Infection Prevention and Control Training

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Part 2

Strategies for Preventing and Managing Multidrug-Resistant Organisms (MDROs) and C. difficile in Nursing Homes
Presentation Objectives

- Brief review of multidrug-resistant organisms (MDROs) and *C. difficile*
- Understand the emergence and spread of MDROs and *C. difficile* in healthcare settings
- Outline the actions that caregivers should take to minimize the spread of MDROs and *C. difficile* in healthcare settings
Understanding Multidrug-Resistant Organisms (MDROs)

- Multidrug-resistant organisms (MDROs) are a group of bacteria with important resistance patterns
- Sometimes just one key drug will define an MDRO
  - Methicillin-resistance in *Staphylococcus aureus*
  - Vancomycin-resistance in *Enterococcus species*
- Sometimes bacteria acquire resistance to several classes of antibiotics, often seen in gram negative rods
  - Carbapenem-resistance in *E. coli/Klebsiella species* is associated with resistance to many other antibiotics
  - *Pseudomonas* can be resistant to many antibiotics including fluoroquinolones and cephalosporins
## ABC’s of MDROs

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Abbrev.</th>
<th>Antibiotic Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>MRSA</td>
<td>Methicillin-resistant</td>
</tr>
<tr>
<td><em>Enterococci (faecalis/faecium)</em></td>
<td>VRE</td>
<td>Vancomycin-resistant</td>
</tr>
<tr>
<td><em>Enterobacteriaceae (e.g., E. coli/Klebsiella)</em></td>
<td>ESBL</td>
<td>Extended-spectrum beta-lactamase (resistance to penicillins/cephalosporins)</td>
</tr>
<tr>
<td><em>Enterobacteriaceae (e.g., E. coli/Klebsiella)</em></td>
<td>CRE</td>
<td>Carbapenem-resistant</td>
</tr>
<tr>
<td><em>Pseudomonas/Acinetobacter</em></td>
<td>MDR</td>
<td>Resistance to multiple drug classes</td>
</tr>
</tbody>
</table>
NHs are reservoirs of MDROs

- NH residents colonized with MDR-Gram Negative Rods (~20% prevalence)

- NH residents colonized with MRSA (40-50% prevalence)

- NH residents colonized with VRE (5-10% prevalence)
- More than half of healthcare associated *Clostridium difficile* (*C. difficile*) infection cases occur in long-term care facilities.
- A significant number of individuals admitted to LTC are colonized with *C. difficile*
  - Up to 20% acquire it while in nursing homes.
- Fluoroquinolone antibiotics have been associated with CDI with a more severe strain of *C. difficile*
  - Longer antibiotic exposure carries higher risk.
**C. difficile infections with onset in nursing homes**

- >100,000 cases of CDI occur in NHs each year
- Up to 75% of residents with NH-onset CDI received antibiotics
  - ~80% occurred within 30-days of hospital discharge
  - 18% were hospitalized
  - 8% died within

![Figure 1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4719744/)

*Figure 1
Number of days from hospital discharge to *Clostridium difficile* infection (CDI) onset among cases with hospitalization in 12 weeks prior to *C. difficile* positive stool collection date (n = 200)*. *Figure does not include 14 patients who did not have a hospitalization date available.*

Healthcare Drivers of *C. difficile* and MDROs

- **Development**
  - Antibiotic pressure
    - Risk for acquisition and infection

- **Spread**
  - Colonization pressure
  - Resident-to-resident transmission through the hands of healthcare personnel
  - Contamination of shared equipment/environmental surfaces
Antibiotic Use Drives Resistance

Figure 1: Levofloxacin use and outpatient *Escherichia coli* resistance to levofloxacin versus time.

Biofilm Formation on Device Surfaces

- Biofilm: An collection of bacteria within a sticky film that forms a community on the surface of a device
- Antibiotics can’t penetrate the biofilm
  - Bacteria in the biofilm are sheltered from the antibiotic and develop resistance

http://www.ul.ie/elements/Issue7/Biofilm%20Information.htm
Biofilm on an Indwelling Catheter

Colonization vs. Infection

- “Colonizing” bacteria may not be harmful, even when they are antibiotic-resistant
  - Example: CRE cultured from a rectal swab may not harm the colonized person
- Only when bacteria invade our bodies and cause signs/symptoms of illness do we need treatment with antibiotics
- Separating colonization from infection can be difficult
  - Examples: Bacteriuria in an older adult; respiratory secretions from a person on a ventilator
- However, both colonized and infected people can serve as a source for spreading resistant organisms
Colonization Pressure on Risk of Acquisition

- Colonization pressure: High burden of other MDRO carriers on a unit will increase the risk of MDRO acquisition for others.

