

# CRE Case Studies

# Disclosures

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

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# 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

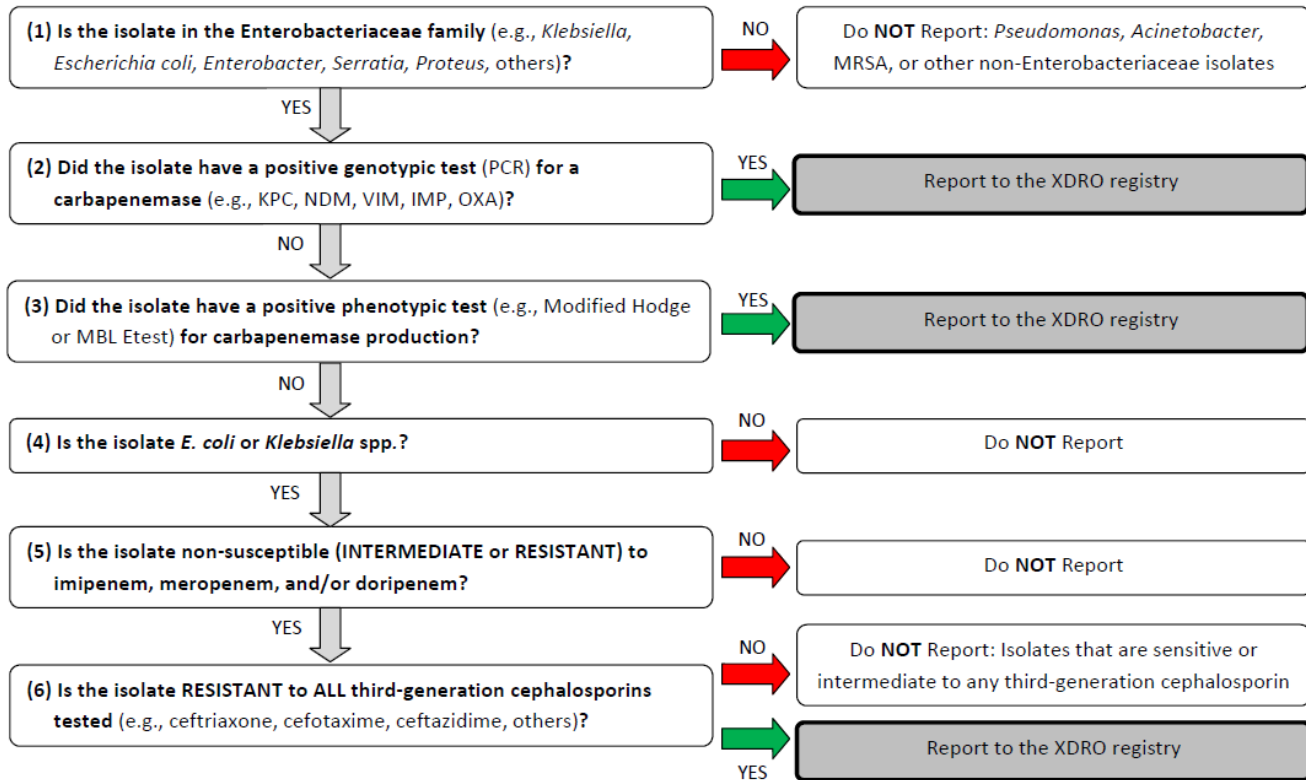
- 1) Perform the steps of a healthcare-associated infection outbreak investigation
- 2) Formulate a communication plan between infection prevention, laboratory, and local health department staff
- 3) Identify gaps in regional outbreak response

# 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



# Warm-up exercise

Initials	Age	Gender	Specimen Collection Date	Specimen Type	Organism	Antibiotic Susceptibility	MHT	PCR – bla <sub>KPC</sub>	Which reporting criteria does this meet? (1/2/3/NONE/UNSURE)	Reportable? (YES / NO/ UNSURE)
PJ	70	F	5/2/14	BAL	<i>Klebsiella pneumoniae</i>	Ertapenem -- R Meropenem -- I Imipenem -- S Ceftriaxone -- R Cefotaxime -- R Ceftazidime -- I	NEG	NEG		
TJ	84	F	5/6/14	Blood	<i>Klebsiella pneumoniae</i>	N/D	POS	N/D		
JD	53	M	5/8/14	Urine	<i>Klebsiella pneumoniae</i>	Ertapenem -- R Meropenem -- S Imipenem -- I Ceftriaxone -- R Cefotaxime -- R Ceftazidime -- R	NEG	NEG		
KC	62	F	5/9/14	Ahd. Abscess	<i>Klebsiella pneumoniae</i>	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

# Suzie Sanders

- 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<sup>3</sup> cells/uL, 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

