CRE Case Studies
Disclosures

Mary Alice Lavin, Jodi Morgan, Angela Tang: Nothing to disclose

Nicholas Moore:
– Research support through the CDC Chicago Prevention Intervention Epicenter (C-PIE), RA Weinstein, PI and MK Hayden, Co-I
– Industry sponsored grants/contracts (Cepheid)
– Unpaid research (AdvanDx)
Case Studies – Purpose

Get to know your partners in CRE prevention!

Regional tables with representatives from:
- Local/state health departments
- Acute care facilities
- Long-term care facilities
- Labs
Case Studies – Objectives

1) Perform the steps of a healthcare-associated infection outbreak investigation

2) Formulate a communication plan between infection prevention, laboratory, and local health department staff

3) Identify gaps in regional outbreak response
Illinois CRE Surveillance Definition

Enterobacteriaceae with one of the following test results:

1. **Molecular test** (e.g., PCR) specific for carbapenemase
   OR
2. **Phenotypic test** (e.g., Modified Hodge) specific for carbapenemase production
   OR
3. **Susceptibility test** (*for E. coli and Klebsiella species only*):
   - non-susceptible (intermediate or resistant) to ONE of the carbapenems (doripenem, meropenem, or imipenem) AND
   - resistant to ALL third generation cephalosporins tested (ceftriaxone, cefotaxime, and ceftazidime).
   - Ignore ertapenem
Report Carbapenem-Resistant Enterobacteriaceae (CRE) isolates to the XDRO registry

1. Is the isolate in the Enterobacteriaceae family (e.g., Klebsiella, Escherichia coli, Enterobacter, Serratia, Proteus, others)?
   - NO: Do NOT Report: Pseudomonas, Acinetobacter, MRSA, or other non-Enterobacteriaceae isolates
   - YES

2. Did the isolate have a positive genotypic test (PCR) for a carbapenemase (e.g., KPC, NDM, VIM, IMP, OXA)?
   - NO
   - YES: Report to the XDRO registry

3. Did the isolate have a positive phenotypic test (e.g., Modified Hodge or MBL Etest) for carbapenemase production?
   - NO
   - YES: Report to the XDRO registry

4. Is the isolate E. coli or Klebsiella spp.?
   - NO: Do NOT Report
   - YES

5. Is the isolate non-susceptible (INTERMEDIATE or RESISTANT) to imipenem, meropenem, and/or doripenem?
   - NO: Do NOT Report
   - YES

6. Is the isolate RESISTANT to ALL third-generation cephalosporins tested (e.g., ceftriaxone, cefotaxime, ceftazidime, others)?
   - NO: Do NOT Report: Isolates that are sensitive or intermediate to any third-generation cephalosporin
   - YES: Report to the XDRO registry

IDPH

XDRO registry website: www.xdro.org  •  XDRO registry e-mail: DPH.XDROregistry@illinois.gov
Revised 7/2015
## Warm-up exercise

<table>
<thead>
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<th>Initials</th>
<th>Age</th>
<th>Gender</th>
<th>Specimen Collection Date</th>
<th>Specimen Type</th>
<th>Organism</th>
<th>Antibiotic Susceptibility</th>
<th>MHT</th>
<th>PCR – blakpc</th>
<th>Which reporting criteria does this meet? (1/2/3/NONE/UNSURE)</th>
<th>Reportable? (YES / NO / UNSURE)</th>
</tr>
</thead>
</table>
| PJ       | 70  | F      | 5/2/14                    | BAL           | *Klebsiella pneumoniae* | Ertapenem -- R  
Meropenem -- I  
Imipenem -- S  
Ceftriaxone -- R  
Cefotaxime -- R  
Ceftazidime -- I | NEG | NEG | | | |
| TJ       | 84  | F      | 5/6/14                    | Blood         | *Klebsiella pneumoniae* | N/D | POS | N/D | | |
| JD       | 53  | M      | 5/8/14                    | Urine         | *Klebsiella pneumoniae* | Ertapenem -- R  
Meropenem -- S  
Imipenem -- I  
Ceftriaxone -- R  
Cefotaxime -- R  
Ceftazidime -- R | NEG | NEG | | | |
| KC       | 62  | F      | 5/9/14                    | Abscess       | *Klebsiella pneumoniae* | Ertapenem -- R  
Meropenem -- R  
Imipenem -- R  
Ceftriaxone -- R  
Cefotaxime -- R  
Ceftazidime -- R | N/D | POS | | | |
**XDRO criteria** (select all that apply)

- [ ] **Reporting rule**

- [ ] **Molecular test** (e.g. PCR) specific for carbapenemase

- [ ] **Phenotypic test** (e.g. Modified Hodge) specific for carbapenemase production