- Studies have demonstrated the impact of colonization pressure on acquisition of *C. difficile*.

- Both asymptomatic carriers and clinically infected individuals contribute to the reservoir for transmission on a unit.

Dubberke ER et al. Arch Intern Med. 2007 May 28;167(10):1092-7
Colonization Pressure: *C. difficile* Infection (CDI)

Unit A
Fewer patients with active CDI = lower risk of acquiring CDI

Unit B
More patients with active CDI = higher risk of acquiring CDI

CDI pressure = 1 × days in unit

CDI pressure = 5 × days in unit

Dubberke ER et al. *Arch Intern Med.* 2007;167(10):1092-7
Bacterial Contamination of the Hands of Healthcare Personnel Prior to Hand Hygiene in a Long-Term Care Facility

- Cultured the hands of healthcare personnel (HCP) immediately after direct care to residents
- Gram negative bacteria were the most common bugs cultured from hands of staff
- Most Gram neg. bacteria live in the GI tract or colonize the urine

MRSA Contamination of Healthcare Personnel Hand/Clothes in a Long-Term Care Facility

- Evaluated ~950 different interactions between HCP and MRSA colonized residents
- Used cultures of gowns/gloves to mimic transmission
- Morning/evening care bundled together increased transmission
- Presence of chronic wounds increased transmission

Roghmann MC et al. Infect Control Hosp Epidemiol. 2015; 36(9):1050-7
Okay... So Now What?™

OK... so what now?
Prevention Strategies for MDRO/C. difficile

- Consistent performance of hand hygiene (HH)
- Appropriate use of gowns and gloves
- Consider resident risk factors when selecting room placement
- Cleaning and disinfection of shared equipment, rooms/surfaces

- Assessment of antibiotic use in the facility
- Awareness of use and management of medical devices
CLEAN HANDS SAVE LIVES
Protect patients, protect yourself

Alcohol-rub or wash before and after EVERY contact.
Barriers to Hand Hygiene Adherence in Nursing Homes

- Belief that the 2002 CDC Hand Hygiene Guidelines are not applicable
  - 30% would not change current practices: 20% said the guidelines were impractical

- Lack of access to appropriate hand hygiene supplies
  - 16.2% lack of available sink; 27.5% lack of alcohol-based hand rub (ABHR)

- No hand hygiene because of glove use
  - 23% nurses; 17% CNAs; 26% other healthcare workers

- Forgot hand hygiene because of workload
  - 35% nurses; 22% CNAs; 44% other healthcare workers

- Lack of access to feedback on hand hygiene practices and/or education
  - 55% said “never” or “rarely received” personal feedback on hand hygiene practices
  - Other healthcare workers less often received periodic education on hand hygiene (86.9% vs. 92% of nurses and CNAs, p=0.03)

Ashraf MS et al. ICHE 2010; 31(7):758-762
Strategy 1 - Teach and Reinforce the Moments for Hand Hygiene

- Before and after physical contact with a resident
- Before donning gloves and after removing gloves
- After handling soiled or contaminated items and equipment, including linens
- Before performing an invasive procedures
- Before handling sterile or clean supplies
- *When hands are visibly dirty or soiled with blood and/or bodily fluids*
- *After care of a resident with known or suspected infectious diarrhea*
- *Before and after eating or handling food*
- *After personal use of bathroom*

*Situations where soap and water preferred over alcohol-based hand rub
Hand Hygiene and *C. difficile*

- Hand hygiene is the primary means of preventing transmission of infections...
- However, confusion exists about when soap and water are preferred over alcohol hand rubs
Have Clear Messaging and Policies for Hand Hygiene Practices

Address confusion related to HH and *C. difficile*

- Most effective intervention is glove use because spores may be hard to remove even with soap and water
  - Glove use is NEVER a surrogate for hand hygiene
- Alcohol-based hand rubs (ABHR) may not be effective against *C. difficile* spores, but they are very effective against all other MDROs
  - Avoid discouraging all use of alcohol-based products even during of residents with *C. difficile*
- Recommend AHBR before care; soap and water after care of residents with acute diarrhea
- Promote appropriate use of gowns/gloves during care of residents with incontinence

Ellingson K, McDonald C. Infect Control Hosp Epidemiol 2010;31:571-3
Strategy 2 - Educate Healthcare Personnel on the Appropriate PPE Use

