Preventing *Clostridioides difficile* Infection with Infection Control and Appropriate Antibiotic Use

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Disclosures

• MDstewardship
  -consultant and owner
Objectives

1) Describe the changes to the new C diff treatment guidelines
2) Explain the relationship between environmental cleaning and C diff prevention
3) Outline monitoring methods for environmental cleaning
4) Discuss the impact on CDI rates with reduction in treatment of asymptomatic bacteriuria
**IMPACT**

- **500,000**
  
  Caused close to half a million illnesses in one year.

- **For people over 65, one in 11 died of a healthcare-associated CDI within a month of receiving a diagnosis with *C. difficile*.**

**RISK**

- **People on antibiotics are 7-10 times more likely to get *C. difficile* while on the drugs and during the month after.**

- **Being in healthcare settings, especially hospitals or nursing homes.**

- **More than 80% of *C. difficile* deaths occurred in people 65 and older.**
Rick Factors for C diff

- Antibiotics Exposure
- Age of the patient >65
- Immunosuppressed
- Isolation and Hand Hygiene
- Environmental Cleaning
- Gastric acid suppression
• Annually in the United States:
  – 30% of hospital admissions due to infection
  – 2 million people develop HAI

• 30-50% of hospitalized patients receive antibiotics

• 50% of antibiotic orders: unnecessary or inappropriate

• Antimicrobials are 30% of hospital pharmacy budgets
30% of antibiotic prescribed in the outpatient setting are unnecessary

Most of this unnecessary:
- colds, bronchitis, sore throats caused by viruses, and even some sinus and ear infections

Antibiotics are the most common cause of adverse drug events in children

A 10% decrease in inappropriate prescribing in the community
- Can result in a 17% reduction in C diff infection
Risk Factors for Community-Associated *Clostridium difficile* Infection in Adults: A Case-Control Study

Alice Y. Guh, 1 Susan Hocevar Adkins, 1 Quan Li, 1 Sandra N. Bulens, 1 Monica M. Farley, 2,4 Zirka Smith, 3,4,5 Stacy M. Holzbauer, 6,7 Tony Whitten, 6 Erin C. Phipps, 6 Emily B. Hancock, 6 Ghinwa Dumyati, 9 Cathleen Concannon, 5 Marion A. Kainer, 10 Brenda Rue, 10 Carol Lyons, 10 Danyel M. Olson, 11 Lucy Wilson, 12 Rebecca Perlmutter, 12 Lisa G. Winston, 13 Erin Parker, 14 Wendy Bamberg, 15 Zintars G. Beldavs, 16 Valerie Ocampo, 16 Maria Karlsson, 1 Dale N. Gerding, 17,18 and L. Clifford McDonald 1

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Results

• N= 226 pairs
• 70.4% were female
• 52.2% were ≥60 years old
• More case patients than controls had prior outpatient health care (82.1% vs 57.9%; P < .0001)
• Antibiotic (62.2% vs 10.3%; P < .0001) exposures
Clinical Practice Guidelines for *Clostridium difficile* Infection in Adults and Children: 2017 Update by the Infectious Diseases Society of America (IDSA) and Society for Healthcare Epidemiology of America (SHEA)

L. Clifford McDonald,1 Dale N. Gerding,2 Stuart Johnson,2,3 Johan S. Bakken,4 Karen C. Carroll,5 Susan E. Coffin,6 Erik R. Dubberke,7 Kevin W. Garey,6 Carolyn V. Gould,1 Ciaran Kelly,9 Vivian Loo,10 Julia Shaklee Sammons,6 Thomas J. Sandora,11 and Mark H. Wilcox12

