Clostridium difficile Infection: Current State of Prevention

Wednesday, October 20th, 2010

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Today’s Speaker

Ruth M. Carrico PhD RN CIC

Ruth M. Carrico, is an assistant professor with the University of Louisville School of Public Health and Information Sciences, and associate faculty with the Center for Health Hazards Preparedness. With more than 30 years in healthcare, Carrico has focused her practice toward issues dealing with infection prevention in the healthcare and public health sectors, and is board certified in infection control. She has received training specific for healthcare epidemiology and public health at the Centers for Disease Control and Prevention (CDC) in conjunction with the Rollins School of Public Health at Emory University and the Society for Healthcare Epidemiology of America (SHEA). In 2010, Carrico was deemed a SHEA Fellow. Carrico has authored or co-authored numerous peer reviewed manuscripts as well as abstracts, posters, e-learning modules, two book chapters, and six books. Carrico currently serves as a reviewer for the American Journal of Infection Control (AJIC), Infection Control and Hospital Epidemiology (ICHE), and Critical Care Medicine and has served on the APIC national board of directors.
Clostridium difficile Infection: Current State of Prevention

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Objectives

• Review the impact, background and changing epidemiology of *C. difficile* and *C. difficile* Infection (CDI)
• Identify specific interventions designed to recognize cases of CDI early then facilitate preventive interventions
• Recognize limitations in our knowledge regarding effectiveness of interventions
Disclosure

• Thanks to Drs. Cliff McDonald and Carolyn Gould with CDC for sharing the CDI Toolkit
Impact of *C. difficile*

- Hospital-acquired, hospital-onset: 165,000 cases, $1.3 billion in excess costs, and 9,000 deaths annually

- Hospital-acquired, post-discharge (up to 4 weeks): 50,000 cases, $0.3 billion in excess costs, and 3,000 deaths annually

- Nursing home-onset: 263,000 cases, $2.2 billion in excess costs, and 16,500 deaths annually

Impact of CDI
Age-Adjusted Death Rate* for Enterocolitis Due to C. difficile, 1999–2006

*Per 100,000 US standard population
1. Ingestion of spores transmitted from other patients via the hands of healthcare personnel and environment

2. Germination into growing (vegetative) form

3. Altered lower intestine flora (due to antimicrobial use) allows proliferation of C. difficile in colon

4. Toxin A & B Production leads to colon damage +/- pseudomembrane

Pathogenesis of CDI
Pathogenesis of CDI

<table>
<thead>
<tr>
<th>Normal Colonic Flora &amp; Mucosa</th>
<th>Abnormal Flora &amp; C diff Colonization</th>
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C diff Production

Pseudomembranous Colitis

Colonization
### Pathogenesis of CDI

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<tr>
<th>Normal Colonic Flora &amp; Mucosa</th>
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<th>C diff Production of Toxins A &amp; B</th>
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Diagram showing the progression from normal colonic flora and mucosa, through abnormal flora and *C. diff* colonization, to production of toxins A & B, leading to Pseudomembranous Colitis.
Pathogenesis of CDI

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- Normal Colonic Flora & Mucosa
- Abnormal Flora & C diff Colonization
- C diff Production of Toxins A & B
- Pseudomembranous Colitis
Pathogenesis of CDI

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<th>Abnormal Flora &amp; <em>C diff</em> Colonization</th>
<th><em>C diff</em> Production of BI NAP Toxin</th>
<th>Pseudomembranous Colitis</th>
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Pathogenesis of *Clostridium difficile* (CDI) involves the colonization of the colon by abnormal flora and the production of BI NAP toxin, leading to pseudomembranous colitis.
Current Epidemic Strain of *C. difficile*

- BI/NAP1/027, toxinotype III
- Historically uncommon – epidemic since 2000
- More resistant to fluoroquinolones
  - Clindamycin and quinolones recognized as risk factors
  - Higher MICs compared to historic strains and current non-BI/NAP1 strains
- More virulent
  - Increased toxin A and B production
  - Increased sporulation

Risk Factors

• Antimicrobial exposure
• Acquisition of *C. difficile* organism
• Advanced age
• Underlying illness
• Immunosuppression
• Tube feeds
• Use of electronic thermometers
• ? Gastric acid suppression
Surveillance:
Categorize Cases by location and time of onset

Admission

Discharge

Day 1
Day 4

Time

HO: Hospital (Healthcare)-Onset
CO-HCFA: Community-Onset, Healthcare Facility-Associated
CA: Community-Associated

* Depending upon whether patient was discharged within previous 4 weeks, CO-HCFA vs. CA

Prevention Strategies

• **Core Strategies**
  – Should be first line prevention
  – Some high levels of scientific evidence
  – Demonstrated feasibility

