The Growing Threat of Antibiotic Resistance in Post-Acute Care

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November 17th, 2016
None to report
Pa. woman first in U.S. diagnosed with new drug-resistant superbug

Are we headed for an antibiotic apocalypse? Deadly superbugs

Deadly 'superbugs' invade U.S. health care facilities
DEADLY BACTERIA THAT DEFY DRUGS OF LAST RESORT

‘Nightmare’ bacteria on warpath
Objectives

• Discuss the increasing importance of post-acute care facilities in healthcare delivery

• Describe the epidemiology of multidrug-resistant organisms (MDROs) in post-acute care facilities
  • MRSA
  • Clostridium difficile
  • Multidrug-resistant gram-negative bacteria
    – Carbapenem-resistant Enterobacteriaceae

• Discuss interventions and future directions for preventing the emergence of MDROs in long-term care settings
Antibiotic resistance in the 21st century: “no institution is an island”
Changes in the aging population

Total number of persons age 65 or older, by age group, 1900 to 2050, in millions

Note: Data for the years 2000 to 2050 are middle-series projections of the population. Reference population: These data refer to the resident population. Source: U.S. Census Bureau, Decennial Census Data and Population Projections.
What is a long-term care facility?

- Residential setting for individuals with functional disabilities
  - Nursing homes, skilled nursing facilities (SNFs), VA Community Living Centers (CLCs)
  - ~70% of people ≥ 65 years will require some long-term care services
Antibiotic resistance in nursing homes

Resident characteristics
- Aging
- Immune senescence
- Comorbidities
- Functional disability

Facility characteristics
- Prolonged LOS
- Transfers
- Interaction with other residents and staff

Practices
- Indwelling devices
- Antibiotic use
- Infection prevention practices and resources

Colonization/infection with MDROs
## The nursing home population

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>Age ≥ 65 years</td>
<td>85%</td>
</tr>
<tr>
<td>Number of ADL impairments</td>
<td>62%</td>
</tr>
<tr>
<td>4-5</td>
<td></td>
</tr>
<tr>
<td>Cognitive impairment</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>26%</td>
</tr>
<tr>
<td>Severe</td>
<td>38%</td>
</tr>
<tr>
<td>Incontinence</td>
<td>36%</td>
</tr>
<tr>
<td>Stage ≥2 pressure ulcers</td>
<td>6%</td>
</tr>
</tbody>
</table>
Antibiotic resistance in nursing homes

- Resident characteristics:
  - Aging
  - Immune senescence
  - Comorbidities
  - Functional disability

- Facility characteristics:
  - Prolonged LOS
  - Transfers
  - Interaction with other residents and staff

- Practices:
  - Indwelling devices
  - Antibiotic use
  - Infection prevention practices and resources

Colonization/infection with MDROs

References:
- Van Buul L. J Amer Med Dir Assoc 2012;568.
Antibiotic resistance in nursing homes

**Resident characteristics**
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- Antibiotic use
- Infection prevention practices and resources

Colonization/infection with MDROs

1. Mody L. CID 2011;52.
Antibiotic Stewardship in Nursing Homes

Up to 70% of nursing home residents received antibiotics during a year\textsuperscript{23}

Up to 75% of antibiotics are prescribed incorrectly\textsuperscript{2,3}

Centers for Disease Control and Prevention
National Center for Emerging and Zoonotic Infectious Diseases
What is an LTACH?

- Hospital Length of Stay
  - 1975 = 11.4 days
  - 2004 = 6.5 days
  - 2006 - 2011 = 4.8 days

- Require hospitalization for ≥ 25 days (CMS)

- Complex medical conditions → 90% had LOS in hospital of ≥14 days

- Acuity of care meets acute care hospital requirements
  - Licensed and credentialed under same criteria as short-term acute care hospitals
LTACH Growth

- Currently ~450 in the U.S.
- Moratorium expires September 2017
Patient severity of illness varies by healthcare setting

- ~40% of discharges to LTACHs → chronic mechanical ventilation
LTACHs: the “Perfect Storm” for emergence of antibiotic resistance

- Complex patient population with average LOS >25 days
- Device utilization high
  - Up to ~75% central venous catheter use
- Rate of antibiotic use high
  - Use of broad-spectrum antibiotics higher than 50th-75th percentile of ICU use
- Logistics of isolation and cohorting

ANTIBIOTIC RESISTANCE THREATS in the United States, 2013

HAZARD LEVEL URGENT
These are high-consequence antibiotic-resistant threats because of significant risks identified across several criteria. These threats may not be currently widespread but have the potential to become so and require urgent public health attention to identify infections and to limit transmission.