1Centers for Disease Control and Prevention, Atlanta, Georgia; 2Edward Hines Jr Veterans Administration Hospital, Hines, and 3Loyola University Medical Center, Maywood, Illinois; 4St Luke's Hospital, Duluth, Minnesota; 5Johns Hopkins University School of Medicine, Baltimore, Maryland; 6Children's Hospital of Philadelphia, Pennsylvania; 7Washington University School of Medicine, St Louis, Missouri; 8University of Houston College of Pharmacy, Texas; 9Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts; 10McGill University Health Centre, McGill University, Montréal, Québec, Canada; 11Boston Children's Hospital, Massachusetts; and 12Leeds Teaching Hospitals NHS Trust, United Kingdom
<table>
<thead>
<tr>
<th>CDI Agent</th>
<th>Dosing</th>
<th>Duration</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metronidazole</td>
<td>500 mg po tid</td>
<td>10 days</td>
<td>25.75</td>
</tr>
<tr>
<td>Vancomycin liquid</td>
<td>125 mg qid</td>
<td>10 days</td>
<td>78.85</td>
</tr>
<tr>
<td>Vancomycin capsule</td>
<td>125 mg qid</td>
<td>10 days</td>
<td>409.59</td>
</tr>
<tr>
<td>Fidaxomicin</td>
<td>200 mg bid</td>
<td>10 days</td>
<td>4,187.00</td>
</tr>
<tr>
<td>Bezlotoxumab</td>
<td>10mg/kg iv</td>
<td>Single dose</td>
<td>3,000.00</td>
</tr>
</tbody>
</table>

March 2017. Northland Pharmacy, Duluth, MN
### Initial Episode

<table>
<thead>
<tr>
<th>Clinical Definition</th>
<th>Supportive Clinical Data</th>
<th>Recommended Treatment¹</th>
</tr>
</thead>
</table>
| Initial episode, non-severe | Leukocytosis with a white blood cell count of \( \leq 15,000 \) cells/mL and a serum creatinine level <1.5 mg/dL | - VAN 125 mg given 4 times daily for 10 days, OR  
  - FDX 200 mg given twice daily for 10 days  
  - Alternate if above agents are unavailable: metronidazole, 500 mg 3 times per day by mouth for 10 days |
| Initial episode, severeᵇ   | Leukocytosis with a white blood cell count of \( \geq 15,000 \) cells/mL or a serum creatinine level >1.5 mg/dL | - VAN, 125 mg 4 times per day by mouth for 10 days, OR  
  - FDX 200 mg given twice daily for 10 days |
| Initial episode, fulminant | Hypotension or shock, ileus, megacolon                        | - VAN, 500 mg 4 times per day by mouth or by nasogastric tube. If ileus, consider adding rectal instillation of VAN. Intravenously administered metronidazole (500 mg every 8 hours) should be administered together with oral or rectal VAN, particularly if ileus is present. |

Abbreviations: FDX, fidaxomicin; VAN, vancomycin.
Risk factors for CDI recurrence

- Advanced age (>65 years)
- Concurrent antibiotic during initial treatment of CDI
- Prior infection with C diff epidemic strain(s)
- Defective humeral immune response against *C. difficile*
- Underlying co-morbid medical conditions
- Continuous gastric acid barrier therapy (H2B, PPI)

Leffler et al. NEJM 2015;372:1539
McDonald EG et al. JAMA Int Med 2015;175(5):784
Wilcox MH et al. NEJM 2017;376:305
<table>
<thead>
<tr>
<th>Clinical Definition</th>
<th>Supportive Clinical Data</th>
<th>Recommended Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>First recurrence</td>
<td></td>
<td>• VAN 125 mg given 4 times daily for 10 days if metronidazole was used for the initial episode, OR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Use a prolonged tapered and pulsed VAN regimen if a standard regimen was used for the initial episode (eg, 125 mg 4 times per day for 10–14 days, 2 times per day for a week, once per day for a week, and then every 2 or 3 days for 2–8 weeks), OR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• FDX 200 mg given twice daily for 10 days if VAN was used for the initial episode</td>
</tr>
<tr>
<td>Second or subsequent recurrence</td>
<td></td>
<td>• VAN in a tapered and pulsed regimen, OR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• VAN, 125 mg 4 times per day by mouth for 10 days followed by rifaximin 400 mg 3 times daily for 20 days, OR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• FDX 200 mg given twice daily for 10 days, OR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fecal microbiota transplantation(^c)</td>
</tr>
</tbody>
</table>

Abbreviations: FDX, fidaxomicin; VAN, vancomycin.
Nebraska HAI Rates
As of January 1, 2017

