

Hospital Acquired Infections



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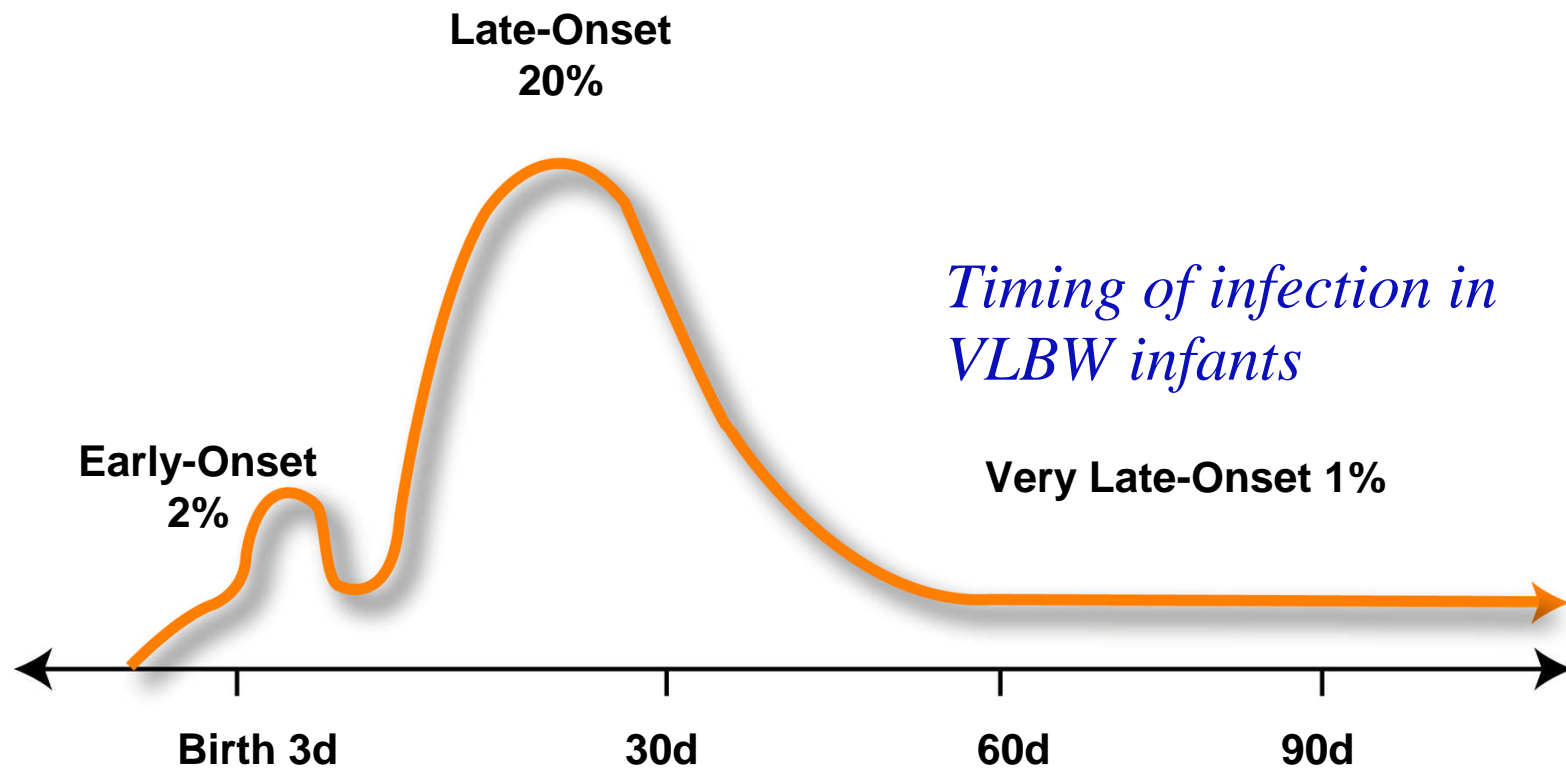


Educational Objectives

- * To review the clinical significance and epidemiology of hospital acquired infections.
- * To discuss the the relative merits of prevention strategies for hospital-acquired infections in the neonate.