- Based on the nature of healthcare personnel-resident interaction
  - Type of task being performed
- Anticipated degree of contact with blood and/or body fluids, or pathogen exposure
- HH always performed before/after PPE use

<table>
<thead>
<tr>
<th>Personal protective equipment (PPE)</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloves</td>
<td>For touching blood, body fluids, secretions, excretions, contaminated items; for touching mucous membranes and nonintact skin</td>
</tr>
<tr>
<td>Gown</td>
<td>During procedures and patient-care activities when contact of clothing/exposed skin with blood/body fluids, secretions, and excretions is anticipated.</td>
</tr>
<tr>
<td>Mask, eye protection (goggles), face shield*</td>
<td>During procedures and patient-care activities likely to generate splashes or sprays of blood, body fluids, secretions, especially suctioning, endotracheal intubation</td>
</tr>
</tbody>
</table>

Challenges with Transmission-Based Precautions in Nursing Homes

- Staff concerns about negative impact of personal protective equipment and isolation on residents
  - Unlikely to change practices if aware of an MDRO
  - Negative impact on resident’s psychosocial well-being
- Lack of private rooms / limited ability to move residents
  - Moving rooms is disrupting to residents and staff
  - Ability to identify carriers to cohort is limited (no active surveillance in most facilities)
- Determining duration of contact precautions
  - Unable to restrict resident mobility and participation in social events/therapy for prolonged periods
  - Unlikely to document clearance of carriage

Furuno, JP et al. AJIC. 2011; 1-5 epub
What the CMS says...
The Transmission-Based Precautions section of CMS Infection Control Program Interpretive Guidance (F441):

Transmission Based Precautions
When used appropriately, transmission-based precautions (i.e., isolation due to infection) is not to be considered involuntary seclusion. The facility’s policies must identify the type and duration of the transmission-based precautions required, depending upon the infectious agent or organism involved; and the precautions should be the least restrictive possible for the resident based on his/her clinical situation. Furthermore, the resident’s record must contain the rationale for the selected transmission-based precautions. However, once the resident is no longer a risk for transmitting the infection, the removal of transmission-based precautions is required in order to avoid unnecessary involuntary seclusion. See also 42 CFR 483.65 – Infection Control (Tag F880).

(iii) Standard and transmission-based precautions to be followed to prevent spread of infections;
(iv) When and how isolation should be used for a resident; including but not limited to:
   (A) The type and duration of the isolation, depending upon the infectious agent or organism involved, and
   (B) A requirement that the isolation should be the least restrictive possible for the resident under the circumstances.
   (v) The circumstances under which the facility must prohibit employees with a communicable disease or infected skin lesions from direct contact with residents or their food, if direct contact will transmit the disease; and
   (vi) The hand hygiene procedures to be followed by staff involved in direct resident contact.

https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/GuidanceforLawsAndRegulations/Nursing-Homes.html
Considerations for the Use of Transmission-Based Precautions

“Consider the individual resident’s clinical situation and prevalence or incidence of MDRO in the facility when deciding whether to implement or modify Contact Precautions in addition to Standard Precautions for a patient infected or colonized with a target MDRO”

Using a Resident-Centered Approach to Gown/Glove Use

Conceptual Model for Reducing Infections and Antimicrobial Resistance in Skilled Nursing Facilities: Focusing on Residents with Indwelling Devices

- Gown/glove use during care of all high-risk residents, regardless of MDRO status
- High risk = presence of indwelling medical devices, chronic wounds, uncontained secretions or excretions
Pros and Cons of a Resident-Centered Approach to Gown/Glove Use

PROS

- No longer relying on identification of specific pathogens
- Care planning based on resident needs aligns with principles of “resident-centered care”
- Simplifies messaging to front-line staff
- Enables early implementation of appropriate PPE based on new risks or changing care needs

CONS

- Paradigm shift for facility staff, residents, families and visitors – will require education
- Approach will increase gown/glove use during care of a subset of high risk residents – devices, wounds, new or worsening incontinence, etc.
Considerations for Gown/Glove Use to Prevent the Spread of MDROs

- Identify risk factors among residents identified with CRE colonization/infection
  - Presence of indwelling devices, wounds, ventilator-dependence
  - Functional dependence, incontinence, uncontained secretions
- Consider types of care which may increase transmission of CRE to hands/clothes of healthcare personnel
  - Bathing, dressing, assisting with toileting, changing linens
  - Wound care, device handling, suctioning/oral care
- Use of gown/gloves during direct resident care activities does not prevent individuals from participating in social activities if sites of colonization are covered/contained
- Educate all healthcare personnel on the proper use of PPE during resident care
- Ensure communication to caregivers, families and residents about the facility’s approach to MDRO management
  - For example, decisions and rationale about gown/glove use during resident care and room placement should be clearly documented
- Monitor adherence to gown/glove use and provide feedback to staff
MRSA Contamination of Healthcare Personnel Hand/Clothes in a Long-Term Care Facility
Strategy 3 - Resident Placement, Based on Risk Factors