Nebraska HAI SIRs 2015-2017

<table>
<thead>
<tr>
<th>SIR</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLABSI SIR*</td>
<td>1.15</td>
<td>0.73</td>
<td>0.85</td>
</tr>
<tr>
<td>CAUTI SIR*</td>
<td>1.00</td>
<td>0.98</td>
<td>0.92</td>
</tr>
<tr>
<td>MRSA Bacteremia SIR*</td>
<td>0.96</td>
<td>0.72</td>
<td>0.69</td>
</tr>
<tr>
<td>CDI SIR*</td>
<td>0.84</td>
<td>0.89</td>
<td>0.80</td>
</tr>
<tr>
<td>Colon SSI SIR*</td>
<td>0.96</td>
<td>1.40</td>
<td>1.32</td>
</tr>
<tr>
<td>HYSTER SSI SIR*</td>
<td>1.70</td>
<td>0.87</td>
<td>0.98</td>
</tr>
</tbody>
</table>

http://dhhs.ne.gov/Pages/HAI-Rates-in-Hospitals.aspx
Nationally, among acute care hospitals, the highlights in this report include:

- Nebraska we had about 13% statistically significant decrease in CDI infections between 2016 and 2017.
• Odds ratio for study pathogens was 2.14 [95% confidence interval (CI): 1.65-2.77]
  – Methicillin-resistant Staphylococcus aureus (MRSA)
  – Vancomycin-resistant enterococcus (VRE)
  – Clostridium difficile
  – Acinetobacter
  – Extended-spectrum b-lactamase-producing organism (ESBL)
  – Pseudomonas

• Gram-positive and Gram-negative organisms, the pooled acquisition odds ratio for Gram-negatives was 2.65 (95% CI: 2.02-3.47) and 1.89 (95% CI: 1.62-2.21) for Gram positives

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Decreased acquisition</th>
<th>Control</th>
<th>Odds Ratio M-H, Random, 95% CI</th>
<th>Odds Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events</td>
<td>Total</td>
<td>Events</td>
<td>Total</td>
</tr>
<tr>
<td>Huang (MRSA)</td>
<td>57</td>
<td>1454</td>
<td>248</td>
<td>8697</td>
</tr>
<tr>
<td>Nseir (ESBL producing Gram neg)</td>
<td>8</td>
<td>50</td>
<td>50</td>
<td>461</td>
</tr>
<tr>
<td>Huang (VRE)</td>
<td>58</td>
<td>1291</td>
<td>256</td>
<td>9058</td>
</tr>
<tr>
<td>Ajao (Klebsiella sp. or Escherichia coli)</td>
<td>32</td>
<td>648</td>
<td>235</td>
<td>8723</td>
</tr>
<tr>
<td>Nseir (Pseudomonas)</td>
<td>21</td>
<td>85</td>
<td>61</td>
<td>426</td>
</tr>
<tr>
<td>Drees (VRE)</td>
<td>19</td>
<td>138</td>
<td>31</td>
<td>500</td>
</tr>
<tr>
<td>Shaughnessy (Clostridium difficile)</td>
<td>10</td>
<td>91</td>
<td>77</td>
<td>1679</td>
</tr>
<tr>
<td>Mitchell (MRSA)</td>
<td>74</td>
<td>884</td>
<td>163</td>
<td>5344</td>
</tr>
<tr>
<td>Nseir (Acinetobacter)</td>
<td>16</td>
<td>52</td>
<td>41</td>
<td>459</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>4643</td>
<td>34886</td>
<td>100.0%</td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>287</td>
<td>1112</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Tau² = 0.09; Chi² = 21.32, df = 7 (P = 0.003); I² = 67%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 5.74 (P &lt; 0.00001)</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Impact of routine use of a spray formulation of bleach on *Clostridium difficile* spore contamination in non-*C difficile* infection rooms

- Ng Wong YK, Alhmidi H, Mana TSC, Cadnum JL, Jencson Al, Donskey CJ.

C diff & MRSA in Rooms with Ammonium Disinfectant and Spray Bleach Disinfectant

Results

• Suggest that use of sporicidal disinfectants for all post discharge room disinfection might be helpful in reducing the risk for C diff transmission from contaminated surfaces

• Future studies are needed to determine if routine use of sporicidal disinfectants in non-CDI rooms will result in a reduction in rates of CDI
Modern technologies for improving cleaning and disinfection of environmental surfaces in hospitals

- John M. Boyce
Fluorescent Marker “Black Light” On High Touch Surface

Fig. 2

Photographs of a fluorescent marker visible with a “black light” on a high touch surface before cleaning (left), and absence of the fluorescent marker after cleaning was performed (right)
High Touch Surface Monitoring

