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Abstract

Background: Hospital water systems have been implicated as a source of serious nosocomial infections.

A cluster of potential waterborne pathogens were identified in the NICU in 8/05. **Objective:** To determine effects of infection control measures on isolation of potential waterborne pathogens between 6/05 and 12/06 in the NICU.

Methods: Retrospective review of clinical and active surveillance cultures (ASC) between 6/05 and 12/06 and enhanced infection control interventions including ASC in 7/05, contact isolation and universal gown/gloves in 8/2005, sterile water bathing in 9/05, and point-of-use water filters in 10/05. ASC for *S. maltophilia*, *A. baumannii*, *P. aeruginosa*, and MRSA were done weekly from skin, nares, and lower respiratory tract (LRT).

Results: Between 6/05 and 12/06 there were 321 admissions to the NICU. Clinical isolates of 22 potential waterborne pathogens including 8 positive cultures for *S. maltophilia*, 7 *P. aeruginosa*, 3 *A. baumannii*, 3 *Citrobacter* spp., and 1 *S. marcescens*, 18 of 22 isolates were LRT. 15/22 isolates clustered between 7/05 and 10/05. There were 30 positive cultures for CoNS, 17 MRSA, 10 Enterococcus, and 4 Grp B Strep, 27 other Gram neg rods, and 13 fungal isolates.

ASC isolates identified 6 positive cultures for *S. maltophilia*, 2 *A. baumannii*, 1 *P. aeruginosa*, (6/9 isolates from LRT) and 34 MRSA (0/34 from LRT).

From 12/05 through 2/06, there no potential waterborne pathogens isolated. From 3/06 through 12/06 there was a reduction in the isolation of waterborne pathogens, and no further clusters.

From 7/05 through 12/06 isolation of non-waterborne organisms (i.e. MRSA, CoNS and Gram negative rods) appeared unchanged.

Conclusions: Waterborne pathogen identification in the NICU was reduced after implementation of sterile water bathing and point-of-use water filtration. Isolation of non-waterborne pathogens (i.e. MRSA, CoNS, and Gram neg rods) did not appear to be affected suggesting that water sterilization/microfiltration may have reduced the transmission of waterborne pathogens and may have a role in preventing nosocomial infections caused by these organisms.

Background

- Water is an important source of hospital-acquired infections. Tap water harbors a variety of microorganisms. Some microorganisms can form biofilms in plumbing systems
- Patient exposure to waterborne microorganisms
 - Bathing
 - Drinking (water or ice)
 - Contact with contaminated medical equipment rinsed with tap water (e.g. tube feed bags, endoscopes, and respiratory equipment, humidified isolettes.)
- Waterborne pathogens can also be spread via health care workers' hands
- Hospital water systems have been incriminated as the source of serious waterborne nosocomial infections
- The most common organisms include:
 - Gram negative bacilli
 - Legionella* spp.
 - Pseudomonas aeruginosa*
 - Stenotrophomonas maltophilia*
 - Serratia marcescens*
 - Acinetobacter baumannii*
 - Non-tuberculosis mycobacteria
 - Viruses
 - Fungi
 - Aspergillus* and *Fusarium* spp.
 - Possibly *Candida* spp.
 - Parasites
 - Cryptosporidium parvum*
 - Giardia lamblia*
 - Acanthamoeba* spp.
- A cluster of potential waterborne pathogens were identified in the NICU in August and September 2005
- This prompted implementation of several infection control measures as well as the present investigation

Objectives

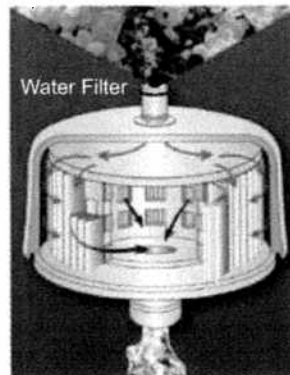
- To determine the possible effects of infection control measures on identification of potential waterborne pathogens in clinical and surveillance isolates between 1 June 2005 and 26 December 2006 in the NICU.

Setting and Population

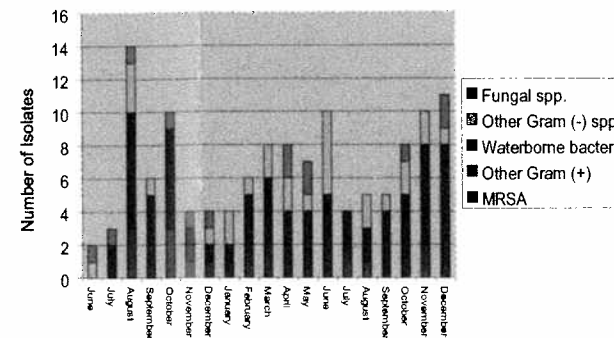
- The NICU is a 25-bed level III unit
- Medical and surgical management of critically ill newborns
- Accepts infants and surgical transfers from across the state
- 321 admissions from 1 June 05–26 December 06
- Patient acuity and gestational age require indwelling catheters, ventilatory support, and GI devices
- NICU patients are at risk for hospital-acquired infections
 - Immune compromised
 - Require multiple invasive devices
 - Repeated courses of antibiotics