*This presentation will not include discussion of any pharmaceuticals or devices approved or unapproved by the FDA. I am on the scientific advisory board for Discovery Laboratories.

Clinical Spectrum of Neonatal Sepsis



Why Worry about Hospital-acquired infections?

- ◆ HAIs are responsible for 100,000 deaths and \$6.5 billion dollars in excess expenditure annually (U.S.) .
- ◆ 50-60% are caused by resistant bacteria
- ◆ Late onset sepsis is responsible for up to 45% of deaths after two weeks of age
- ◆ HAIs prolong hospitalization, increase costs and are associated with a poorer neurodevelopmental outcome.
- ◆ The Center for Medicare and Medicaid Services no longer reimburses hospitals for expenses associated catheter related blood stream infections (October 2008)

Adverse Neurodevelopmental Outcome in ELBW Infants with Infections

	<i>Clinical infection (n=1538)</i>	<i>Sepsis (n=1922)</i>	<i>Sepsis + NEC (n=279)</i>
<i>MDI < 70</i>	<i>1.3 (CI 1.1,1.5)</i>	<i>1.3 (CI 1.1,1.6)</i>	<i>1.6 (CI 1.2,2.2)</i>
<i>PDI < 70</i>	<i>1.5 (CI 1.3,2.0)</i>	<i>1.5 (CI 1.2,1.9)</i>	<i>2.4 (CI 1.7,3.4)</i>
<i>CP</i>	<i>1.3 (CI 1.0,1.6)</i>	<i>1.4 (CI 1.1,1.8)</i>	<i>1.7 (CI 1.2,2.5)</i>
<i>Microcephaly</i>	<i>1.3 (CI 1.1,1.6)</i>	<i>1.5 (CI 1.2,1.7)</i>	<i>2.0 (CI 1.5, 2.6)</i>

Stoll et al JAMA 292: 2357, 2004 (n=6093, 18 month follow-up)

Rates of Neonatal Hospital-acquired Infections

Birth weight (gm)	UV & CVC BSI*	VAP*
< 1000	10.3	2.0
1001-1250	6.3	0
1251-1500	3.7	0
>2500	2.8	0

*= per 1000 device days (NNIS Data 1995-2003) median values are shown

*Epidemiology of Nosocomial
Infections in the NICU*

Pathogens Causing Nosocomial Sepsis

Staphylococcus-coagulase negative	55%*	47%**	47.9%#
Staphylococcus aureus	9%	4%	7.8%
Enterococcus/Group D Streptococcus	5%	3%	3.3%
Gram negative enterics	18%	31%	18%
Fungi	9%	11%	12.2%

**Stoll J Pediatr. 1996 ** Makhoul Ped 2002, #Stoll Ped. 2002*

Coagulase Negative Staphylococcal Sepsis

- * Most common cause of catheter associated sepsis, but also a common contaminant
- * Only a single blood culture is commonly obtained and the volume of blood is a critical variable
- * Cultures drawn through a catheter hub may represent either line colonization, contamination of the culture site or true bacteremia
- * Quantitative blood cultures may help distinguish contaminated blood cultures from true infections, but are not commonly used.

Treatment of CONS positive Blood Cultures: Controversies

- * Should a colonized central line be treated?
- * Should two peripheral blood cultures be drawn for presumed catheter related sepsis rather than a central and peripheral blood culture?
- * Should oxacillin be first line therapy for a presumed catheter related infection (rather than vancomycin)
- * If a central line is removed because of presumed colonization (and persistently positive cultures) how many days of additional treatment are necessary once the line is removed?

Epidemiology of Nosocomial Infections in the NICU

- * Strongest correlation with birth weight & gestation
- * Use of parenteral alimentation and central lines
- * Sicker infants (controversial)
- * Steroids for BPD
- * Histamine blockers
- * Low serum IgG levels at birth

Epidemiology of Nosocomial Infections in VLBW Infants

- ❄ Prolonged duration of mechanical ventilation
- ❄ Overcrowding & heavy workloads
- ❄ Staffing problems (inexperienced nurses)

Prevention Strategies for Hospital Acquired Infections

Category IA: Strongly recommended & supported by well designed experimental, clinical or epidemiologic studies.

