Investigating Carbapenem-Resistant Enterobacteriaceae

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Healthcare-Associated Infections (HAI) Program
Center for Health Care Quality
California Department of Public Health
Objectives:

1. Describe public health agency roles and responsibilities during HAI investigations
2. Review epidemiology of carbapenem resistant Enterobacteriaceae (CRE)
3. Understand steps for investigating CRE
4. Describe CRE infection control measures for patients and residents in acute care hospitals and nursing homes
Roles and Responsibilities During HAI Investigations
Roles and Responsibilities

CDPH

Center for Health Care Quality

Healthcare-Associated Infections (HAI) Program

Licensing and Certification (L&C) Program

L&C District Offices
Roles and Responsibilities

Authorities

• Local health department (LHD) responsible for ensuring safety of people (and patients) within jurisdiction
• L&C responsible for ensuring safe care in licensed healthcare facilities
• HAI Program is consultative, non-regulatory
Roles and Responsibilities

L&C Program District Offices:

• Ensure healthcare facilities are in compliance with applicable state and federal laws and regulations

• Receive reports of unusual occurrences and outbreaks of HAI
Roles and Responsibilities

HAI Program

- Oversee HAI prevention, surveillance, and reporting in California’s general acute care hospitals
- CDPH healthcare epidemiology and infection control subject matter experts
Roles and Responsibilities

Coordination

• HAI Program provides expert guidance to local health department (LHD)
• LHD determines follow up actions at the healthcare facility
• L&C ensures facility has and follows corrective action plan that incorporates LHD recommendations
HAI Program Assistance to LHD, 2015-2016

• 61 of 97 (63%) consultations for one of three pathogen types
  – Multidrug resistant organisms (MDRO)
  – Legionella
  – Hepatitis B and C viruses (HBV, HCV)
HAI Program Assistance by Pathogen, 2015-2016

- Legionella: 25%
- Multidrug Resistant Organisms: 25%
- Hepatitis B or C: 13%
- Other: 37%
HAI Program Assistance to LHD for Investigations of Multidrug Resistant Pathogens, 2015-present

- Klebsiella pneumoniae: 8 investigations
- C. difficile: 6 investigations
- MRSA: 3 investigations
- Pseudomonas aeruginosa: 3 investigations
- Acinetobacter baumanii: 2 investigations
- E. coli: 2 investigations
- Enterobacter spp.: 1 investigation
CRE Surveillance & Epidemiology
CRE Surveillance & Epidemiology

CDC 2015 Surveillance Definition of CRE

• Any Enterobacteriaceae that is either:
  – Resistant to at least one carbapenem antibiotic
  – Demonstrated to produce carbapenemase (e.g. KPC, NDM, OXA, VIM, etc.)
Different kinds of CRE

- Carbapenemase-producing CRE (CP-CRE)
  - produce enzymes that make carbapenem ineffective

- Non carbapenemase-producing CRE (non CP-CRE)
  - resistant by other mechanisms (e.g., ESBL with porin loss mutation)
Urgent Level Threat

- CDC identifies CRE as top tier threat to public health, along with *C. difficile* and drug resistant *Neisseria gonorrhoeae*

- CP-CRE have increased in prevalence throughout the US during the past decade and are a public health priority
CRE Surveillance & Epidemiology

Slide courtesy of Maryn McKenna,
“What do we do when antibiotics don't work any more?” TED2015
Antibiotic Resistance of *Klebsiella pneumoniae* in the United States

Source: Center for Disease Dynamic, Economics, and Policy
CRE Surveillance & Epidemiology

Geographical Distribution of KPC-Producers 2001
Geographical Distribution of KPC-Producers 2005
Geographical Distribution of KPC-Producers 2006
CRE Surveillance & Epidemiology