Clostridium difficile (C. difficile), Carbapenem-resistant Enterobacteriaceae (CRE), Drug-resistant Neisseria gonorrhoeae (cephalosporin resistance)

HAZARD LEVEL SERIOUS
These are significant antibiotic-resistant threats. For varying reasons (e.g., low or declining domestic incidence or reasonable availability of therapeutic agents), they are not considered urgent, but these threats will worsen and may become urgent without ongoing public health monitoring and prevention activities.

Multidrug-resistant Acinetobacter, Drug-resistant Campylobacter, Fluconazole-resistant Candida (a fungus), Extended spectrum β-lactamase producing Enterobacteriaceae (ESBLs), Vancomycin-resistant Enterococcus (VRE), Multidrug-resistant Pseudomonas aeruginosa, Drug-resistant Non-typhoidal Salmonella, Drug-resistant Salmonella Typhi, Drug-resistant Shigella, Methicillin-resistant Staphylococcus aureus (MRSA), Drug-resistant Streptococcus pneumonia, Drug-resistant tuberculosis (MDR and XDR)

HAZARD LEVEL CONCERNING
These are bacteria for which the threat of antibiotic resistance is low, and/or there are multiple therapeutic options for resistant infections. These bacterial pathogens cause severe illness. Threats in this category require monitoring and in some cases rapid incident or outbreak responses.

Vancomycin-resistant Staphylococcus aureus (VRSA), Erythromycin-resistant Streptococcus Group A, Clindamycin-resistant Streptococcus Group B

“...require urgent public health attention to identify infections and to limit transmission.”

CRE C. difficile

MRSA
Epidemiology of MRSA in nursing homes
The epidemiology of MRSA in nursing homes

• Burden in NHs significantly less well-studied than in acute care hospitals → less standardized infection prevention policies

• Prevalence of colonization: ~25-50%
  • Residents with indwelling devices: ~75%
  • Acute care hospitals: 6-12%; ICUs: 7-24%

• Highly dependent on local prevalence and importation pressure

• Risk factors for MRSA colonization
  • Older age • Poor functional status
  • Prior antibiotic therapy • Indwelling devices
  • Low nursing : bed ratio • ↓ social engagement levels
  • Environmental contamination of common areas

Reynolds C. Infect Control Hosp Epidemiol 2011;32
Murphy C. BMC Infect Dis 2012;12.
Clostridium difficile in nursing homes

C. diff no longer just a hospital superbug
National Estimates of U.S. Short-Stay Hospital Discharges with *Clostridium difficile*
National Estimates of U.S. Short-Stay Hospital Discharges with *C. difficile* by Age
Changing epidemiology of *C. difficile* in nursing homes

- 400 cases of CDI, 2005 - 2010
- >300,000 cases/year
- $2.2 billion in excess costs
- 16,500 deaths/year

Outbreak at NIH

They tore out pipes, walled off a hallway, and sent in a robot. But staff at the National Institutes of Health seemed powerless to stop the spread of a drug-resistant superbug.

By John Buntin | June 4, 2013
Novel Carbapenem-Hydrolyzing β-Lactamase, KPC-1, from a Carbapenem-Resistant Strain of *Klebsiella pneumoniae*

HESNA YIGIT, ANNE MARIE QUEENAN, GREGORY J. ANDERSON, ANTONIO DOMENECH-SANchez, JAMES W. BIDDLE, CHRISTINE D. STEWARD, SEBASTIAN ALBERTI, KAREN BUSH, and FRED C. TENOVER
### Carbapenem-Resistant Enterobacteriaceae (CRE)
**a major therapeutic challenge**

