Investigating Carbapenem-Resistant Enterobacteriaceae

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California Department of Public Health

California Department of PublicHealth

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

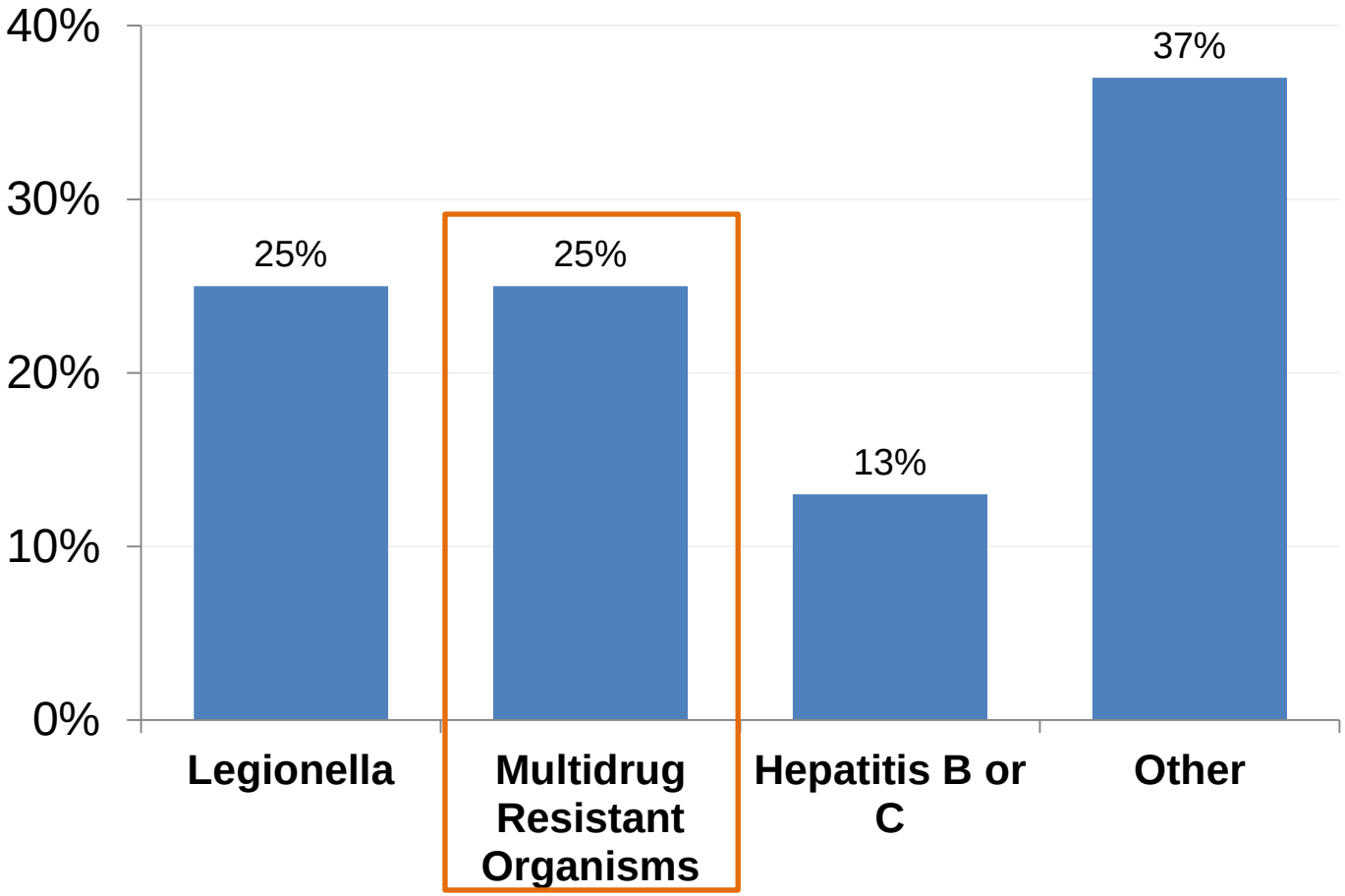
Coordination

- 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

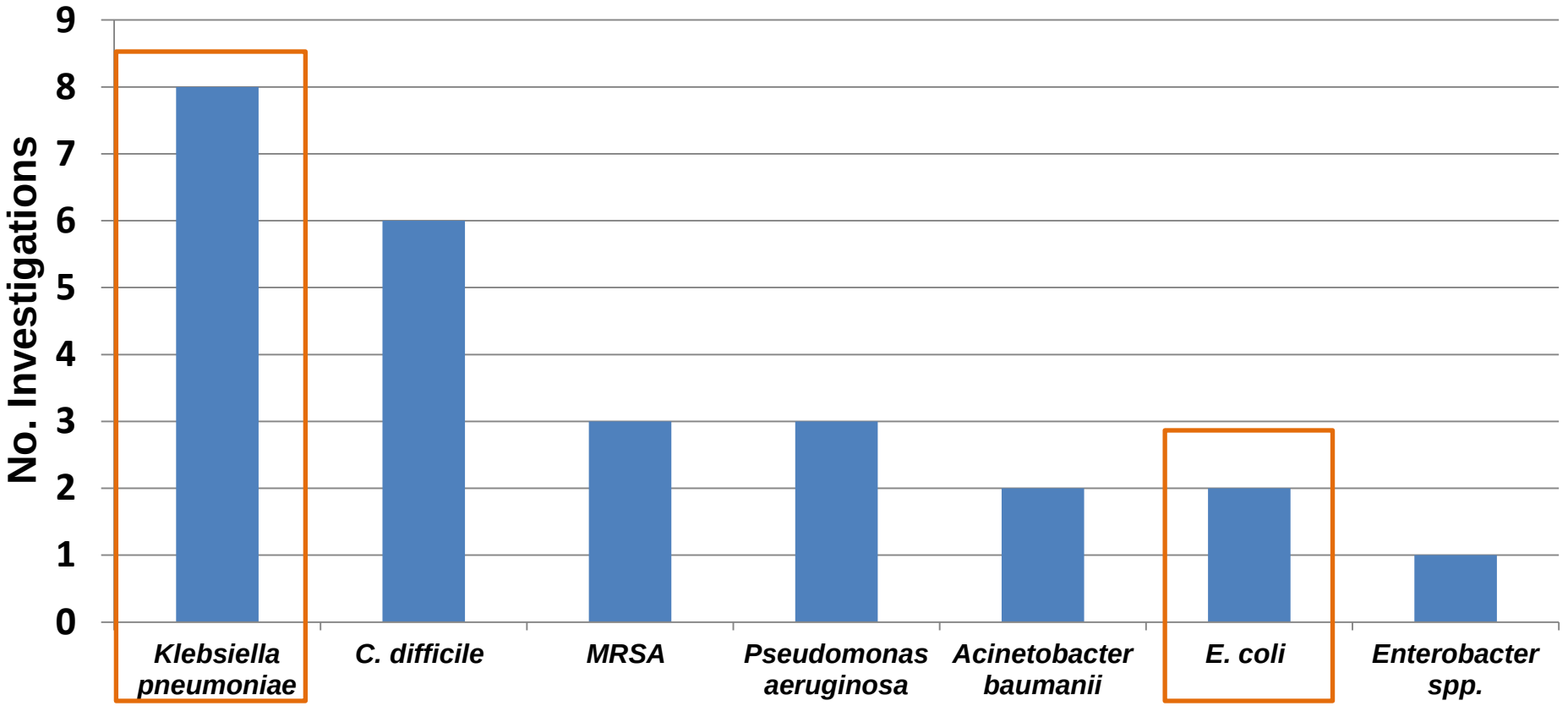
HAI Program Assistance to LHD, 2015-2016

- 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



HAI Program Assistance to LHD for Investigations of Multidrug Resistant Pathogens, 2015-present



CRE Surveillance & Epidemiology

CRE Surveillance & Epidemiology

CDC 2015 Surveillance Definition of CRE

- Any Enterobacteriaceae that is either:
  - Resistant to at least one carbapenem antibiotic

- OR -

  - Demonstrated to produce carbapenemase (e.g. KPC, NDM, OXA, VIM, etc.)

CRE Surveillance & Epidemiology

Different kinds of CRE

- Carbapenemase-producing CRE (CP-CRE)
  - produce enzymes that make carbapenems ineffective
- Non carbapenemase-producing CRE (non CP-CRE)
  - resistant by other mechanisms (e.g., ESBL with porin loss mutation)

CRE Surveillance & Epidemiology

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

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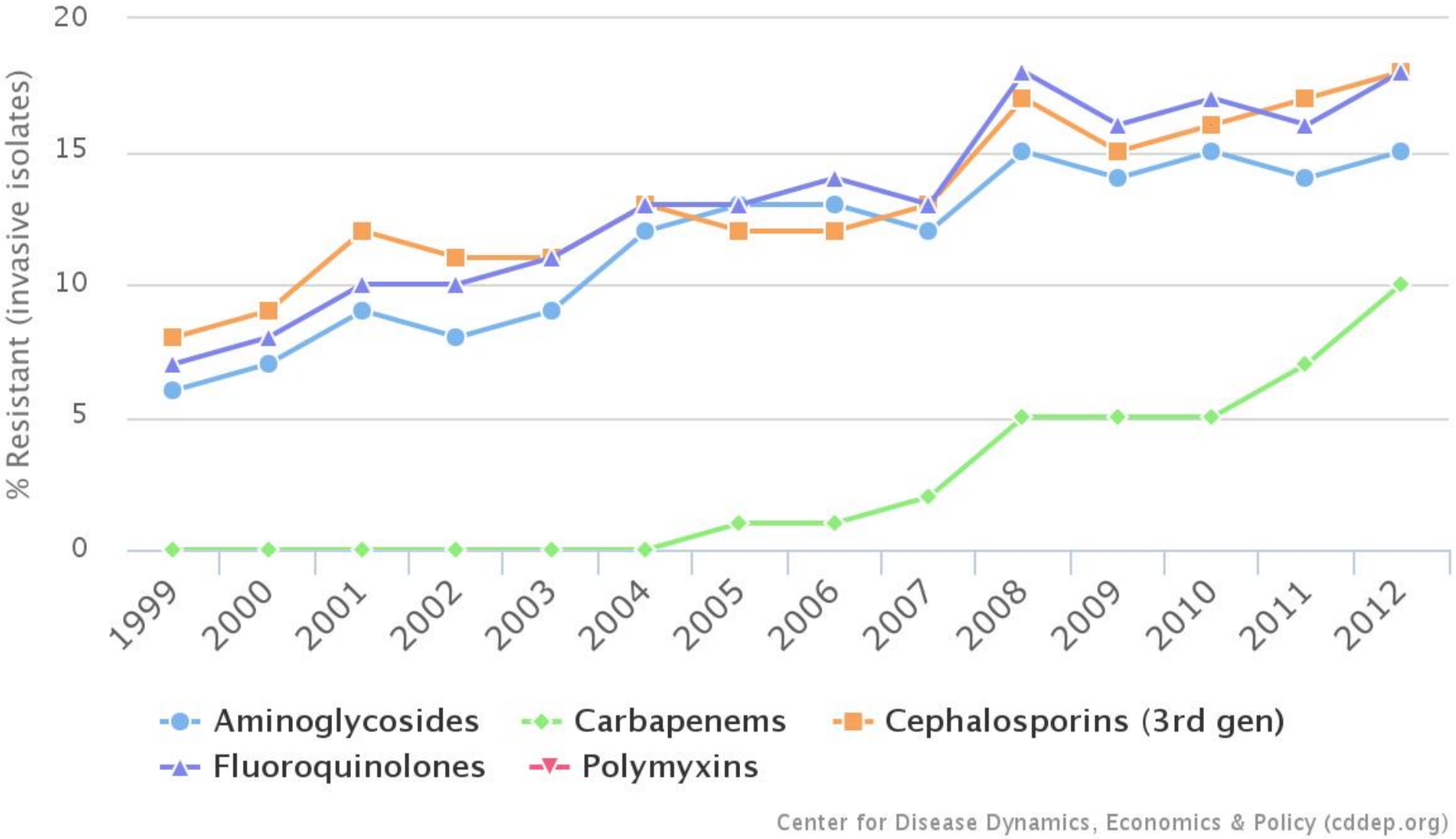
Antibiotic Resistance of *Klebsiella pneumoniae* in United States



