CDI and CRE in LTC:
An Alphabet Soup of Gut Bacteria

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Speaker Disclosures

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The opinions presented herein are my own and do not represent those of the Veterans Affairs system or the federal government.
Learning Objectives

By the end of the session, participants will be able to:

• Articulate risk factors for developing *C. difficile* infection
• Describe infection control interventions to reduce the risk of acquiring *C. difficile*
• Recognize carbapenem-resistant Enterobacteriaceae (CRE) and describe infection prevention strategies for these bacteria

Pathophysiology
Clinical Disease

C. difficile Infection
Non-severe
Severe
Severe, Complicated

Asymptomatic Carrier
No C. difficile

Slide courtesy of Dubert Guerrero
Clinical Disease

C. difficile Infection
- Non-severe
- Severe
- Severe, Complicated

Asymptomatic Carrier

No C. difficile

Clinical Disease

Recurrent Disease

C. difficile Infection
- Non-severe
- Severe
- Severe, Complicated

Asymptomatic Carrier

No C. difficile

Slide courtesy of Dubert Guerrero
Colonization Resistance

normal microbiome

Loss of Colonization Resistance

normal microbiome systemic antibiotic
C. difficile Infection (CDI)

- normal microbiome
- systemic antibiotic
- ingest spores

C. difficile Infection (CDI)

- normal microbiome
- systemic antibiotic
- ingest spores
- toxin production
Antibiotics are the most important risk factor for developing C. difficile infection.
More Antibiotic Classes Increases the Risk of *C. difficile* Infection

- ~400,000 adults admitted to 14 hospitals in 2011-2012
- ~2,600 with CDI (0.7%)

<table>
<thead>
<tr>
<th>Antibiotic Classes</th>
<th>Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 vs. 0</td>
<td></td>
</tr>
<tr>
<td>2 vs. 0</td>
<td></td>
</tr>
<tr>
<td>≥3 vs. 0</td>
<td></td>
</tr>
</tbody>
</table>

Steps You Can Take:

Antibiotics

Tartof et al. Infection Control & Hospital Epidemiology 2015; 36 (12): 1409
**Steps You Can Take:**

**Antibiotics**

| Avoid antibiotics when possible
| Active monitoring
| Promote watchful waiting

**When you must use antibiotics...**

| Use shorter courses (≤ 7 days)
| Choose narrow spectrum agents
| Choose agents with less excretion into the GI tract

---

**Advanced Age** is the second most important risk factor for developing *C. difficile* infection.
Epidemic *C. difficile* Strain

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases/10,000 Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>20</td>
</tr>
<tr>
<td>2001</td>
<td>40</td>
</tr>
<tr>
<td>2002</td>
<td>60</td>
</tr>
<tr>
<td>2003</td>
<td>80</td>
</tr>
<tr>
<td>2004</td>
<td>100</td>
</tr>
<tr>
<td>2005</td>
<td>120</td>
</tr>
</tbody>
</table>


Age-Related Vulnerability

- In 2010, >90% of deaths due to CDI were in people > 65 years.
- Aging leads to immune senescence.
- A poor antibody response to *C. difficile* correlates with infection.
- Older adults have a less diverse and less resilient gut microbiome.

Kelly Clin Microbiol Infect 2012; 18 Suppl 6:21-7
Biagi *et al.* PLoS ONE 2010; 5: e10667;
Rea *et al.* J Clin Micro 2012; 50(3):867-75
Steps You Can Take:
Advanced Age

Youth

Fountain
Other Risk Factors

- Previous hospitalization
- Resident at a long-term care facility
- Underlying disease severity
- Albumin ≤ 3.5 g/dL
- Gastric acid suppression

McDonald et al. MMWR 2012; 61(9):157-62
Dial et al. JAMA 2005; 294: 2989-2995
Kyne et al. Age & Ageing 1999; 28: 107-113

