Pediatric Pulmonology Quality Improvement Grand Rounds:

Pulmonary Infections in CF and Infection Control

September 28, 2007

We have a problem –

11 year old male with CF

- Colonized with pseudomonas, then B. Cepacia
- First + MRSA culture 2004
- Sought care elsewhere 2nd to infection control concerns – was he infected as an inpatient at WCHOB?
- MRSA contributed to death 12/25/06

Another Case

4 ½ y.o. girl with CF & MI, adherent family

- 8/31/02 20 days  V7
- 11/4/02  8 days  V9
- 1/23/03  1st + culture for pseudomonas
- 11/2/03  4 days  V7
- 11/25/03  1st + culture for staph
- 11/3/04  1st + culture for MRSA
- 3 subsequent admissions, total 36 days

Cases Cont

- Her predominant organism is MRSA
- The MRSA is very resistant
- Likely not community acquired
- Currently, the only outpatient option is linezolid
- She will need life long antibiotic rx – what happens when she’s totally resistant?

Why Do People with CF Have Airways Colonization?

- Thick mucus
- Dysfunctional beta-defensins
- CFTR bacterial binding
- Intracellular CFTR triggers inflammation
Age Specific Prevalence of Respiratory Infections in CF Patients, 2005

- **P. aeruginosa**: 56.4%
- **H. influenza**: 17.0%
- **B. cepacia Complex**: 3.1%
- **S. aureus**: 51.8%
- **S. maltophilia**: 12.3%
- **MRSA**: 17.2%

The Burkholderia Cepacia Story

- Initially seen in end-stage patients
- Was associated with sepsis ("cepacia syndrome") and death
- Clearly transmitted from one patient to another through respiratory secretions

Cepacia Species

- **B. cepacia (I)**: 3%
- **B. multivorans (II)**: 40%
- **B. cenocepacia (III)**: 45%
- **B. stabilis (IV)**: <1%
- **B. vietnamensis (V)**: 6%
- **B. dolosa (IV)**: 4%
- **...plus others**

We Hate Pseudomonas

- Acquisition of pseudomonas is a strong predictor of decline in lung function
- Need to use two IV antibiotics for acute intervention
  - New options for chronic control
- Mucoidy makes it harder to treat
  - Can macrolides prevent this?
How is Pseudomonas Spread?
- By contact, not by aerosols
- Non-mucoid strains suspended in saliva can survive > 24 h
- Mucoid strains survive > 48 h
- Any strain suspended in CF sputum can survive on dry surfaces as long as 8 days

Patient-to-Patient Transmission
- Not as clear cut as with cepacia, but:
  - Siblings can share strains
  - Epidemic clones have been seen
  - Epidemics are controlled by isolation and hand hygiene
  - Transmission of multi-drug-resistant strains has been seen in the UK and Australia
  - Possible transmission via crowded waiting rooms

Saman et al, Clin Microbiol Rev 2004;17:57-71

Pseudomonas is a Water Bug
- Sinks and drains can be a source
- Use waterless handwash instead of water
- Wet items lying near a sink can be a source
- Air dry all respiratory care equipment

Age Specific Prevalence of Respiratory Infections in CF Patients, 2005
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- S. maltophilia 12.3%
- MRSA 17.2%

Methicillin-Resistant S. aureus Infection Rate by CF Center, 2005
- The national rate is 17.2 percent. The range is 0 to 42.9 percent.
Is MRSA Bad for Patients with CF?

- ESCF database 1/1/2001 - 12/31/2001
- 1,834 / 20,451 patients had SA only
- Of 6-17 year olds:
  - FEV₁ = 80.7% predicted if MRSA +
  - FEV₁ = 89.4% predicted if MSSA +
- Similar results were seen in patients > age 18 yrs

Ren et al, Pediatr Pulmonol 2007;42:513-518

What are the Risk Factors for MRSA Acquisition in CF?

