Clostridium difficile infection (CDI) in the Pediatric Population

Children’s Hospitals
FHA Hospital Improvement Innovation Network (HIIN)
May 1, 2018
Overview

• Welcome Back
• Review of the data
• **Interactive** Presentation by Linda Greene
• What’s Next?
• Questions/Open Discussion
Readmissions
Unplanned within 30 Days

30-day Readmission Rates

* 5 out of 6 facilities reporting
** 4 out of 6 facilities reporting
*** 3 out of 6 facilities reporting
Readmissions
Unplanned within 7 Days

7-day Readmission Rates

* 5 out of 6 facilities reporting
** 4 out of 6 facilities reporting
*** 3 out of 6 facilities reporting
* 5 out of 6 facilities reporting
Facility-wide C. difficile Rate

* 4 out of 6 facilities reporting
** 3 out of 6 facilities reporting
Questions?
Pediatric C. difficile

Are Children Just Tiny adults?

Linda R. Greene, RN, MPS, CIC, FAPIC
linda_greene@urmc.rochester.edu
Manager, Infection Prevention
UR Highland Hospital
Rochester, NY
linda_greene@urmc.rochester.edu
Polling Question 1

What is your background?

1. Infection Prevention
2. Nurse
3. Clinician
4. Quality
5. Other
Clostridium *difficile*

- Gram positive, spore forming, anaerobic bacillus
- Spores can survive for long periods of time in the environment (~ 2 years)
- Spores are resistant to:
  - Heat
  - Radiation
  - Drying
  - Chemicals
  - Oxygen
Clostridium *difficile*

- Virulence Factors
  - Toxin A [Enterotoxin]
  - Toxin B [Cytotoxin]
    - Both toxins A and B can independently cause disease
  - Binary Toxin – role is not fully understood

- Non toxigenic *C diff* strains are common, but these do not cause disease
Clostridium *difficile*

- Both toxins bind to intestinal epithelial cells, where they are internalized and catalyze the glucosylation of cytosolic rho proteins.
- Causes necrosis, increased intestinal permeability, and inhibition of protein synthesis.
- Overall both toxins cause enterocyte cell death, a marked inflammatory response, and severe mucosal injury.
C. difficile: Pathophysiology

- Organism is normal part of intestinal flora in some people – exists in spore form
- Overgrowth occurs when there is a disruption of the normal microbial balance [normal colonic microflora confirms “colonization resistance” against CDI]
- Spores germinate and elaborate toxins
- Mucosal injury and diarrhea occur
C. difficile: Pathophysiology

- Essential components for development of CDI
  1. Exposure and acquisition of C diff
  2. Disruption of normal colonic microbiome or flora (usually due to antibiotic exposure)

- Important additional factors
  1. Virulence factors of the particular C diff strain
  2. Host susceptibility
Ingested Normal flora interrupted

Small Intestine Spores Germinate

C. difficile reproduces in the intestinal crypts, releasing toxins A and B, causing severe inflammation. Mucous and cellular debris are expelled, leading to the formation of pseudomembranes.

Toxin A attracts neutrophils and monocytes, and toxin B degrades the colonic epithelial cells, both leading to colitis, pseudomembrane formation, and watery diarrhea.
Clinical Disease

- Asymptomatic carriage
- Diarrhea
  - Watery, mild to moderate
  - Can have blood or mucous
- Abdominal pain and cramping
- Fever
- Leukocytosis
- Mucosal injury to gut
  - Ulcerations and “pseudomembranous colitis”
  - Occasionally, can develop necrotizing enterocolitis or toxic megacolon
- Complications of severe colitis:
  - Dehydration, electrolyte abnormalities, bowel perforation, hypotension, renal failure, sepsis, death
- Extraintestinal manifestations have been reported, but are very rare
Colonoscopy of patient with *C. difficile*
Pseudomembranous colitis

An inflammatory process that can lead to formation of pseudo membranes; a mixture of inflammatory cells, fibrin, bacteria and cellular components, which exude from the bowel mucosa.
Figure 1. Age-specific incidence of patients with *Clostridium difficile* infection (CDI) per 10,000 hospitalizations, Health Care Utilization Project Kids’ and Inpatient Database, United States, 1997–2006.
Polling Question 2

Our nurses check to see if the patient has another explanation for diarrhea (e.g. Laxative or enema) in the prior 24 hours and do NOT submit the loose stool if yes to either laxative or enema?