Source: Center for Disease Dynamic, Economics, and Policy

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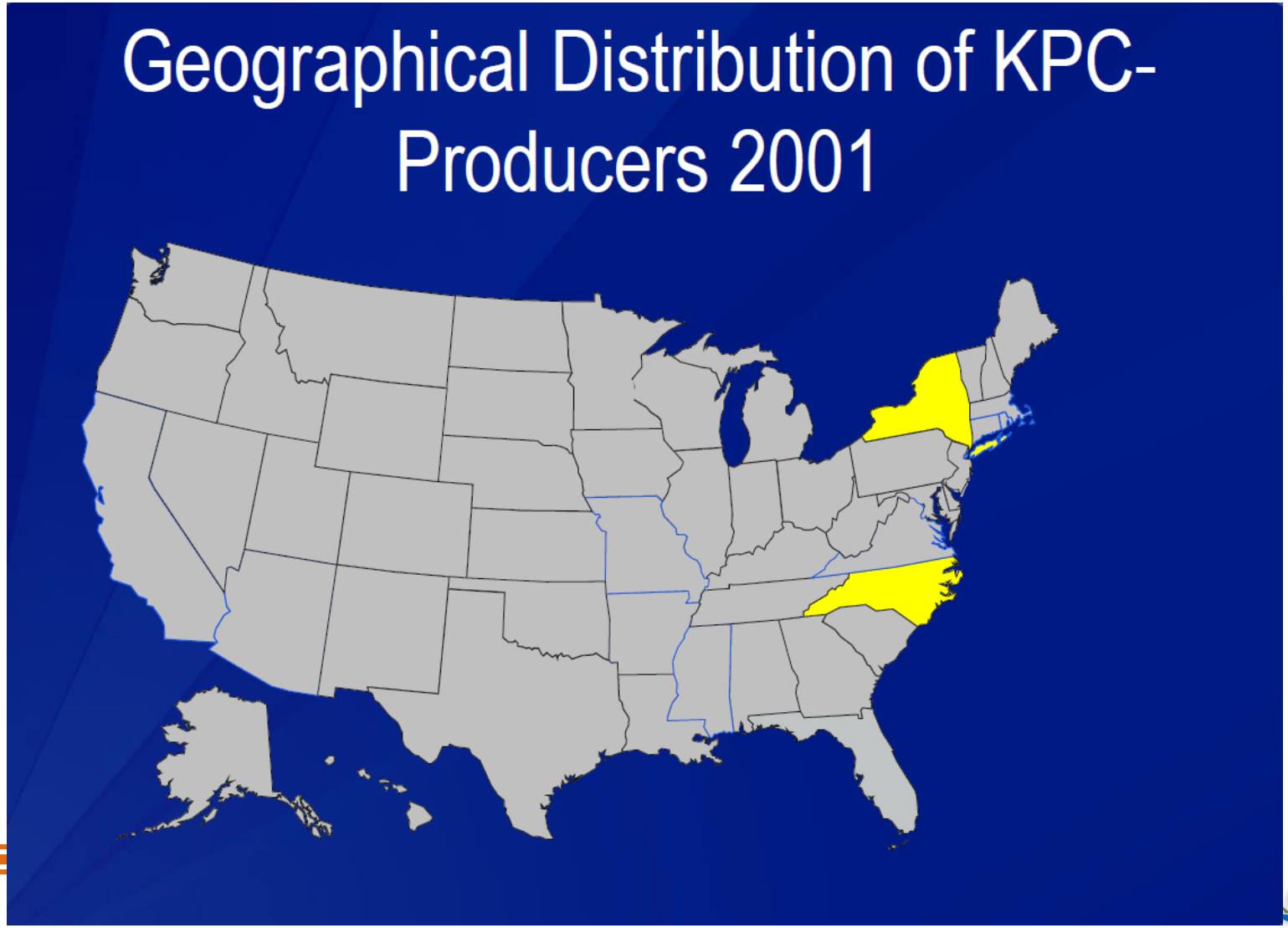

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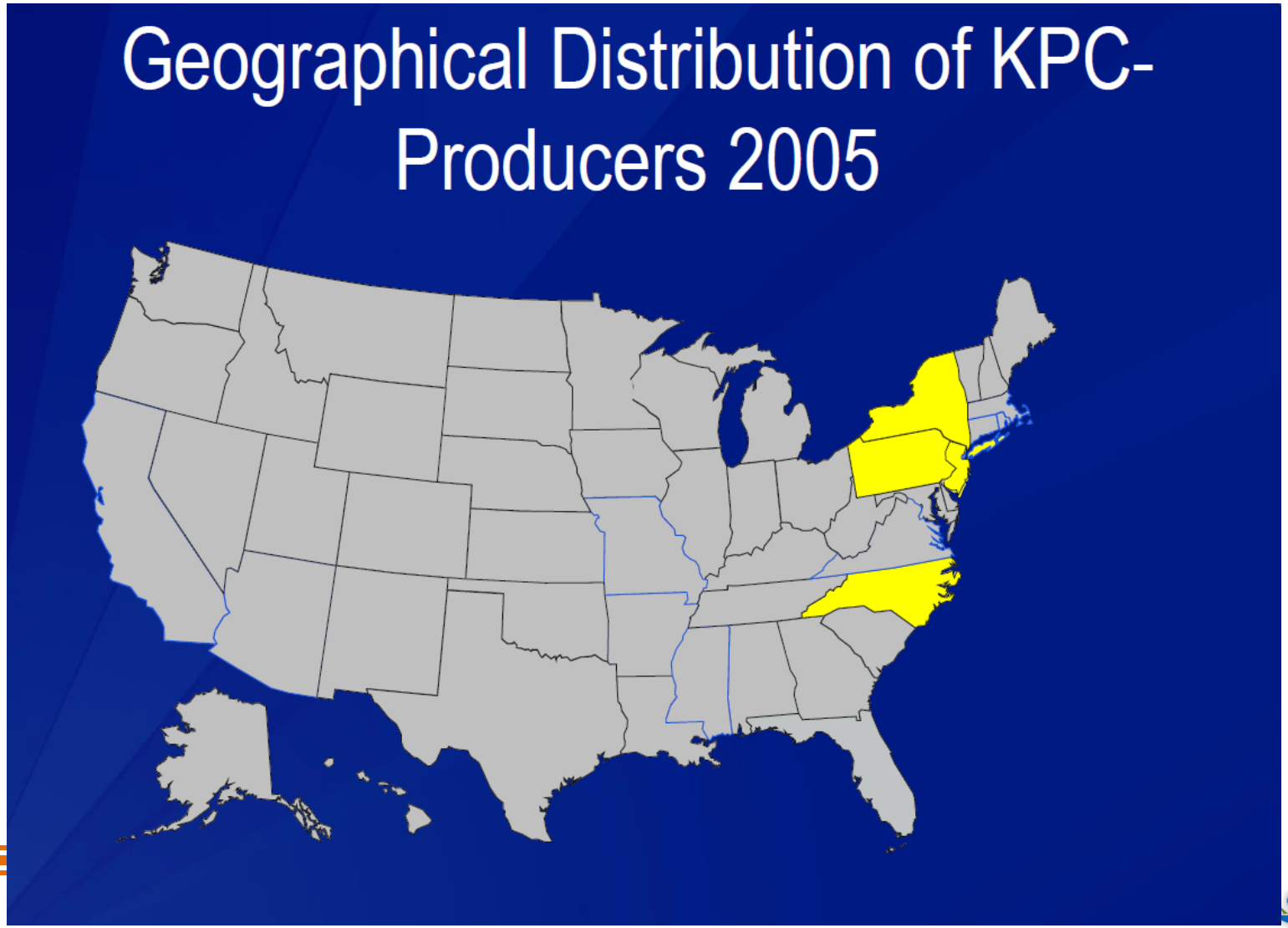