- Number of days in the hospital
- Number of days of oral ciprofloxacin
- Number of days of oral/intravenous cephalosporins
- Chronic colonization with Aspergillus fumigatus

Nadesalingam et al, JCF 2005;4:49-52

MRSA Transmission

- MSSA was shared among CF patients at camp
  - Schlichtig et al, J Clin Microbiol 1995;33:227

- Spread from non-CF patient → CF pt and CF pt → CF pt was seen in a hospital ward

Ignac Semmelweis

- 1847 - Deduced that puerperal fever was caused by failure to wash hands
- Mandated use of chlorine and a scrub brush
- Deaths fell from 20% to 1%
- Attacked co-workers and colleagues
- Perceived the call for proof as a personal insult
• 1865 – Pasteur suggested that “decay” was caused by microorganisms
• Lister made the connection with wound sepsis
• 45-50% of his amputation cases at Royal Glasgow Infirmary died from sepsis
• Lister began to clean wounds and dress them using a solution of carbolic acid
• 1867 – Reported to Br. Med. Assoc. – no sepsis x 9 months

Getting Physicians to Wash Hands at Brigham and Women’s Hospital

- Posted signs
- Repositioned sinks / Added sinks / Automated sinks
- Bought “precaution carts”
- Gave away free movie tickets to high-performing units
- Issued report cards
  Adherence rates = 35-40%

Waterless Handwash

- Recommended by CDC – Grade I evidence
- Prevents hands from becoming chapped and trapping ↑ #s of bacteria
- 50-95% alcohol content more efficient than soap at killing bacteria
- Takes less time (15 seconds vs. 1 minute)

Adherence to hand hygiene improved to 70%

We Hate Methicillin Resistant Staphylococcus Aureus

- 70% of new staphylococcal cultures at WCHOB are MRSA

History of MRSA at WCHOB

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Why Should You Care?

- Treatment requires longer hospital stays and treatment with IV Vancomycin
- Increased incidence of VRE
- Increased patient and family dissatisfaction
- Increased institutional liability
- Morbidity and mortality

Cases continued

- Healthy 4 year old boy (without CF)
- MRSA wound infection from a scrape on a shower door
- Death 2nd to MRSA pneumonia despite aggressive treatment in PICU with ECMO

Regional MRSA Summit

- October 11, 2006 – “A Kickoff to QI”
- Representation of all major hospital systems in WNY including Kaleida, the Catholic System and ECMC
- Speakers from Niagara Quality Health Coalition, BGH, Pittsburg VA, and the CDC

Key Components of Pittsburgh VA Program

- Identification of MRSA carriers through 100% swabbing in acute and long term care
  - Especially inter-unit transfers
- Removal of barriers to hand hygiene and isolation compliance
- Staff engagement and ownership of infection prevention. Share data with staff
- Leadership commitment and support
Arthur Ashe 1943-1993

- Start where you are
- Use what you have
- Do what you can

GLOBAL AIM STATEMENT:
We aim to improve the pulmonary status of CF patients at the WCHOB Cystic Fibrosis Center.

The process begins with identifying patients who are not receiving optimal pulmonary interventions. The process ends when 100% of patients are offered and are receiving appropriate pulmonary interventions.

By working on this process we expect FEV₁ to be at or above the median for the Top Ten CF Centers in the US and the prevalence of resistant organisms will be below the national median.

It is important to work on this now because maintaining the best FEV₁ and minimizing resistant organisms will improve quality and length of life for our patients.

SPECIFIC AIM:
We aim to apply universal contact precautions for all CF patients at the Women and Children’s Hospital of Buffalo Cystic Fibrosis Center. The process begins with educating ourselves, our patients, and care providers outside our CF Center about contact precautions and developing systems to implement them in the outpatient and inpatient settings. The process ends when 100% of patient encounters are done using contact precautions. By working on this process we expect to decrease intrapatient transmission of pseudomonas, MRPA and MRSA.

Cause and Effect: Fishbones
- “Every system is perfectly designed to get the results it gets”
- Science is about understanding cause and effect and influencing cause and effect
- A fishbone is a “scientific tool:
  - A → B
  - Brainstorm about the causes that lead to effects

Fishbone Diagrams

Usual Major drivers: People, Equipment, Materials, Processes
Problems Identified at WCHOB

- Lack of uniformity in MRSA / Contact precautions
- Need for staff and family education
- Unavailability of necessary supplies
- Need for monitoring, staff engagement and ownership
- Needs to be a priority

Communication Plan

- Mail letter to families
- Discuss with Lead Team at each Integrated Team Meeting
- Discuss with entire Lung Center at Division Meetings
- Communicate with Respiratory Care at monthly meetings
- Inform V-10 staff
- Communicate with UPA clinic staff at each clinic session
- Get feedback from families at Parent-Patient Advisory Council meetings
- Interact with Kaleida Quality Improvement Committee

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By working on this process, we expect FEV1 to be at or above the median of the Top Ten CF Centers in the US and the prevalence of resistant organisms will be below the national median.

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