Methods

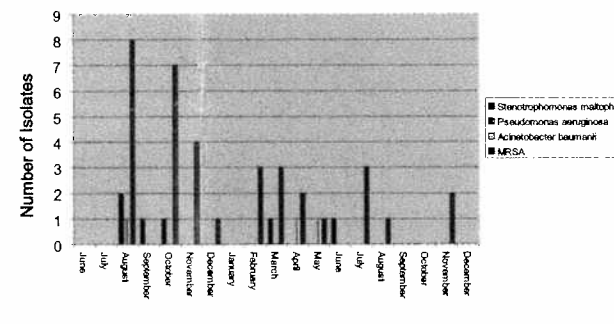
- Retrospective review of clinical and surveillance culture reports from the microbiology laboratory
- Evaluation of infection control interventions in the NICU instituted between 1 June 2005 and 26 December 2006.
- All cultures were completed using standard techniques in the clinical microbiology laboratory
- The infection control interventions included:
 - Weekly surveillance cultures from
 - Skin (axilla and groin)
 - Lower respiratory tract (tracheal aspirates)
 - Nares
 - Specimens were analyzed for *S. maltophilia*, *A. baumannii*, *P. aeruginosa* and Methicillin-resistant *Staphylococcus aureus* (MRSA)
 - Infants were placed in contact isolation if positive cultures of the above organisms plus *Serratia* spp and *Citrobacter* spp were isolated from clinical or surveillance cultures
 - Universal use of gowns and gloving for staff and visitors of all NICU babies was instituted on a temporary basis
 - Use of sterile water for bathing
 - Permanent placement of point-of-use water filters: 0.2 micron pleated bacterial retention membranes (Pall Aquasafe, Pall Medical, East Hill, NY) on all faucets in the NICU that are changed weekly



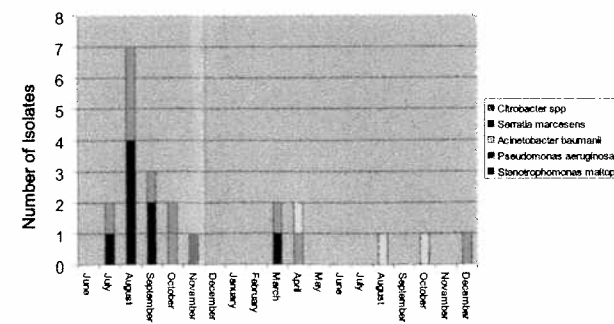
Overview of Clinical Isolates 1 June 2005 – December 26 2006



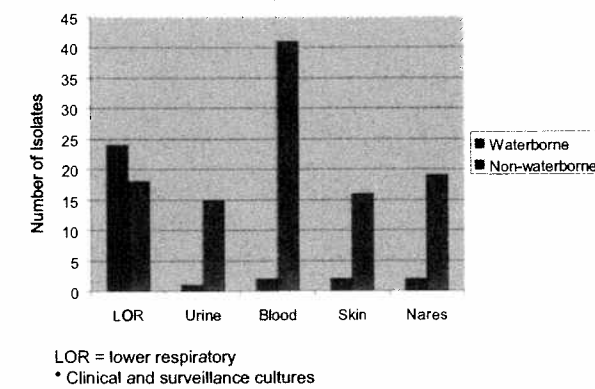
Overview of Surveillance Isolates 1 June 2005 – December 26 2006



Clinical Cultures for Waterborne Bacteria 1 June 2005 – December 26 2006



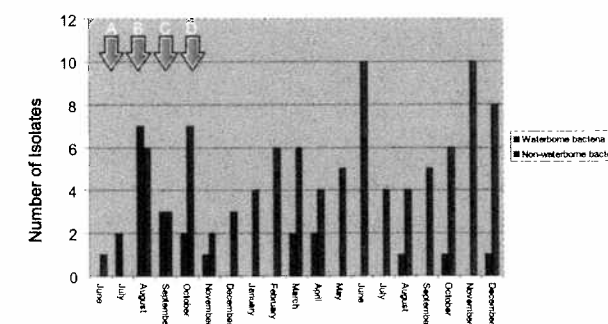
All Cultures by Site*



LOR = lower respiratory
* Clinical and surveillance cultures

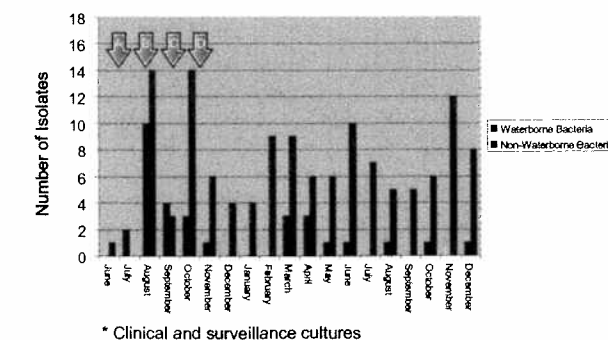
Effects of Infection Control Interventions on Clinical Isolates

A=Surveillance cultures B=Gowns, gloves, isolation
C=Sterile H₂O baths D=H₂O filters



Effects of Infection Control Interventions on All Isolates*

A=Surveillance cultures B=Gowns, gloves, isolation
C=Sterile H₂O baths D=H₂O filters



* Clinical and surveillance cultures

Clinical vs. Surveillance Isolates 1 June 2005 – December 26 2006

Organism	Clinical isolates	Surveillance isolates
CON Staphylococci	30	N/A
MRSA	17	35
<i>Enterococcus</i> spp.	10	N/A
<i>S. maltophilia</i>	8	6
<i>P. aeruginosa</i>	7	1
Group B Streptococci	4	N/A
<i>A. baumannii</i>	3	2
<i>Citrobacter</i> spp.	3	N/A
<i>S. marcescens</i>	1	N/A

Conclusion

- Waterborne pathogen identification in clinical and surveillance specimens from the NICU was reduced after the implementation of sterile water bathing and point-of-use water filtration. Isolation of non-waterborne pathogens like MRSA, coagulase-negative *Staphylococcus* spp. and other Gram negative rods did not appear to be reduced
- These data suggest that water sterilization/microfiltration may have reduced the transmission of waterborne pathogens
- These interventions may have a role in the prevention of nosocomial infections in the NICU