1. No
2. Variable
3. Yes, on at least one unit
4. Yes, on all units
New Epidemic Strain

• B1/NAP1/027
  – B1 : restriction endonuclease analysis
  – NAP1 : North America Pulsed Field type
  – 027 : PCR ribotype

• Factors associated with increased virulence
  – Increased production of toxins A and B
  – Resistance to fluoroquinolones
  – Production of binary toxin
Outcomes of CDI in hospitalized children

- Methods: retrospective cohort study of hospitalized children at 41 children’s hospitals from 2006-2011

- Increased mortality
  - pts with HO-CDI compared with unmatched controls: OR 6.73 (3.77 – 12.02)
  - No differences between HO-CDI and CO-CDI

- Longer length of stay
  - Mean difference for CO-CDI: 5.55 days
  - Mean difference for HO-CDI: 21.60 days

- Higher Costs
  - Mean difference for CO-CDI: $18,900
  - Mean difference for HO-CDI: $93,600

Sammons, et al. CID 2013
Risk Factors

• Previous antibiotic exposure
  • Incidence of CDI at 14 days after admission\(^1\)
    • 42/1000 – on antibiotics
    • 5.4/1000 – not on antibiotics
  • Various studies: OR 5-6 for inpatients on Abx
  • Clindamycin, cephalosporins, fluoroquinolones
  • Most present during or shortly after use (but can be delayed by as much as 2-3 months)

• Other bowel/microbiome disrupters:
  • Bowel preparation for colonoscopy or surgery
  • Cytotoxic chemotherapy
  • Colitis due to IBD

\(^1\)Loo, et al. NEJM 2011;365(18):1693-1703
Risk Factors

- Increased exposure to *C. difficile* spores
  - Hospitals and other health care facilities are often contaminated with *C. difficile* spores
  - Exposure to another person with *C. difficile*

- Host health and immune status
  - Older age
  - Comorbid conditions
    - Cancer, solid organ transplantation, IBD, immunocompromised
    - Presence of gastrostomy or jejunostomy tubes
  - Women in the peripartum period
Risk Factors

- Gastric acid-suppressing agents
  - Association between PPI use and CDI in adult patients\(^1\)-\(^4\)
  - FDA safety warning 2-8-2012
  - \(H_2\) blockers\(^5\)
  - NNH: 58 for hospitalized patients receiving antibiotics
  - NNH: 4549 for outpatients

Specific Risk Factors in Children

- Antibiotic exposure
- Underlying comorbid conditions
  - Cardiovascular disease - highest among young children
  - Cancer – age 5-17
  - Inflammatory bowel disease - high incidence
Clostridium *difficile* Infection Among Children Across Diverse US Geographic Locations

**OBJECTIVE:** Little is known about the epidemiology of *Clostridium difficile* infection (CDI) among children, particularly children ≤3 years of age in whom colonization is common but pathogenicity uncertain. We sought to describe pediatric CDI incidence, clinical presentation, and outcomes across age groups.

**METHODS:** Data from an active population- and laboratory-based CDI surveillance in 10 US geographic areas during 2010–2011 were used to identify cases. A convenience sample of CA cases were interviewed. Demographic, exposure, and clinical data for cases aged 1 to 17 years were compared across 4 age groups: 1 year, 2 to 3 years, 4 to 9 years, and 10 to 17 years.

Wendt et. al. *Pediatrics* April 2014;133
RESULTS: Of 944 pediatric CDI cases identified, 71% were CA. CDI incidence per 100,000 children was highest among 1-year-old (66.3) and white (23.9) cases.

