tbody>
</table>
Secondary BSI Attribution

• The period in which a positive blood culture must be collected to be considered a secondary BSI to a primary site of infection
  – Includes the 7-day infection window combined with the 14-day repeat infection timeframe, or 14-17 days depending on the date of the event
  – A positive blood culture collected outside this 14-17 date range cannot be considered a secondary BSI to the primary infection
• A primary BSI (CLABSI) cannot have a secondary BSI
Secondary BSI

• A secondary BSI may be attributed to a primary site of infection if one of the following is true:
  1. The blood culture pathogen matches an organism also cultured in the primary infection site

OR

  2. A positive blood culture is an element used to meet the primary site infection

• See the Secondary BSI Guide (Appendix 1) of the CLABSI protocol for more details

Chapter 4 Device-Associated Module: BSI
Pathogen Assignment

• If an additional blood pathogen is identified within the 14-day repeat infection timeframe, it should be added to the already reported CLABSI as a secondary pathogen.

• Pathogens excluded from specific infection definitions (e.g. yeast for UTI and PNEU) are also excluded from being considered secondary bloodstream infections.
  – Positive blood cultures of yeast or other excluded pathogens must be attributed as either a CLABSI or as a secondary BSI to another primary site of infection (other than UTI or PNEU).

Refer to the NHSN protocol for more details on pathogen assignment and secondary BSI.

NHSN Patient Safety Module: Chapter 4 Device-Associated Module: BSI
HEALTHCARE-ASSOCIATED INFECTIONS PROGRAM


1 National Institutes of Health, Bethesda, Maryland
2 Infusion Nurses Society, Norwood, Massachusetts
3 Greenfield Hospital, Greenwich, Connecticut
4 University of Washington, Seattle, Washington
5 Wharton Franciscan Healthcare-St. Joseph, Milwaukee, Wisconsin
6 University of Massachusetts Medical School, Worcester, Massachusetts
7 Johns Hopkins University School of Medicine, Baltimore, Maryland
8 Warren Alpert Medical School of Brown University and Rhode Island Hospital, Providence, Rhode Island
9 Office of Infectious Diseases, CDC, Atlanta, Georgia
10 MD Anderson Cancer Center, Houston, Texas
11 The Children’s Hospital, Boston, Massachusetts
12 University of Nebraska Medical Center, Omaha, Nebraska

SHEA/IDSA Practice Recommendation

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

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P uspose
Previously published guidelines are available that provide comprehensive recommendations for detecting and preventing healthcare-associated infection (HAI). 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” published in 2009. 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 update.3

SECTION 1: RATIONALE AND STATEMENTS OF CONCERN

I. Patients at risk for CLABSI in acute care facilities
A. ICU patients and associated with substantial risk (eg, pulmonary artery catheters with catheter introducers), and the fact that catheter care frequently placed in emergency circumstances, repeatedly accessed each day, and often needed for extended periods of time.1,7

B. Non-ICU patients: although the primary focus of attention over the last 2 decades has been the ICU setting, the majority of CLABSI’s occur in hospital units outside the ICU or in outpatients.6,10

C. Infection prevention and control efforts should include other vulnerable populations, such as patients receiving hemodialysis through catheters,10 intraoperative patients,12 and oncology patients.

D. Besides central venous catheters (CVCs), peripheral arterial catheters also carry a risk of infection.7

II. Outcomes associated with hospital-acquired CLABSI
A. Increased length of hospital stay.1,7
B. Increased cost (the non-inflation-adjusted attributable cost of CLABSI has been found to vary from $3,700 to $39,000 per episode1,6,7).10

III. Independent risk factors for CLABSI (in at least 2 published studies)10

A. Factors associated with increased risk:
1. Prolonged hospitalization before catheterization
2. Prolonged duration of catheterization
3. Inadequate catheter surveillance

B. Factors associated with decreased risk:
   1. Use of Seldinger technique
   2. Sepsis as the indication for catheterization

C. Factors associated with variable impact on the risk of CLABSI:
   1. Type of catheter
   2. Site of catheter insertion
   3. Duration of catheterization

SHEA Compendium 2014
Measure CLABSI Prevention

Changes in rates may be visible over time. In this example, the rate of CR-BSI decreased three-fold over one year.
Questions?

For more information, please contact any HAI Liaison Team member.

Thank you.