## Suzie Sanders (cont.)

- 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

## 1 Klebsiella pneumoniae

### 1 K. pneumoniae

<u>Drug</u>	<u>MIC</u>	<u>Expert</u>	<u>Interps</u>
Gentamicin	>8		R
Tobramycin	>8		R
Amikacin	>32		R
Amox/K Clav	>16/8		R
Ampicillin	>16		R
Amp/Sulbactam	>16/8		R
Pip/Tazo	>64		R
Cefazolin	>4		N/R
Cefuroxime	>16		R
Cefotaxime	>32	R	R
Ceftazidime	>16	R	R
Ceftriaxone	>32	R	R
Cefepime	>16		R
Ertapenem	>2		R
Imipenem	>8	R	R
Meropenem	>8	R	R
Ciprofloxacin	>2		R
Levofloxacin	>4		R
Trimeth/Sulfa	>2/38		R
Tetracycline	8		I
Tigecycline	<=2		S

*MicroScan NC68 Combo Panel*

# INJECT: Modified Hodge Test

- Lab performs MHT (below) and MBL Etest, which is negative
- Lab director requests isolate be tested for *bla*<sub>KPC</sub> gene by PCR
- Lab sends slant of isolate to reference lab that can perform PCR for *bla*<sub>KPC</sub> gene



# INJECT

The following day, the hospital laboratory receives the PCR result from the reference laboratory.

The isolate submitted was **positive for *bla*<sub>KPC</sub> by PCR.**

The laboratory director communicates this to the IP.

# INJECT

- 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-*K. pneumoniae* with similar susceptibility profile to Ms. Dalton's bacteremia isolate is identified. This isolate is also positive for *bla*<sub>KPC</sub> by PCR.



# INJECT

- 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

# INJECT

Ms. Smith was placed on Contact Precautions because she is ventilated and incontinent of urine.

# INJECT

**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.

# INJECT

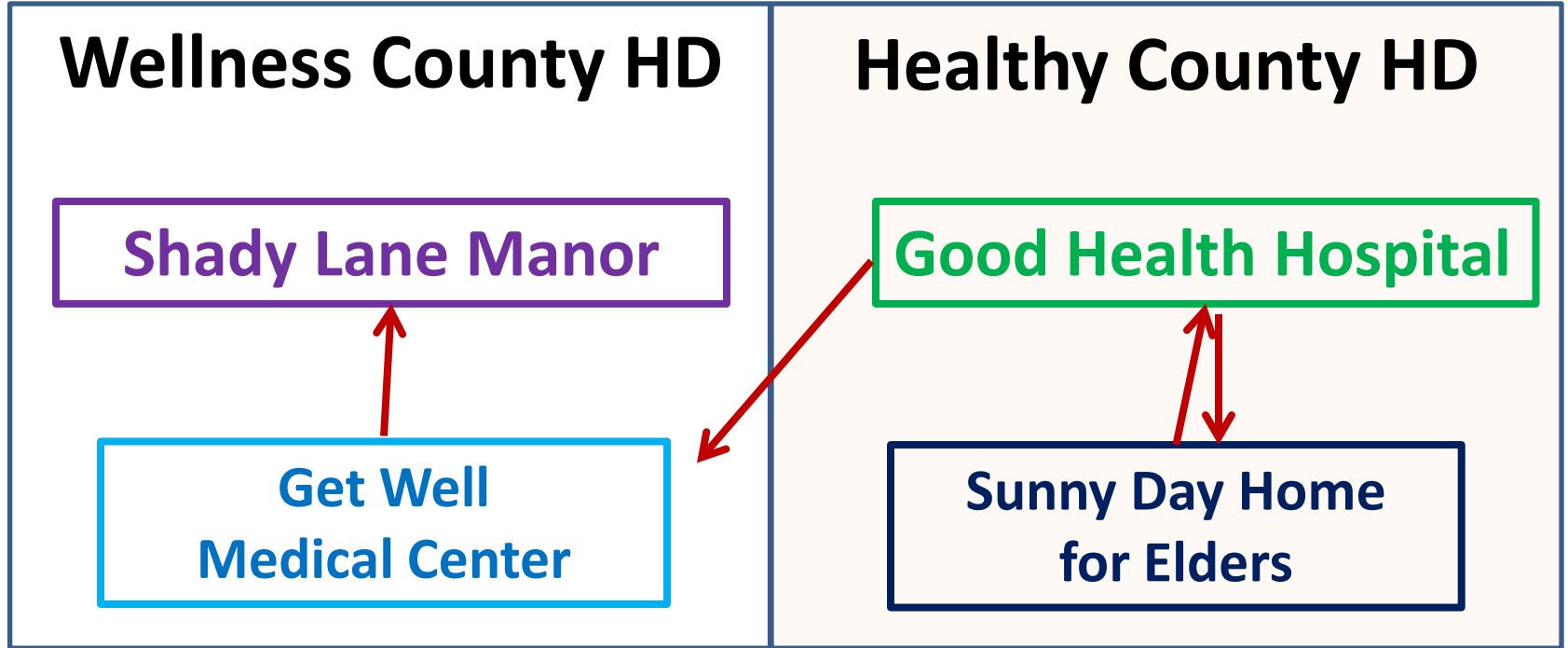
- Upon notification and discussion with **Get Well Medical Center**, Wellness County Health Department (WCHD) determined that Ms. Smith was in **Good Health Hospital** prior to being transferred to **Get Well Medical Center**
- **Good Health Hospital** is in Healthy County Health Department's (HCHD) jurisdiction. WCHD notified HCHD