Category IB: Strongly recommended and supported by some experimental, clinical or epidemiologic studies and a strong theoretical rationale

Category IC: Required by State or federal regulations

Category II: Suggested for implementation and supported by suggestive clinical or epidemiologic studies or a theoretic rationale

Unresolved issue:

Routine Use of Gowns in the NICU

- * Eight trials with 3,811 infants were reviewed (two were of good quality)
- * Gowns are not effective in limiting death, infection or bacterial colonization

Venous Catheters and Nosocomial infections

▣ *Guidelines for Prevention of Intravascular Catheter -Related infections* (<http://www.pediatrics.org/cgi/content/full/110/5/e51>)

Guidelines for Prevention of Intravascular Catheter -Related infections

- * Site of catheter placement (no evidence in the pediatric population that any one site has a lower risk of infection).
- * Tunneled vs. non-tunneled catheters (adult literature suggests tunneled catheters have a lower risk of infection)

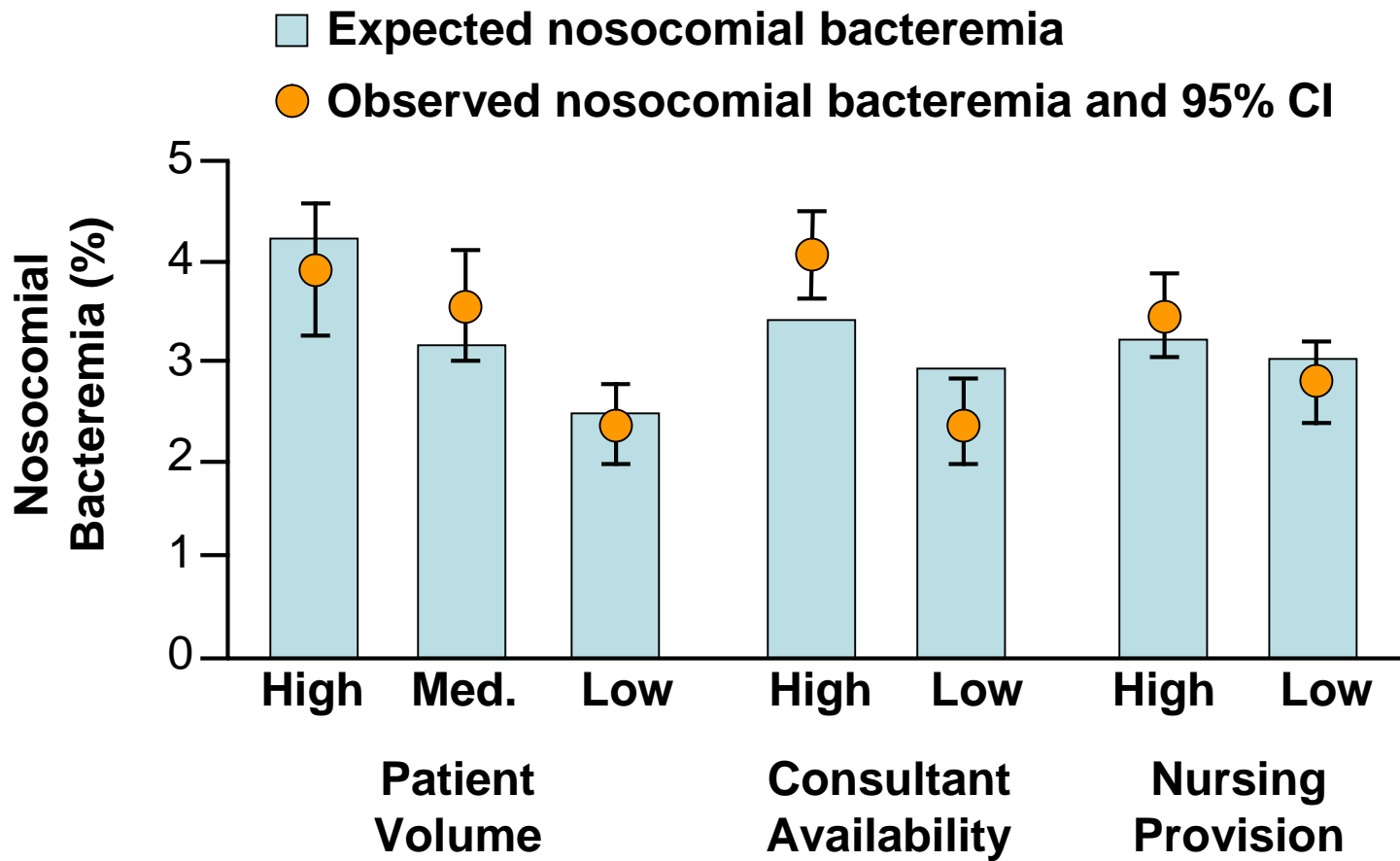
Rates of Nosocomial Blood Stream Infections for Umbilical Venous, Percutaneous and Broviac Catheters