Risk Factors for Recurrent Disease

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Adjusted Hazard Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 75 years</td>
<td>1.5 (1.1 – 2.0)</td>
</tr>
<tr>
<td>PPI* Use</td>
<td>1.5 (1.1 – 2.0)</td>
</tr>
<tr>
<td>Antibiotic re-exposure</td>
<td>1.3 (0.9 – 1.7)</td>
</tr>
<tr>
<td>Length of Stay, per day</td>
<td>1.003 (1.002 – 1.004)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indication for PPI Use</th>
<th>No. (%) (n = 191)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No indication</td>
<td>101 (53%)</td>
</tr>
<tr>
<td>Age &gt; 60 y w/ 2 other risk factors</td>
<td>39 (20%)</td>
</tr>
<tr>
<td>Upper GI bleeding</td>
<td>17 (9%)</td>
</tr>
<tr>
<td>GERD in previous 90 days</td>
<td>15 (8%)</td>
</tr>
</tbody>
</table>

*PPI = proton pump inhibitor
McDonald et al. JAMA Internal Med 2015; (online 3/2/15)
### Types of Tests

<table>
<thead>
<tr>
<th>Common Name  (No. tests)</th>
<th>Type of Test</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDH (4)</td>
<td>Enzyme Immunoassay (EIA) for Glutamate dehydrogenase (GDH)</td>
<td><em>C. difficile</em> (sensitive)</td>
</tr>
<tr>
<td>EIA (9)</td>
<td>EIA for toxin</td>
<td>Toxins B &amp; A (specific)</td>
</tr>
<tr>
<td>NAAT or PCR (11)</td>
<td>Nucleic Acid Amplification Test (NAAT)</td>
<td>Toxin B (&amp; A); epidemic strain (sensitive)</td>
</tr>
</tbody>
</table>

*Crobach et al. Clin Micro and Infection 2016 (22): S63-81*
Principles of Testing

- Enable nurses to initiate tests for *C. difficile*
- Sample should take the shape of the container, *i.e.* unformed stool
- If there is a concern for an ileus, send a rectal swab*

- No need for repeat tests
- NO TESTS OF CURE!

*rectal swabs can be tested using GHD EIA or NAAT

Testing Algorithm*

- No single commercial test is sufficient as a stand-alone test

- 2-step approach
  1. High negative predictive value, *i.e.* sensitive test to rule-out
  2. High positive predictive value, *i.e.* specific test to conform

*European Society of Clinical Microbiology and Infectious Disease; Crobach et al. Clin Micro and Infection 2016 (22): S63-81
Step 1:
Highly sensitive test: NAAT or GDH EIA

Positive test result:

Step 2:
Highly specific test:
Toxin A/B EIA

Positive test result:
CDI is likely to be present

Negative test result:
Clinical evaluation: CDI or carriage of (toxigenic) C. difficile is possible

No further testing required:
CDI is unlikely to be present

Step 3 (optional):
Perform TC or NAAT (in case first test was a GDH EIA)

Crobach et al. Clin Micro and Infection 2016 (22): S63-81

Treatment
# Treatment of Non-Severe C. difficile Infections

- Diarrhea; 3 or more unformed stools in <24 hours
- Stool tests positive for toxigenic *C. difficile*

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop the inciting antibiotics</td>
<td>A-II</td>
</tr>
<tr>
<td>Oral metronidazole</td>
<td>A-I</td>
</tr>
<tr>
<td>If on warfarin, oral vancomycin</td>
<td>A-I</td>
</tr>
</tbody>
</table>

Cohen *et al.* Infec Control Hosp Epi 2010; 31:431-55

# Treatment of Severe C. difficile Infections

- Severe infection
  - WBC >15K, Cr >1.5 x baseline

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral vancomycin</td>
<td>B-I</td>
</tr>
</tbody>
</table>

- IV metronidazole and oral vancomycin together associated with reduced mortality (16%) compared to oral vancomycin alone (36%).

- Single center, retrospective study.