Geographical Distribution of KPC-Producers 2008
CRE Surveillance & Epidemiology

Geographical Distribution of KPC-Producers 2010
CRE Surveillance & Epidemiology

Geographical Distribution of KPC-Producers 2012
CRE Surveillance & Epidemiology

Geographical Distribution of KPC-Producers 2015
CRE Trends in California

Antibiotic Resistance Patient Safety Atlas
http://gis.cdc.gov/grasp/PSA

Source: CDC National Healthcare Safety Network
CRE Trends in Orange County CA

Hospital and Healthcare-Associated Community Onset CRE Incidence
(N = 21 Hospitals)

Number of New CRE Cases

Gohil S. IDWeek, 2014; Slide courtesy of Susan Huang, UC Irvine
Steps for Investigating CRE
Healthcare-Associated CRE Investigation Quicksheet

- CRE Investigations Quicksheet

- Other HAI investigation quicksheets are available at [www.cdph.ca.gov/HAI](http://www.cdph.ca.gov/HAI)
  - Click on “Public Health Partners”
Investigation Steps

Main Steps

1. Confirm CRE case(s) and gather information

2. Determine appropriate notification and reporting

3. Follow up with healthcare facility to assess for transmission and ensure appropriate infection control measures are in place
Investigation Step: Confirm Case

Facility identifies CRE

• **Clinical cultures** collected because of suspected infection

• **Active surveillance cultures** may include CRE colonization testing of patients in high risk units (e.g., ICU) or upon hospital admission
  – Healthcare exposures outside the US
  – Recent stay in a long term acute care (LTAC) hospital
Investigation Step: Confirm Case

CRE Surveillance Definition, CDC 2015

• Any Enterobacteriaceae that is either:
  – Resistant to at least one carbapenem antibiotic
  -OR-
  – Documented to produce a carbapenemase (e.g. KPC, NDM, OXA, VIM, etc.)
Tests for CP-CRE

• Phenotypic tests (e.g., Modified Hodge Test, Carba-NP) can tell whether a carbapenemase is present, but not the type (e.g., KPC vs. NDM)
• Molecular tests (i.e., PCR-based) can tell what kind of carbapenemase is present
Considerations for Detecting CRE

- CP-CRE is most commonly identified in *Klebsiella* spp., *E. coli*, and *Enterobacter* spp.
- *Acinetobacter* spp. and *Pseudomonas* spp. can produce carbapenemases, although rare
- *Proteus, Providencia, and Morganella* species are intrinsically resistant to imipenem
Collect Patient Information

- Demographics
- Admission date and prior location
- Epidemiologic information (i.e., locations, roommates, procedures, dates on contact precautions, symptoms, onset date)
- Microbiology data (i.e., collection date, specimen source, test type, result)
Main Steps

1. Confirm CRE case(s) and gather information

2. Determine appropriate notification and reporting

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Investigation Step: Notification

Reporting CRE

• Not currently reportable statewide, but may be locally reportable via health order

• Facilities must
  – report outbreaks or unusual occurrences to their LHD and L&C District Office
  – notify LHD when transmission suspected
  – report a single case as unusual occurrence if rarely or never seen
Investigation Step: Notification

• Consider reporting via **CalREDIE** to facilitate information exchange with LHD and HAI Program

• Make sure to report at least
  – Name
  – Date of birth
  – County of residence
  – Healthcare facility
  – Specimen source and collection date
Investigation Step: Assess Transmission

Main Steps

1. Confirm CRE case(s) and gather information

2. Determine appropriate notification and reporting

3. Follow up with healthcare facility to assess for transmission and ensure appropriate infection control measures are in place
Investigation Step: Infection Prevention Strategies

CDC CRE Toolkit
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Investigation Step: Assess Transmission

Surveillance

• Review microbiology laboratory records to identify any previous CRE cases in the past 6-12 months
• Ensure process in place for lab to immediately alert infection prevention staff of any possible CRE in the future
• Instruct laboratory to retain CRE isolates for 6-12 months or duration of investigation
Investigation Step: Assess Transmission

