Prevention of Hospital Acquired Infections

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The speaker has signed a disclosure form and indicated he has no significant financial interest or relationship with the companies or the manufacturer(s) of any commercial product and/or service that will be discussed as part of this presentation.

Session Summary

Hospital acquired infections are a major source of morbidity and mortality in the NICU. Well tested strategies for the prevention of hospital acquired infections in adult ICUs are now being tested in the NICU setting. This talk will present a practice system-based approach for infection prevention.

Session Objectives

Upon completion of this presentation, the participant will:

- understand the epidemiology and risk factors for hospital acquired infections in the NICU;
- be able to describe the rationale behind common HAI prevention strategies;
- understand how quality improvement plans can help your NICU decrease CLABSIs.

References


**Session Outline**

See presentation handout on the following pages.
Prevention of Hospital Acquired Infections in the NICU

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Why should we worry about HAI?

- HAI’s cause 100,000 deaths/year in U.S.
- 50 to 60% caused by antibiotic resistant bacteria
- Late onset sepsis causes 45% of NICU deaths after 2 weeks of age
- Associated with longer hospital stay, increased costs and worse developmental outcome
- Non-reimbursed care?

Infection Increases Relative Risk of Poor Neurodevelopmental Outcome

<table>
<thead>
<tr>
<th>Clinical Infection (n=1538)</th>
<th>Sepsis (n=1922)</th>
<th>Sepsis + NEC (n=279)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDI &lt; 70</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>PDI &lt; 70</td>
<td>1.5</td>
<td>1.4</td>
</tr>
<tr>
<td>CP</td>
<td>1.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Microcephaly</td>
<td>1.3</td>
<td>1.5</td>
</tr>
</tbody>
</table>

@ 18 month follow-up
Stoll et al. JAMA 2004; 292:2357

Rates of HAI by Birth Weight

<table>
<thead>
<tr>
<th>Birth Weight (g)</th>
<th>UVC &amp; CV BSI*</th>
<th>VAP*</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1000</td>
<td>10.3</td>
<td>2.0</td>
</tr>
<tr>
<td>1001 - 1250</td>
<td>6.3</td>
<td>0</td>
</tr>
<tr>
<td>1251 - 1500</td>
<td>3.7</td>
<td>0</td>
</tr>
<tr>
<td>&gt; 2500</td>
<td>2.8</td>
<td>0</td>
</tr>
</tbody>
</table>

* Per 1,000 device days
NNIS Data 1995 – 2003, median values

Epidemiology of Hospital-Acquired Infections in the NICU

Epidemiology of late-onset infections

- Risk factors include:
  - Lower gestational age
  - Lower birth weight
  - Prolonged mechanical ventilation
  - Necrotizing enterocolitis
  - Bronchopulmonary dysplasia
Other Associated Factors
- Use of parenteral nutrition and lipid emulsion
- Presence of central catheter
- Steroids for BPD (? hypotension)
- Histamine blockers
- Low serum IgG levels at birth
- Overcrowding and heavy workloads

Late-onset infections in NICHD Network
- 6215 VLBW infants in 15 sites
- 21% of infants diagnosed with LOS
- 72% with one episode; 28% more than one
- Considerable inter-center variability
  - Rates ranged from 10.7 to 31.7% of VLBWs
  - 18 to 51% in infants < 28 weeks

Epidemiology of Late-Onset Infections

Epidemiology of late-onset infections: Gram-positive organisms

Coagulase Negative Staphylococci
- Most common cause of catheter related sepsis
- Also common contaminant
- Usual practice to obtain single blood culture; volume of blood critical
- Culture drawn through catheter hub may be line colonization or contamination

Coagulase Negative Staphylococci
- CoNS on NICU RN’s hands more likely to be antibiotic resistant
- Pre and post vacation isolates different
- Almost all blood isolates of CoNS genetically related to organisms isolated from hands of NICU personnel
- Suggests invasive CoNS nosocomially acquired
Strategies to prevent hospital-acquired infection in the NICU

**Hand hygiene**
- “Mom and apple pie”
- Historically low rates, difficult to enforce
- Quality improvement methodology works to improve compliance
- Does it prevent infections?

**Hand Hygiene Compliance and MRSA Acquisition**

Song X, Am J Infect Contr, 2013

**Hand Hygiene Practice and Infections**

Mukerji A, BMJ Open, 2013

**12 Steps: Antibiotic “Stewardship”**

Prevention of Antimicrobial Resistance
- Diagnose and treat by targeting the pathogen
- Use local organism susceptibility data to guide antimicrobial use
- Treat infection, NOT colonization or contamination
- Stop therapy when cultures are negative or clinical course doesn’t support antibiotic use
- Antimicrobial control to drive judicious use
Vancomycin Use in NICUs

- 27% of vancomycin courses in pediatric hospitals were initiated by neonatology service
- 28% of hospitalized pediatric patients were in the NICU when vancomycin initiated
- Resistant organisms necessitating vancomycin use were isolated in only 8% of cases in which it was initiated
- 32% of vancomycin days in NICU setting were inappropriate based on the CDC 12 step antimicrobial control program

Pediatr Infect Dis J 2009;28:1047-1051
Pediatrics 2003, 112:e104

Venous Catheters and Infection

- Evidence basis for strategies to prevent of intravascular catheter-related infections

What is a CLABSI?