Cohen *et al.* Infec Control Hosp Epi 2010; 31:431-55
Rokas *et al.* CID 2015; 61: 934-41
Vancomycin vs. Metronidazole

- Retrospective cohort study of ~47,000 Veterans with *C. diff* infection (2005 – 2012)
- Of those, ~4% treated with oral vancomycin
- *Matched* these to those treated with metronidazole, stratified by disease severity
- No difference in rate of recurrence

For Severe CDI
Vancomycin Reduces Mortality

*All-Cause 30-day Mortality*

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Vancomycin</th>
<th>Metronidazole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild to Moderate</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Severe</td>
<td>30%</td>
<td>15%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Stevens et al. JAMA Int Med 2017.02.06 on-line
Treatment of Severe C. difficile Infections

- Severe infection
  - WBC >15K, Cr >1.5 x baseline
- Severe & Complicated
  - Unstable, Ileus, Toxic Mega-colon

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral vancomycin (high dose)</td>
<td>C-III</td>
</tr>
<tr>
<td>(If ileus, consider rectal instillation)</td>
<td></td>
</tr>
<tr>
<td>Consider IV metronidazole</td>
<td></td>
</tr>
<tr>
<td>Monitor serum lactate, WBC</td>
<td>B-II</td>
</tr>
</tbody>
</table>

Recommendation Strength

- Consult Surgery & Infectious Disease

Cohen et al. Infec Control Hosp Epi 2010; 31:431-55

Treatment, Recurrent Disease

No tests of cure!

Cohen et al. Infec Control Hosp Epi 2010; 31:431-55;
Treatment, Recurrent Disease

No tests of cure!

<table>
<thead>
<tr>
<th>Recurrence</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any</td>
<td>Stop the inciting antibiotics</td>
</tr>
<tr>
<td>First</td>
<td>Repeat metronidazole</td>
</tr>
<tr>
<td>Second</td>
<td>Oral vancomycin</td>
</tr>
<tr>
<td>&gt;2nd</td>
<td>.....oral vanco......or......</td>
</tr>
</tbody>
</table>

Cohen et al. Infec Control Hosp Epi 2010; 31:431-55;

Fidaxomicin

- Active against C. difficile but spares other members of gut microbiome
- Treatment outcomes = vancomycin
- Reduces the risk of recurrent disease

## Cost Comparison

<table>
<thead>
<tr>
<th>Medicine</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fidaxomicin (10 days)</td>
<td>$3300</td>
</tr>
<tr>
<td>Vancomycin (capsules; 14 days)</td>
<td>$2000</td>
</tr>
<tr>
<td>Vancomycin (compounded)</td>
<td>$40</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>$30</td>
</tr>
</tbody>
</table>

Cruz; Pharmacy & Therapeutics, 2012 37(5):278-81

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## Preventing Recurrence?

- Risk of recurrent CDI ~20-30%
- ~1000-bed teaching hospital
- Retrospective cohort of people with history of CDI who went on to receive systemic antibiotics
- Of 203 patients, 71 received oral vancomycin while on systemic antibiotics
- Recurrent disease in 4% (3/71) of those on po vancomycin; 27% (35/102) of those not on po vanco

Preventing Recurrence?

- In general, risk of recurrent CDI ~20-30%
- Retrospective cohort of people with history of CDI who went on to receive systemic antibiotics

<table>
<thead>
<tr>
<th>Group</th>
<th>Recurrent CDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systemic antibiotic</td>
<td>27% (35/102)</td>
</tr>
<tr>
<td>Systemic antibiotic &amp; oral vancomycin*</td>
<td>4% (3/71)</td>
</tr>
</tbody>
</table>

*PO vanco for 0-6 days after end of systemic antibiotic

Risk of subsequent recurrence?
Risk of VRE?

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Fecal Microbiota Transplant (FMT)

- Administration of feces from a healthy donor
- Symptom resolution in 1-2 days
- 15/16 (93%) patients cured with 1-2 treatments
- In small series of 10 adults >80 years, 8 of 10 had symptom resolution

Rubin et al. 2009 JAGS;57:2386;
Fresh or Frozen?