• **Supplemental Strategies**
  – May be implemented in response to epidemic or ongoing transmission
  – Some scientific evidence
  – Variable levels of feasibility
Prevention Strategies:
Knowledge Gaps

• Lack of high quality studies
• Implementation of bundles may cloud recognition of what actually works
• What is the situational context in which prevention activities should be applied (e.g., does environmental disinfection prevent CDI transmission during outbreaks)?
• What are the unintended consequences that result from interventions?
Core Prevention Strategies

• Contact Precautions for duration of diarrhea
• Hand hygiene in compliance with CDC/WHO
• Cleaning and disinfection of equipment and environment
• Laboratory-based alert system for immediate notification of positive test results
• Educate about CDI: HCP, housekeeping, administration, patients, families

http://www.cdc.gov/ncidod/dhqp/id_CdiffFAQ_HCP.html
Patient/Family Education

• What is CDI
• Diagnosis and treatment
• Transmission to others
• Isolation
• Hand hygiene
• Environmental cleaning
• Discharge instructions
• When to contact their clinician

• Excellent patient education handout in the APIC Elimination Guide
Supplemental Prevention Strategies

- Extend use of Contact Precautions beyond duration of diarrhea (e.g., 48 hours)*
- Presumptive isolation for symptomatic patients pending confirmation of CDI
- Evaluate and optimize testing for CDI
- Implement soap and water for hand hygiene before exiting room of a patient with CDI
- Implement universal glove use on units with high CDI rates*
- Use sodium hypochlorite (bleach) – containing agents for environmental cleaning
- Implement an antimicrobial stewardship program

* Not included in CDC/HICPAC 2007 Guideline for Isolation Precautions
Supplemental Prevention Strategies: Rationale for considering extending isolation beyond duration of diarrhea

Supplemental Prevention Strategies:
Consider presumptive isolation for patients with \( \geq 3 \) unformed stools within 24 hours

- Patients with CDI may contaminate environment and hands of healthcare personnel pending results of diagnostic testing
- CDI responsible for only \( \sim 30-40\% \) of hospital-onset diarrhea
- However, CDI more likely among patients with \( \geq 3 \) unformed (i.e. taking the shape of a container) stools within 24 hours
  - Information must be shared between shifts and HCP
  - Send specimen for testing and presumptively isolate patient pending results
  - Positive predictive value of testing will also be optimized if focused on patients with \( \geq 3 \) unformed stools within 24 hours
  - Exception: patient with possible recurrent CDI (isolate and test following first unformed stool)
Supplemental Prevention Strategies:
Evaluate and optimize test-ordering practices and diagnostic methods

- Most laboratories have relied on Toxin A/B enzyme immunoassays
  - Low sensitivities (70-80%) lead to low negative predictive value
- Despite high specificity, poor test ordering practices (i.e. testing formed stool or repeat testing in negative patients) may lead to many false positives
- Consider more sensitive diagnostic methods but apply these more judiciously across the patient population
  - Employ a highly sensitive screen with confirmatory test or a PCR-based molecular assay
  - Restrict testing to unformed stool only
  - Focus testing on patients with ≥ 3 unformed stools within 24 hours
  - Require expert consultation for repeat testing within 5 days

Challenges in Diagnostic Methods

- Sensitivity - True positives
- Specificity - True negatives

- Must recognize when to test (not testing formed stool unless specific reasons to do so, defining what is meant by “diarrhea”, and determine how many samples to be tested during a diarrhea episode).
- If diagnostic methods change, it is important that it be known for both infection prevention and clinical decision-making purposes.
- Do not know if testing methods lead to improved patient outcomes
Supplemental Prevention Strategies: Hand Hygiene – Soap vs. Alcohol Hand Rub

- Alcohol not effective in eradicating *C. difficile* spores
- However, one hospital study found that from 2000-2003, despite increasing use of alcohol hand rub, there was no concomitant increase in CDI rates
- Discouraging alcohol hand rub may undermine overall hand hygiene program with untoward consequences for HAIs in general

## Supplemental Prevention Strategies:
### Hand Washing: Product Comparison

<table>
<thead>
<tr>
<th>Product</th>
<th>Log10 Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tap Water</td>
<td>0.76</td>
</tr>
<tr>
<td>4% CHG antimicrobial hand wash</td>
<td>0.77</td>
</tr>
<tr>
<td>Non-antimicrobial hand wash</td>
<td>0.78</td>
</tr>
<tr>
<td>Non-antimicrobial body wash</td>
<td>0.86</td>
</tr>
<tr>
<td>0.3% triclosan antimicrobial hand wash</td>
<td>0.99</td>
</tr>
<tr>
<td>Heavy duty hand cleaner used in manufacturing environments</td>
<td>1.21*</td>
</tr>
</tbody>
</table>

