The Prevalence of Carbapenem Resistant *Enterobacteria aerogenes* 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
Carbapenem\textsuperscript{a}-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>
</tr>
</thead>
<tbody>
<tr>
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</table>

2. If you service multiple facilities, please list each with the number of unduplicated count of patients.

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Unduplicated count of patients</th>
</tr>
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</table>

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

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

*Imipenem (imipenem/cilastatin), Meropenem, Erupenem, Doripenem, Panipenem, Biapenem

Contact information:

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Title</td>
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<td>Phone Number</td>
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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>
</tr>
</thead>
<tbody>
<tr>
<td>Automated</td>
<td>Automated antibiotic susceptibility (Vitek, Microscan, Phoenix)</td>
<td>14 (67%)</td>
</tr>
<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>
</tbody>
</table>
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!
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References


Questions?