Healthcare-Associated Infections in Neonates and Young Children

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Objectives

• To describe unique features of neonates and young children that predispose them to nosocomial infections
• To identify common pathogens associated with nosocomial infections in neonates and young children

Magnitude of the Problem

• Approximately 10% of hospitalized patients develop a healthcare-associated infection (HAI)
  – Children in PICU - HAI 13.9/1000 pt days
• Impact on hospitalized children:
  – Mean increased LOS – 30 days
  – >$121,000 increase in hospital charges
  – Mean increase in-hospital mortality (OR 2.2)


HAIs in Children and Adults

• Pediatric: 6-7/100 patients
  – ↑ viral respiratory tract and GI infections
• Adult: 4/100 patients
  – ↑ wound infections
  – ↑ ventilator-associated pneumonias (27% vs 21%)
  – ↑ urinary tract infections (31% vs 15%)


Host Factors Unique to the Child

• High rate of community-acquired infections
• Developmental immaturity
  • Lack of bowel control
  • Mouthing of objects
• Immunologic immaturity
• Congenital immunodeficiency
• Congenital abnormality

Social Factors Unique to Children

• Children require total care from HCW or parent (typically incontinent until age 3 or 4 and unable to feed themselves)
• No sense of personal space
• Many potential fomites in shared play areas
• Pet therapy
Factors Unique to Environment

- Typically have sibling visitation with increased exposure
- Patient-to-patient interactions are more frequent on a pediatric unit
- Shared hospital rooms, playrooms and schoolrooms

Toys

- Toys as fomites
- Dirty toy box
- Toy cleaning policy
  - easily cleaned surfaces
  - soap/water and bleach
- Special circumstances
  - stuffed animals and cloth dolls
  - children in isolation

Common Sites of Nosocomial Infection

- Bloodstream 26%
- Pneumonia 18%
- Urinary tract 15%
- Surgical site 12%
- Lower respiratory tract 7%
- Gastrointestinal tract 6%
- Skin/soft tissue 4%

Adapted from Coffin SE in Long, Pickering, & Prober 2007, p577.

Viral Respiratory Tract Infections

- Most common cause of nosocomial upper and lower respiratory tract infections in children
- Often exogenous source
- Potential for widespread transmission
- Children without pre-existing immunity
- Increased reservoir in pediatric units
- Prolonged shedding in some hosts
- Behaviors
- Adenovirus, influenza, measles, parainfluenza, RSV, rhinovirus, varicella zoster, HMPV

Other Important Pediatric Nosocomial Pathogens

- (Varicella zoster virus)
- Pertussis
- Tuberculosis
  - Be aware of family members

<table>
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<th>Beds per room</th>
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NOSOCOMIAL INFECTIONS IN NEWBORN INFANTS

Unique Features of the Newborn
- Naïve immunologic system and microbiome
- Infections can be prepartum, intrapartum or postpartum
- Needs total care from mother or HCW
- Unique nursery environment

Common Neonatal Infections

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<td>Group B strep</td>
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<tr>
<td>Tuberculosis</td>
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</tbody>
</table>

Preventing Infections in Newborns
- HIV
- Rubella
- Syphilis
- Varicella
- Chlamydia
- Group B Strep
- Hepatitis B
- HSV
- Screen & Treat
- Immunize mother
- Screen & Treat
- Immunize mother
- Screen & Treat
- Immunize infant
- ? C-section, suppress

Neonatal Intensive Care Unit
- Nosocomial infection rates in NICU range from 7% to 31%
- Nosocomial infection rates in NICU can be highest in hospital
- Nosocomial infection rates are significantly higher in infants with birthweight < 1500 g
- Very costly
  - Example: coagulase-negative staphylococcus bacteremia
    - prolonged hospital stay 14 days
    - cost $25,000 extra per infant

Unique Issues of NICU Environment
- In most hospitals, the NICU and intermediate nurseries have the largest number of beds of any unit in the hospital
- Can easily put “another bed” in a nursery due to small size of patient

Medication Exposures

- Outbreaks from using shared containers
  - eye drops
  - lotions
  - soaps

Equipment Exposures

- Breast pump contamination
- PICC and UAC lines rarely changed due to technical difficulties

