CLOSTRIDIUM DIFFICILE: A MULTI-FACETED ANALYSIS

Julie A. Radford, RN, PHN, MSN
Pam Weiss, RN, PHN, BSN, CIC

Anaheim Regional Medical Center

February 19, 2014
Objectives

Attendees:

- Will be able to recognize and articulate assumptions, central ideas, and issues that surround *Clostridium difficile* in the hospital environment
- Will gain an understanding of contributing modifiable factors/theories that lead to the increase in hospital-associated rates
- Will be able to discuss evidence-based practice for reducing transmission rates in association with bundled interventional care
Anaheim Regional Medical Center

- 223-bed generalized acute care for-profit facility in Anaheim
  - 22-bed general intensive care unit
  - 10-bed surgical cardio-thoracic intensive care unit
  - 12-bed step-down unit
- 1300 employees
- 44,000 emergency room visits annually
- Designated heart center with stroke certification
  - Pathways to Excellence Nursing Certification
Clostridium difficile

- A spore-forming anaerobic rod
  - Transmitted by the fecal-oral route
  - Creates diarrhea and colitis
- *C. dif* positive patients disseminate spores to surrounding environments from first liquid stool until several days after formed stools are noted
- Spores can live on objects within the healthcare environment for months waiting to be ingested by new host
- Studies have shown the areas of the highest levels of spores:
  - Call button, bedside table, bedrail
  - Nursing and physician work areas
  - Chairs and computer keyboards

Kramer, Schwebke, and Kampf, 2006
**Clostridium difficile**

- Transmission of *C. dif* is not single faceted and has many contributing risk factors
- Typically, patients admitted into the ICU or a Step-down unit may have many of the risk factors associated with acquiring CDI

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.

Evidence-Based Studies

- Evidence-Based Practice (EBP) studies have shown a number of risk factors which lead to an increased opportunity of acquiring CDI.
- EBP studies have also shown the ease with which *C. dif* spores can remain on and be transported via fomites for up to six months to a multitude of areas within the care environment infecting others.
- CDC estimates that CDI is responsible for 30-40% of hospital-acquired diarrhea.
  - Two or more liquid bowel movements in a day should be sent for *C. difficile* testing.

Problem

- The Infection Prevention Department at Anaheim Regional Medical Center (ARMC) noted a 400% increase in Clostridium difficile infections (CDI) during the 3rd quarter 2013 (over the 2nd quarter 2013)

- A retrospective descriptive cohort study was conducted to identify modifiable risk factors and to define sources of transmission
  - Evidence for CDI Bundle implementation
### Definition:

- **HO** – Healthcare Onset
- **CO** – Community Onset
- **CO-HCFA** – Community-Onset Healthcare Facility Associated

### C. difficile 2013

<table>
<thead>
<tr>
<th></th>
<th>Q1 2013</th>
<th>Q2 2013</th>
<th>Q3 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CO</strong></td>
<td>13</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td><strong>CO-HCFA</strong></td>
<td>0</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td><strong>HO</strong></td>
<td>7</td>
<td>4</td>
<td>22</td>
</tr>
</tbody>
</table>
C. dif Prevalence and Incidence Rates by Quarter (2012-2013)
C. difficile Hospital-Acquired Infection/10,000 Patient Days
PCR and Increased Prevalence Rates

- Higher prevalence rates noted for 2012-13 hospital wide related to lab change to PCR testing which is more sensitive than A & B testing
- This prevalence rate stayed fairly steady until the 3rd quarter 2013
Classification of Cases

• Currently, all CDI cases are reported to National Healthcare Safety Network (NHSN)
  • NHSN then assigns each patient as either:
    • Healthcare Facility-Onset (HO),
    • Community-Onset (CO), or
    • Community-Onset Healthcare Facility-Associated (CO-HFCA)
NHSN Definition of Classifications

- Healthcare Facility-Onset (HO): Lab ID collected >3 days after admission to a facility (on or after day 4)

- Community-Onset (CO): Lab ID collected as an outpatient or an inpatient ≤ 3 days after admission to the facility

- Community-Onset Healthcare Facility-Associated (CO-HCFA): Lab ID collected from a patient discharged from the facility ≤ 4 weeks prior to the date the stool specimen was collected
3rd Quarter 2013 Clostridium difficile Infection (CDI) Outbreak

- Total of 48 patients diagnosed with CDI during this time
  - 2 patients removed from study due to non-admittance to hospital care setting
  - NHSN classifications:
    - HO: 26
      - CO-HCFA: 3
    - CO: 20
- Average time of onset for HO: 8.64 days (SD 9.7)
- Average LOS for HO: 14.2 days (SD 10.1)
# Risks Associated with CDI and their Prevalence Among CDI Positive Patients During the Third Quarter of 2013 at ARMC

