

The Public Health Response to CRE

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CLSI CRE Workshop

June 22, 2013

Public Health Awareness of CRE

❑ **Passive surveillance for decade**

- KPC-producer isolated late 1990s, described in 2001
- Early laboratory interest in detecting carbapenem resistance
- Isolates with unusual resistance submitted to CDC; used to track spread of KPC
- CDC infection control guidance in 2009 – focused on KPC

❑ **In recent years**

- Multiple MMWR reports on CRE
- Numerous outbreak investigations
- CRE surveillance studies
- Publication of CRE toolkit
- CRE laboratory studies



Detection of *Enterobacteriaceae* Isolates Carrying Metallo-Beta-Lactamase — United States, 2010

MMWR

Weekly

MMWR Morbidity and Mortality Weekly Report

Morbidity and Mortality Weekly Report

Notes from the Field

Hospital Outbreak of Carbapenem-Resistant *Klebsiella pneumoniae* Producing New Delhi Metallo-Beta-Lactamase — Denver, Colorado, 2012

On August 16, 2012, the Colorado Department of Public

involved in some
CRE was introduced
NDM, a carbapenemase
a patient who had

aining New Delhi
Island, March 2012

Morbidity and Mortality Weekly Report

Vital Signs: Carbapenem-Resistant *Enterobacteriaceae*

Public Health Awareness of CRE

- ❑ **Electronic Surveillance: National Healthcare Safety Network (NHSN)**
 - HAI module
 - MDRO module
 - AUR module
- ❑ **Targeted Surveillance: MuGSI**
 - Determine extent of CRE disease in the United States
 - Identify people most at risk for illness from these organisms
 - Measure trends of disease over time
- ❑ **Expanding capacity at public health laboratories**
 - APHL collaborations, sharing of CRE set
 - APHL project



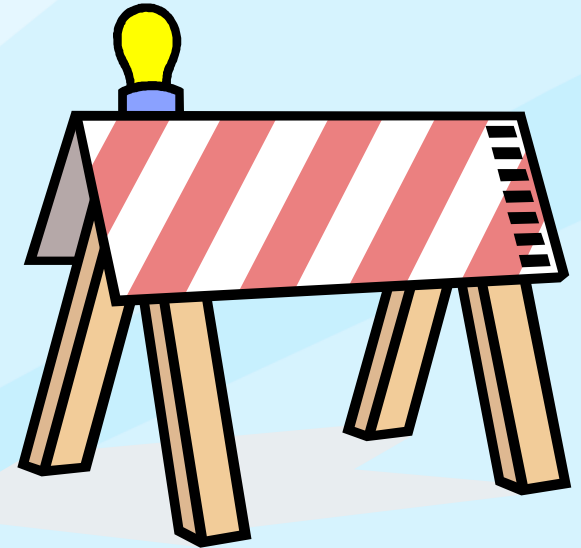
Obstacles to CRE Surveillance

❑ Carbapenem Resistant Enterobacteriaceae

- Resistant to **any** carbapenem or **all** carbapenems?
- Resistant vs. non-susceptible?
- Carbapenemase-producers or all isolates non-susceptible to carbapenems?

❑ Interim Surveillance Definition

- NS* to doripenem, imipenem or meropenem *and* R to all 3rd gen cephalosporins tested
- 1° *Klebsiella* & *E. coli*
- 2° other Enterobacteriaceae



*using CLSI M100-S22 or newer guidance

National Healthcare Safety Network

- ❑ Most widely used tracking system for healthcare-associated infection (HAI) in United States
- ❑ Provides data collection & reporting for medical facilities, states, and the nation in order to:
- ❑ More than 11,000 healthcare facilities nationwide
- ❑ Required for CMS reporting of specific HAIs
- ❑ Tracks AR with three approaches

NHSN for AR reporting: HAI reporting

- ❑ **Target HAIs, antimicrobial susceptibility routinely reported for:**
 - CLABSI: central line-associated blood stream infection
 - **CAUTI: catheter-associated urinary tract infection**
 - SSI: surgical site infection
 - VAE: ventilator-associated event
- ❑ **Clinical signs & symptoms reviewed for each case**
 - Clinical data & isolate data entered into system
- ❑ **Substantial data collection/ entry burden**
 - ❑ Manual and automated data entry options exist
- ❑ **Has been in use since 2005**