* Only value that was statistically better than others

### Conclusion:
Spores may be difficult to eradicate even with hand washing.

Supplemental Prevention Strategies: Hand Hygiene Methods

• Since spores may be difficult to remove from hands even with hand washing, adherence to glove use, and Contact Precautions in general, should be emphasized for preventing *C. difficile* transmission via the hands of healthcare personnel

• Have hand hygiene practices make sense to HCP

• Must address hand hygiene needs and impact beyond CDI

Supplemental Prevention Strategies:  
Glove Use

Rationale for considering universal glove use (in addition to Contact Precautions for patients with known CDI) on units with high CDI rates

- Although the magnitude of their contribution is uncertain, asymptomatic carriers have a role in transmission
- Practical screening tests are not available
- There may be a role for universal glove use as a special approach to reducing transmission on units with longer lengths of stay and high endemic CDI rates
- General benefit in minimizing hand contamination
- Focus enhanced environmental cleaning strategies and avoid shared medical equipment on such units as well
Supplemental Prevention Strategies: Environmental Cleaning

- Bleach can kill spores, whereas other standard disinfectants cannot
- Limited data suggest cleaning with bleach (1:10 dilution prepared fresh daily) reduces *C. difficile* transmission
- Two before-after intervention studies demonstrated benefit of bleach cleaning in units with high endemic CDI rates
- Therefore, bleach may be most effective in reducing burden where CDI is highly endemic

Supplemental Prevention Strategies: Environmental Cleaning

Assess adequacy of cleaning before changing to new cleaning product such as bleach

- Ensure that environmental cleaning is adequate and high-touch surfaces are not being overlooked
- Evaluate processes used in cleaning (clean to dirty, products support process)
- One study using a fluorescent environmental marker to assess cleaning showed:
  - only 47% of high-touch surfaces in 3 hospitals were cleaned
  - sustained improvement in cleaning of all objects, especially in previously poorly cleaned objects, following educational interventions with the environmental services staff
- If changing products, ensure staff can be successful with switching and sustaining

Supplemental Prevention Strategies:
Audit and feedback targeting broad-spectrum antibiotics

- Monitoring and feedback a critical element in antimicrobial stewardship programs
- A prospective, controlled interrupted time-series analysis in 3 acute medical wards for the elderly in the UK demonstrated the impact of antimicrobial management on reducing CDI.
  - Introduced a narrow-spectrum antibiotic policy
  - Reinforced using feedback
  - Associated with significant changes in targeted antibiotics and a significant reduction in CDI

Summary of Prevention Measures

Core Measures

- Contact Precautions for duration of illness
- Hand hygiene in compliance with CDC/WHO
- Cleaning and disinfection of equipment and environment
- Laboratory-based alert system
- CDI surveillance
- Education

Supplemental Measures

- Prolonged duration of Contact Precautions*
- Presumptive isolation
- Evaluate and optimize testing
- Soap and water for HH upon exiting CDI room
- Universal glove use on units with high CDI rates*
- Bleach for environmental disinfection
- Antimicrobial stewardship program

* Not included in CDC/HICPAC 2007 Guideline for Isolation Precautions
Process Measurement

• **Core Measures:**
  – Measure compliance with CDC/WHO recommendations for hand hygiene and Contact Precautions
  – Assess adherence to protocols and adequacy of environmental cleaning

• **Supplemental Measures:**
  – Intensify assessment of compliance with process measures
  – Track use of antibiotics associated with CDI in a facility
# NHSN CDAD Module

**Laboratory-identified MDRO or CDAD Event**

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<tr>
<th>Field</th>
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<tbody>
<tr>
<td>Facility ID</td>
<td>Event #;</td>
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<tr>
<td>Patient ID</td>
<td>Social Security #;</td>
</tr>
<tr>
<td>Secondary ID</td>
<td></td>
</tr>
<tr>
<td>Patient Name, Last</td>
<td>Patient Name, First</td>
</tr>
<tr>
<td>Gender</td>
<td>Date of Birth:</td>
</tr>
<tr>
<td>Ethnicity (Specify)</td>
<td>Race (Specify):</td>
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</table>