The proportion of cases with documented diarrhea (72%) or severe disease (8%) was similar across age groups;

Among the 84 cases interviewed who reported diarrhea on the day of stool collection, 73% received antibiotics during the previous 12 weeks.

CONCLUSIONS: Similar disease severity across age groups suggests an etiologic role for *C difficile* in the high rates of CDI observed in younger children. Prevention efforts to reduce unnecessary antimicrobial use among young children in outpatient settings should be prioritized.
Increasing CA-CDI

- Increasing reports of CDI presenting to the ED
- Increased identification of \textit{C diff} during outpatient colonoscopies for GI complaints
- Recent population based study found that the majority of cases of pediatric CDI were community acquired

Reasons for increased CA-CDI

- Raises the concern that there are unidentified risk factors increasing the probability of CDI in this patient population
- Outpatient medical visits?
- Outpatient antibiotic use?
- Exposure to colonized animals/pets?
  - C diff colonizes and causes disease in cats, dogs, pigs, cows, and horses
  - Strains are generally species specific, but identical pathogenic strains have been isolated from humans and animals
- Exposure to contaminated food?
Pediatric CA-CDI vs. HA-CDI

- 9 year retrospective study at Johns Hopkins Children’s Center
- 222 pediatric inpatients diagnosed with CDI
  - 38 CA-CDI
  - 144 HA-CDI
  - 20 indeterminate (disease onset in the community 4-12 weeks after hospital discharge)

Pediatric CA-CDI vs. HA-CDI

- CA-CDI more likely to:
  - Have comorbidities (OR 0.14)
  - Been exposed to antibiotics (OR 0.17)
  - Have prior surgeries (OR 0.03)

- CA-CDI had more frequent complications (more episodes of toxic shock and megacolon) and recurrences than HA-CDI

- “Indeterminate” CDI should be classified as HA-CDI for surveillance purposes
Infants

- Asymptomatic C. *diff* colonization in neonates ranges from 30-70%.
- By 2 years of age, colonization rates approach those of healthy adults (3-10%).
- The significance of C. *diff* in infants is controversial – and not well understood.
What do we know?

- Neonates are uniquely susceptible
  - Immaturity of neonatal intestine
  - Microbial flora doesn’t approach that of adults until about 1 year of age (lack of protective intestinal microbiota)
  - Immature immune system
- Breast fed infants less likely to be colonized than formula fed infants
- Risk of colonization increases with length of stay in the hospital
- Mothers are rarely identified as the source
What do we know?

- Despite high colonization rates, clinically apparent disease in infants is rare.
- Infants with and without diarrhea have the same rates of colonization and toxin production.

Hypotheses:
- Absence of or immature C diff toxin receptors in infant intestine (supported by rabbit models, but not supported by pig models).
- Differences in intestinal mucous that inhibits toxin binding.
- Lack of activation/recruitment of neutrophils by the immature immune system.
• Enrolled 10 infants at birth
• Sampled monthly

Results:
- All infants became colonized
- All were colonized for several months
- 2 patterns of acquisition
  - Early (first month)
  - Late (4-6 months)

Sampled 85 infants from 2 day nurseries in France

<table>
<thead>
<tr>
<th>AGE</th>
<th>C. diff carriage rate</th>
<th>Presence of toxigenic strain</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-6 months</td>
<td>36%</td>
<td>18%</td>
</tr>
<tr>
<td>7-9 months</td>
<td>67%</td>
<td>13%</td>
</tr>
<tr>
<td>10-12 months</td>
<td>75%</td>
<td>19%</td>
</tr>
<tr>
<td>12-24 months</td>
<td>41%</td>
<td>11%</td>
</tr>
<tr>
<td>24-36 months</td>
<td>6%</td>
<td>6%</td>
</tr>
</tbody>
</table>

Table 4. Unadjusted and Adjusted Association of Comorbidity and Demographic Variables With *Clostridium difficile* Infection