	<i>Adjusted RR</i>	<i>Days after insertion</i>	<i>Infection incidence (per 1000 CVC days)</i>
<i>Umbilical venous</i>	2.0	4 ± 8.9	7.2
<i>Percutaneous</i>	3.5	10 ± 10.9	13.1
<i>Broviac</i>	3.0	16 ± 19.1	12.1
<i>No CVC</i>			2.9

Study population included 20,488 admissions to the Canadian Neonatal Network

Chien LY et al Pediatr Infect Dis. J 21: 505, 2002

- * Health care worker education and training (*IA*)
- * Ensuring appropriate nursing staff levels in ICUs (*IB*)



Current Recommendations for Catheter Placement & Maintenance

- * Monitor the catheter sites visually or by palpation (IA)
- * Do not routinely culture catheter tips (IA)
- * Maintain aseptic technique during catheter insertion & dressing changes (1A)
- * Use sterile gloves for insertion of central and arterial catheters (IA)
- * In infants > 2 months a 2% chlorhexidine preparation is preferable; in infants < 2 months skin preparation is an unresolved issue (IA)*

*The national evidence-based guidelines in England (epic2-2007) recommend chlorhexidine as level “A” guideline

Current Recommendations for Catheter Placement & Maintenance

- ✧ Use either a sterile gauze or transparent dressing at the catheter insertion site (*IA*)*
- ✧ Replace the dressing if the catheter site becomes damp or soiled (*1B*)
- ✧ Do not use topical antibiotics at the insertion site (*IA*)
- ✧ *Promptly remove any intravascular catheter that is not essential* (*IA*)
- ✧ Replace administration sets no more frequently than every 72 hours (*IA*)
- ✧ Replace tubing used to administer blood or lipid emulsions within 24 hours (*1B*)

Handwashing

- * Removal of rings, no “dark” nail polish or false nails & trim nails. *Clear nail polish is acceptable.*
- * Initial scrub to the elbows with an antiseptic soap before beginning the shift (*disposable sponges are acceptable and less damaging*).
- * A 10 second wash *without a brush* (but with an antiseptic soap and vigorous rubbing) is required before and after handling each infant and when touching objects in the environment. (*alcohol based emollients would be acceptable* as long as the hands are not soiled)
- * *Handwashing is needed even when gloves are worn*

Guidelines for Perinatal Care 2007

Strength of Evidence & Indications for Handwashing and Hand Antisepsis

- ❖ When hands are soiled by body secretions or debris, **handwashing** is indicated (**1A**).
- ❖ When hand appear clean, but disinfection is needed (before and after patient contact), hand hygiene is indicated (**1B**).
- ❖ Decontaminate hands before donning & after removal of sterile gloves (**1B**)
- ❖ Decontaminate hands after contact with a patients skin, body fluids, mucous membranes or excretions (**1B**)
- ❖ Decontaminate hands after contact with inanimate objects in the patients environment (**II**)

“*Hand Hygiene Alternatives*”

- * Alcohol based formulations (with appropriate emollients are equivalent or superior to antiseptic detergents (in addition they require no washing & minimal drying)
- * Soaps and detergents, particularly those that are anionic or cationic, are the most damaging substances (*Larson Rev. Inf. Dis. 1999*).

Compliance with Hand Hygiene is Poor!