CRE Colonization Testing

• CRE colonized patients
  – can have positive cultures with no clinical signs or symptoms of infection
  – can be source of contamination of environment, HCW hands or clothing

• Testing can identify 70-80% of CRE colonized patients
  – Clinical cultures fail to identify 30-50% of patients with CRE
Investigation Step: Assess Transmission

CRE Colonization Testing

- Facilities should identify method (e.g., rectal or fecal swabs) and access to testing before an outbreak

CDC Lab Protocol for Detection for CRE

https://www.cdc.gov/hai/pdfs/labsettings/klebsiella_or_ecoli.pdf
Investigation Step: Assess Transmission

CRE Colonization Testing: Rectal or Fecal Swabs

- Swabs can be collected and sent to CDC Antibiotic Resistance Regional Lab (ARLN) in Washington State
  - HAI Program can coordinate testing via the ARLN
Investigation Step: Assess Transmission
Investigation Step: Assess Transmission

Examples of Acceptable Swabs for Xpert® Carba-R Assay Testing
Investigation Step: Assess Transmission

Targeted CRE Colonization Testing:

• Patients with epidemiological links to a newly identified CRE case
  – Roommates
  – Patients with shared healthcare personnel
  – Patients with common device/procedure (if suspected source of transmission)
  – Point prevalence survey on unit(s) where transmission suspected
Investigation Step: Infection Prevention Strategies

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Investigation Step: Infection Prevention Strategies

Hand Hygiene

• Promote staff ownership using techniques like local (e.g., unit) champions

• Ensure access to adequate hand hygiene stations (i.e., clean sinks and/or alcohol-based handrubs)

• Adherence monitoring tools available online http://www.cdph.ca.gov/programs/hai/Pages/AdherenceMonitoringTools.aspx
Hand Hygiene Adherence Monitoring Tool

Regular monitoring with feedback of results to staff can improve hand hygiene adherence. Use this tool to identify gaps and opportunities for improvement. Monitoring may be performed in any type of patient care location.

**Instructions:** Observe at least 10 hand hygiene (HH) opportunities per unit. Observe a staff member and record his/her discipline. Check the type of hand hygiene opportunity you are observing. Indicate if HH was performed. Record the total number of successful HH opportunities and calculate adherence.

<table>
<thead>
<tr>
<th>HH Opportunity</th>
<th>Discipline</th>
<th>What type of HH opportunity was observed? (select/✓ 1 per line)</th>
<th>Was HH performed for opportunity observed? ✓ or Ø</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>N</td>
<td>□ before care/entering room* □ before task □ after body fluids □ after care* ✓ upon leaving room</td>
<td>☑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Remember: Hand hygiene should be performed before and after glove use</td>
<td></td>
</tr>
<tr>
<td>HH1.</td>
<td></td>
<td>□ before care/entering room □ before task □ after body fluids □ after care □ upon leaving room</td>
<td></td>
</tr>
<tr>
<td>HH2.</td>
<td></td>
<td>□ before care/entering room □ before task □ after body fluids □ after care □ upon leaving room</td>
<td></td>
</tr>
</tbody>
</table>
Investigation Step: Infection Prevention Strategies

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Facility Guidance for Control of Carbapenem-resistant Enterobacteriaceae (CRE)
November 2015 Update - CRE Toolkit
Investigation Step: Infection Prevention Strategies

Contact Precautions - Key Requirements

• Perform hand hygiene before donning a gown and gloves
• Don gown and gloves before entering the affected patient’s room
• Remove the gown and gloves and performing hand hygiene prior to exiting the affected patient’s room
Investigation Step: Infection Prevention Strategies

- Educate and train HCW on the rationale for and proper use of contact precautions
- Contact precaution adherence should be monitored and adherence rates communicated directly to front line staff

Adherence monitoring tools available at
http://www.cdph.ca.gov/programs/hai/Pages/AdherenceMonitoringTools.aspx
Contact Precautions Adherence Monitoring Tool

Healthcare-Associated Infections Program Adherence Monitoring
Contact Precautions

Regular monitoring with feedback of results to staff can maintain or improve adherence to contact precautions practices. Use this tool to identify gaps and opportunities for improvement. Monitoring may be performed in any type of patient care location where patients are on contact precautions.