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Univariate</th>
<th>Multivariate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comorbid disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflammatory bowel disease</td>
<td>12.81 (11.75-13.97)</td>
<td>11.42 (10.16-12.83)</td>
</tr>
<tr>
<td>Solid organ transplant</td>
<td>7.76 (6.91-8.71)</td>
<td>4.53 (3.92-5.24)</td>
</tr>
<tr>
<td>Human immunodeficiency virus infection</td>
<td>6.16 (4.94-7.69)</td>
<td>4.09 (3.16-5.30)</td>
</tr>
<tr>
<td>Hematopoietic stem cell transplantation</td>
<td>19.38 (17.54-21.42)</td>
<td>3.31 (2.87-3.82)</td>
</tr>
<tr>
<td>Neoplastic disease</td>
<td>6.84 (6.53-7.16)</td>
<td>3.10 (2.89-3.31)</td>
</tr>
<tr>
<td>Fungal infection</td>
<td>13.28 (12.13-14.53)</td>
<td>2.71 (2.39-3.07)</td>
</tr>
<tr>
<td>Cystic fibrosis</td>
<td>4.00 (3.47-4.61)</td>
<td>2.65 (2.22-3.17)</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>5.06 (4.44-5.77)</td>
<td>2.86 (2.41-3.39)</td>
</tr>
<tr>
<td>Hematologic disorders</td>
<td>5.16 (4.94-5.39)</td>
<td>2.50 (2.34-2.66)</td>
</tr>
<tr>
<td>Gastrostomy</td>
<td>6.81 (5.90-7.84)</td>
<td>2.00 (1.67-2.39)</td>
</tr>
<tr>
<td>Liver disease</td>
<td>6.74 (6.11-7.42)</td>
<td>2.04 (1.80-2.32)</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>8.50 (7.85-9.22)</td>
<td>2.39 (2.14-2.67)</td>
</tr>
<tr>
<td>Renal disease</td>
<td>6.81 (6.45-7.20)</td>
<td>2.09 (1.99-2.19)</td>
</tr>
<tr>
<td>Systemic lupus erythematosus</td>
<td>2.95 (2.36-3.70)</td>
<td>2.06 (1.58-2.68)</td>
</tr>
<tr>
<td>Gastroesophageal reflux</td>
<td>3.32 (3.04-3.63)</td>
<td>1.97 (1.76-2.20)</td>
</tr>
<tr>
<td>Bacterial infection</td>
<td>2.57 (2.47-2.68)</td>
<td>1.84 (1.74-1.94)</td>
</tr>
<tr>
<td>Cardiac disease</td>
<td>2.06 (1.86-2.26)</td>
<td>1.38 (1.23-1.56)</td>
</tr>
</tbody>
</table>

Increase in Clostridium difficile infection (CDI) among pediatric oncology patients.

- **Methods:** CDI cases were defined as first C difficile positive stool tests between December 1, 2010, and September 6, 2012, in pediatric oncology patients receiving inpatient or outpatient care at a single hospital. A case-control study was performed to identify CDI risk factors, infection prevention and antimicrobial prescribing practices were assessed, and environmental sampling was conducted. Available isolates were strain-typed by pulsed-field gel electrophoresis.
Continued

Results: An increase in hospital-onset CDI cases was observed from June-August 2012.

Independent risk factors for CDI included hospitalization in the bone marrow transplant ward and exposure to computerized tomography scanning or cefepime in the prior 12 weeks. Cefepime use increased beginning in late 2011, reflecting a practice change for patients with neutropenic fever. There were 13 distinct strain types and 22 available isolates. Hospital-onset CDI rates decreased to near-baseline levels with enhanced infection prevention measures, including environmental cleaning and prolonged contact isolation.