- Focus on resident risk factors for MDRO carriage
  - High risk: Antibiotic use; presence of medical devices or wounds; bowel/bladder incontinence; lack of mobility

- New roommate assignments based on resident characteristics and history of MDRO carriage
  - Try to avoid placing two high risk residents together

- Do not change stable room assignments just because of a culture result, unless it poses a new risk
  - Roommates who have been together for a long time have already had opportunity to share organisms in the past
Resident Placement Principles (continued)

- Establish strategies for movement of residents outside of the room based on level of risk for spread of infection
- Consider the following issues:
  - Presence of active signs/symptoms of infection (e.g., new vomiting or diarrhea, undiagnosed cough, and/or new fever)
  - Inability to contain excretions or secretions
  - Challenges with maintaining personal hygiene
- Only restrict resident movements and participation in group activities for as long as needed
  - Discontinue as soon as high risk diagnosis ruled out; active signs/symptoms resolve; risk of transmission is low

Resident Placement Principles (Overall)

Determine resident placement based on these overall principles:

- Route(s) of transmission of the known or suspected infectious pathogen
- Risk factors for transmission in the infected resident (e.g. draining wounds, diarrhea, uncontrolled secretions)
- Risk factors for adverse outcomes resulting from an infection in other residents in the room
- Duration of time in the facility and stability of current roommate
- Consider availability of single rooms, and options for room-sharing (e.g. cohorting, placement with a resident at lower risk of infection)
Strategy 4 - Environmental Cleaning

- Ensure that environmental cleaning is adequate and high-touch surfaces are not being overlooked
- One study using a fluorescent environmental marker to assess cleaning showed:
  - Only 47% of high-touch surfaces were adequately cleaned
  - Sustained improvement in cleaning of all objects, especially in previously poorly cleaned objects, following educational interventions with the environmental services staff
- The use of environmental markers to audit practices is a promising method to improve cleaning.
- Assess efficacy of cleaning products being used – *C. difficile* spores need sporicidal products for removal

The Invisible Reservoir of MDROs

X marks the locations where VRE was isolated in this room

Slide courtesy of Teresa Fox, GA Div PH
Frequency of *C. difficile* Culture Positive Sites in Study Areas

Strategy 5 - Equipment Cleaning and Disinfection

- Ensure that all shared equipment is being cleaned and disinfected between resident use
  - Some equipment, like glucose meters must be designed for multi-person use, otherwise frequent cleaning may affect the functioning of the device
- Make sure nursing staff and environmental services agree to which pieces of equipment they are assigned to clean
- Maintain log books of cleaning/disinfection for large equipment (e.g., wheel-chairs, stretchers)
- Dedicate single use, disposable equipment for residents with MDRO/C. diff when possible
Summary Points

- Understand how MDROs and *C. difficile* emerge and spread

- Evaluate staff perceptions and barriers to implementing hand hygiene and standard and transmission-based precautions

- Verify staff adherence to policies (auditing/feedback)

- Identify one or two strategies that you can implement to improve these basic infection prevention practices in your facility
Thank you!!
Questions?
HAIAR@cdc.gov
EXTRA SLIDES
Case Example

- 70 year old admitted from a long-term acute care hospital to your nursing home
  - Had complicated hospital history including surgery, prolonged ICU stay, multiple courses of antibiotics
  - Spent 5 weeks in the LTACH for ventilator-weaning, antibiotics and wound care
- On transfer, has tracheostomy, PEG tube, indwelling urinary catheter and partially healing sacral pressure ulcer with a wound vac

What are this resident’s risk factors for being colonized or acquiring an MDRO?
## Resident Risk Factors Associated with MDROs