• Fluorescent Markers
  – Fluorescent gel, powder, and lotion - marking high touch objects prior to room cleaning
• Fluorescent gel dries transparent on surfaces, resists abrasion
  – there are several studies demonstrating the accuracy of the system
• Fluorescent markers are all designed to indicate physical removal of an applied substance
  – surfaces that are effectively disinfected but less effectively cleaned may be more likely flagged as failing to meet a quality standard

Three steps of an ATP bioluminescence assay for monitoring cleanliness of surfaces. Step 1: a special swab is used to sample the surface. Step 2: the swab is placed in a reaction tube and shaken for 10–15 s. Step 3: the reaction tube is placed in a luminometer and a result is reported as relative light units (RLUs). The higher the RLU value, the greater the amount of ATP detected on the surface.
High Touch Surface Monitoring with ATP

- Measurement of organic ATP on surfaces using a luciferase assay and luminometer
  - been used to evaluate cleanliness of food preparation surfaces for >30 years
- Total amount of ATP, both microbial and non-microbial
  - quantified and expressed as relative light units
- Although readout scales vary more than 10 fold and sensitivity varies between commercially available systems
  - very low readings are typically associated with low aerobic colony counts (ACCs)
  - very high readings may represent either a viable bioburden, organic debris including dead bacteria or a combination of both
- ATP system shown
  - significant improvement in daily cleaning
  - quantitative measurement to indicate the level of cleanliness of high touch surfaces

https://www.cdc.gov/hai/toolkits/appendices-evaluating-environ-cleaning.html
BACTERIA IN THE PATIENT ROOM

$33 billion each year for HAIs cost hospitals

75,000 deaths per year occur as a result of HAIs

1 in 25 patients will acquire a healthcare-associated infection during their hospital stay

See some of the key areas where bacteria live in the patient room.

About 1 in 25 patients will acquire a healthcare-associated infection during their hospital stay.

Skin contamination and environmental shedding remained high at the time of resolution of diarrhea (60% and 37%). Lower at the end of treatment C diff treatment (32% and 14%).
Process For Hospitalized Patient When CDI Resolves

1) Move patient with CDI to new room once symptoms resolve
2) Educate patient & family about need to move out of contaminated environment to clean one
3) Bathe or shower patient before moving to clean room
4) Unit staff will request a room transfer within 24hrs
5) Leave isolation caddy on door until Hospitality has completed Discharge cleaning
6) If patient cannot be transferred to a new room
   - patient continues on contact precautions in existing room until room change or discharge
   - existing room is cleaned with bleach-based cleaner

https://infectioncontrol.ucsfmedicalcenter.org
Impact on CDI rates with Reduction in Treatment of Asymptomatic Bacteriuria
• 11% of nursing home residents were on antibiotics on any single day
• 1 in 3 of these antibiotic prescriptions was for the treatment of urinary tract infections
  – At least ½ of these prescriptions were for either the wrong drug, dose, or duration

Massachusetts Department of Public Health: Reducing C diff

- Educational Interventions in Nursing Homes
- 16 nursing homes implemented multi-faceted educational interventions to reduce unnecessary antibiotic use for asymptomatic bacteriuria
- Conducted in-person trainings on antibiotic use for UTI
- 1 year later
  - 28% decrease in unnecessary urine cultures for patients
  - 37% reduction in antibiotics given to patients experiencing asymptomatic bacteriuria
  - 47% percent reduction in healthcare-acquired CDI
Reducing unnecessary urine culturing and antibiotic overprescribing in long-term care: a before-and-after analysis

- Kevin Antoine Brown, Andrea Chambers, Sam MacFarlane, Bradley Langford, Valeri Leung, Jacquelyn Quirk, Kevin L. Schwartz, Gary Garber

5 Main Intervention with Coaching and Champions

1. Urine cultures only when residents have the indicated clinical signs and symptoms of a urinary tract infection
2. Urine specimens according to a midstream procedure or an “in-and-out” catheterization
3. Prescribe antibiotics- only specified clinical criteria have been met
4. Cease the use of dipsticks for the diagnosis of urinary tract infection
5. Cease urine culture screening (i.e., on admission or annually)
Over the study period there was a decrease in the rates of urine culturing & antibiotic prescribing.
Q + A

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