Conclusion: C difficile strain diversity associated with a cluster of CDI among pediatric oncology patients suggests a need for greater understanding of modes and sources of transmission and strategies to reduce patient susceptibility to CDI. Further research is needed on the risk of CDI with cefepime and its use as primary empirical treatment for neutropenic fever.
Clostridium difficile infections increasing among children

January 03, 2011 | By Shari Roan, Los Angeles Times
# Table 1. Summary of Findings from Studies Demonstrating the Presence of *Clostridium difficile* in Retail Foods

<table>
<thead>
<tr>
<th>Country (region), product</th>
<th>No. of positive samples/total no. cultured (%)</th>
<th>PCR ribotype</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States (Arizona)</td>
<td></td>
<td></td>
<td>[10]</td>
</tr>
<tr>
<td>Ground beef</td>
<td>13/26 (50.0)</td>
<td>027, 078</td>
<td></td>
</tr>
<tr>
<td>Summer sausage</td>
<td>1/7 (14.3)</td>
<td>027</td>
<td></td>
</tr>
<tr>
<td>Ground pork</td>
<td>3/7 (42.9)</td>
<td>027, 078</td>
<td></td>
</tr>
<tr>
<td>Braunschweiger</td>
<td>10/16 (62.5)</td>
<td>027, 078</td>
<td></td>
</tr>
<tr>
<td>Chorizo</td>
<td>3/10 (30)</td>
<td>027, 078</td>
<td></td>
</tr>
<tr>
<td>Pork sausage</td>
<td>3/13 (23.1)</td>
<td>027, 078</td>
<td></td>
</tr>
<tr>
<td>Ground turkey</td>
<td>4/9 (44.4)</td>
<td>078</td>
<td></td>
</tr>
<tr>
<td>Canada (Ontario, Quebec)</td>
<td></td>
<td></td>
<td>[11]</td>
</tr>
<tr>
<td>Ground beef</td>
<td>11/53 (20.8)</td>
<td>077, M31, 014, M26</td>
<td></td>
</tr>
<tr>
<td>Ground veal</td>
<td>1/7 (14.3)</td>
<td>M31</td>
<td></td>
</tr>
<tr>
<td>Canada (nationwide)</td>
<td></td>
<td></td>
<td>[12]</td>
</tr>
<tr>
<td>Ground beef</td>
<td>10/149 (6.7)</td>
<td>M26, 077, J, 014, C, F, H</td>
<td></td>
</tr>
<tr>
<td>Veal chops</td>
<td>3/65 (4.6)</td>
<td>M26, J, K</td>
<td></td>
</tr>
<tr>
<td>Canada (British Columbia, Saskatchewan, Ontario, Quebec)</td>
<td></td>
<td></td>
<td>[13]</td>
</tr>
<tr>
<td>Ground beef</td>
<td>14/115 (12.2)</td>
<td>078, 027, C</td>
<td></td>
</tr>
<tr>
<td>Ground pork</td>
<td>14/115 (12.2)</td>
<td>078, 027, C, E, Y</td>
<td></td>
</tr>
<tr>
<td>Scotland</td>
<td></td>
<td></td>
<td>[14]</td>
</tr>
<tr>
<td>Salad</td>
<td>3/40 (7.5)</td>
<td>017, 001</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** PCR, polymerase chain reaction.
Colonization in adults

- Consecutive stool sample collected on adult patients without diarrhea admitted to a Mayo Clinic hospital
  31 of 320 (9.7%) positive for C. difficile

- Prospective study of C. diff colonization in adults admitted to 6 Canadian hospitals
  4143 patients enrolled
  117 (2.8%) had CDI (+c. diff test with diarrhea)
  123 (3.0%) were colonized with C. diff (+C. diff test without diarrhea)

Toxic megacolon

Toxic megacolon is characterized by extreme inflammation and distention of the colon. Common symptoms are pain, distention of the abdomen, fever, rapid heart rate, and dehydration. This is a life-threatening complication that requires immediate medical treatment.
General Guidelines for Testing

- Current guidelines recommend using a nucleic acid amplification test (primarily PCR) for C diff toxin genes as the standard diagnostic test.