<table>
<thead>
<tr>
<th>Common</th>
<th>MDR-GNB</th>
<th>MRSA</th>
<th>VRE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional disability</td>
<td>• Long stay, advanced age, large facilities</td>
<td>• Long stay, advanced age, male sex</td>
<td>• Prior hospitalization</td>
</tr>
<tr>
<td>Presence of wounds</td>
<td>• Prior colonization</td>
<td>• Low cognitive status</td>
<td>• Proximity to other colonized individuals</td>
</tr>
<tr>
<td>Presence of urinary catheters</td>
<td>• Presence of feeding tubes</td>
<td>• Prior colonization</td>
<td>• Presence of feeding tubes</td>
</tr>
<tr>
<td>Prior antibiotic therapy</td>
<td>• Bladder dysfunction, fecal incontinence</td>
<td>• Prior hospitalization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Pressure ulcers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Comorbid conditions such as diabetes, cancer, renal disease, and inflammatory bowel disease</td>
<td></td>
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</tbody>
</table>
Case Example, continued

- One week into the nursing home admission, he develops a fever, increased oxygen requirements and increased purulent respiratory secretions; X-ray shows a new infiltrate

- That same week, he suddenly develops diarrhea

- MD orders a stool culture and culture from tracheostomy secretions
  - Stool culture, *C. difficile* positive
  - Trach secretions, *Klebsiella pneumoniae* positive, >10⁵ cfu/ml

<table>
<thead>
<tr>
<th>Drug</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>Resistant</td>
</tr>
<tr>
<td>Amp/Sulbactam</td>
<td>Resistant</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>Resistant</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>Resistant</td>
</tr>
<tr>
<td>Cefepime</td>
<td>Resistant</td>
</tr>
<tr>
<td>Ceftazidime</td>
<td>Resistant</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>Resistant</td>
</tr>
<tr>
<td>Cefuroxime</td>
<td>Resistant</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>Resistant</td>
</tr>
<tr>
<td>Levofloxcin</td>
<td>Resistant</td>
</tr>
<tr>
<td>Meropenem</td>
<td>Resistant</td>
</tr>
<tr>
<td>Piperacillin/Tazobactam</td>
<td>Resistant</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>Resistant</td>
</tr>
<tr>
<td>Trimethoprim/Sulfa</td>
<td>Resistant</td>
</tr>
</tbody>
</table>


C. difficile and MDRO Prevention Strategies

- **Identification**
  - Laboratory notification
  - Communication of C. difficile or MDRO status during interfacility-transfer

- **Prevention of emergence**
  - Careful use of invasive medical devices
  - Antibiotic stewardship

- **Prevention of spread**
  - Hand hygiene
  - Contact precautions
  - Placement/cohorting of residents and staff
  - Environmental cleaning

Healthcare Personnel Education
A Targeted Infection Prevention Intervention in Nursing Home Residents With Indwelling Devices: A Randomized Clinical Trial

Mody L et al. JAMA Intern Med. 2015 May;175(5):714-23
Presented as oral abstract #1208. IDWeek 2013, San Francisco, CA. Oct 5, 2013

### Table: Intervention Details

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Control sites: usual care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-emptive barrier precautions&lt;br&gt; Gown and glove use for any intimate care including am and pm care, ADL help</td>
<td>Standard Precautions&lt;br&gt; Gown and/or glove use per facility policies</td>
</tr>
<tr>
<td>Active Surveillance and monthly feedback MDRO colonization (surveillance cultures) Infections</td>
<td>Data gathering for outcomes&lt;br&gt; MDRO colonization Infections</td>
</tr>
<tr>
<td>Interactive Education&lt;br&gt; 1. Hand hygiene promotional posters, glo-germ, pre and post hand cultures demonstrations&lt;br&gt; 2. Personal use hand sanitizers&lt;br&gt; 3. Interactive Infection Prevention Modules (10 modules, q 2-3 mo)&lt;br&gt; 4. IP Mini-conference on surveillance&lt;br&gt; 5. Surveillance definition cards to providers</td>
<td>Education&lt;br&gt; As needed (response to audits, state surveys)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Control</th>
<th>Number of MDROs/1000 device days</th>
<th>RR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA</td>
<td>15.1</td>
<td>21</td>
<td>0.72 (0.61, 0.85)</td>
</tr>
<tr>
<td>VRE</td>
<td>7.4</td>
<td>10.3</td>
<td>0.71 (0.56, 0.9)</td>
</tr>
<tr>
<td>CTZ-R GNB</td>
<td>10</td>
<td>16.3</td>
<td>0.68 (0.50, 0.75)</td>
</tr>
<tr>
<td>CIP-R GNB</td>
<td>35.8</td>
<td>46.1</td>
<td>0.78 (0.70, 0.86)</td>
</tr>
<tr>
<td>All MDRO</td>
<td>68.4</td>
<td>93.7</td>
<td>0.73 (0.68, 0.79)</td>
</tr>
</tbody>
</table>