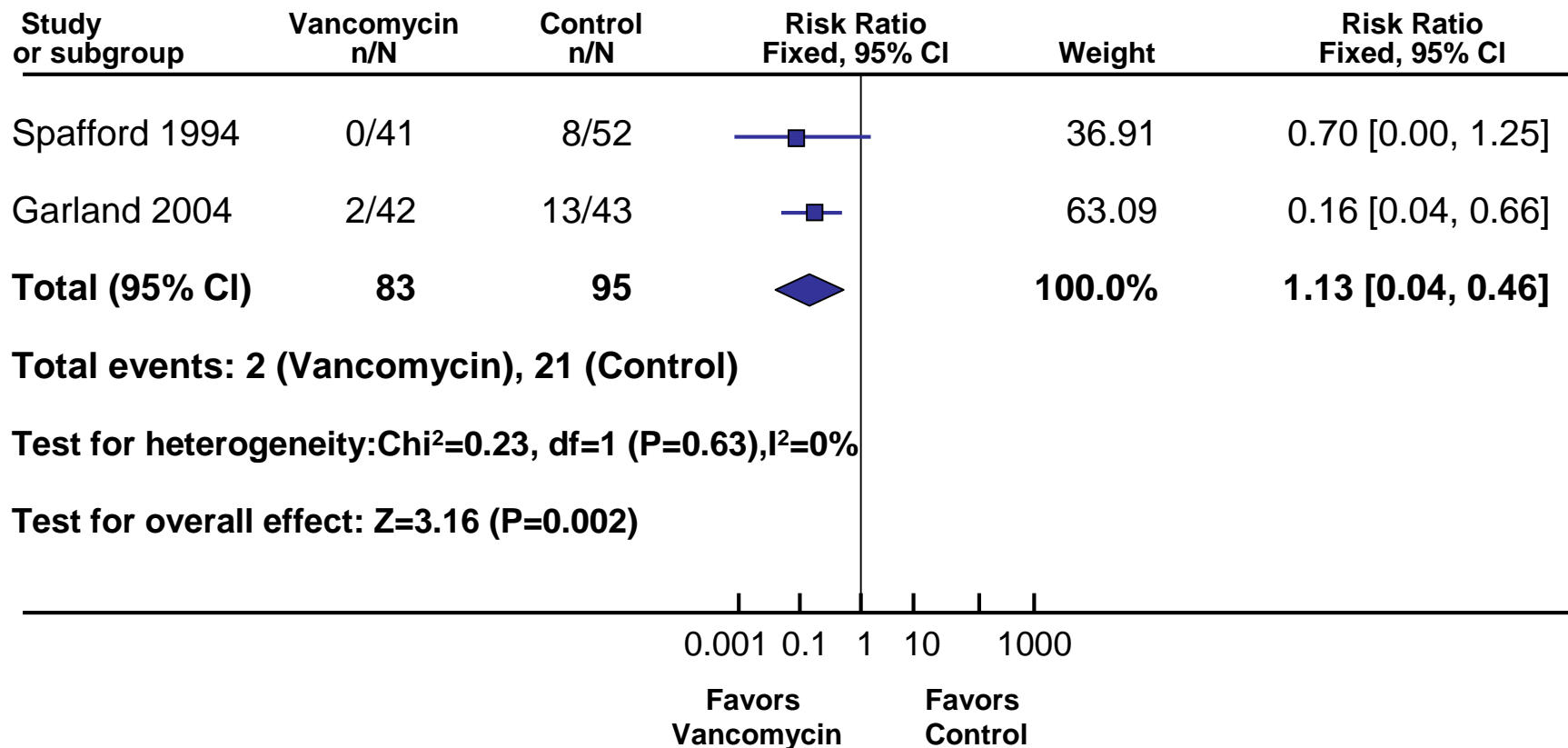
Rationale for use of Prophylactic Antibiotics or Antibiotic Impregnated Catheters to Prevent Catheter Related Blood Stream Infections

❄ Microorganisms gain access to intravenous catheters by one of three mechanisms.