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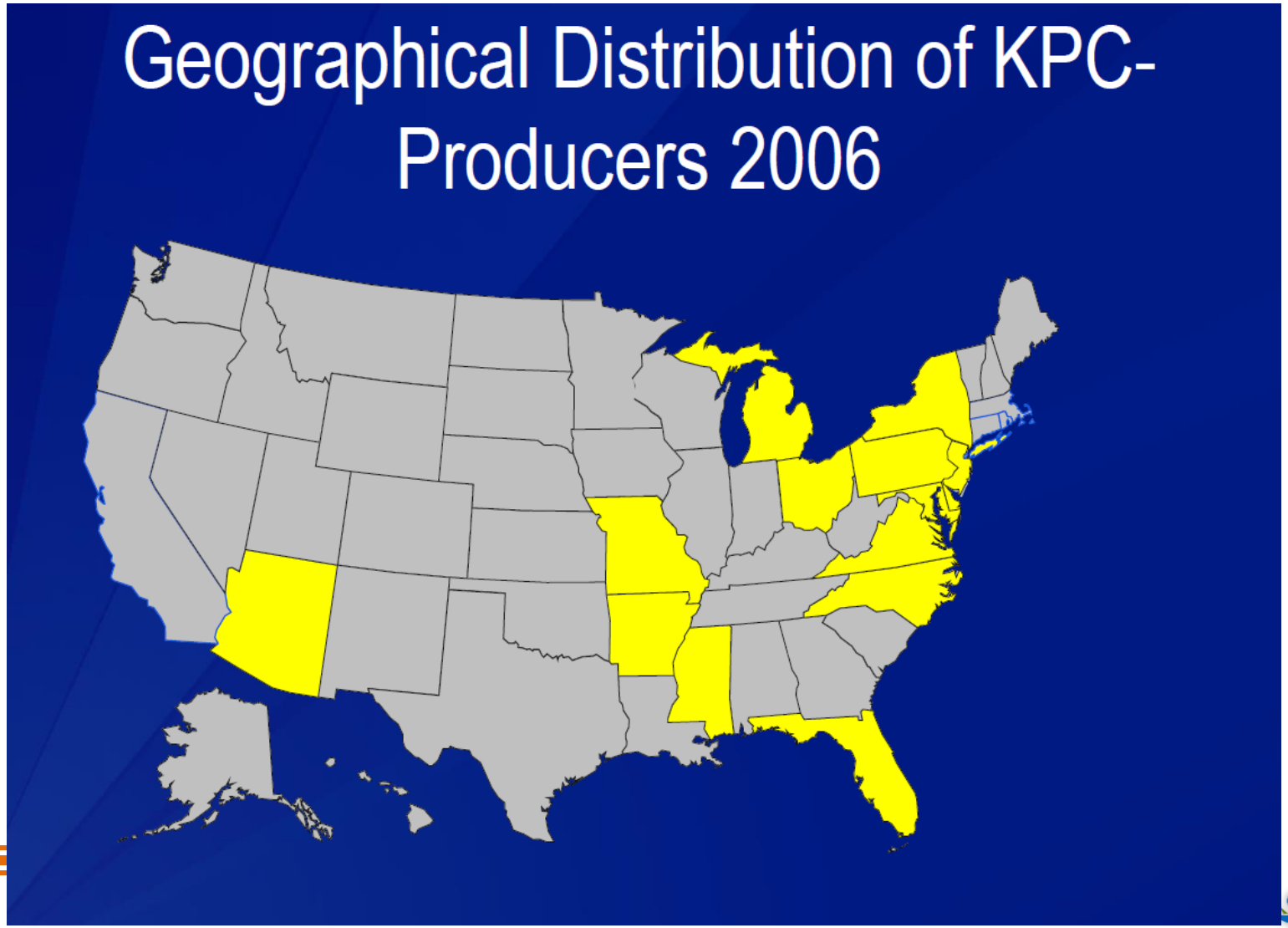

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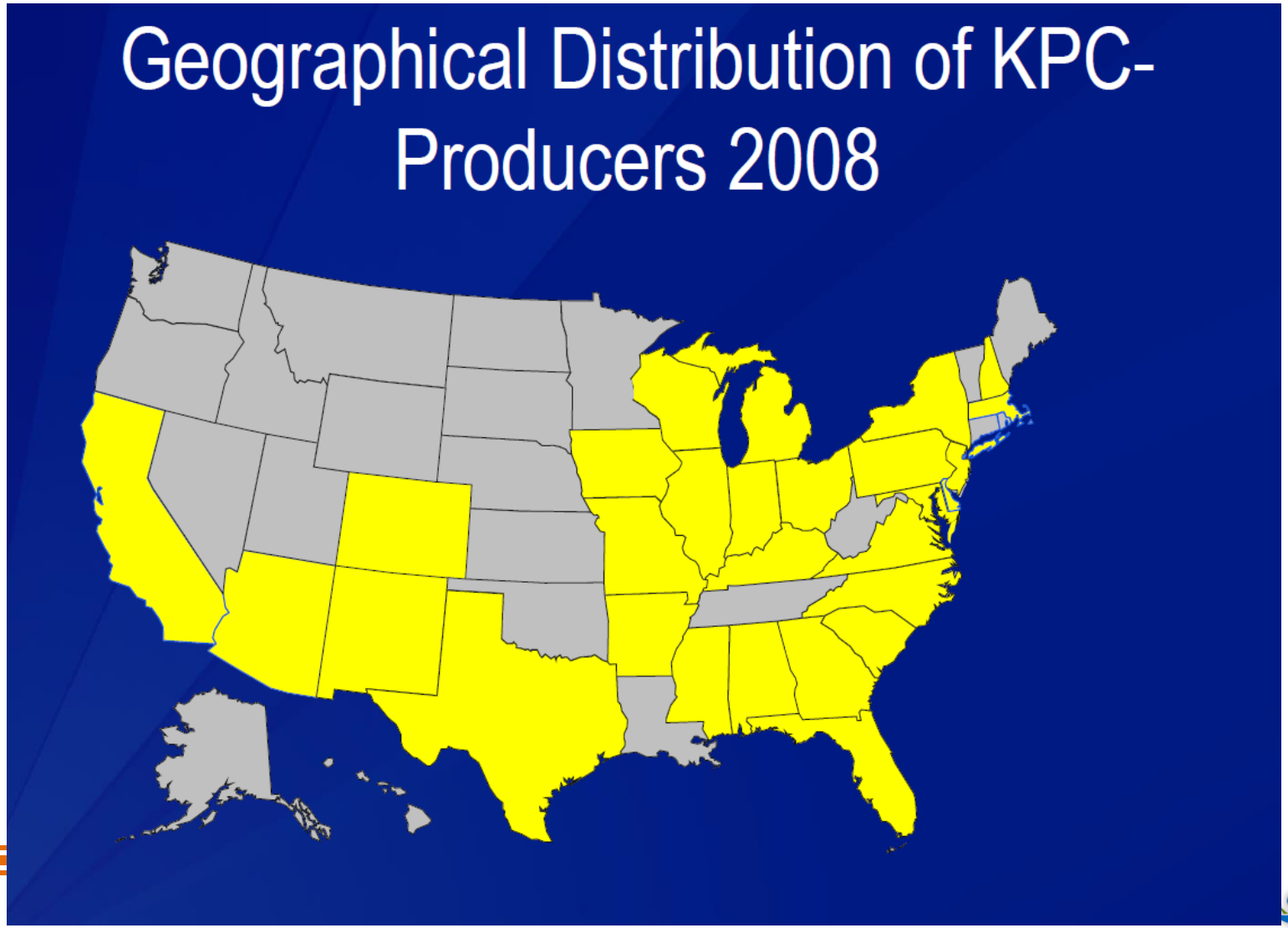
CRE Surveillance & Epidemiology



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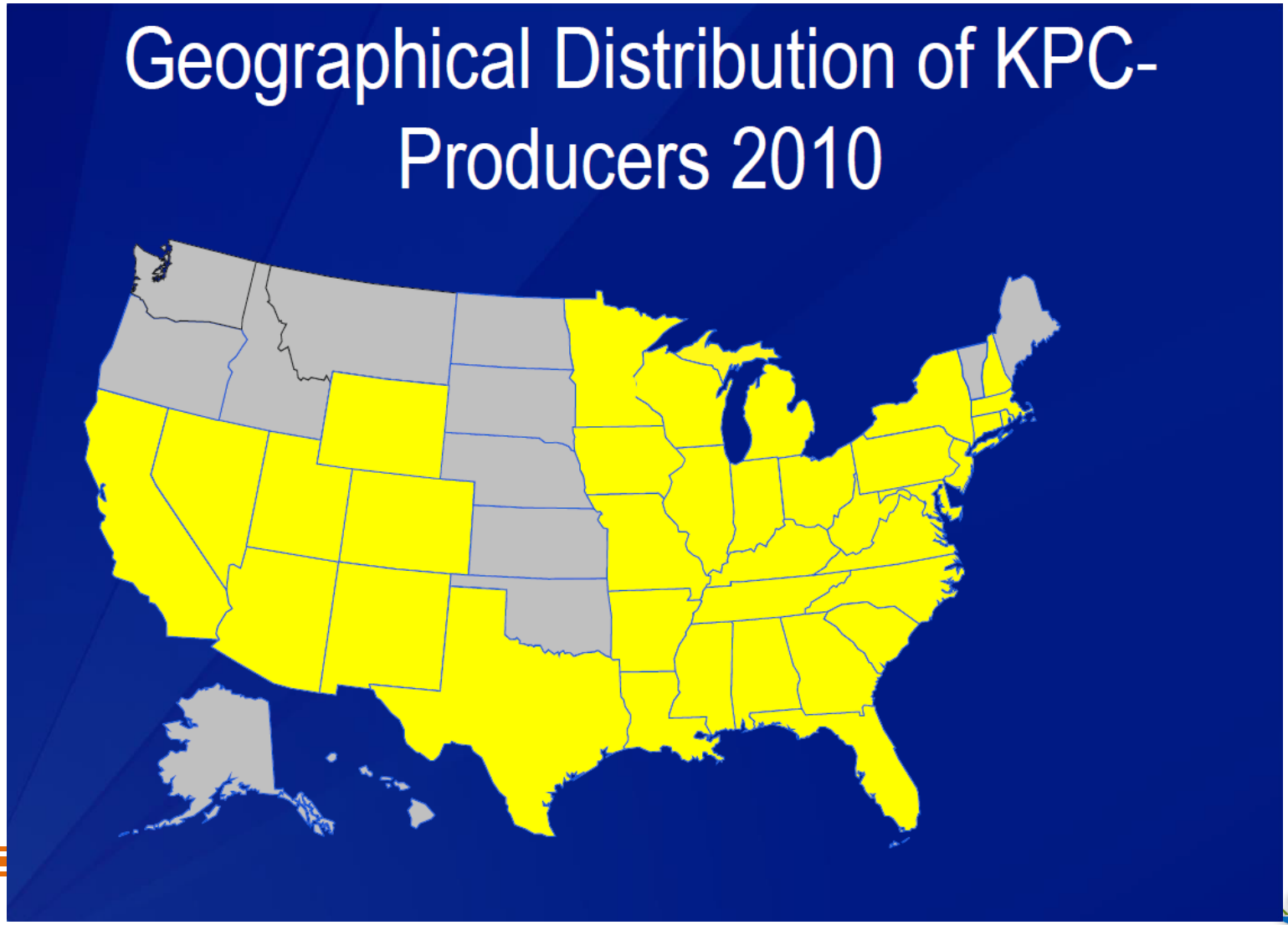