- Randomized non-inferiority study
- 232 adults (~73 years) with refractory CDI
- Frozen → thawed FMT works as well as fresh FMT
- FMT is a cost-effective, well-tolerated strategy
- To start your own center…

A Variety of Poop Pills

- **Frozen stool.** Capsules stored at -80°C. Each treatment made from a single donor
- **Trial on 20 patients, ages 7 – 90 with refractory/ recurrent CDI**
- **15 capsules a day for 2 days**
- **14 responded to first treatment; 4 to second treatment for 90% cure rate**

- **Spore capsules.** Spores generated by ethanol-treatment of stool samples
- **30 patients (median age 65 yrs) with recurrent CDI**
- **26 with clinical resolution**
- **15 capsules a day for 2 days**
A Variety of Poop Pills

- **Frozen stool.** Capsules stored at -80°C. Each treatment made from a single donor
  - Trial on 20 patients, ages 7 – 90 with refractory/recurrent CDI
  - 15 capsules a day for 2 days
  - 14 responded to first treatment; 4 to second treatment for 90% cure rate

- **Spore capsules.** Spores generated by ethanol-treatment of stool samples
  - 30 patients (median age 65 yrs) with recurrent CDI
  - 26 with clinical resolution
  - 15 capsules a day for 2 days

Freeze-Dried Poop Pills

Case Report:
46 year old woman with Crohn's disease who developed refractory *C. difficile* infection

Infection Control & Prevention

C. difficile Spores

- May be recovered months after left on a surface
- Difficult to kill using routine cleaning agents
- Spores are shed onto skin and into the environment

Kim et al. Jnl Hosp Infection 1981; 143(1) 43-50
Asymptomatic Carriers

- Environment, any
- Call button
- Bed rail
- Table
- Telephone

Patients with CDAD
Asymptomatic carriers
Noncarriers

Riggs et al. Clinical Infec Dis 2007; 45:99208

Nursing-Home Onset

Guerrero et al. Infec Control Hosp Epi 2011; 32:513-15
Hunter et al. Open Forum Infect Di 2016 3(1); PMID 26798767
Kim et al Infect Control Hosp Epi 2011; 32:656-60
Nursing-Home Onset

Exposure to *C. difficile* spores

- Guerrero *et al.* Infect Control Hosp Epi 2011; 32:513-15
- Hunter *et al.* Open Forum Infect Dis 2016 3(1); PMID 26798767
- Kim *et al.* Infect Control Hosp Epi 2011; 32:656-60

Consider Extending Isolation

Time until negative results for *C. difficile* cultures from residents’ abdomen or chest

There’s no place like home…

…but how do we clean it?

Slide Courtesy of Curtis Donskey

Sitzler et al. Infect Control Hosp Epi 2012; 33:534-36

Steps You Can Take: Infection Control

Minimize Transmission by Patients/Residents

- Private rooms if know or suspect C. difficile infection*
- Encourage hand hygiene
- Extend isolation
- Have them use common equipment at the end of the day

*Who moves?

Cohen et al. Infec Control Hosp Epi 2010; 31:431-55
http://www.cdc.gov/HAI/prevent/prevention_tools.html#lc
Steps You Can Take: Infection Control

Minimize Transmission by Staff

- Hand hygiene with soap & water
- Single use/disposable equipment
- Dedicated equipment (e.g., slings)
- Mandatory education annually; more often for high-turnover staff

Cohen et al. Infec Control Hosp Epi 2010; 31:431-55
http://www.cdc.gov/HAI/prevent/prevention_tools.html/ltc

Steps You Can Take: Infection Control

Minimize Transmission by Staff

- Contact precautions (gown, glove)
  - Make equipment available at the door
  - Designate someone on every shift to replenish supplies
  - Supply disinfectant wipes with bleach

Cohen et al. Infec Control Hosp Epi 2010; 31:431-55
http://www.cdc.gov/HAI/prevent/prevention_tools.html/ltc
Steps You Can Take: Infection Control

Minimize Environmental Reservoirs

- Involve & educate housekeeping staff
- Daily disinfection of high-touch surfaces
- Assess adequacy of cleaning before changing to a new product
- Cleaning & disinfection with sporicidal agent (i.e. bleach)

Cohen et al. Infec Control Hosp Epi 2010; 31:431-55
http://www.cdc.gov/HAI/prevent/prevention_tools.html#ltc

Active Surveillance?