- Skin organisms invade the percutaneous tract extraluminally (facilitated by capillary action- *Most common route for short term devices*)
- Contamination occurs at the time of catheter insertion.
- Microorganisms contaminate the catheter hub (common mechanism in neonatal catheter related blood stream infections)

* Use of continuous low dose vancomycin reduced the incidence of sepsis but had no effect on mortality (two studies). Absolute risk reduction 20.6% and NNT=5

* No vancomycin resistant organisms were identified



Use of Antibiotic Impregnated Catheters

- ❄ Most data originates from adult ICUs
- ❄ Externally coated chlorhexidine/silver sulfadiazine (CHG/SSD) catheters are effective in preventing catheter related blood stream infections
- ❄ Newer CHG/SSD catheters are coated internally and externally
- ❄ Antibiotic coated catheters may foster development of resistance (animal data)
- ❄ Minocycline-Rifampin coated catheters may be more effective than externally coated CHD/SSD catheters
- ❄ Silver-ion/alloys offer no protection
- ❄ Routine use is not recommended (concerns about quality of evidence, efficacy for varied organisms)

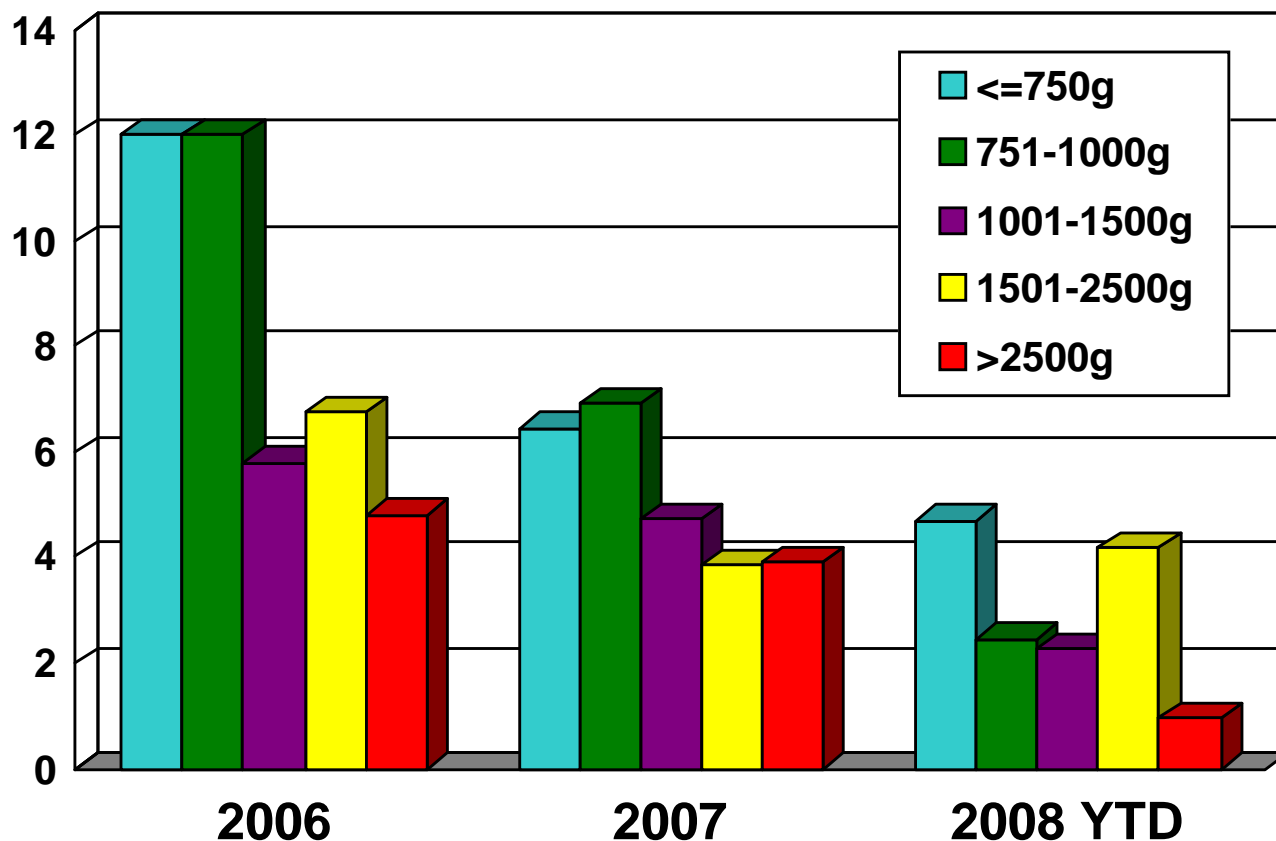
Common Sense Strategies to Prevent Hospital Acquired Infections in the NICU