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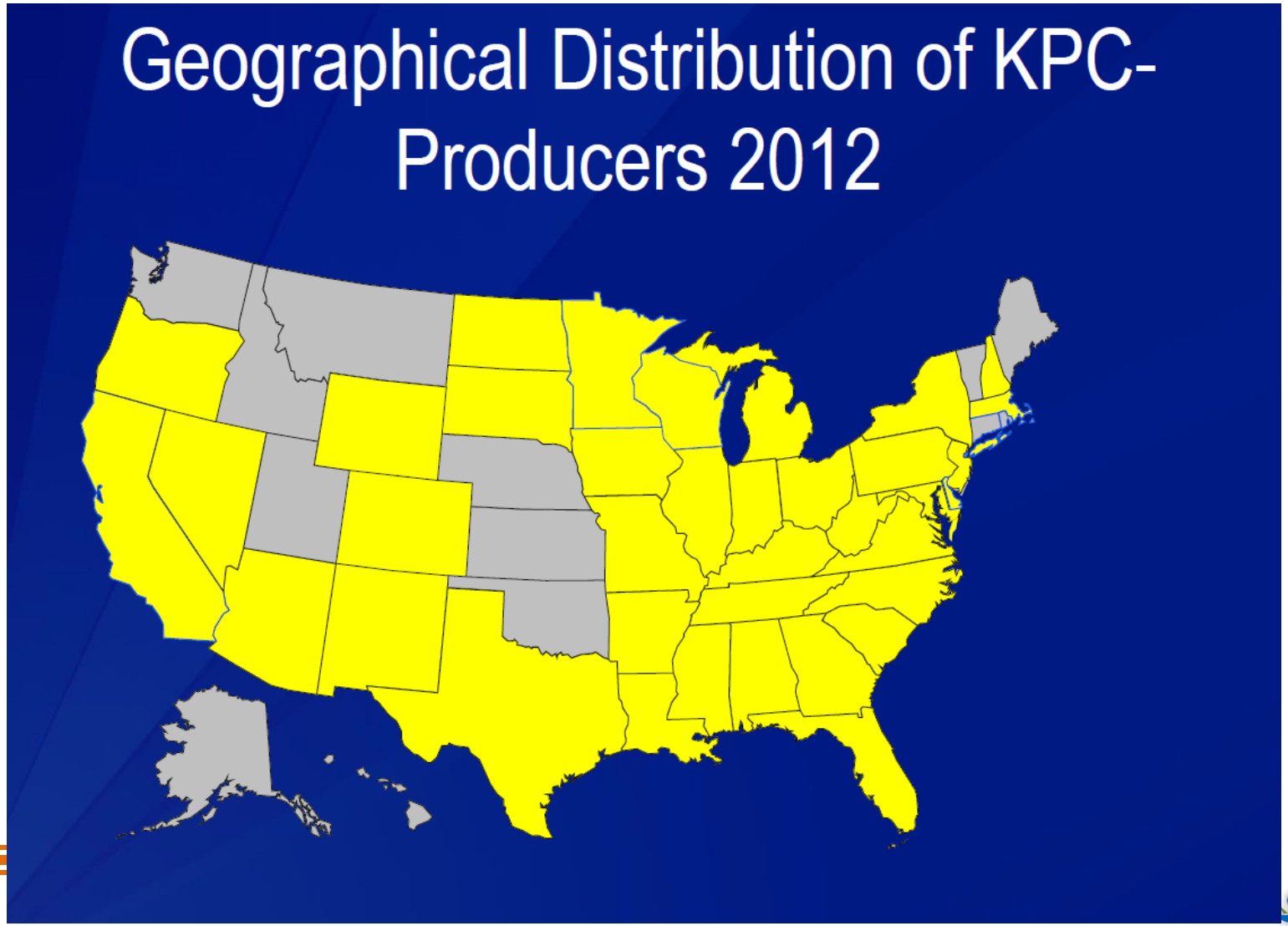

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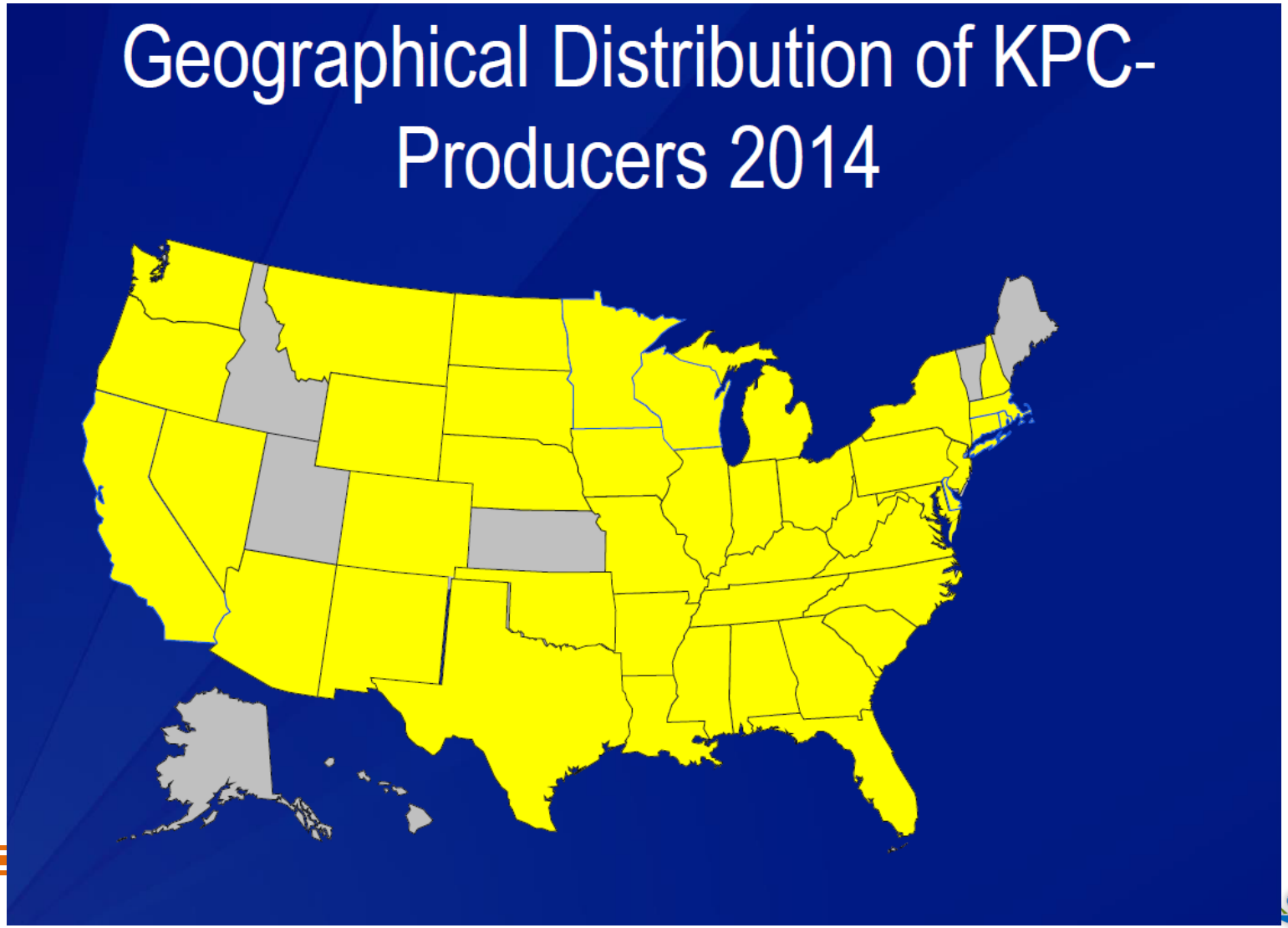

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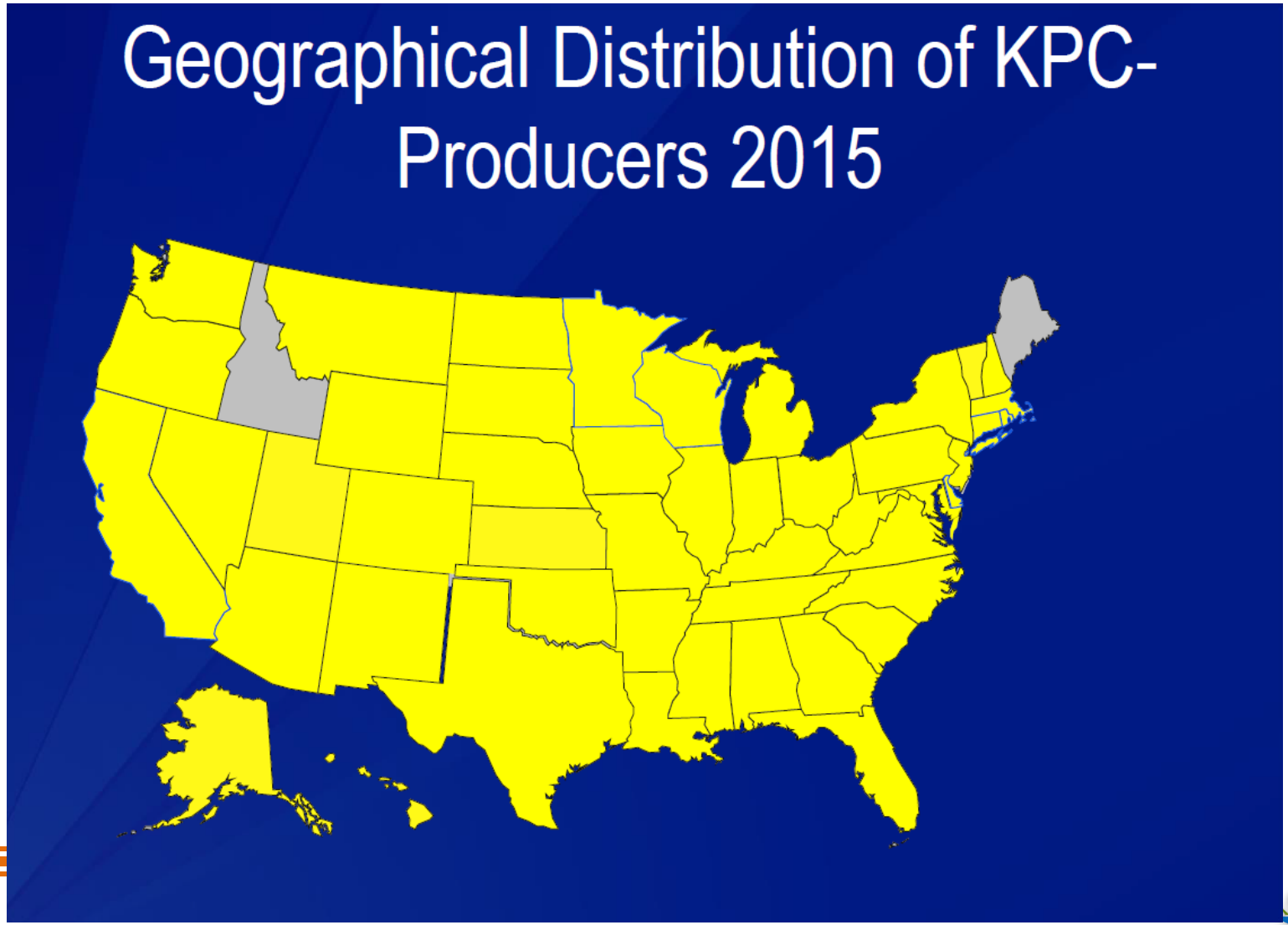