- Rectal swabs upon hospital admission to detect gene for Toxin B
- If positive, contact precautions during the hospitalization
- Of ~7600 admissions, 5% identified as carriers

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Rate of HA-CDI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidemic period (8/04 – 7/07)</td>
<td>11.1</td>
</tr>
<tr>
<td>Pre-intervention period (7/07 – 11/13)</td>
<td>6.9</td>
</tr>
<tr>
<td>Intervention period (12/13 – 3/15)</td>
<td>3.0</td>
</tr>
</tbody>
</table>

*Healthcare-associated C. difficile infections/10,000 patient days

### Steps You Can Take: Infection Prevention

#### Facility-wide Measures

<table>
<thead>
<tr>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimicrobial Stewardship Program</td>
</tr>
<tr>
<td>Surveillance for C. difficile infection</td>
</tr>
<tr>
<td>Avoid tests of cure</td>
</tr>
<tr>
<td>Laboratory-based alert system</td>
</tr>
</tbody>
</table>

Source: [http://www.cdc.gov/HAI/prevent/prevention_tools.html#ltc](http://www.cdc.gov/HAI/prevent/prevention_tools.html#ltc)

### Steps You Can Take: Infection Prevention

#### Early response to potential CDI

<table>
<thead>
<tr>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define criteria to suspect CDI</td>
</tr>
<tr>
<td>Preemptive contact isolation</td>
</tr>
<tr>
<td>Standing orders to test for <em>C. difficile</em> (when criteria met)</td>
</tr>
</tbody>
</table>

Source: [http://www.cdc.gov/HAI/prevent/prevention_tools.html#ltc](http://www.cdc.gov/HAI/prevent/prevention_tools.html#ltc)
Probiotics for Primary Prevention?

- Meta-analysis slightly favors probiotics
  - *Lactobacillus casei*, *L. acidophilus* and *L. rhamnosus* in varying combinations
  - Above given as part of clinical trials
- Double-blind RCT of *Sacromyces boulardii* stopped for futility
- FDA-approved probiotics?
  - *Yogurt*
  - *Kefir***

Evans & Johnson, Clin Infec Dis 2015:60 (s2)S122-8
Ehrhardt et al. OFID on-line January 2016
**Bakken. CID 2014:59 (858-61)
On the Horizon: Vaccines

- Tested in healthy adults 50-85 years old
- 3 dose regimen (0, 1 & 6 months)
- Generated antibodies against Toxins A & B lasting through (at least) 6 months post-vaccine
- Well-tolerated
- Efficacy studies pending

Take Home Messages

- Antibiotic exposure is the main risk factor for *C. difficile* infection
- Metronidazole and oral vancomycin are the mainstays of treatment
- Fecal microbiota transplant is safe and effective
- More palatable options are becoming available
Together, we can wipe out *C. diff*

Let’s doo it!

**CRE**

Carbapenem-Resistant Enterobacteriaceae
Gram-Positive & Gram-Negative Bacteria

Peptidoglycan Layer

Staphylococcus aureus
Streptococci spp.

Cytoplasmic membrane
Outer membrane
Cytoplasmic membrane

Gram Negative Bacteria

Enterobacteriaceae /
Lactose-Fermenting

- Escherichia coli
- Klebsiella spp.
- Enterobacter spp.