- ❄ Avoid care practices which bypass normal skin barrier defense mechanisms (central lines, UA/UV catheters, heel sticks)
- ❄ Limit the use of drugs which are associated with nosocomial infection (steroids for BPD, H₂ blockers)
- ❄ Cohort infants colonized with resistant or invasive microorganisms (use gloves and gown)
- ❄ Limit the use of antibiotics and when needed use the simplest and most appropriate drug

Common Sense Strategies to Prevent Hospital Acquired Infections in the NICU

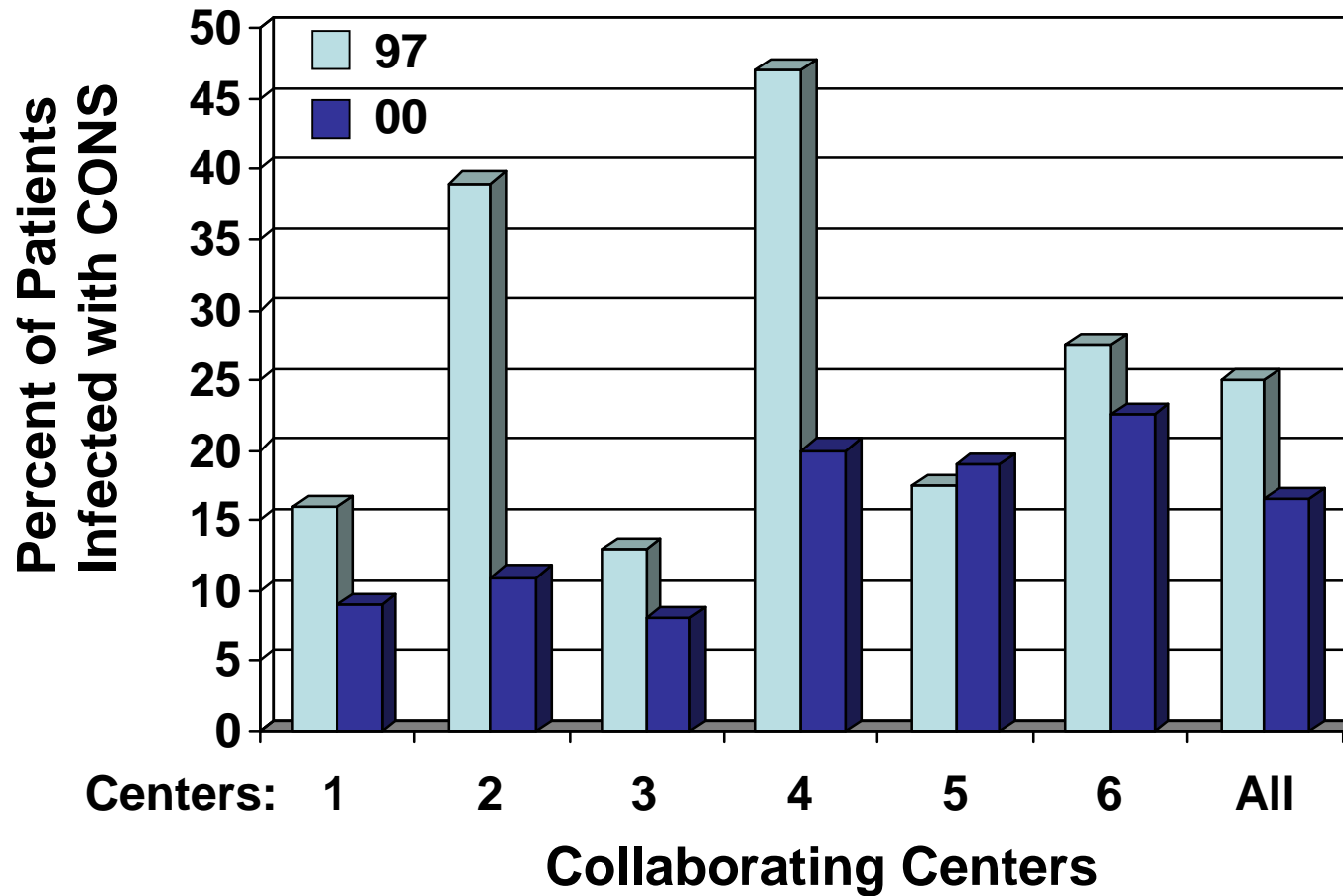
- ❄ Use of alcohol based emollients (improved compliance)
- ❄ Avoid skin damage (e.g., scrubbing with brushes)
- ❄ Encourage use of breast milk
- ❄ Minimize central venous catheter days
- ❄ Use sterile barriers for central venous line insertion and line maintenance