Instructions: Observe 3-4 patients/residents on contact precautions. Observe each practice and check a box if adherent, Yes or No. In the column on the right, record the total number of “Yes” for adherent practices observed and the total number of observations (“Yes” + “No”). Calculate adherence percentage in the last row.

<table>
<thead>
<tr>
<th>Contact Precautions Practices</th>
<th>Contact Precautions Patient/Resident 1</th>
<th>Contact Precautions Patient/Resident 2</th>
<th>Contact Precautions Patient/Resident 3</th>
<th>Contact Precautions Patient/Resident 4</th>
<th>Adherence by Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP1. Gloves and gowns are available and located near point of use.</td>
<td>□ Yes □ No</td>
<td>□ Yes □ No</td>
<td>□ Yes □ No</td>
<td>□ Yes □ No</td>
<td># Yes # Observed</td>
</tr>
<tr>
<td>CP2. Signs indicating the patient/resident is on contact precautions are clear and visible.</td>
<td>□ Yes □ No</td>
<td>□ Yes □ No</td>
<td>□ Yes □ No</td>
<td>□ Yes □ No</td>
<td># Yes # Observed</td>
</tr>
<tr>
<td>CP3. The patient/resident on contact precautions is housed in single-room or cohorted based on a clinical risk assessment.</td>
<td>□ Yes □ No</td>
<td>□ Yes □ No</td>
<td>□ Yes □ No</td>
<td>□ Yes □ No</td>
<td># Yes # Observed</td>
</tr>
</tbody>
</table>
Investigation Steps: Infection Prevention Strategies

Use of Contact Precautions for Patients with CRE among California Acute Care Hospitals in 2015 (N=373)

- CP for all infected or colonized with CRE
- CP only for patients infected with CRE
- Only high risk patients or admitted to high risk settings
- None

Source: 2015 NHSN Annual Survey
Investigation Steps: Infection Prevention Strategies

Contact Precautions in Skilled Nursing Facilities

• Should be used for CRE colonized or infected residents at higher risk of CRE transmission
  – Single room preferred
  – If limited, reserve for residents at highest transmission risk

• Standard precautions should always be observed
  – Gloves and/or gowns anytime contact with colonized/infected sites is possible
# Investigation Steps: Infection Prevention Strategies

## Transmission Risk Assessment for Nursing Home Residents

<table>
<thead>
<tr>
<th>Higher Transmission Risk</th>
<th>Lower Transmission Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Totally dependent on assistance for activities of daily living, could include recovering from recent hospitalization</td>
<td>• Less dependent on staff for activities of daily living</td>
</tr>
<tr>
<td>• Incontinent of stool or urine, which cannot be reliably contained</td>
<td>• Continent of stool or urine</td>
</tr>
<tr>
<td>• Cognitively unable to maintain personal hygiene</td>
<td>• Cognitively able to follow instructions to perform hand hygiene</td>
</tr>
<tr>
<td>• Wounds with drainage that is difficult to control</td>
<td>• Do not have draining wounds</td>
</tr>
<tr>
<td>• Ventilator-dependent</td>
<td></td>
</tr>
</tbody>
</table>
Investigation Steps: Infection Prevention Strategies

Contact Precautions - Duration

- Acute Care settings and subacute/ventilator units of nursing homes
  - Maintained for the duration of hospitalization
  - Flag patients upon readmission and place in contact precautions

- Nursing Homes
  - Modify duration based on periodic risk assessment

- Do not perform repeat cultures to demonstrate “clearance”
Investigation Step: Infection Prevention Strategies