Non-Lactose Fermenting

- Pseudomonas aeruginosa
- Acinetobacter baumanii

http://www.cdc.gov/drugresistance/threat-report-2013/
Antibiotics Used Against Gram-Negative Bacteria

1\textsuperscript{st} / 2\textsuperscript{nd} generation cephalosprins
Penicillins
Fluoroquinolones
Extended-spectrum cephalosporins
Beta-lactam inhibitor combinations
Carbapenems
Aminoglycosides
Tigecycline
Colistin

Alphabet Soup of MDR GN

- Fluoroquinolone-resistant GN bacteria
- Extended-spectrum Beta-lactamase (ESBL) producing bacteria
  - Resistant to amp/sulbactam, piperacillin/tazobactam, ceftriaxone, ceftazidime, aztreonam
  - Carbapenems are treatment of choice
- Carbapenem-Resistant \textit{Enterobacteriaceae} (CRE)
  - \textit{Klebsiella pneumoniae} carbapenemase (KPC)
  - New Delhi Metallo-beta-lactamase (NDM)
  - Resistant to ertapenem, meropenem, imipenem/cilastin, doripenem
  - Sometimes tigecycline, usually colistin….

Why are CRE such a concern?

Antibiotics Used Against Gram-Negative Bacteria

- 1st/2nd-generation cephalosprins
- Penicillins
- Fluoroquinolones
- Extended-spectrum cephalosporins
- Beta-lactam inhibitor combinations
- Carbapenems
- Aminoglycosides
- Tigecycline
- Colistin
Selective Pressure

Continued Consequences of Selective Pressure

Prevalent MDRO More Gorillacillin use

Gorillacillin resistance

Adapted from the CDC
Continued Consequences of Selective Pressure

Prevalent MDRO → More Gorillacillin use

MORE RESISTANCE

KingKong-acillin use ← Gorillacillin resistance

Adapted from the CDC
Prevalent MDRO

MORE RESISTANCE

KingKong-acillin use

Continued Consequences of Selective Pressure

Adapted from the CDC
Reducing Selective Pressure?

Prevalent MDRO

Antibiotic stewardship
Infection prevention & control

Reducing Selective Pressure?

Prevalent MDRO

Antibiotic stewardship
Infection prevention & control

Decreased prevalent MDRO
Residents: Colonization vs. Infection

Clinical Perspective

 Colonization  Infection

Do not treat  Treat

Infection Control Perspective

 Colonization  Infection

Reservoir for Pathogens

Nursing Homes as Reservoirs of MDROs

• Analysis of MDS data over 15 months
• Of ~4 million NH residents, 5% with MDRO infection
• For those infected with an MDRO during the study, 57% in NH, 41% in acute care
• Colonization rate unknown

Kahvecioglu et al. ICHE 2014 35(S3):S48–S55
Carbapenem-Resistant *Klebsiella pneumoniae* Outbreak

- Hospital reported an outbreak
- Cases investigated from April 2009 – February 2011
- 19 cases identified
  - 16 admitted from a LTCF
  - 14 from LTCF A
- Genetic analysis >88% similarity among isolates

Field Investigation of LTCF A

- No infection preventionist x 9 months
- Did not record MDRO status of residents
- Hand hygiene stations not conveniently located
- PPE supplies not available for those on contact precautions
- 11 of 118 resident samples (9%) with CRE; 8 previously undetected
Pathogen Transmission and Reservoirs

Environment

Health Care Worker

Residents

Pathogen Transmission in Nursing Homes

Transmission of MRSA to Healthcare Personnel Gowns and Gloves during Care of Nursing Home Residents

Mary-Claire Roghmann, MD, MS1, J. Kristie Johnson, PhD2, John D. Sorkin, MD, PhD3, Patricia Langenberg, PhD4, Alison Lydecker, MPH5, Brian Sorace, BS1, Lauren Levy, JD, MPH1, and Lona Mody, MD, MSc6