2006-2008 MSCHONY NICU Annual Mean CLABSI* Rates

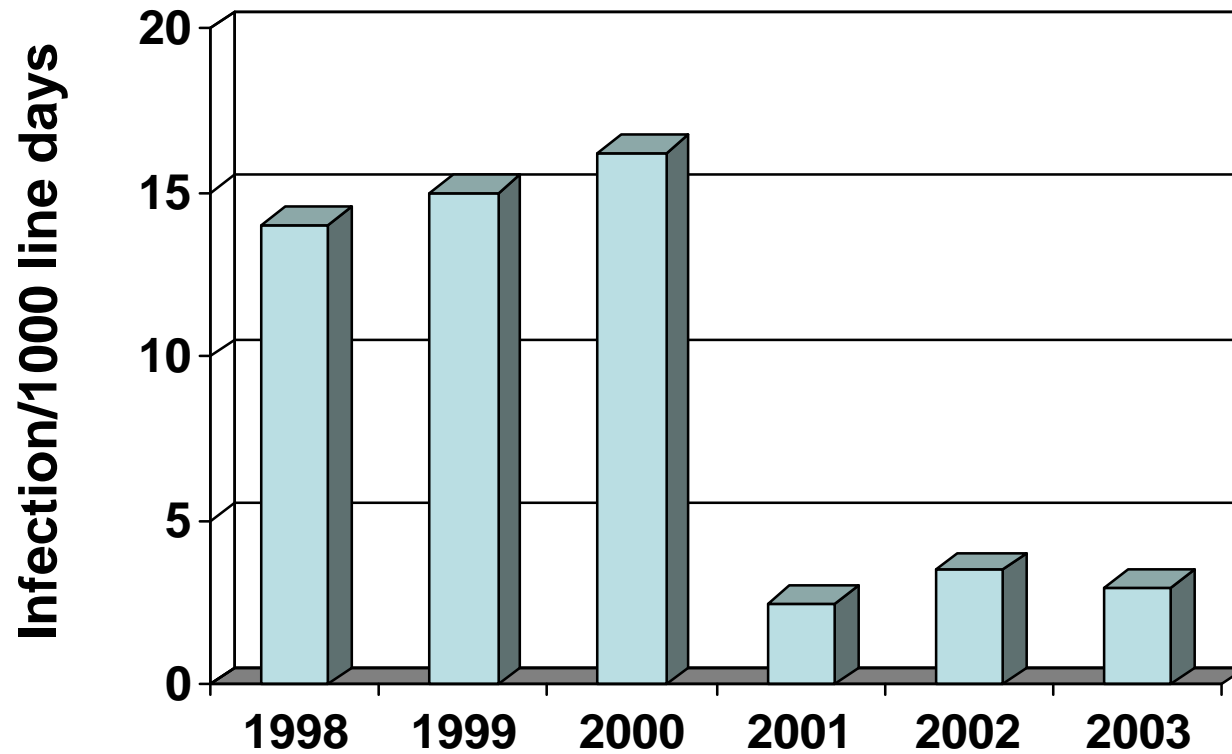


*# of Blood Stream Infections divided by Total Central Line Days X 1000

Rates of coagulase negative staphylococcal bacteremia at the collaborative institutions before and after interventions



*Annual Rates of Central Line-Related Blood Stream Infections
at George Washington University Hospital*



Conclusions

- ❄ Nosocomial sepsis is an immense problem (worldwide) that increases mortality and morbidity and adds tens of millions of dollars to the costs of NICU care
- ❄ The frequency of nosocomial sepsis can be reduced by multidisciplinary, collaborative quality improvement