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Investigation Steps: Infection Prevention Strategies

Patient Cohorting

- Cohort residents on a single unit, ward, wing
- Patients with the same resistance mechanism may share rooms
- If no private room are available, place with a roommate who is at lowest risk of acquisition
Investigation Steps: Infection Prevention Strategies

Dedicated Staffing

• Primary caregiving staff should be assigned to care for only CRE residents

• Non-dedicated staff (e.g., physical or occupational therapists) should provide care for CRE residents at end of shift
Investigation Step: Infection Prevention Strategies

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Inter-facility Communication

- Instruct healthcare facility to notify transfer hospitals receiving patients with CRE infections or colonization

CDPH Infection Control Transfer Form sample form available at http://www.cdph.ca.gov/programs/hai/Documents/InterfacilityTransferForm_fillable060816.pdf
Infection Control Transfer Form

<table>
<thead>
<tr>
<th>Currently in Isolation Precautions?</th>
<th>☐ Yes</th>
<th>☐ No</th>
</tr>
</thead>
<tbody>
<tr>
<td>If Yes, check:</td>
<td>☐ Contact ☐ Droplet ☐ Airborne ☐ Other: _________</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Did or does have (send documentation, e.g. culture and antimicrobial susceptibility test results with applicable dates):</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA</td>
</tr>
<tr>
<td>VRE</td>
</tr>
<tr>
<td><em>Acinetobacter resistant to carbapenem antibiotics</em></td>
</tr>
<tr>
<td><em>E. coli, Klebsiella or Enterobacter resistant to carbapenem antibiotics (CRE)</em></td>
</tr>
<tr>
<td><em>E. coli or Klebsiella resistant to expanded-spectrum cephalosporins (ESBL)</em></td>
</tr>
<tr>
<td>C. difficile</td>
</tr>
<tr>
<td>Other*:</td>
</tr>
<tr>
<td>^e.g. lice, scabies, disseminated shingles, norovirus, flu, TB, etc</td>
</tr>
</tbody>
</table>

*Additional information if known:

<table>
<thead>
<tr>
<th>Current (or previous) infection or colonization, or ruling out*</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ No known MDRO or communicable diseases</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ No symptoms / PPE not required as “contained”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Check yes to any that currently apply**:</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Cough/uncontrolled respiratory secretions</td>
</tr>
<tr>
<td>☐ Incontinent of urine</td>
</tr>
<tr>
<td>☐ Vomiting</td>
</tr>
<tr>
<td>☐ Acute diarrhea or incontinent of stool</td>
</tr>
<tr>
<td>☐ Draining wounds</td>
</tr>
<tr>
<td>☐ Other uncontained body fluid/ drainage</td>
</tr>
<tr>
<td>☐ Concerning rash (e.g.; vesicular)</td>
</tr>
</tbody>
</table>

**NOTE: Appropriate PPE required ONLY if incontinent/drainage/rash NOT contained.

PERSONAL PROTECTIVE EQUIPMENT CONSIDERATIONS

<table>
<thead>
<tr>
<th>PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Gloves</td>
</tr>
<tr>
<td>☐ Gown</td>
</tr>
<tr>
<td>☐ Mask</td>
</tr>
</tbody>
</table>

CHECK ALL PPE TO BE CONSIDERED AT RECEIVING FACILITY

Answers to sections above

Person completing form: ____________________________
Role: ____________________________ Date: __/__/____

<table>
<thead>
<tr>
<th>Is the patient currently on antibiotics?</th>
<th>☐ Yes</th>
<th>☐ No</th>
</tr>
</thead>
</table>

| Antibiotic | Dose, Frequency | Treatment for: | Start date: | Stop date: |
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Investigation Steps: Infection Prevention Strategies