- [ ] **For E. coli and Klebsiella spp. only:**
  Resistant to ALL 3rd gen cephalosporins tested and non-susceptible (intermediate or resistant) to one carbapenem. **Ignore ertapenem.**
Case 1
- 68 y.o. female resident of skilled nursing facility
- CVA 3 years prior, with persistent right-sided hemiplegia
- Arrives with Foley catheter and G-tube in place
- In ED, was febrile at 39° C/ 102.2° F
  - WBC count was 26.4 x 10^3 cells/μL, with differential showing 77% segmented neutrophils, 6% lymphocytes, 8% monocytes, 9% band neutrophils
  - Blood and urine cultures collected
- Started on empiric meropenem and vancomycin before being transferred to general medical unit in stable condition
After 48 hours, urine culture grew out VRE

General medical attending discontinued vancomycin, switched to daptomycin due to concern for possible urosepsis

After one week, began to improve clinically, with decreased WBC and resolved fever
Daisy Dalton

- 72 y.o. female, Suzie’s roommate
- Found unresponsive, febrile, hypotensive
  - Had been admitted 5 days prior for diabetic neuropathy, with non-healing ulcer on left foot
- Transferred to MICU in critical condition
- Blood cultures collected after transfer grew multidrug-resistant *Klebsiella pneumoniae*
Figure 1 – ID/AST Report

MicroScan NC68 Combo Panel

<table>
<thead>
<tr>
<th>Drug</th>
<th>MIC</th>
<th>Expert</th>
<th>Interps</th>
</tr>
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<tr>
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<td>&gt;8</td>
<td></td>
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<tr>
<td>Tobramycin</td>
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<td>Amikacin</td>
<td>&gt;32</td>
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<td>Amox/K Clav</td>
<td>&gt;16/8</td>
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<td>Ampicillin</td>
<td>&gt;16</td>
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<td>R</td>
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<tr>
<td>Amp/Sulbactam</td>
<td>&gt;16/8</td>
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<td>R</td>
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<tr>
<td>Pip/Tazo</td>
<td>&gt;64</td>
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<td>Cefazolin</td>
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<td>Cefuroxime</td>
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<tr>
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<td>Trimeth/Sulfa</td>
<td>&gt;2/38</td>
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<td>Tetracycline</td>
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<td>I</td>
</tr>
<tr>
<td>Tigecycline</td>
<td>≤2</td>
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</tbody>
</table>
INJECT: Modified Hodge Test

- Lab performs MHT (below) and MBL Etest, which is negative
- Lab director requests isolate be tested for $bla_{KPC}$ gene by PCR
- Lab sends slant of isolate to reference lab that can perform PCR for $bla_{KPC}$ gene
The following day, the hospital laboratory receives the PCR result from the reference laboratory. The isolate submitted was positive for $bla_{KPC}$ by PCR. The laboratory director communicates this to the IP.
- IP obtains order for rectal swab for Ms. Sanders

- Laboratory follows broth enrichment procedure using 10ug meropenem disk and performs identification and susceptibility testing on distinct colony morphologies recovered upon subculture to MacConkey agar

- MDR-\textit{K. pneumoniae} with similar susceptibility profile to Ms. Dalton's bacteremia isolate is identified. This isolate is also positive for \textit{bla}_{KPC} by PCR.
- 4 more patients on the unit, all in rooms that are physically near Ms. Sanders’s room, also KPC+ by PCR.

- 3 patients’ KPC+ isolates were also *K. pneumoniae*, while one patient had a KPC+ *E. coli*. 
Case 2:
Unusual Mechanism in an LTACH
Mary Smith

- 70 y.o. female resident
- Admitted to **Shady Lane Manor** (LTACH) for continued care of congestive heart failure
- History of diabetes with chronic kidney disease and pneumonia
- Recent admissions to **Good Health Hospital**, **Get Well Medical Center** and **Sunny Day Home for Elders**
Mary Smith (cont.)

- Screened for CRE on admission and four days after, lab notified facility that she had
  - *K. pneumoniae* that was MHT+
  - *Enterobacter cloacae* that was NDM+ by PCR
- Currently ventilated and has PICC line
Ms. Smith was placed on Contact Precautions because she is ventilated and incontinent of urine.
Shady Lane Manor decided to perform surveillance cultures on the 8 other residents that were on the unit at the same time as Ms. Smith.
• Upon notification and discussion with Get Well Medical Center, Wellness County Health Department (WCHD) determined that Ms. Smith was in Good Health Hospital prior to being transferred to Get Well Medical Center.

• Good Health Hospital is in Healthy County Health Department’s (HCHD) jurisdiction. WCHD notified HCHD.
HCHD determined that Ms. Smith had several admissions to Good Health Hospital.

