The Prevalence of Carbapenem Resistant *Enterobacteriaceae* in Maryland Acute Care Care Hospitals

Michael McAllaster

2011-2012 PHASE Internship
Overview

• Organization of PHASE and DHMH Internship
• Carbapenem-resistant *Enterobacteriaceae*
• Objectives
• Methods
• Results
• Discussion: Public health implications, challenges limitations and lessons learned
Organization: PHASE and Maryland Department of Health and Mental Hygiene

- Internship
  - Maryland Department of Health and Mental Hygiene
    - Emerging Infections Program
      - Healthcare Associated Infections
  - Johns Hopkins School of Public Health
    - PHASE
Carbapenem

- β-lactam antimicrobial agents with a broad spectrum of activity
- Inhibit bacterial cell wall synthesis
- Include: Imipenem, meropenem, etrapenem, doripenem and razupenem
Resistant

• Class of bacterial enzymes that inactivate carbapenem antibiotics called carbapenemases
• Plasmid mediated
• Carbapenemases first found in *Klebsiella pneumoniae* (KPC)
• Found in other organisms:
  – *Proteus, Salmonella, Citrobacter, Serrratia*
**Enterobacteriaceae**

- Stain Gram-negative, facultative anaerobes
- Found in normal human flora in the gastrointestinal tract

**Carbapenem Resistant Enterobacteriaceae**

Gram negative bacteria carrying genes that confer resistance to carbapenem antibiotics

Or

**CRE**
CRE is a Healthcare Associated Infection (HAI)

• In 2002, HAIs accounted for 99,000 deaths and a financial burden of $28-33 billion in excess healthcare spending\(^1\)

• Increasing incidence of CRE in tertiary care centers, hospitals and nursing homes\(^2-4\)

• High mortality rates among CRE infected patients, even higher in long term care facilities\(^5\)
CRE in the United States, 2011

Yellow: Confirmed CRE cases caused by the KPC enzyme.

Blue dot: confirmation of CRE caused by the NDM-1 enzyme.

Orange dot: CRE caused by a VIM or IMP enzyme.

Centers for Disease Control and Prevention, 2011.
CRE in Maryland Acute Care Hospitals, 2010

- 572 CRE positive patients from 42 reporting hospitals (36 clinical laboratories)
- Mean number of cases was 14
- Heterogeneous surveillance
- Wide distribution

Patricia Lawson, David Blythe, et al. 2011
Objectives

• Survey the prevalence of CRE in acute care hospitals in Maryland from September 2010 to August 2011

• Survey the methods to detect and confirm CRE in clinical specimens in Maryland

• Compare the prevalence of cases observed in Maryland from 2010 to 2011
Project Timeline

October 2011 – December 2011
- Finalize survey
- Disseminate survey

January 2012 – March 2012
- Data entry
- Follow-up with clinical laboratories

April 2012 – May 2012
- Analyze data
- Interpret results
**Methods: Survey**

Carbapenem*-Resistant *Enterobacteriaceae* Survey

Please base responses on the unduplicated count of patients (not number of isolates).

1. Number of patients with CRE (all species) from September 2010 to August 2011.

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Unduplicated count of patients</th>
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2. If you service multiple facilities, please list each with the number of unduplicated count of patients.

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<tr>
<th>Facility Name</th>
<th>Unduplicated count of patients</th>
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3. Testing method(s) used by your laboratory to define CRE from September 2010 to August 2011? Check all that apply.
   - Screen (manual susceptibility testing)
   - Screen (automated susceptibility testing)
   - Modified Hodge test
   - E-test
   - Kirby-Bauer disk diffusion
   - PCR-based detection of resistance mechanism
   - Reference laboratory for confirmatory testing. If yes, please provide the name of the reference laboratory.

4. Has your laboratory implemented the 2011 CLSI Guidelines for MIC breakpoints?
   - YES
   - NO. Please answer next question.

5. If NO, when do you anticipate implementation of these guidelines?
   - ≤ 6 months
   - 1 year
   - >1 year
   - Do not plan to implement

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Survey Question:

- What further actions would your laboratory routinely take? Check all that apply.
  - Call the infection control department
  - Call the nursing station
  - Call the physician
  - Report to local health department
  - Call public health laboratory
  - No further action taken
  - Other, please specify:

7. Does your facility have the capacity to build a query for carbapenem-resistant *Enterobacteriaceae* results?
   - YES
   - NO

*Imipenem (imipenem/cilastatin), Meropenem, Erapenem, Doripenem, Panipenem, Biomipenem

Contact Information:

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<tr>
<th>Name</th>
<th>Title</th>
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<th>Phone Number</th>
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Questions?

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Methods: Dissemination of Survey

• There are 36 clinical laboratories serving 42 Maryland acute care hospitals

• Distributed to clinical laboratory staff of Maryland acute care hospital microbiology laboratories at 2011 Laboratory Response Network Sentinel Laboratory Bioterrorism Preparedness Training

• Three follow up phone calls or e-mails per clinical laboratory
2011 CRE Prevalence Survey Results

36 reporting hospitals
21 clinical laboratories
269 CRE positive patients
Mean: 8
Median: 3
Mode: 0
Distribution of CRE in Maryland Acute Care Hospitals 2011

- **Western**: 1 (0.4%)
- **Capital**: 13 (5%)
- **Central**: 193 (71%)
- **Southern**: 22 (8%)
- **Eastern Shore**: 40 (15%)
## CRE Clinical Laboratory Testing Methods, 2011

<table>
<thead>
<tr>
<th>Test Category</th>
<th>Laboratory Test</th>
<th>Number (%) laboratories performing tests</th>
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</thead>
<tbody>
<tr>
<td>Automated</td>
<td>Automated antibiotic susceptibility (Vitek, Microscan, Phoenix)</td>
<td>14 (67%)</td>
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<tr>
<td>Manual</td>
<td>Manual screening (E-test)</td>
<td>2 (10%)</td>
</tr>
<tr>
<td>Manual</td>
<td>Kirby-Bauer (disk diffusion)</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>Confirmatory</td>
<td>Modified Hodge Test</td>
<td>14 (67%)</td>
</tr>
<tr>
<td>Confirmatory</td>
<td>PCR</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>Confirmatory</td>
<td>Reference Laboratory (confirmatory testing)</td>
<td>4 (19%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>Unknown screening test</td>
<td>2 (10%)</td>
</tr>
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</table>
CRE Case Comparison 2010 vs. 2011

![Bar chart showing the comparison of CRE cases between 2010 and 2011 for different ranges of CRE+ individuals. The chart indicates a significant decrease in the number of hospitals with CRE cases in 2011 compared to 2010, especially in the categories <10 and 10 to 20 CRE+ individuals.]
Limitations and Challenges

• Data collection
  – Non-responders
  – Out of phase with clinical lab reporting cycle
  – Electronic queries, 86% have capability

• Project timeline beyond PHASE internship
  – Policy implications
  – 2012 survey
Policy and Practice Implications

• CRE is not a reportable disease in Maryland
  – Not reportable nationally
  – Variable response by clinical labs to a CRE positive case

• Standardized testing
  – Feasible?

• 2012 CRE Survey
  – Leave it to the epidemiologists?
  – A single survey for all HAIs
  – MuGSI
Lessons Learned

• Public health practice is challenging
• Public health practice is rewarding
• Friday outbreak meetings are cool!
Acknowledgements

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Questions?