## Event Details

<table>
<thead>
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</thead>
<tbody>
<tr>
<td>Event Type: LabID</td>
<td>Date Specimen Collected:</td>
</tr>
<tr>
<td>Specific Organism Type:</td>
<td>Specimen Source:</td>
</tr>
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<td>MRSA</td>
<td>Yes</td>
</tr>
<tr>
<td>MSSA</td>
<td>No</td>
</tr>
<tr>
<td>VRE</td>
<td></td>
</tr>
<tr>
<td>MDR-Klebsiella</td>
<td></td>
</tr>
<tr>
<td>MDR-Acinetobacter</td>
<td></td>
</tr>
<tr>
<td>C. difficile</td>
<td></td>
</tr>
<tr>
<td>Outpatient:</td>
<td></td>
</tr>
<tr>
<td>Date Admitted</td>
<td>Location:</td>
</tr>
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<td>Specimen Source:</td>
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</table>
Resources

SHEA/IDSA Compendium of Recommendations

SHEA/IDSA Practice Recommendation

Strategies to Prevent *Clostridium difficile* Infections in Acute Care Hospitals

Erik R. Dubberke, MD; Dale N. Gerding, MD; David Classen, MD, MS; Kathleen M. Arias, MS, CIC; Kelly Podgorny, RN, MS, CPHQ; Deverick J. Anderson, MD, MPH; Helen Burstin, MD; David P. Calfee, MD, MS; Susan E. Coffin, MD, MPH; Victoria Fraser, MD; Frances A. Griffin, RRT, MP; Peter Gross, MD; Keith S. Kaye, MD; Michael Klompas, MD; Evelyn Lo, MD; Jonas Marschall, MD; Leonard A. Mermel, DO, ScM; Lindsay Nicolle, MD; David A. Pegues, MD; Trish M. Perl, MD; Sanjay Saint, MD; Cassandra D. Salgado, MD, MS; Robert A. Weinstein, MD; Robert Wise, MD; Deborah S. Yokoe, MD, MPH


CDI Checklist Example

*Clostridium difficile* Infection (CDI) Checklist

Hospital interventions to decrease the incidence and mortality of healthcare-associated *C. difficile* infections

**Prevention Checklist**

- When an MD, PA, NP, or RN suspects a patient has CDI:
  - Physician, Physician Assistant, or Nurse Practitioner:
    - Initiate Contact Precautions Plus
  - Order stool *C. difficile* toxin testing
  - Discontinue non-essential antimicrobials
  - Discontinue all anti-peristaltic medications

**Registered Nurse**

- Obtain stool sample for *C. difficile* toxin test
- Place patient in single-patient room
- Place Contact Precautions Plus sign on patient’s door
- Ensure that gowns and gowns are easily accessible from patient’s room
- Place dedicated stethoscope in patient’s room
- Remind staff to wash hands with soap and water following patient contact

**Microbiology Laboratory Staff Person**

- Cell relevant patient floor with positive *C. difficile* toxin test result
- Provide daily list of positive test results for Infection Control Practitioner
- Check microbiology results daily for positive *C. difficile* toxin test results
- Cell relevant floor to confirm that patient with positive *C. difficile* toxin test results is in a single-patient room and that the Contact Precautions Plus sign is on the patient’s door
- Flag the patient’s *C. difficile* status in the hospital’s clinical information system or in the patient’s paper chart
- Alert housekeeping that the patient is on Contact Precautions Plus

**Environmental Services Staff Person**

- Prior to discharge cleaning, check for Contact Precautions Plus sign on the patient’s door
- If Contact Precautions Plus sign is on the door, clean the room with a bleach-based cleaning agent
- Confirm for supervisor that bleach-based cleaning agent was used for discharge cleaning for every patient on Contact Precautions Plus

**Treatment Checklist**

- When an MD, PA, or NP diagnoses mild CDI:
  - Physician, Physician Assistant, or Nurse Practitioner:
    - Initiate oral metronidazol at dose 500mg every 8 hours
    - If no clinical improvement by 48-72 hours after diagnosis, treat patient as moderate CDI
    - Continue therapy for at least 14 days total and at least 10 days after symptoms have abated

- When an MD, PA, or NP diagnoses moderate CDI:
  - Physician, Physician Assistant, or Nurse Practitioner:
    - Initiate oral vancomycin at dose 250mg every 6 hours
    - Consider oral metronidazol at dose 500mg every 8 hours
    - Continue therapy for at least 14 days total and at least 10 days after symptoms have abated

**When an MD, PA, or NP diagnoses severe CDI**

- Physician, Physician Assistant, or Nurse Practitioner:
  - Initiate oral vancomycin at dose 250mg every 6 hours together with IV metronidazol at dose 500mg every 6 hours
  - Following consultation with general surgery regarding its use, consider rectal vancomycin
  - Add general surgery service to assess the need for colectomy

*Abbreviations: MD=medical doctor, PA=physician assistant, NP=nurse practitioner; RN=registered nurse, MR=medical resident; M.D.=doctor of medicine; CT=computed tomography, N/A=not available*
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