During the discussion, HCHD learned that Good Health Hospital routinely performs surveillance cultures for CRE.

Ms. Smith was found to have negative surveillance cultures on her last two admissions.

Good Health Hospital reported that Ms. Smith had recently been at Sunny Day Home for Elders.
Patient Transfer Diagram

Wellness County HD

- Shady Lane Manor
- Get Well Medical Center

Healthy County HD

- Good Health Hospital
- Sunny Day Home for Elders
Case 3
Jonathan Smith

- 44 y.o. male
- Admitted to LTACH following complicated and extended stay in acute care hospital after severe motor vehicle accident
- Had extensive orthopedic and neurologic surgery due to injuries
- 37.3°C (99.1°F), slightly tachycardic (108 bpm), BP 132/86
- On full ventilator support and arrives with gastrostomy tube
- Pressure ulcer (4cm x 3cm x 2.5cm) noted on sacrum; has been covered with a xeroform dressing
Jonathan Smith (cont.)

- LTACH routinely screens all new admissions for CRE
  - Nurse collects rectal swab and submits to lab for testing
- Preliminary report from reference lab says that carbapenem-resistant *E. cloacae* was isolated
  - Confirmatory testing pending for $bla_{KPC}/bla_{NDM}$ PCR
Mr. Smith placed on contact precautions per facility infection control policy for MDROs.

After 24 hours, reference lab sends finalized report:
- Organism confirmed as *E. cloacae*
- But isolate was negative for *bla*$_{KPC}$/*bla*$_{NDM}$ by PCR
- Phenotypic modified Hodge test also negative
# E. cloacae

## ID/AST Report

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Illinois Infection Prevention and CRE Workshops, 2015 - Case Study Worksheets

Carbapenem-Resistant Enterobacteriaceae (CRE) CASE STUDY – Opening Exercise

In May 2014, a cluster of four potential CRE cases was identified on Unit 6-East at Hospital A. The first lab report for each patient appears below.

Examine the data and determine whether
(1) the cases meet the Illinois CRE definition, and if so, which criteria
(2) they should be reported to the XDRO registry.

If you are unsure whether the case is CRE, what additional steps could you take to help make this determination?

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<th>Gender</th>
<th>Specimen Collection Date</th>
<th>Specimen Type</th>
<th>Organism</th>
<th>Antibiotic Susceptibility</th>
<th>MHT</th>
<th>PCR – bla\textsubscript{KPC}</th>
<th>Which reporting criteria does this meet? (1/2/3/NONE/UNSURE)</th>
<th>Reportable? (YES / NO / UNSURE)</th>
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<td>Urine</td>
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<td>NEG</td>
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<tr>
<td>KC</td>
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<td>5/9/14</td>
<td>Abd. Abscess</td>
<td>Klebsiella pneumoniae</td>
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<td>N/D</td>
<td>POS</td>
<td>N/D</td>
<td>NO</td>
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</table>

MHT = Modified Hodge Test for carbapenemase production
PCR – bla\textsubscript{KPC} = Polymerase Chain Reaction testing for the Klebsiella pneumoniae carbapenemase gene
N/D= Testing Not Done
CRE Case Study #1

Suzie Sanders, a 68-year-old female patient, is taken to the emergency department for fever and mental status changes. Ms. Sanders is a resident in a skilled nursing facility with a past medical history notable for a CVA 3 years prior, with persistent right-sided hemiplegia. The patient arrives with a Foley catheter and G-tube in place. In the ED, she was febrile at 39°C/102.2°F and her WBC count was 26.4 x 103 cells/μL, with the differential showing 77% segmented neutrophils, 6% lymphocytes, 8% monocytes, and 9% band neutrophils. Blood and urine cultures were collected; the patient was started on empiric meropenem and vancomycin before being transferred to a general medical unit in stable condition. After 48 hours, the patient’s urine culture grew out vancomycin-resistant enterococci. The general medical attending discontinued vancomycin and switched the patient to daptomycin due to concern for possible urosepsis. After one week of therapy, the patient began to improve clinically, with a decreased WBC and resolved fever.

A few days later, Suzie’s roommate, Daisy Dalton, was found unresponsive, febrile, and hypotensive. Ms. Dalton is a 72-year-old woman admitted from home with a long history of diabetes; she had been admitted five days earlier for diabetic neuropathy, with a non-healing ulcer on the left foot. She was transferred to the MICU in critical condition. Blood cultures collected after transfer grew a multidrug-resistant *Klebsiella pneumoniae* (See Figure 1 – Susceptibility report).

**Question 1:** Based on the susceptibility profile of this organism, what potential antibiotic resistance mechanism do you suspect?