<table>
<thead>
<tr>
<th>Risk Variable</th>
<th>Total CDI positive patients (n=46)</th>
<th>HA and CO-HA CDI patients (n=26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, year mean (SD)</td>
<td>70 (SD 14)</td>
<td>72 (SD 15)</td>
</tr>
<tr>
<td>Male sex</td>
<td>23 (50%)</td>
<td>13 (50%)</td>
</tr>
<tr>
<td>Resident of care facility</td>
<td>25 (54%)</td>
<td>14 (53.8%)</td>
</tr>
<tr>
<td>History of CDI</td>
<td>8 (17%)</td>
<td>3 (11%)</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>36 (78%)</td>
<td>20 (76%)</td>
</tr>
<tr>
<td>Proton-pump inhibitors</td>
<td>34 (73%)</td>
<td>22 (84%)</td>
</tr>
<tr>
<td>Enteral feed/ GI surgery or procedure</td>
<td>28 (60%)</td>
<td>17 (65%)</td>
</tr>
</tbody>
</table>
Single Antibiotic (ABX) Usage By HO/CO-HCFA CDI Cases Prior to Diagnosis (7/24)

- Zosyn: 5 (72%)
- Levaquin: 1 (14%)
- Rocephin: 1 (14%)
HO/ CO-HCFA CDI Patients on Combined Antibiotics Prior to Diagnosis

- 3+ Combination ABX: 11 patients
- 2+ Combination ABX: 4 patients
- 1 ABX: 7 patients
- No ABX: 3 patients

Patients on Combination Antibiotics Prior to Diagnosis of CDI (n=15)
Many of these were in combination with other ABX as noted on previous slide. Vancomycin was noted to have been used at least one time prior to diagnosis being made.
Proton-Pump Inhibitor Usage

- Proton-pump inhibitors (PPI’s) are prescribed to decrease stomach acid and prevent stress stomach ulcers in hospitalized patients.
- Controversial studies have speculated that reducing the natural stomach acid barrier with the use of PPI’s makes acquiring CDI easier.
- Common practice at ARMC is to place the majority of patients on PPI’s upon admission.
Hospital-Acquired CDI During the 3rd Quarter 2013 Who Were on PPI's Prior to CDI Diagnosis (n=24)

- On PPI's prior: 20 (85%)
- Not on PPI's prior: 4 (15%)
Known Issues with Isolation and CDI Specific to ARMC

- Bedside tables being used as water carts
- In November 2011, ARMC changed from PDI wipes for decontamination to Clorox bleach wipes
  - Staff refusing to utilize new wipes for first year due to smell and concerns for personal scrub discoloration
- Nursing not utilizing “Safe Zone” tape on CDI patient rooms
  - Utilizing of red signs as a reminder
The Safe Zone
Precaution Signs
Known Issues with Isolation and CDI Specific to ARMC

- Equipment is frequently shared between rooms
  - Especially chairs for visitors
    - Studies show high rates of spores on chairs

- Curtains in rooms
  - Often touch the patients bed
  - Are often touched by staff without consequential thought about transmission
  - Are not changed every six months, but are to be changed after each CDI discharge

- Poor hand hygiene
  - Includes visitors, doctors, nursing, respiratory and physical therapy and all other staff that may enter patients room
Known Issues with Isolation and CDI Specific to ARMC

- Possible food tray/counter contamination
  - Reusable trays are served on the bedside table, where as the table is known to contain the highest rate of spore colonization
  - Trays are then removed from the room and placed on the counter surrounding the nursing station as food cart has already been taken
  - Due to the critical nature of the patients, trays can remain on counter until next food cart comes
  - Once new cart comes, dirty trays are then placed on cart, leaving spores on once clean counter
  - Families and staff utilize these counter tops throughout the day, passing the spores onto susceptible patients
Known Issues with Isolation and CDI Specific to ARMC

- Stool specimens sent to lab
  - Microbiology was testing most of the stool samples whether they were liquid stools or not
    - Would have identified patients who were colonized with *C. difficile*; but did not have active CDI
Transmission Theories

- Due to the retrospective nature of this study, the mode of transmission could only be theorized, not confirmed
  - Poor hand-hygiene transmission
  - Poor cleaning of shared patient equipment
  - Lack of terminal cleaning of CDI rooms
Identifying Modes of Transmission

- Carefully conducted retrospective descriptive analysis of data collected to differentiate ailment patterns
  - All CDI positive patients were tracked with the help of the facilities electronic charting system, CPSI
  - Midnight room charges, which coordinated with specific room numbers, helped establish a pattern of patient movement within the facility
Identifying Modes of Transmission

- Each movement was then graphed according to date of admission and diagnosis of CDI by unit.
- Color coding was then used to represent patients designated as CO in order to draw attention to units and patients who may have been exposed.
Identifying Modes of Transmission