- Alternative approach – 2 step
  - Glutamate dehydrogenase as a screen
  - + GDH followed up by EIA or NAAT

- EIA for toxin A + B is no longer recommended as a stand alone test due to lack of sensitivity.
General Guidelines for Testing

- Problem with GDH
  - GDH is an enzyme produced in large amounts by both toxigenic and nontoxigenic strains of C diff
  - Antibodies against GDH can cross react with same enzyme from other clostridial species
  - About 10% of patients with toxigenic C diff will be missed by GDH assays

- Problem with PCR
  - Might be too sensitive
  - False positives
General Guidelines for Testing

- Only stools from patients with diarrhea (symptomatic patients) should be tested.
- Repeat testing is discouraged.
- Testing for cure should not be done.
- Consider testing for alternative etiologies.
- Limit testing under 1 yo.
Polling Question 3

It is our practice to routinely make a diagnosis of CDI based solely on a positive molecular test (PCR) for C. difficile regardless of the clinical characteristics of the patient (Pre-test probability)?

1. No
2. Sometimes
3. Yes
Differences in outcome according to Clostridium difficile testing method: a prospective multicentre diagnostic validation study of C difficile infection

Timothy D Planche, Kerrie A Davies, Pietro G Coen, John M Finney, Irene M Monahan, Kirsti A Morris, Lily O’Connor, Sarah J Oakley, Cassie F Pope, Mike W Wren, Nandini P Shetty, Derrick W Crook, Mark H Wilcox

Lancet Infect Dis 2013; 13: 936–45
Treatment

- If possible, discontinue antibiotics

- Generally advised to avoid use of antiperistaltic agents
  - Obscure symptoms
  - Can precipitate symptoms
  - Literature review of 55 patients with CID who received these agents – 17 developed colonic dilatation and 5 died – but these patients were not receiving therapy for C diff
We do not allow difficile testing on:

1. Infants under 6 mo.
2. Under 2 years
3. Variable
4. None of the above
When should a neonate or infant be tested for *C. difficile*?

Because of the high prevalence of asymptomatic carriage of toxigenic *C. difficile* in infants, testing for CDI should never be routinely recommended for neonates or infants ≤12 months of age with diarrhea (*strong recommendation, moderate quality of evidence*).
When should a toddler or older child be tested for *C. difficile*?

*Clostridium difficile* testing should not be routinely performed

- In children with diarrhea who are 1–2 years of age unless other infectious or noninfectious causes have been excluded (*weak recommendation, low quality of evidence*).

- In children ≥2 years of age, *C. difficile* testing is recommended for patients with prolonged or worsening diarrhea and risk factors (e.g., underlying inflammatory bowel disease or immunocompromising conditions) or relevant exposures (e.g., contact with the healthcare system or recent antibiotics) (*weak recommendation, moderate quality of evidence*).
Table 2. Recommendations for the Treatment of *Clostridium difficile* Infection in Children