- Central Line Associated Blood Stream Infection = CLABSI
- Positive blood culture x 2 with recognized pathogen in patient with central line in place without any other source identified
- Expressed as infection per 1000 line days

Catheter Site

- Catheter site important in incidence of CLABSI in adults
- Groin > neck > subclavian
- Little data in pediatric population
- Tunneled versus non-tunneled catheters

Infections by Type of Line

<table>
<thead>
<tr>
<th>Line Type</th>
<th>Adjusted RR</th>
<th>Days after insertion</th>
<th>Infections per 1000 line days</th>
</tr>
</thead>
<tbody>
<tr>
<td>UVC</td>
<td>2.0</td>
<td>4 ± 8.9</td>
<td>7.2</td>
</tr>
<tr>
<td>PICC</td>
<td>3.5</td>
<td>10 ± 10.9</td>
<td>13.1</td>
</tr>
<tr>
<td>Broviac</td>
<td>3</td>
<td>16 ± 19.1</td>
<td>12.1</td>
</tr>
</tbody>
</table>

Compared to no CVC infection rate of 2.9 per 1000 non-line days


CLABSI Free Rate by Duration of UVC Use

Butler-O’Hara, J Pediatr 2012
Quality Improvement Teams and Prevention of Hospital Acquired Infections

Guidelines v. Bundles
- Guidelines tend to be long, all-inclusive, and confusing
  - Many potential interventions are supported by some evidence
- Guidelines are difficult to translate into action and often ignored by clinicians
- What if just a few key, actionable interventions, supported by strong evidence, were culled from the guidelines?

What Is a Bundle?
- Grouping of best practices that individually improve care; when applied together result in substantially greater improvement
- Sound evidence base
- Bundle elements are dichotomous; compliance can be measured: yes/no answers
- Bundles reject the piecemeal application of proven therapies in favor of an “all or none” approach
- Occur in a specific point in time

CLABSI: Access to Patient

Catheter Insertion Bundles
- Associated with decreased CLABSI in adults and pediatric patients
- Little data in newborns
- Stress hand hygiene, full barrier precautions, site, sterile technique and teamwork
- Use of checklists


Central Line Insertion Checklist: Adults
- Hand Hygiene
- Aseptic Technique
- Use of Checklists
- Site Selection
- Sterile Technique
- Use of Checklists
- Initial Access
- Continuous Maintenance
- Checklists
- Compliance
- CLABSI Rate

**Keystone ICU Project**

- 103 participating adult ICUs in Michigan, United States
- Implementation of CVL insertion bundle
- Additional interventions
  - Daily goal sheet
  - VAP reduction
  - Unit-based safety program


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**Catheter Site Cleansing**

- Chlorhexadine as antiseptic more effective in prevention of CLABSI in adult and pediatric patients than povidone-iodine
- Approved in U.S. for use > 2 months of age
- Problems with skin irritation and absorption in newborns (especially preterm) – use controversial

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**Use of Chlorhexadine in U.S. NICUs**

Tamma PD, Infect Control Hosp Epidemiol 2010

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**Restriction of Chlorhexidine Use by Gestational Age**

Tamma PD, Infect Control Hosp Epidemiol 2010

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**Catheter Dressing**

- Biopatch® is chlorhexidine impregnated catheter dressing
- Used in adults and children also helps prevent CLABSI
- Cannot be used in preterm infants secondary to skin irritation (~15%)
“Maintenance” Bundles

- Guidelines for care of CVL
- Dressing type and change schedule
- Duration of IV tubing before change
- Specify when sterile field should be used
- Teamwork to prevent distraction/error
- Daily assessment of line necessity

A statewide quality improvement collaborative to reduce neonatal central line-associated bloodstream infections

Development of a statewide collaborative to decrease NICU central line-associated bloodstream infections

Wirtschafter DG, J Perinatol 2010

CLABSI Rate Improved by Higher Checklist Use

Schulman J, Pediatrics 2011

CLABSI Rate Affected by Patient Volume

Schuman J, Pediatrics 2011
Use of Line Team to Decrease CLABSI

Decay in Overall Infections Driven by Decrease in CoNS

Getting to Zero: Neonatal v. Adult CVL Infections
- Data suggest that most line infections in neonates “intraluminal” source
- Limited effect of insertion bundles
- Lines used differently
  - Access for blood draws
  - Longer duration
- Bedside management most critical
- Sustainability remains issue

Getting to Zero: Is it Harder in Neonates?
- Are all CLABSI’s really line related?
  - Other sources – porous gut, prolonged mechanical ventilation, altered microbiome
  - Adjudication of CLABSI may affect rate
- Excellent line maintenance may not eliminate all infections in babies with CVL
- Need additional strategies

Common Sense Strategies
- Alcohol based gels for hand hygiene at every bedside
  - Compliance generally poor, though improving
- Minimize central line days (checklist)
- Use sterile barriers for line insertion and maintenance
- Encourage use of breast milk

Common Sense Strategies
- Limit use of drugs associated with HAI (e.g. H2 blockers)
- Cohort infants with resistant or virulent organisms
- Antibiotic “stewardship”; use narrowest spectrum allowed
- Safety culture and training