- Thorough examination of this graph allowed for possible correlations of transmission to be hypothesized when compared to staffing for the days surrounding possible exposure (not greater than seven calendar days).
- Strong association could be made when active CDI patients had the same nurse or other staff member, as the patient who developed CDI within the next seven calendar days.
Identifying Modes of Transmission Issues

- Additionally, many units share multiple pieces of equipment between patients (blood pressure cuffs, pulse oxymeters, glucometers, thermometers, scale-tronics, maxi-move and dopplers)
  - Consideration was taken for BP cuffs due to Velcro
    - Probable that spores maintained on cuff for transmission despite use of Clorox bleach wipes due to Velcro fabric found on it
- It is also known that CVU (clean unit) staff come to DOU (dirty unit) to get equipment (suction sets and flo-meters)
  - Even if wiped in bleach there is no way to know if spores were killed
  - Can explain several HO CDI patients from that unit
Transmission Theory Related to a Lack of Proper Hand-washing or Shared Equipment Cleaning By Unit (n=16)
Terminal Cleaning

- Tele tracking bed board was utilized to assess for terminal cleaning orders upon discharge for each room in which a CDI patient inhabited during the third quarter
  - Issues: Does not guarantee that terminal cleaning was or was not conducted despite no order being implemented
    - Current practice at time of outbreak included “The Safe Zone” which may have signaled necessity of terminal cleaning without order or nursing communication with EVS
    - Majority of the room which held CDI patients had never been ordered for terminal cleaning during the outbreak
Terminal Cleaning

- Additional cleaning issues:
  - Bleach was instituted 1 year ago but EVS wasn’t using it daily in patient’s rooms
    - only upon discharge if EVS knew what type of isolation the patient was in
Transmission Related to Lack of Terminal Cleaning by Unit (n=8)

- ICU: 2.00 (25%)
- DOU: 3.00 (37%)
- CVOU: 1.00 (13%)
- Tower 4/5: 2.00 (25%)
Current CDC guidelines state the two main modifiable risk factors include:
- Antibiotic exposure
- Acquisition / transmission of CDI
  - Supported by a multitude of EBP studies

Faires, Pearl, Berke, Reid-Smith and Weese (2013), Rubin et al. (2013), and The London Department of Health (2009)
Supplemental Prevention Strategies: Environmental Cleaning

How Much Can be Achieved via Environmental Decontamination?

Interventions: Back to Basics

- Began daily cleaning with bleach only for all patient rooms (Oct. 2013)
- Bagging of curtains
- Only submitting liquid stool sample after greater than 2 liquid bowel movements noted in a day
  - Assisted nursing staff with charting deficiencies by adding standardized Bristol Stool Chart definitions to CPSI
### Bristol Stool Chart

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Separate hard lumps, like nuts (hard to pass)</td>
</tr>
<tr>
<td>2</td>
<td>Sausage-shaped but lumpy</td>
</tr>
<tr>
<td>3</td>
<td>Like a sausage but with cracks on its surface</td>
</tr>
<tr>
<td>4</td>
<td>Like a sausage or snake, smooth and soft</td>
</tr>
<tr>
<td>5</td>
<td>Soft blobs with clear-cut edges (passed easily)</td>
</tr>
<tr>
<td>6</td>
<td>Fluffy pieces with ragged edges, a mushy stool</td>
</tr>
<tr>
<td>7</td>
<td>Watery, no solid pieces. <strong>Entirely Liquid</strong></td>
</tr>
</tbody>
</table>
Interventions: Back to Basics

- Hand washing skill competency for ALL staff
- Safe zone and other signage implementation enforcement
- Strict Isolation
- Antibiotic Stewardship
  - Still in the process of development
Definition:
- HO – Healthcare Onset
- CO – Community Onset
- CO-HCFA – Community Onset Healthcare Facility Associated

Comparison of C. dif for Entire Year 2013

<table>
<thead>
<tr>
<th></th>
<th>Q1 2013</th>
<th>Q2 2013</th>
<th>Q3 2013</th>
<th>Q4 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>13</td>
<td>14</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>CO-HCFA</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>HO</td>
<td>7</td>
<td>4</td>
<td>22</td>
<td>8</td>
</tr>
</tbody>
</table>
Conclusion

- The approach to solving the *C. dif* problem is multi-faceted and requires the assistance of many different departments and disciplines.
- A bundle approach must be implemented to see an improvement among hospital-acquired infections.
- We still don’t know for sure who, what, where, and when transmission occurred.
References


Faires, M. C., Pearl, D. L., Berke, O., Reid-Smith, R. J., & Weese, J. S. (2013). The identification and epidemiology of methicillin-resistant Staphylococcus aureus and Clostridium difficile in patient rooms and the ward environment. BMC Infectious Diseases, 13, 342.