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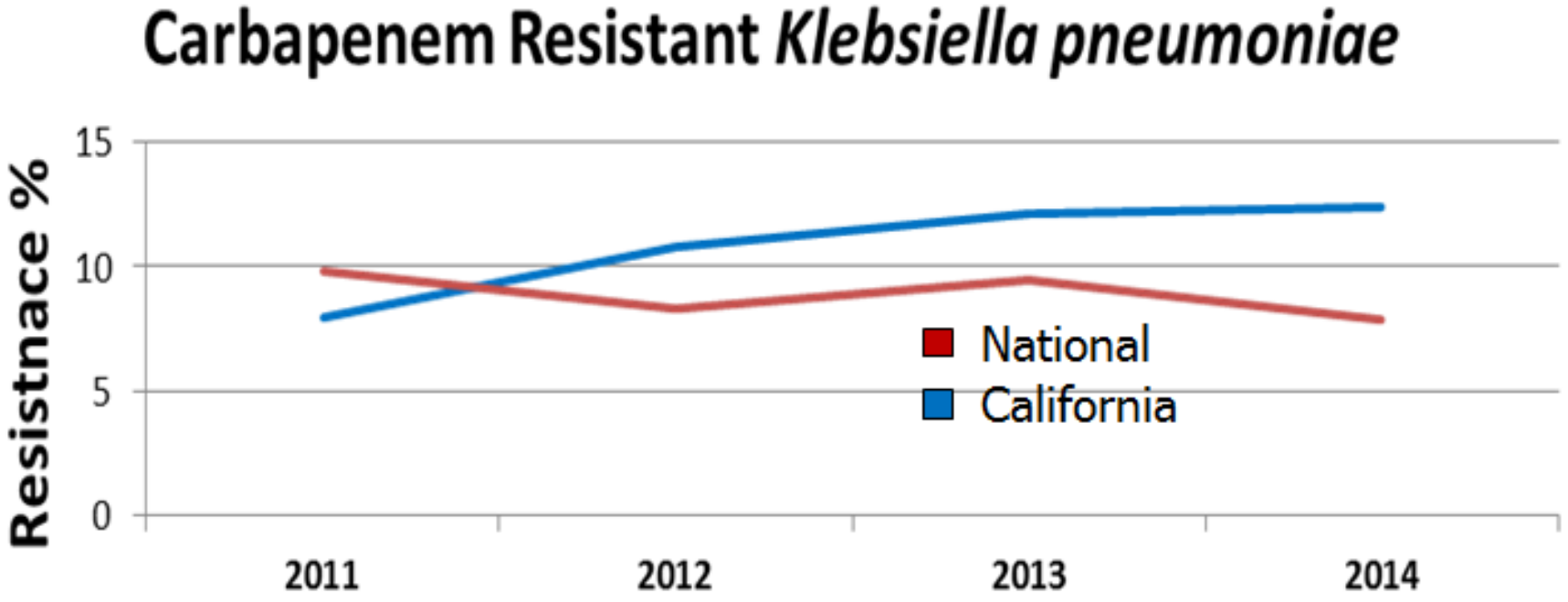
CRE Trends in California



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

Source: CDC National Healthcare Safety Network

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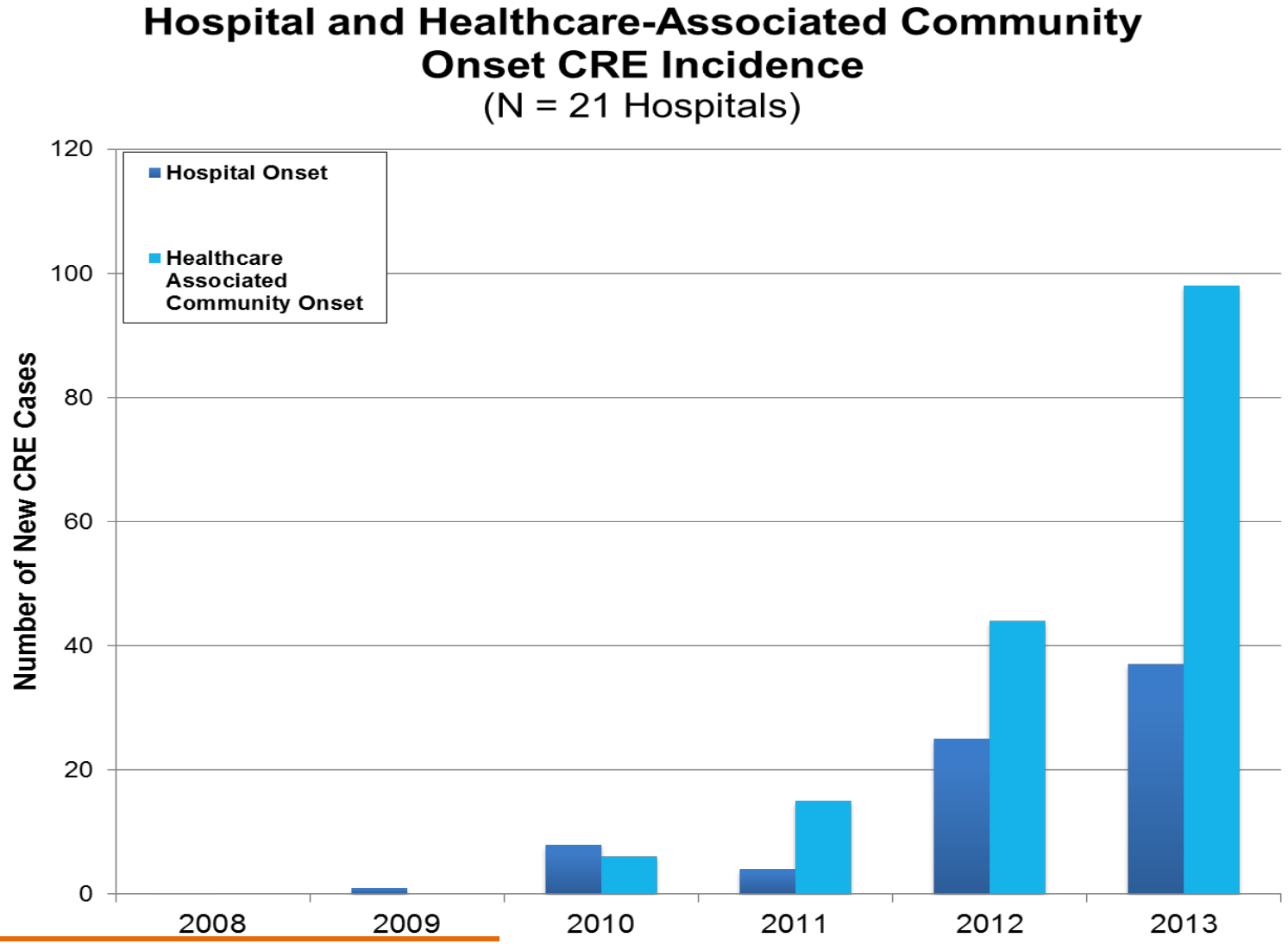
CRE Trends in Orange County CA



Gohil S. IDWeek, 2014; Slide courtesy of Susan Huang, UC Irvine

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Steps for Investigating CRE

Healthcare-Associated CRE Investigation Quicksheet

- CRE Investigations Quicksheet

  http://www.cdph.ca.gov/programs/hai/Documents/CRE_Quicksheet_Jan2017.pdf

- Other HAI investigation quicksheets are available at 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.)

Investigation Step: Confirm Case

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

Investigation Step: Confirm Case

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

Investigation Step: Gather Information

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)

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: 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 <u>at least</u>
  - Name
  - Date of birth
  - County of residence
  - Healthcare facility
  - Specimen source and collection date

Investigation Step: Assess Transmission

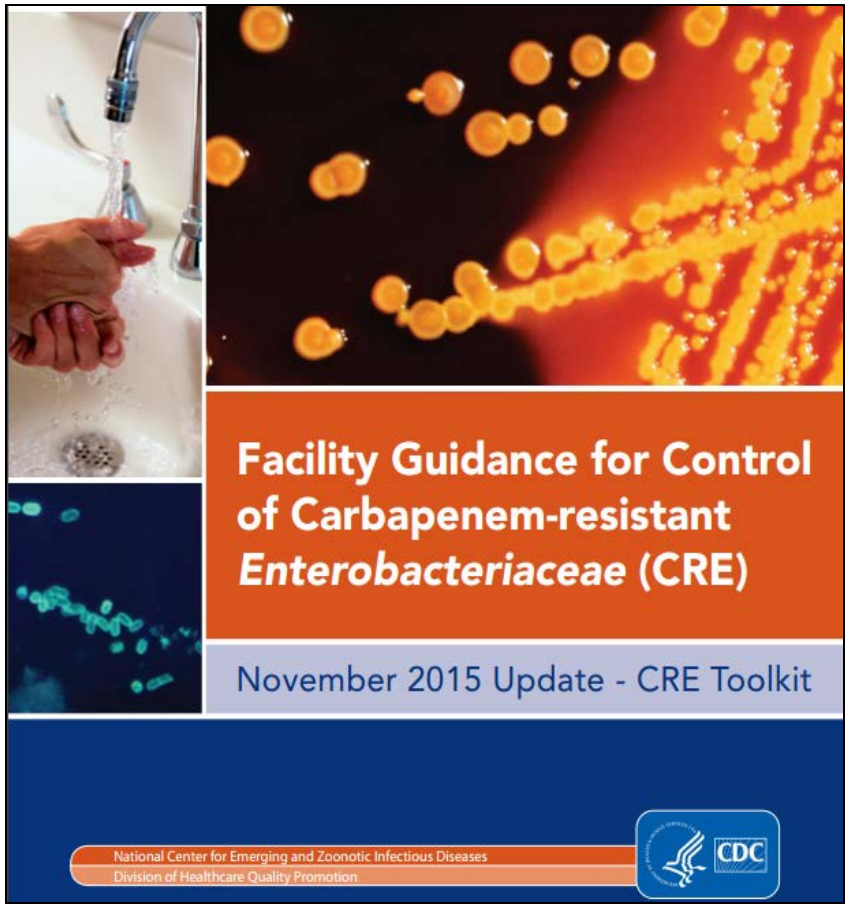
Main Steps

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

1. Hand Hygiene
2. Contact Precautions
3. Healthcare Worker Education
4. Minimize Device Use
5. Rapid Laboratory Notification
6. Inter-facility Communication
7. Antimicrobial Stewardship
8. Environmental Cleaning
9. Patient and Staff Cohorting
10. Screen CRE Patient Contacts
11. Active Surveillance Testing
12. Chlorhexidine (CHG) Bathing