# INJECT

- 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



# 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

# INJECT

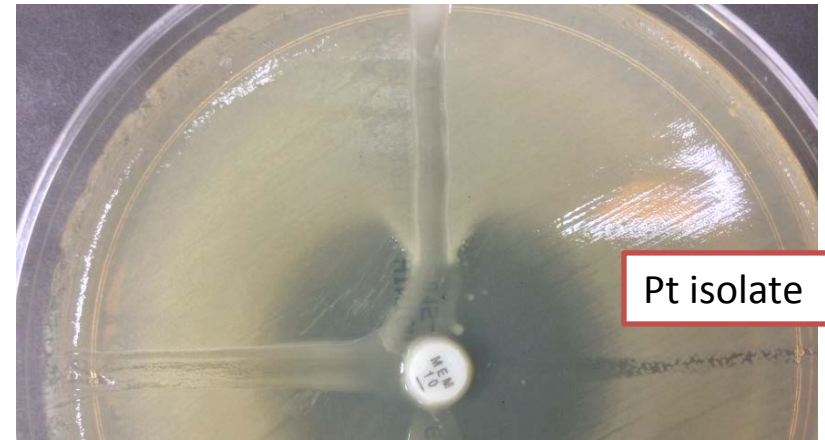
- Mr. Smith placed on contact precautions per facility infection control policy for MDROs
- After 24 hours, reference lab sends finalized report
  - Organism confirmed as *E. cloacae*
  - But isolate was negative for bla<sub>KPC</sub>/bla<sub>NDM</sub> by PCR
  - Phenotypic modified Hodge test also negative

# 01 E. cloacae

<u>Drug</u>	<u>MIC</u>	<u>Expert</u>	<u>Interps</u>
Gentamicin	>8		R
Tobramycin	>8		R
Amikacin	<=16		S
Amox/K Clav	>16/8		R
Ampicillin	>16		R
Amp/Sulbactam	>16/8		R
Pip/Tazo	>64		R
Cefazolin	>4		N/R
Cefuroxime	>16		R
Cefotaxime	8	R	R
Ceftazidime	8	I	I
Ceftriaxone	8		R
Cefepime	<=4		S
Ertapenem	>2		R
Imipenem	4	R	R
Meropenem	2	I	I
Ciprofloxacin	>2		R
Levofloxacin	>4		R
Trimeth/Sulfa	>2/38		R
Tetracycline	>8		R
Tigecycline	<=2		S

## ID/AST Report

### Modified Hodge Test



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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?

Initials	Age	Gender	Specimen Collection Date	Specimen Type	Organism	Antibiotic Susceptibility	MHT	PCR – bla <sub>KPC</sub>	Which reporting criteria does this meet? (1/2/3/NONE/UNSURE)	Reportable? (YES / NO/ UNSURE)
PJ	70	F	5/2/14	BAL	<i>Klebsiella pneumoniae</i>	Ertapenem -- R Meropenem -- I Imipenem -- S Ceftriaxone -- R Cefotaxime -- R Ceftazidime -- I	NEG	NEG		
TJ	84	F	5/6/14	Blood	<i>Klebsiella pneumoniae</i>	N/D	POS	N/D		
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KC	62	F	5/9/14	Abd. Abscess	<i>Klebsiella pneumoniae</i>	Ertapenem -- R Meropenem -- R Imipenem -- R Ceftriaxone -- R Cefotaxime -- R Ceftazidime -- R	N/D	POS		

MHT= Modified Hodge Test for carbapenemase production

PCR – bla<sub>KPC</sub> = 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 10<sup>3</sup> cells/uL, 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).

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**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?

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**Inject**

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**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)?

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**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?

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**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?

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**Inject**

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**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?

## CRE Case #2 – Unusual Mechanism in a LTACH

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?**

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

----- Inject -----

**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?**

**----- Inject -----**

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

**----- Inject -----**

**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 *bla*<sub>KPC</sub>/*bla*<sub>NDM</sub> PCR.

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

**Q2. What are the immediate steps for the LTACH's IP?**

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.....

**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:

<b>Interventions</b> CRE prevention measures you are or plan on implementing	
<b>Timeline</b> Timeframe of implementation	
<b>Department(s) Responsible</b> Who will monitor progress and compliance	
<b>Resources Needed</b> Materials needed to accomplish this intervention	
<b>Potential Barriers + Solutions</b> What things or people may prevent you from implementing interventions and possible solutions	
<b>Monitor &amp; Measure</b> How will you track and measure progress	