Glove contamination higher than gown contamination

High Risk Activities:
Dressing
Transferring
Hygiene
Changing Linens
Toileting

Residents with skin breakdown had higher rates of transmission

ICHE 2015 Sep 36(9):1050-1057
Isolation Precautions

<table>
<thead>
<tr>
<th>Standard Precautions (aka Universal Precautions)</th>
<th>Infection prevention practices that apply to all residents, regardless of diagnosis or presumed infection status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission-based Precautions (aka Isolation Precautions)</td>
<td>Actions beyond Standard Precautions based on means of transmission (i.e., airborne, droplet &amp; contact)</td>
</tr>
<tr>
<td>Contact Precautions</td>
<td>Measures to prevent transmission of infectious agents spread by direct or indirect contact with the resident or their environment</td>
</tr>
</tbody>
</table>

2007 Guideline for Isolation Precautions (CDC HICPAC)

Colonization with MDR GN in Nursing Home Residents

Gram-negative bacteria may last hours to days to months on inanimate surfaces
Colonization with FQ-resistant GNR on average 76 days (± 66d) after admission
- Average length of stay is 463 days
- Up to 50% with quinolone-resistant Gram-negatives
- 17% with ESBL
- 1% with CRE
ESBL transmission rate of nearly 10% in a long-term care unit without contact precautions

Sites & Duration of Colonization with MDR GN

- May colonize stool
- May also colonize urine, devices, wounds, skin
- No protocols for declonization
- May continue to harbor organisms for months.
- Duration of contact precautions
  - ? Forever
  - ? 6 months without hospitalizations, antimicrobial therapy, and invasive devices before reculturing patients to document clearance of carriage


MDR GNB*
Core Prevention Strategies

- Hand hygiene
- Contact Precautions
- Recognize previously colonized patients
- Rapidly report ESBL & CRE lab results
- Provide ESBL & CRE education for healthcare providers
- Minimize use of devices
- Screen for ESBL & CRE

Adapted from the CDC
Risk Factors for Multi-Drug Resistant Organisms in NHs

- Recent antibiotic exposure (4 months)
- Dependence for assistance with ADLs
- Indwelling medical devices, decubitus ulcers, other wounds, urinary and fecal incontinence


Contact Precautions for In-Room Care

- Hand hygiene
- Gowns, gloves upon entry
- Removal of gowns, gloves at exit
- Hand hygiene
- Single use equipment
- Dedicate equipment to individual resident when possible
- Clean/disinfect between individuals

The burden is on healthcare workers
Socialization & Other Ideas

- Encourage resident hand hygiene
- Clean
- Contained
- Cooperative

May cohort with a “low risk roommate”
- No (major) wounds.
- No invasive devices.
- Not immunocompromised.
- No recent antibiotic exposure (?)

Designate someone to restock PPE on every shift

Targeted Infection Prevention Study

For residents with urinary catheters or feeding tubes
- Hand hygiene before/after care
- Gown & glove use during morning/evening care, device care
- Staff education (intensive!)
- Active surveillance for MDROs

Mody et al. JAMA Int Med. 2015 175(5):714-723
Targeted Infection Prevention Study

- 418 residents enrolled; >6000 samples

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Rate Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDRO prevalence</td>
<td>0.77</td>
</tr>
<tr>
<td>New MRSA acquisitions</td>
<td>0.78</td>
</tr>
<tr>
<td>Risk of first CAUTI</td>
<td>0.54</td>
</tr>
<tr>
<td>Risk of all CAUTI</td>
<td>0.69</td>
</tr>
</tbody>
</table>

- No change in GNR acquisition, feeding-tube associated pneumonia or skin/soft tissue infections

Mody et al. JAMA Int Med. 2015 175(5);714-723

Regional Approach to Infection Control

- Automated, **regional** sharing of information about CRE
- In 1 year, ~1500 reports of CRE from 115 hospitals, 5 LTACHs, 46 long-term care facilities and 7 reference laboratories

Take Home Messages

• Balance between resident safety and individual liberty
• Any resident with an MDRO is a reservoir for that organism
• Activities most linked to transmission involve a health care workers (i.e., not resident-to-resident)
• For MDROs, transmission-based precautions based on resident risk factors may be most rational, feasible strategy
• Coordinated, regional approaches feasible, helpful and necessary

Thank you!
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