Central Line-Associated Bloodstream Infection: An Introduction
Conflicts Of Interest

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- National Institute for Aging
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- Veterans Health Administration
- Centers for Disease Control and Prevention

Disclosure of Off-Label and/or investigative Uses
*I will not discuss off label use and/or investigational use*
Vineet Chopra, MD, MSc
Assistant Professor of Medicine/Research Scientist
Patient Safety Enhancement Program
University of Michigan Health System

Contributions by
Kristi Felix, RN, CRRN, CIC
Madonna Rehabilitation Hospital

Karen Jones, RN, MPH, CIC
St. John Hospital and Medical Center

Len Mermel, DO, MS, FACP, FIDSA, FSHEA
Medical School of Brown University

Russ Olmsted, MPH, CIC
Trinity Health, Livonia MI

Payal Patel, MD, MPH
University of Michigan
Learning Objectives

• Understand the impact, cost, morbidity and mortality of CLABSI
• Recognize that CLABSI is defined in different ways and there are multiple routes of developing CLABSI
• Describe technical and socioadaptive interventions to prevent CLABSI
What is a Central Venous Catheter?

• Intravascular device that terminates at or close to the heart or one of the great vessels
  – Nontunneled CVCs (subclavian, jugular, femoral)
  – Tunneled CVCs (Broviac, Hickman, Groshong)
  – Dialysis catheter (Quinton)
  – Peripherally inserted central catheters (PICCs)
  – Implanted ports (Permacath)

• Used increasingly to provide short-, medium- and long-term venous access in all settings
What is CLABSI?

- An infection that originates from or is related to a central venous catheter
- Two definitions: surveillance and clinical
- CDC/NHSN Surveillance Definition:
  - A laboratory confirmed infection where a CVC is in place for >2 calendar days prior to +ve culture and is also in place the day of or day prior to culture
  - Example: PICC placed June 1. Pt febrile June 3. PICC in place. Cultures positive for Staph Aureus: CLABSI
  - PICC placed June 2 and removed June 5. Pt febrile June 6. Cultures positive for Coag Neg Staph: CLABSI
Clinical Definition of CLABSI

• CLABSI occurs when these 3 criteria exist:
  – Clinical signs of infection
    • E.g., fever, rigors, altered mental status, hypotension
  – No alternate source of bloodstream infection
  – Positive blood culture from a peripheral vein with any 1 of the following:
    • Catheter tip/segment culture that matches organism grown from blood;
    • At least 3-fold higher number of organisms grown from the catheter vs. peripheral blood culture on simultaneously drawn cultures
    • Growth from the catheter-drawn blood culture occurs at least 2 hours before growth of the same organism from a percutaneously-drawn blood culture
Burden of CLABSI

• Epidemiology of CLABSI is changing
  – 46% decrease in CLABSI since 2008-2013
  – An estimated 30,100 CLABSI occur in US hospitals on an annual basis
    • Prolongs hospital stay
    • Increase morbidity
    • Raises mortality: estimates 12-25%

• CDC estimates CLABSI cost ~ $16,550/episode


Pathogenesis of CLABSI

• Based on route of entry of bacteria:
  – Extraluminal: Pathogens migrate along external surface of catheter from skin entry site
    • Often occurs within 7 days of insertion
  – Intraluminal: Hub contamination, migration along internal surface of catheter
    • More commonly occurs >7 days, intraluminal colonization
  – Hematogenous seeding from another source
  – Contaminated infusates (rare)
Risk Factors for CLABSI

• **Patient Characteristics**
  – Immune compromised host/neutropenic hosts
  – Severe skin burns or protein calorie malnutrition
  – Prolonged hospital stay prior to device placement

• **Provider Characteristics**
  – Emergent insertion
  – Excessive device manipulation
  – Improper site or dressing care
  – Nurse : patient staffing ratio (catheter hub care)
  – Failure to remove unnecessary devices

• **Device Characteristics**
  – Site of insertion
  – Number of lumens
  – Indication for use (total parenteral nutrition, chemotherapy)
Preventing CLABSI

• MHA Keystone Study:
  – State-wide initiative in Michigan to prevent CLABSI
  – 103 ICUs, launched Oct 2003
  – Made use of a “Bundle” of best practices

• What is a bundle?
  – Structured way of improving process of care and patient outcomes using a set of evidence-based interventions at the same time

• Keystone Bundle Intervention:
  – Hand hygiene prior to catheter insertion
  – Use of maximal sterile barrier precautions
  – Use of alcohol-containing chlorhexidine for skin antisepsis before insertion
  – Avoidance of the femoral site
  – Removal of unnecessary catheters as soon as possible

Institute for Healthcare Improvement
Keystone Study Decreased CLABSI Rates

Table 3. Rates of Catheter-Related Bloodstream Infection from Baseline (before Implementation of the Study Intervention) to of Follow-up.*

<table>
<thead>
<tr>
<th>Study Period</th>
<th>No. of ICUs</th>
<th>No. of Bloodstream Infections per 1000 Catheter-Days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Overall</td>
</tr>
<tr>
<td>Baseline</td>
<td>55</td>
<td>2.7 (0.6–4.8)</td>
</tr>
<tr>
<td>During implementation</td>
<td>96</td>
<td>1.6 (0–4.4)</td>
</tr>
<tr>
<td>After implementation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–3 mo</td>
<td>96</td>
<td>0 (0–3.0)</td>
</tr>
<tr>
<td>4–6 mo</td>
<td>96</td>
<td>0 (0–2.7)</td>
</tr>
<tr>
<td>7–9 mo</td>
<td>95</td>
<td>0 (0–2.1)</td>
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<tr>
<td>10–12 mo</td>
<td>90</td>
<td>0 (0–1.9)</td>
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<tr>
<td>13–15 mo</td>
<td>85</td>
<td>0 (0–1.6)</td>
</tr>
<tr>
<td>16–18 mo</td>
<td>70</td>
<td>0 (0–2.4)</td>
</tr>
</tbody>
</table>

CLABSI Prevention Bundles

Technical Interventions

Socioadaptive Interventions
CLABSI Prevention

- Technical Interventions
- Adaptive Interventions
Evidence for Technical Element: Chlorhexidine

Meta-analysis: Among patients with CVC, chlorhexidine prep reduced risk of CRBSI by 49%

CLABSI Prevention

Technical Interventions

Socioadaptive Interventions
Not just about having a bundle...

Socioadaptive Interventions include:

• Clinician education
• Designated Physician and Nursing Team Leader
• Central-line cart in each ICU
• Insertion Checklist
• Nurse empowerment to stop procedure if best practices not followed
• Adherence to best practices
• Feedback provided regarding rates of CLABSI to frontline staff
Socioadaptive Changes are Important

• Question: does adopting a bundle alone led to CLABSI prevention?

• In 250 hospitals, CLABSI rate was 2.1 per 1000 catheter days and 49% had a bundle policy

• CLABSI rates decreased only when units:
  – had a bundle policy
  – monitored compliance
  – Demonstrated ≥ 95% compliance

Recommendations

• To improve CLABSI rates, first focus on known technical ‘active ingredients’
  – Alcohol containing chlorhexidine skin prep
  – Avoid femoral site
  – Maximal sterile barrier precautions

• Must also focus on socioadaptive elements
  – Measure and encourage compliance with bundle
  – Improve culture, communication and staff empowerment to improve outcomes

Summary

• Despite progress, CLABSI remains a costly, morbid and lethal condition
• Prevention of CLABSI should focus on both technical and socioadaptive elements
• Guidance using each of these strategies will be provided during the course of this quality improvement intervention
THANK YOU!