<table>
<thead>
<tr>
<th>Clinical Definition</th>
<th>Recommended Treatment</th>
<th>Pediatric Dose</th>
<th>Maximum Dose</th>
<th>Strength of Recommendation/Quality of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial episode, non-severe</td>
<td>• Metronidazole × 10 days (PO), OR</td>
<td>7.5 mg/kg/dose tid or qid</td>
<td>500 mg tid or qid</td>
<td>Weak/Low</td>
</tr>
<tr>
<td></td>
<td>• Vancomycin × 10 days (PO)</td>
<td>10 mg/kg/dose qid</td>
<td>125 mg qid</td>
<td>Weak/Low</td>
</tr>
<tr>
<td>Initial episode, severe/fulminant</td>
<td>• Vancomycin × 10 days (PO or PR) with or without metronidazole × 10 days (IV)</td>
<td>10 mg/kg/dose qid</td>
<td>500 mg qid</td>
<td>Strong/Moderate</td>
</tr>
<tr>
<td></td>
<td>• Vancomycin × 10 days (PO or PR)</td>
<td>10 mg/kg/dose tid</td>
<td>500 mg qid</td>
<td>Weak/Low</td>
</tr>
<tr>
<td>First recurrence, non-severe</td>
<td>• Metronidazole × 10 days (PO), OR</td>
<td>7.5 mg/kg/dose tid or qid</td>
<td>500 mg tid or qid</td>
<td>Weak/Low</td>
</tr>
<tr>
<td></td>
<td>• Vancomycin × 10 days (PO)</td>
<td>10 mg/kg/dose qid</td>
<td>125 mg qid</td>
<td>Weak/Low</td>
</tr>
<tr>
<td>Second or subsequent recurrence</td>
<td>• Vancomycin in a tapered and pulsed regimen, OR</td>
<td>10 mg/kg/dose qid</td>
<td>125 mg qid</td>
<td>Weak/Low</td>
</tr>
<tr>
<td></td>
<td>• Vancomycin for 10 days followed by rifaximin for 20 days, OR</td>
<td>Vancomycin: 10 mg/kg/dose qid; rifaximin: no pediatric dosing</td>
<td>Vancomycin: 500 mg qid; rifaximin: 400 mg tid</td>
<td>Weak/Low</td>
</tr>
<tr>
<td></td>
<td>• Fecal microbiota transplantation</td>
<td>…</td>
<td>…</td>
<td>Weak/Very low</td>
</tr>
</tbody>
</table>

Abbreviations: IV, intravenous; PO, oral; PR, rectal; qid, 4 times daily; tid, 3 times daily.

*a* In cases of severe or fulminant *Clostridium difficile* infection associated with critical illness, consider addition of intravenous metronidazole to oral vancomycin.

*b* Tapered and pulsed regimen: vancomycin 10 mg/kg with max of 125 mg 4 times per day for 10–14 days, then 10 mg/kg with max of 125 mg 2 times per day for a week, then 10 mg/kg with max of 125 mg once per day for a week, and then 10 mg/kg with max of 125 mg every 2 or 3 days for 2–8 weeks.

*c* No pediatric dosing for rifaximin; not approved by the US Food and Drug Administration for use in children <12 years of age.
What is the recommended CDI surveillance strategy for pediatric institutions?

Recommendations

1. Use the same standardized case definitions (HO, CO-HCFA, CA) and rate expression (cases per 10,000 patient-days for HO, cases per 1,000 patient admissions for CO-HCFA) in pediatric patients as for adults (good practice recommendation).

2. Conduct surveillance for HO-CDI for inpatient pediatric facilities but do not include cases <2 years of age (weak recommendation, low quality of evidence).

3. Consider surveillance for CA-CDI to detect trends in the community (weak recommendation, low quality of evidence).
What about recurrences?

- 15-25% recurrent rate after one episode of CDI
- After first recurrence, rate of recurrence increases to 35-45%
- After a second recurrence, risk of subsequent recurrence increases to 50-65%
Recurrent C Diff

- 1\textsuperscript{st} recurrence: retreat with initial regimen
  - If severe use oral vanco
  - Some concerns about neuropathy with repeated courses of metronidazole

- 2\textsuperscript{nd} recurrence: tapered or pulsed oral vanco
  - Tapered
    - 10 mg/kg (125 mg) QID x 10 days
    - 10 mg/kg (125 mg) BID x 7 days
    - 10 mg/kg (125 mg) once a day x 7 days
    - 10 mg/kg (125 mg) every 2-3 days for 2-8 weeks
  - Pulsed
    - 125 mg QID x 10 days
    - 125 mg daily every 3 days for 10 doses

- 3\textsuperscript{rd} recurrence: FMT
C difficile Opportunities

Send only appropriate specimens
Child hygiene
Maintain high level of awareness
Environmental cleaning
Attention outpatient clinics
Equipment