**Question 2:** How could you confirm that this organism may produce the resistance mechanism that you suspect?
**Question 3:** As an IP/nurse, what immediate action would you take after receiving laboratory notification of a possible carbapenemase-producing CRE isolate (positive modified Hodge test)?

**Question 4:** What is the most likely explanation of how this patient (Daisy Dalton) acquired an infection with a KPC-producing organism?

**Question 5:** What type of screening could you perform of your suspicious source patient(s) to determine if they harbor a KPC-positive organism?

**Question 6:** How would you determine if the two cases (Ms. Sanders and Ms. Dalton) are epidemiologically linked?

**Question 7:** What additional measures should the facility’s IP and medical directors consider if there appears to be a transmission of KPC between patients?
Inject

**Question 8:** At this point what should the IP and the facility do next?

**Question 9:** What are some of the potential next steps to investigate this cluster?

**Question 10:** What are some potential recommendations to reduce the risk of KPC acquisition in other hospitalized patients?
A 70 year old female resident, Mary Smith, is admitted to Shady Lane Manor, a long term acute care hospital (LTACH), for continued care of congestive heart failure. Her past medical history also includes diabetes with chronic kidney disease and pneumonia. She has had several recent admissions to Good Health Hospital, Get Well Medical Center and Sunny Day Home for Elders. It is the practice of the Shady Lane Manor to screen residents for carbapenem resistant enterobacteriaceae (CRE) on admission. The resident was screened on admission and four days after admission the facility was notified by the lab that the patient had a *Klebsiella pneumoniae* that was Modified Hodge test positive and an *Enterobacter cloacae* that was New Delhi Metallo beta lactamase (NDM) positive by PCR. Ms. Smith is currently ventilated and has a PICC line.

**Q1. What are the immediate steps for the Shady Lane Manor?**

**Q2. Should screening cultures be collected at the Shady Lane Manor?**

**Q3. Who should be notified that the patient was found to have a New Delhi Metallo-beta-lactamase (NDM) strain?**
Q4. What role does the local health department, Wellness County Health Department (WCHD), have in the investigation? What role does the Best State Health Department have in the investigation?

Q5. Why is it important for HCHD to know about the NDM case?

Q6. What should HCHD do with the information they receive from Good Health Hospital?

Q7. What should be entered into the XDRO Registry?

Q8. Should the NDM positive result be confirmed by the CDC’s lab?
CRE Case Study #3

Jonathan Smith is a 44 year-old male who was admitted to a long-term acute care hospital (LTACH) following a complicated and extended stay in an acute care hospital after a severe motor vehicle accident. The patient required extensive orthopedic and neurologic surgery due to his injuries. Upon arrival to the LTACH, the patient is received by the admitting nurse. She notes the patient to be afebrile at 37.3°C (99.1°F), slightly tachycardic (108 bpm), with a blood pressure of 132/86. The patient is on full ventilator support and arrives with a gastrostomy tube. Upon skin examination, a pressure ulcer (4cm x 3cm x 2.5cm) is noted on the patient’s sacrum; the ulcer has been covered with a xeroform dressing. The LTACH routinely screens all new admissions for rectal carriage of carbapenem-resistant Enterobacteriaceae. The nurse collects a rectal swab and submits it to the laboratory for testing.

On hospital day three, a new nurse on the day shift begins caring for Mr. Smith. She is reviewing his records and sees that a new micro lab report is available. The LTACH has received a preliminary report from the reference lab that a carbapenem-resistant Enterobacter cloacae was isolated from the patient’s rectal culture, but confirmatory testing is pending for \( \text{bla}_{KPC}/\text{bla}_{NDM} \) PCR.

Q1. What are the immediate steps for the nurse caring for the patient?

Q2. What are the immediate steps for the LTACH’s IP?
Q3. List the drug classes to which this isolate is resistant. Is this an MDRO? What resistance mechanism might you suspect, based on this antibiogram?

Q4. Is this case reportable to the XDRO registry? Why or why not?

Q5. Based on this final report from the reference laboratory, how should the IP proceed with this patient? With the unit?
# CRE Regional Prevention Plan

## Date:

## Facility Name:

## Other facilities/ organizations in the region:

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<th>Interventions</th>
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<th>Timeline</th>
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<td>Timeframe of implementation</td>
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<td>Who will monitor progress and compliance</td>
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<td>Materials needed to accomplish this intervention</td>
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<th>Potential Barriers + Solutions</th>
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<td>What things or people may prevent you from implementing interventions and possible solutions</td>
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<th>Monitor &amp; Measure</th>
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<tbody>
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<td>How will you track and measure progress</td>
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Adapted from Michigan Department of Health and Human Services