<table>
<thead>
<tr>
<th>Antimicrobial agent</th>
<th>Interpretation</th>
<th>Antimicrobial agent</th>
<th>Interpretation</th>
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<tbody>
<tr>
<td>Amikacin</td>
<td>I</td>
<td>Ertapenem</td>
<td>R</td>
</tr>
<tr>
<td>Amox/clav</td>
<td>R</td>
<td>Gentamicin</td>
<td>R</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>R</td>
<td>Imipenem</td>
<td>R</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>R</td>
<td>Meropenem</td>
<td>R</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>R</td>
<td>Gentamicin</td>
<td>R</td>
</tr>
<tr>
<td>Cefpodoxime</td>
<td>R</td>
<td>Tobramycin</td>
<td>R</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>R</td>
<td>TMP-SMX</td>
<td>R</td>
</tr>
<tr>
<td>Cetotetan</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceftazidime</td>
<td>R</td>
<td>Polymyxin B</td>
<td>≤ 2 μg/mL</td>
</tr>
<tr>
<td>Cefepime</td>
<td>R</td>
<td>Colistin</td>
<td>≤ 2 μg/mL</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>R</td>
<td>Tigecycline</td>
<td>≤ 2 μg/mL</td>
</tr>
</tbody>
</table>
Carbapenem resistant *K. pneumoniae* (CRKP): clinical outcomes in acute care hospitals
Prevalence of carbapenem-resistant Enterobacteriaceae in acute care hospitals versus LTACHs

- U.S. surveillance of healthcare-associated infections
- National Healthcare Safety Network (NHSN)

<table>
<thead>
<tr>
<th>Facility type</th>
<th>Number of facilities with CRE from a CAUTI or CLABSI (2012)</th>
<th>Total facilities performing CAUTI or CLABSI surveillance (2012)</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute care hospitals</td>
<td>145</td>
<td>3,716</td>
<td>(3.9)</td>
</tr>
<tr>
<td>LTACHs</td>
<td>36</td>
<td>202</td>
<td>(17.8)</td>
</tr>
</tbody>
</table>
FY2013 snapshot

→ LTACHs as a large, potentially unrecognized reservoir of CRE
Interventions and future directions for prevention of MDROs in long-term care settings

- Studies characterizing MDROs in nursing homes and LTACHs
  - Systematic surveillance
  - Epidemiologic risk factors, outcomes

- Infection prevention practices **targeted towards the nursing home setting**

- Antibiotic stewardship in long-term care

- Improved interfacility communication/collaboration
  - Regional surveillance networks
  - Standardized communication on transfers
Nursing homes: infection prevention considerations

- Residential setting
- Relative lack of private rooms
- No in-house reference laboratory

- Promotion of socialization
  - Group activities: dining, recreation, PT/OT

- Limited resources and personnel for IPC programs → 37% of NHs received an IPC-related deficiency citation
  - CMS “Reform Requirements for Long-Term Care Facilities” → IPC program within quality assurance and performance improvement (QAPI) program
  - Requirement that facilities have a designated IPC officer for whom overseeing the IPC program is his or her major responsibility
  - Specialized training in infection prevention

Nursing home IPC: contact precautions?

MRSA colonization as prime example

• Potential significant contamination of gowns (up to 24%) and gloves (37%) with typical activities

• Precautions for infection versus colonization?

• ↓ HCW contact, ↑ depression, falls, delirium

• “I’ve been through some very, very serious life and death situations…I have a lot of chronic problems that are difficult to treat. Like my osteomyelitis, it almost killed me, it really did. I am a walking, talking survivor. I am concerned about MRSA, and despite being in and out of facilities for 15 years…I have remained MRSA-free and I want to stay that way. Because I don’t need that [MRSA] on top of all the other things I have going on.”

• “This is my home and it scares me to see people wearing these yellow coverings and gloves. I feel like a pariah sometimes, and people don’t want to be associated with me. It makes me worry about my friends and getting on with my social activities.”

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Antibiotic stewardship in nursing homes

- Leadership commitment
- Accountability
- Drug expertise
- Action to implement policies/practices
- Tracking measures
- Reporting data
- Education

- Considerations: staffing, expertise, data collection
- CMS finalized proposal → requirement for NHs to have antibiotic stewardship program
- 2014 survey of 175 PA LTCFs – only ~37% had an antibiotic stewardship program in place
Interventions and future directions for prevention of MDROs in long-term care settings

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Infection Prevention Symposium: Antimicrobial Stewardship and Carbapenem-Resistant Enterobacteriaceae (CRE)

1st year: 1,557 CRE reports
→ 115 acute care hospitals
→ 5 LTACHs
→ 46 long-term care facilities

Extensively Drug Resistant Organism Registry

Mandatory reporting began November 1, 2013

https://www.xdro.org/img/MEMO_XDRO%20Registry_090413_Final.pdf

www.xdro.org
Summary

- Increasing importance of post-acute care facilities in healthcare delivery
- These facilities can serve as reservoirs of major MDROs
  - MRSA, C. difficile, CRE
- Interventions and future research needed on ↓emergence of MDROs adapted to these settings
Thank you!

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