• Stethoscopes
  – Patient dedicated (missing, quality)
  – Who cleans, where, how, let dry
• Thermometers – in each room – Diaper scales – all inpt rooms
• Medication scanners/charger units
• Refrigerated medications – bagged
• COW’s – not allowed in isolation rooms
• Computer screens
• Game controllers, movies, video games
"Personal" Laundry Instructions at Children's Hospital Colorado

Do's and Do Not's

DO
1. Use for "personal" patient or patient family member items only.
2. Only 1 patient/family member's items in the washer and/or dryer at one time.
3. Use soap provided by TCH (dye-free and fragrance-free).
4. Use hot water cycles when possible.
5. Remove lint from lint trap after each dryer cycle.
6. Wipe top and knobs of washer and dryer after use with a disinfectant wipe provided by TCH.
7. Take laundry back to the patient room to fold and store.
8. TCH staff are to use appropriate PPE (Personal Protective Equipment) when doing patient laundry.
9. ES will also disinfect the outside of the washers and dryers on a daily basis.
10. Report machine problems to unit clerk who will then contact Environment of Care.

DO NOT
1. Do not use for:
   a. patients on isolation precautions (Contact, Droplet or Airborne) or
   b. grossly soiled items (e.g., feces, blood).
2. Do not use for hospital linens. Place these items in the designated linen hampers.
3. Do not place dirty laundry on top of washer or dryer.
4. Do not mix items from different patients/families in the same load.
5. Do not use regular bleach.
6. Do not fold laundry in this room. Take back to patient room to fold.
Environmental Cleaning and Disinfection

Pre-outbreak:
- Microfiber cloths/mops
- Sodium Hypochlorite (bleach) 1:10 solution for all Contact Isolation rooms
- No porous fabric on any furniture inpt or outpt
- ATP environmental testing by ES manager for staff education/compliance

Outbreak:
- Deep cleaning
- Expanded bleach to entire unit and clinic
  - Individual packets, tubs wipes in each room, spray bottles
- Increased frequency:
  - 2x/pt rooms.
  - High risk/high-touch areas 3x (common BRs, family lounge)
  - Toilet paper changed at discharge for all isolation rooms.
- Exception: Floors due to damage to wax, etc.
- ES (FTE increase, re-training, observations)
Questions and Discussion
Upcoming In-Person Events

Readmissions Discussion Forums
SAVE THE DATES! May-August
• May 17, 2018: Jupiter Medical Center, Jupiter, FL
• May 23, 2018: FHA Corporate Office, Orlando, FL
• Jun. 15, 2018: Pensacola, FL
• Other Areas to be Announced
  [Regional invitations and registration details coming soon]

WAKE UP to Protect Patients from Oversedation | Hospital-onset Sepsis
• Jun. 12, 2018: FHA Corporate Office, Orlando, FL
• Jun. 14, 2018: Sacred Heart Hospital, Pensacola, FL
Upcoming Virtual Events

**HRET HIIN | NHSN CDI Surveillance Definition Review**
May 3, 2018: 2:00 p.m. – 3:00 p.m. ET

**FHA HIIN & Beterra | 2018 SafeCulture Offering: Informational Webinar**
May 7, 2018: 2:00 p.m. – 3:00 p.m. ET

**HRET HIIN | Readmissions Sepsis Fishbowl Series: Part 2**
May 8, 2018: 12:00 p.m. – 1:00 p.m. ET

**FHA HIIN | Chasing Zero Infections Coaching Call: Don't Be Resistant: Reducing MRSA and other multi-drug resistant organisms**
May 8, 2018: 1:00 p.m. – 2:00 p.m. ET
How can we help?

► **Quality Advisor:** Dianne Cosgrove, RN, Director of Clinical Quality Improvement
► **Data:** Debbie Hegarty, Surveys/Specials Project Manager
► **Communications & Webinars:** Luanne MacNeill, Quality Initiatives Coordinator
► **Fellowships & Patient and Family Engagement:** Allison Sandera, Project Manager

Email: [HIIN@fha.org](mailto:HIIN@fha.org)
Phone: (407) 841-6230