Investigation Step: Infection Prevention Strategies

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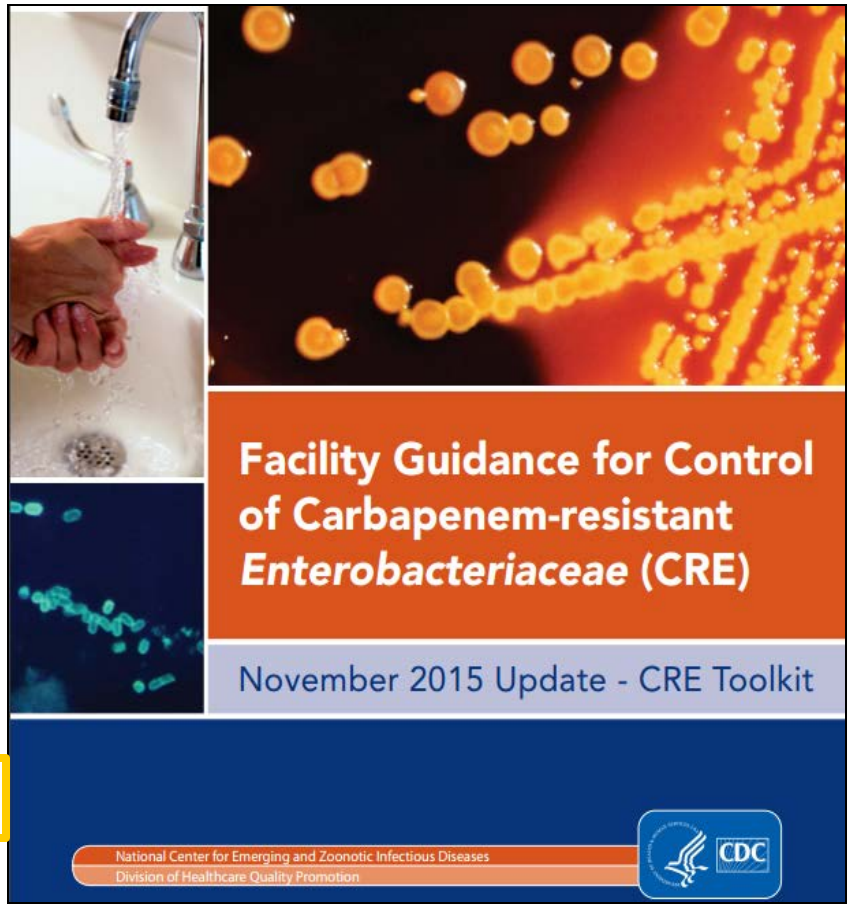

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Investigation Step: Assess Transmission

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

Examples of Highly Soiled Swabs
Do not use with the Xpert Carba-R Assay

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

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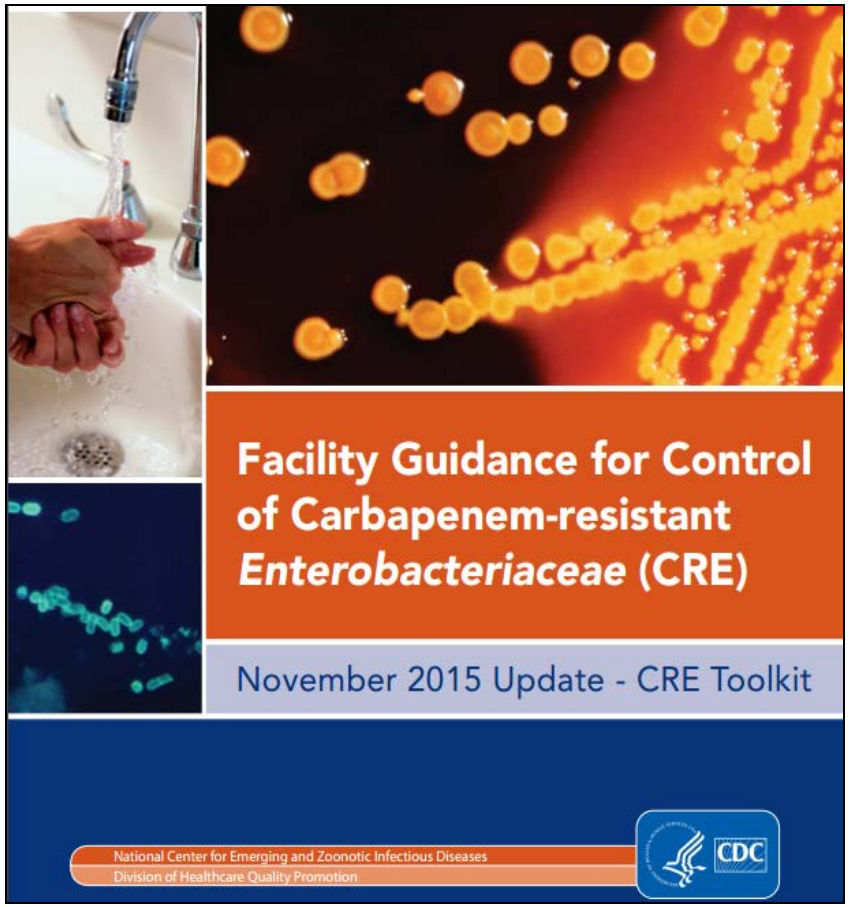

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Investigation Step: Infection Prevention Strategies

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

Healthcare-Associated Infections Program Adherence Monitoring
Hand Hygiene

Assessment completed by:
Date:
Unit:

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.

HH Opportunity	Discipline	What type of HH opportunity was observed? (select/ ☑ 1 per line)	Was HH performed for opportunity observed? ✓ or Ø
Example	N	☐ before care/entering room* ☐ before task ☐ after body fluids ☐ after care* ☑ upon leaving room *Remember: Hand hygiene should be performed before and after glove use	✓
HH1.		☐ before care/entering room ☐ before task ☐ after body fluids ☐ after care ☐ upon leaving room	
HH2.		☐ before care/entering room ☐ before task ☐ after body fluids ☐ after care ☐ upon leaving room	

Investigation Step: Infection Prevention Strategies

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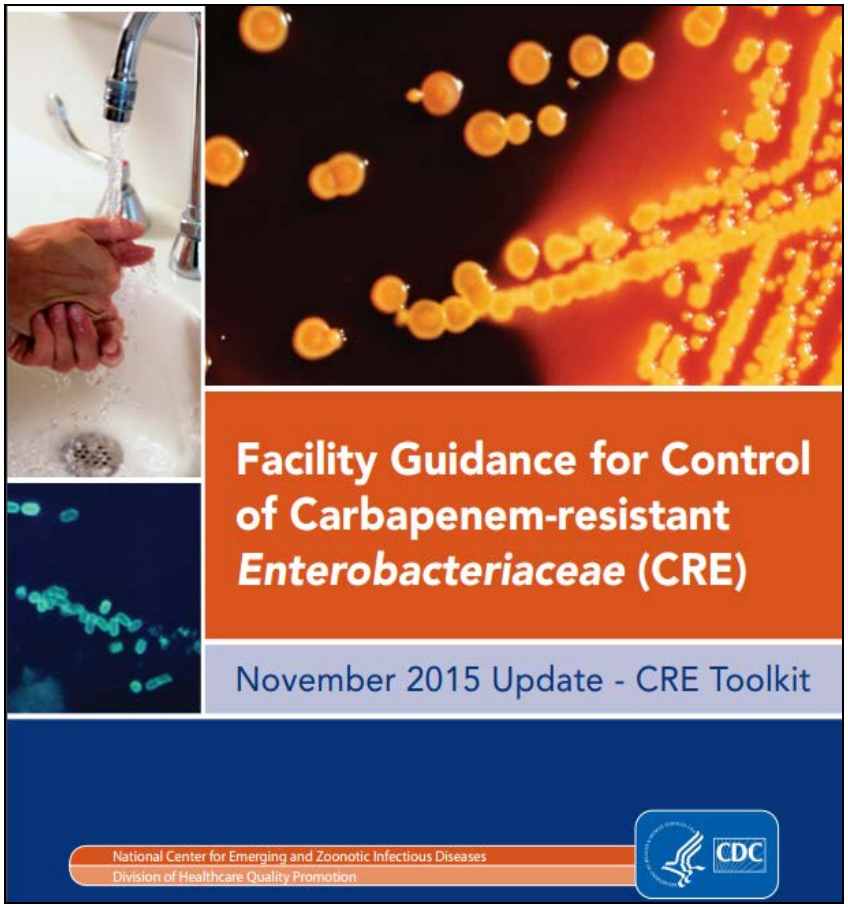

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Investigation Step: Infection Prevention Strategies

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

Assessment completed by:
Date:
Unit:

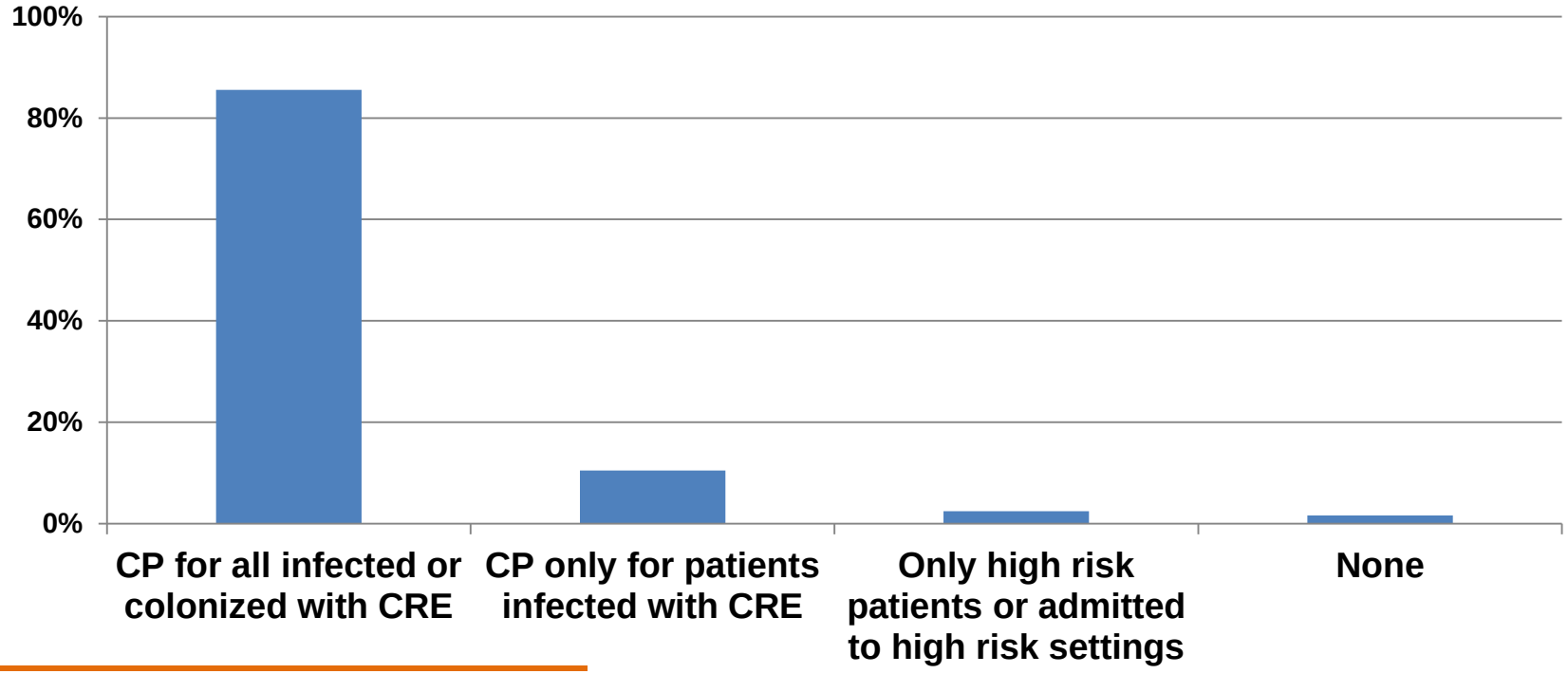
Regular monitoring with feedback of results to staff can maintain or improve adherence to contact precautions practices. Use this tool to identify gaps and opportunities for improvement. Monitoring may be performed in any type of patient care location where patients are on contact precautions.

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.

Contact Precautions Practices		Contact Precautions Patient/Resident 1	Contact Precautions Patient/Resident 2	Contact Precautions Patient/Resident 3	Contact Precautions Patient/Resident 4	Adherence by Task	
						# Yes	# Observed
CP1.	Gloves and gowns are available and located near point of use.	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No		
CP2.	Signs indicating the patient/resident is on contact precautions are clear and visible.	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No		
CP3.	The patient/resident on contact precautions is housed in single-room or cohorted based on a clinical risk assessment.	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No		

Investigation Steps: Infection Prevention Strategies

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



Source: 2015 NHSN Annual Survey

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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

Higher Transmission Risk	Lower Transmission Risk
• Totally dependent on assistance for activities of daily living, could include recovering from recent hospitalization	• Less dependent on staff for activities of daily living
• Incontinent of stool or urine, which cannot be reliably contained	• Continent of stool or urine
• Cognitively unable to maintain personal hygiene	• Cognitively able to follow instructions to perform hand hygiene
• Wounds with drainage that is difficult to control	• Do not have draining wounds
• Ventilator-dependent	

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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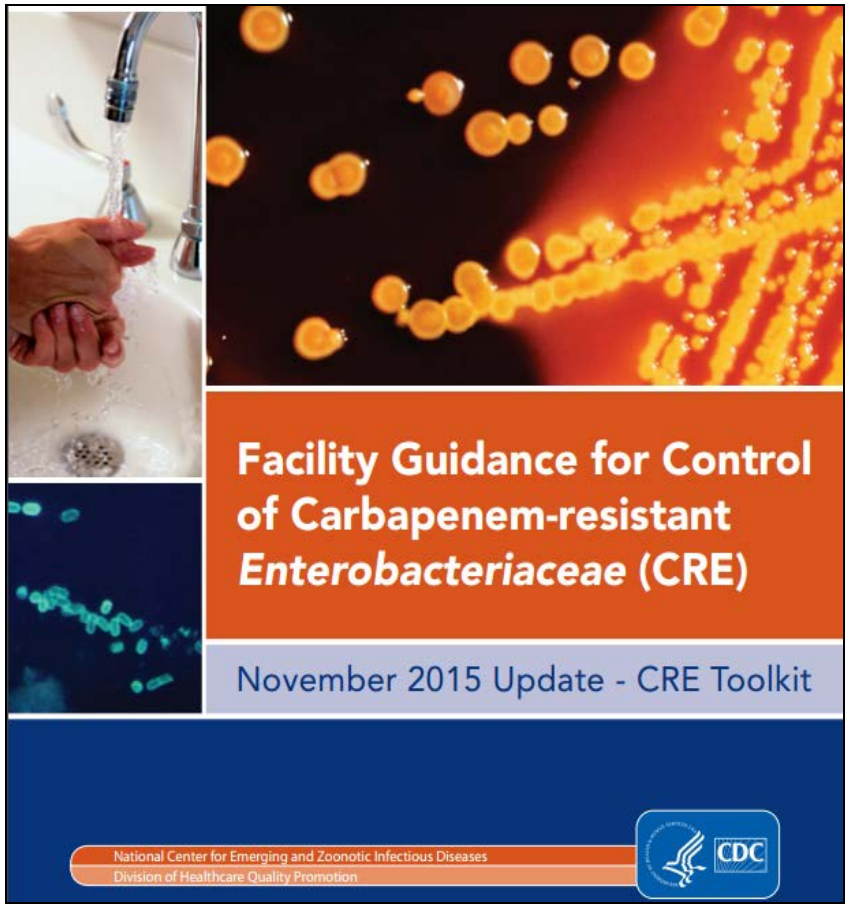

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Investigation Steps: Infection Prevention Strategies

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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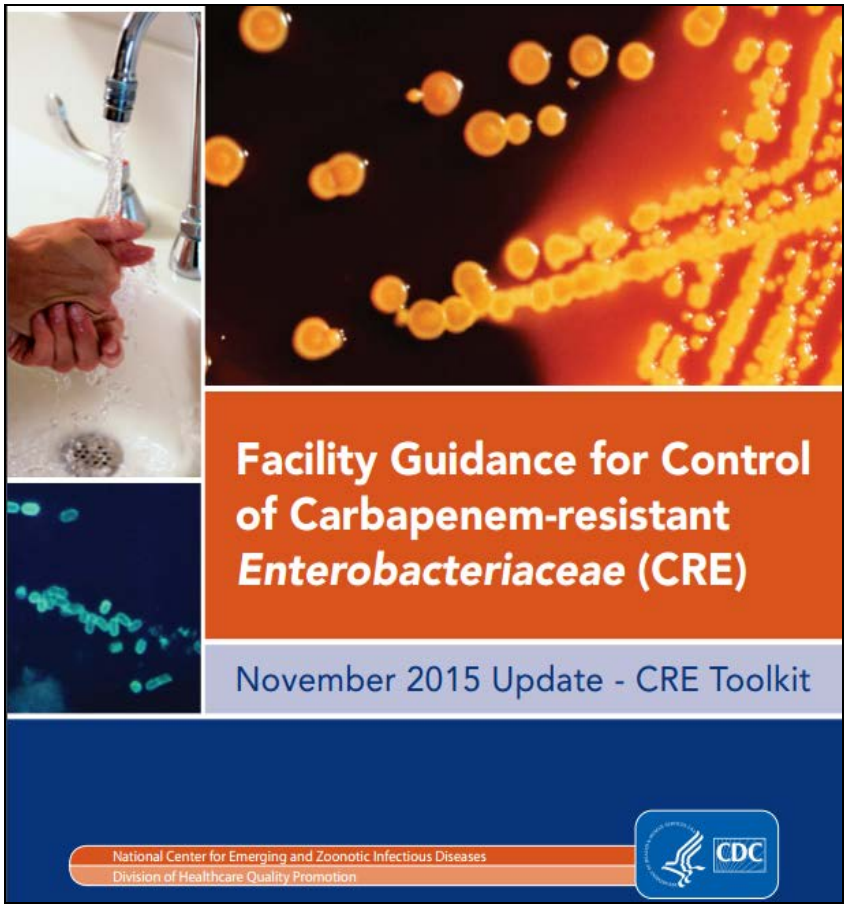

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Investigation Steps: Infection Prevention Strategies

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

⚠	**Currently in Isolation Precautions?** ☐ **Yes** **If Yes, check:** ☐ Contact ☐ Droplet ☐ Airborne ☐ Other: _____	☐ **No** isolation precautions

Organisms	**Did or does have** (send documentation, e.g. culture and antimicrobial susceptibility test results with applicable dates):	Current (or previous) infection or colonization, or ruling out *	☐ **No** known MDRO or communicable diseases
	MRSA	☐	
	VRE	☐	
	Acinetobacter resistant to carbapenem antibiotics	☐	
	E. coli, *Klebsiella* or *Enterobacter* resistant to carbapenem antibiotics (CRE)	☐	
	E. coli or *Klebsiella* resistant to expanded-spectrum cephalosporins (ESBL)	☐	
	C. difficile	☐	
	Other^: _____ ^*e.g. lice, scabies, disseminated shingles, norovirus, flu, TB, etc*	☐ **(current or ruling out*)**	
	***Additional information if known:**		

Symptoms	**Check yes to any that currently apply**:**		☐ **No** symptoms / PPE not required as "contained"
	☐ Cough/uncontrolled respiratory secretions	☐ Acute diarrhea or incontinent of stool	
	☐ Incontinent of urine	☐ Draining wounds	
	☐ Vomiting	☐ Other uncontained body fluid/drainage	
		☐ Concerning rash (e.g.; vesicular)	
	****NOTE: Appropriate PPE required ONLY if incontinent/drainage/rash NOT contained.**		