Chlorhexidine Bathing

• Used in situations where transmission is suspected
• Bathe patients daily in high risk settings like ICUs
  – Skilled nursing facilities may target only high risk residents
• Usually applied to all patients on unit/ward regardless of CRE colonization status
Chlorhexidine Bathing

- Can be effective at reducing MDROs if applied properly
- Evidence shows inadequate bathing can result in suboptimal levels of CHG on the skin

Apply Chlorhexidine **WITH FIRM MASSAGE** to remove bacteria

- **USE ALL 6 CHG CLOTHS**
  - Avoid EYES & EAR CANAL
- **FACE, NECK SHOULDERS & CHEST**
- **BOTH ARMS & HANDS**
- **ABDOMEN, GROIN & PERINEUM**
- **RIGHT LEG & FOOT**
- **LEFT LEG & FOOT**
- **BACK, THEN BUTTOCKS**

- Clean 6 inches of all tubes, lines, and drains closest to patient with CHG
- Safe on superficial wounds, rash, burns

Skin may feel sticky for a few minutes after CHG application. Do **NOT** wipe off. Allow to air dry.

**THIS IS a PROTECTIVE BATH**

Do not use soap which can inactivate CHG

Graphic courtesy of Susan Huang
NDM-producing *Klebsiella pneumoniae*

- Outbreak at an acute care hospital and associated skilled nursing facility
- Hospital screened index patient on admission based on history of healthcare in India → NDM+
- 2\(^{nd}\) patient, a neighbor of index patient, screened NDM+ several weeks later
- Reported to LHD and L&C District Office
CP-CRE Investigation: Case Study

NDM-producing *Klebsiella pneumoniae*

- Public health worked with hospital to assess transmission and recommend control measures
  - Hospital conducted in-depth review of potential routes of transmission
  - Hospital implemented CRE colonization testing
    - ICU, stepdown, and med-telemetry unit
    - Admissions from area nursing homes → 3 additional cases from a nursing home providing subacute care
  - LHD conducted site visit at nursing home
NDM-producing *Klebsiella pneumoniae*

- Network analysis of patient sharing using CMS discharge datasets
- Several other facilities that shared patients with index facility identified
- LHD notified other facilities in network
Summary

Public health departments can assist facilities investigating cases of CRE

• Ensure facilities are prepared to identify CRE

• Help guide strategies to assess for and prevent transmission

• Implement coordinated response to contain transmission across continuum of care
Summary

Important investigation steps

• Confirm CRE case(s), and gather information

• Determine appropriate notification and reporting

• Follow up with healthcare facility to assess for transmission and ensure appropriate infection control measures are in place
Thank you for participating!

Next HAI Investigation Webinar: Thursday, April 27, at 11am

“Acute Viral Hepatitis Investigations”
Additional Resources

- CDPH HAI Program CRE Investigation Quicksheet

- CACDC Recommendations for Infection Control for Residents with CRE in Long-Term Care Facilities
  http://www.cdph.ca.gov/programs/cid/Documents/CareofCREinLongTermCareFacilities.pdf

- CDPH information about CRE
  http://www.cdph.ca.gov/programs/hai/Pages/Carbapenem-ResistantEnterobacteriaceae.aspx
Additional Resources

• FAQ regarding the CRE Definition
  https://www.cdc.gov/hai/organisms/cre/definition.html

• CDC Facility Guidance for Control of CRE

• CDC Laboratory Protocol for Detection of Carbapenem Resistant Klebsiella app. And E. coli from Rectal Swabs
Additional Resources

- Agency for Healthcare Research- CRE Control and Resistance Toolkit

- CDPH Infection Control Transfer Form
  http://www.cdph.ca.gov/programs/hai/Documents/InterfacilityTransferForm_fillable060816.pdf

- Licensing and Certification District Offices
  http://www.cdph.ca.gov/certlic/facilities/Pages/LCDistrictOffices.aspx
Questions?

The HAI Program is available for consultation. Contact us by email:

HAIProgram@cdph.ca.gov