Sibling Visitation

- Encouraged in both the nursery and pediatric inpatient setting
  - “Family centered care”
- Siblings must be screened for current infectious illness or recent exposure (e.g. varicella) by physician or nurse
- Should be directed and limited visitations

Blood Banking

- Patients receive multiple small transfusions during their prolonged hospitalizations
- 50% - 70% of infants receive a transfusion
- Order 10cc/kg transfusion
  - 750 gram infant = 7.5cc  (342.5 cc remaining)
- Common practice to split RBC packs to share among different infants
  - maximizes donor exposure and transfusion-related infectious risks

Breast Milk & Nosocomial Infections

- First weekend on service and you get called by the NICU. A 12 day old was given the wrong breast milk. Please advise.

http://www.cdc.gov/breastfeeding/recommendations/other_mothers_milk.htm
Pathogens Transmitted in Breast Milk

- HIV
- HTLV-1
- CMV
- HBV
- HCV
- Staph aureus
- West Nile Virus

CDC Recommendations

- Expressed breast milk exposure
  - Treat incident like any accidental exposure to body fluids.
  - Inform the mother who expressed the breast milk of the bottle switch
  - Discuss the incident with the parents of the child who was given the wrong bottle

Breast Milk: HIV

- The risk of HIV transmission from expressed breast milk consumed by another child is believed to be low because:
  - HIV positive women advised NOT to breastfeed their infants
  - Time and cold temperatures may destroy the HIV present in expressed breast milk
  - Transmission of HIV from single breast milk exposure has never been documented

Breast Milk: HBV and HCV

- HBV detected in milk of most chronic carriers
  - Before the availability of hepatitis B vaccine, HBV transmission through breastfeeding was not reported.
- HCV not detected in milk of 73 chronically infected women (60% viremic)
  - There is no documented evidence that breastfeeding spreads HCV.

Breast Milk

- No special precautions exist for handling expressed human milk, nor does the milk require special labeling. It is not considered a biohazard. The Universal Precautions to prevent the transmission of human immunodeficiency virus (HIV), Hepatitis B virus, and other bloodborne pathogens do not apply to human milk.
- Standard Precautions

Other Obstacles to Infection Control in NICU

- High nurse to nurse : patient
- Close proximity of neonates to each other
- Compliance with hand washing
- Limited number of isolation rooms
- Admissions from home or outside hospitals
- Sibling visitation
- Lack of data to support prevention strategies
**Chlorhexidine Gluconate (CHG)**

- Widely used topical antiseptic
  - Uses of CHG include:
    - Catheter site skin preparation and maintenance
    - Preoperative skin preparation
    - Hand cleanser
    - Newborn umbilical care and skin cleansing
    - Oral care to prevent VAP
    - *Staphylococcus aureus* decolonization

**CHG Bathing Reduces HAIs**

- Reduces
  - Bacteremia
  - CLABSI
  - VRE transmission
  - MRSA clinical cultures

**CHG Bathing in Children**

- CHG bathing more controversial among pediatricians due to concerns about safety
  - Reported adverse events rare, including:
    - Contact dermatitis
    - Delayed hypersensitivity
    - Ototoxicity & anaphylaxis (extremely rare)

- Hexachlorophene, chemically distinct antiseptic
  - Penetrated intact skin
  - Caused encephalopathy in newborn infants in ‘70s

**MRSA Paradigm**

- Not colonized with MRSA on admission
- Colonized with MRSA on admission
- Acquire MRSA colonization in hospital
- Risk of Infection
- MRSA infection
- Mortality – up to 20%

**ESBL Klebsiella**

- Not colonized with ESBL KP on admission
- Acquire ESBL KP colonization in hospital
- ESBL KP infection
- Mortality 38%

**Sources**:
- Milstone et al. Lancet 2013
- Climo M et al. NEJM 2013
- Huang SS et al NEJM 2013
- Popovic S et al. IHE 2014
Neonates are Unique

- All cases are healthcare-acquired
- Prolonged length of stay, high device utilization, frequent procedures
- Infections are associated with poor neurodevelopment and growth outcomes
- Go home and often never come back


Summary

- Neonates and young children have special factors that predispose them to nosocomial infections
- Guidelines and preventative measures designed for children present a unique challenge to infection prevention and control