PPE	**PERSONAL PROTECTIVE EQUIPMENT CONSIDERATIONS**
	 ☐ ☐ ☐ **CHECK ALL PPE TO BE CONSIDERED AT RECEIVING FACILITY**

Answers to sections above

ANY YES → **PERSONAL PROTECTIVE EQUIPMENT CONSIDERATIONS**

ALL NO →

Person completing form: _____
Role: _____ Date: __/__/__

Risk Factors	***Is the patient currently on antibiotics?*** ☐ **Yes** ☐ **No**				
	Antibiotic	**Dose, Frequency:**	**Treatment for:**	**Start date:**	**Stop date:**

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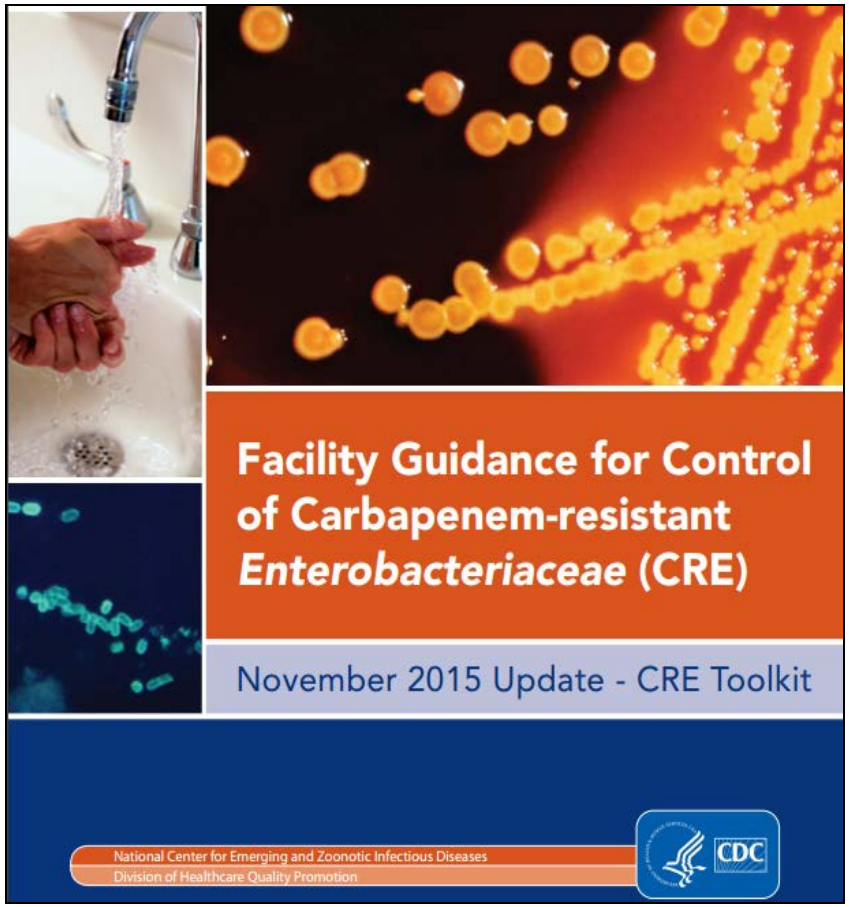


Investigation Steps: Infection Prevention Strategies

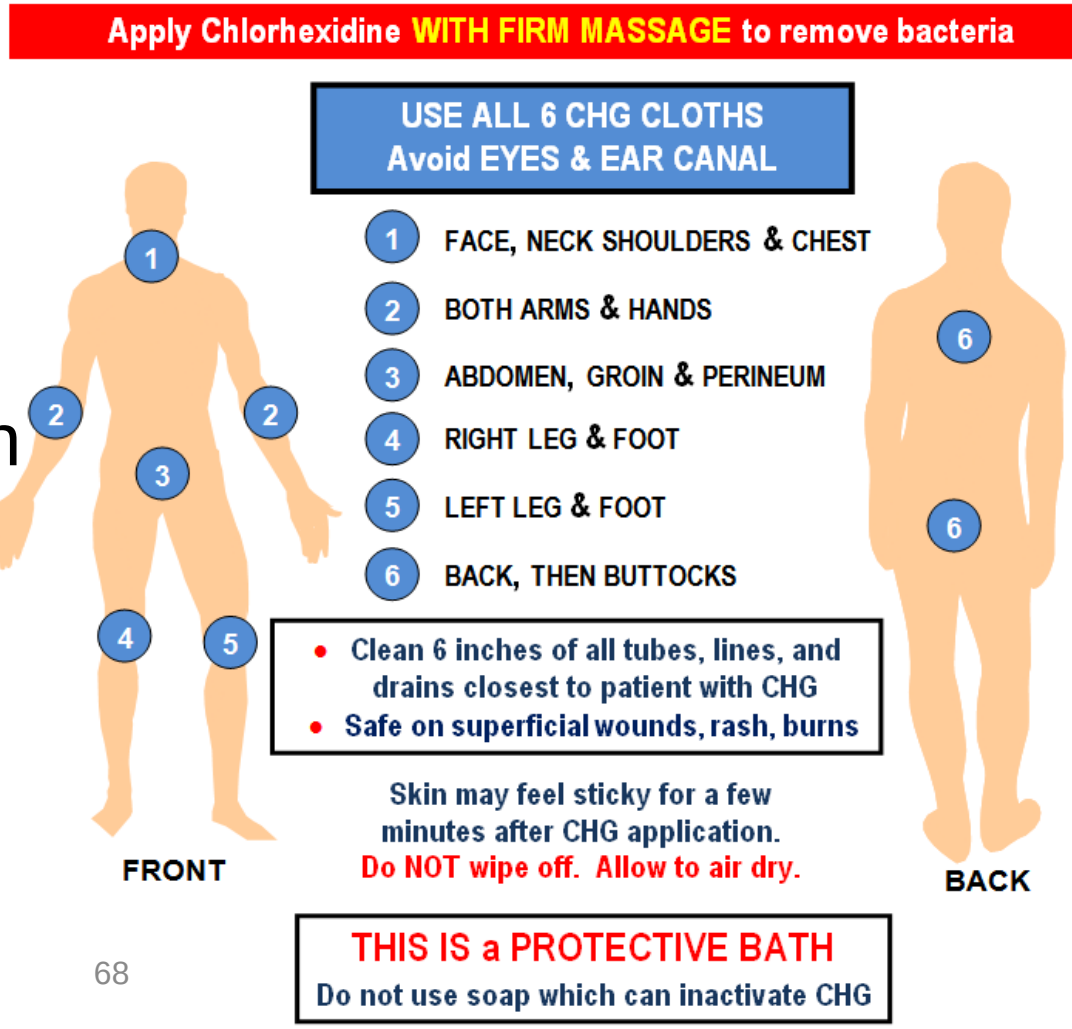
Chlorhexidine Bathing

- 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

Investigation Steps: Infection Prevention Strategies

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



Graphic courtesy of Susan Huang

CP-CRE Investigation: Case Study

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+
- 2nd patient, a neighbor of index patient, screened NDM+ several weeks later
- Reported to LHD and L&C District Office

CP-CRE Investigation: Case Study

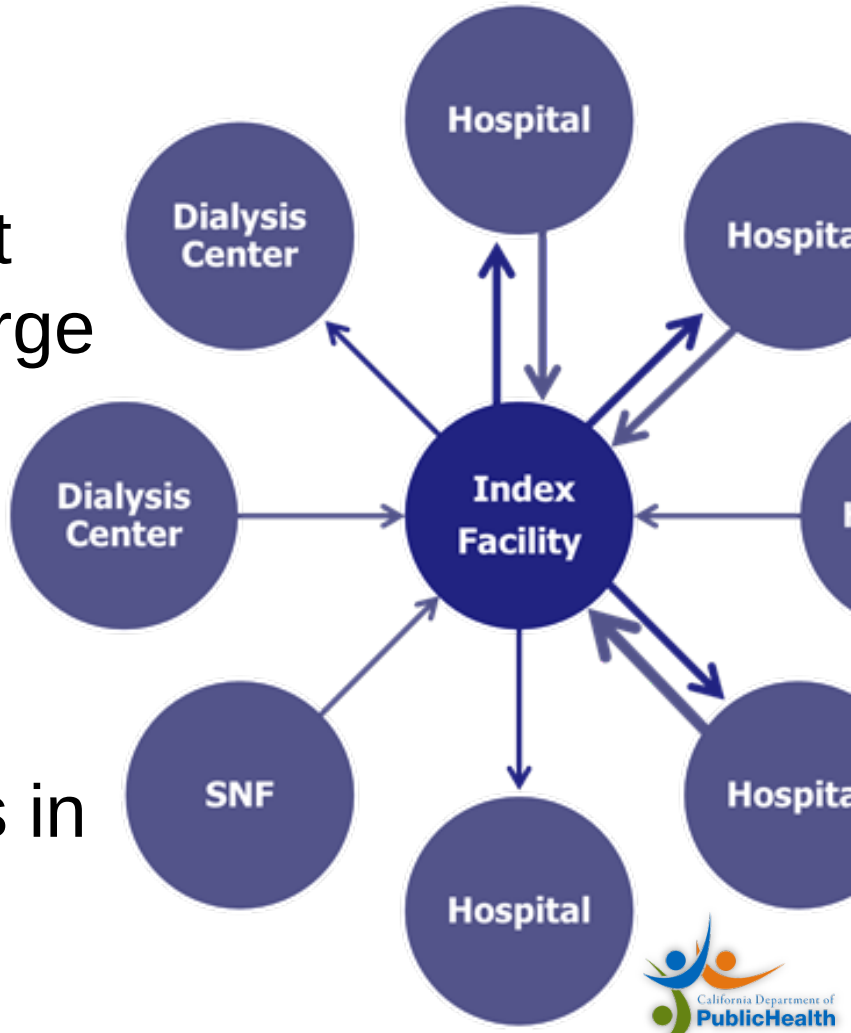
NDM-producing *Klebsiella pneumoniae*

- 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

CP-CRE Investigation: Case Study

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
  http://www.cdph.ca.gov/programs/hai/Documents/CRE_Quicksheet_Jan2017.pdf
- 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
  https://www.cdc.gov/hai/pdfs/cre/CRE-guidance-508.pdf
- CDC Laboratory Protocol for Detection of Carbapenem Resistant Klebsiella app. And E. coli from Rectal Swabs
  http://www.cdph.ca.gov/programs/hai/Documents/CRE_Quicksheet_Jan2017.pdf

Additional Resources

- Agency for Healthcare Research- CRE Control and Resistance Toolkit

  https://www.ahrq.gov/sites/default/files/publications/files/cretoolkit.pdf

- 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