NHSN Estimates of CAUTI-associated CRE

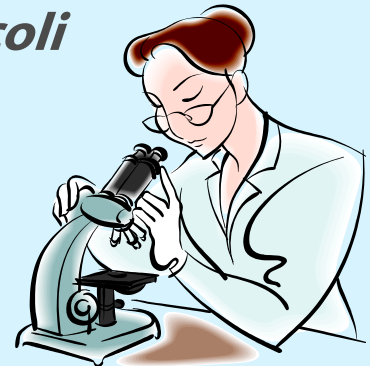
TABLE 10. Changes in Percent Resistance among Pathogens Associated with CAUTIs Reported to the National Healthcare Safety Network, 2007–2010, from Critical Care and Non-Critical Care Locations

Resistant pathogen, antimicrobial agents ^a	Resistance percentage, 2007–2008, % (95% CI)	Resistance percentage, 2009–2010, % (95% CI)	Overall change, %	P value
<i>Staphylococcus aureus</i>				
Oxacillins	65.3 (59.6, 71.0)	58.7 (54.1, 63.3)	–10.2	.07
<i>Enterococcus</i> species				
<i>E. faecium</i> , vancomycin	79.9 (76.0, 83.8)	82.5 (79.5, 85.4)	3.2	.30
<i>E. faecalis</i> , vancomycin	5.6 (4.1, 7.2)	8.4 (7.0, 9.9)	49.9	.02
<i>Klebsiella (pneumoniae/oxytoca)</i>				
ES cephalosporins 4	27.1 (24.6, 29.6)	26.9 (24.9, 28.8)	–0.7	.91
Carbapenems	11.7 (9.6, 13.8)	12.5 (10.8, 14.2)	6.9	.56
Multidrug resistant 1	16.0 (13.8, 18.3)	16.1 (14.3, 17.9)	0.5	.96
<i>Escherichia coli</i>				
ES cephalosporins 4	10.6 (9.5, 11.7)	12.3 (11.4, 13.3)	16.3	.02
Fluoroquinolones 3	27.0 (25.5, 28.5)	31.2 (30.0, 32.5)	15.6	<.0001
Carbapenems	2.9 (2.2, 3.7)	2.3 (1.8, 2.8)	–23.0	.13
Multidrug resistant 1	1.8 (1.2, 2.3)	2.0 (1.5, 2.4)	11.0	.59
<i>Enterobacter</i> species				
ES cephalosporins 4	40.6 (36.4, 44.9)	38.5 (35.2, 41.8)	–5.2	.44
Carbapenems	3.7 (1.7, 5.7)	4.6 (2.9, 6.2)	22.4	.54
Multidrug resistant 1	3.0 (1.3, 4.7)	4.8 (3.2, 6.4)	58.3	.17
<i>Pseudomonas aeruginosa</i>				
Aminoglycosides	10.7 (8.7, 12.7)	10.9 (9.3, 12.5)	1.9	.88
ES cephalosporins 2	24.3 (22.0, 26.5)	25.2 (23.4, 27.0)	3.9	.53
Fluoroquinolones 2	35.2 (32.7, 37.6)	33.5 (31.6, 35.4)	–4.7	.29
Carbapenems	21.8 (19.3, 24.3)	21.3 (19.5, 23.2)	–1.9	.80
Piperacillin/tazobactam	14.5 (12.3, 16.7)	16.6 (14.9, 18.3)	14.4	.16
Multidrug resistant 2	13.4 (11.6, 15.2)	14.0 (12.6, 15.4)	4.4	.62
<i>Acinetobacter baumannii</i>				
Carbapenems	63.5 (54.7, 72.3)	74.2 (66.6, 81.8)	16.9	.08
Multidrug resistant 3	82.1 (75.8, 88.5)	77.6 (71.6, 83.6)	–5.5	.31

Compares antimicrobial resistance trends:
2007–2008 vs. 2009–2010

NHSN for AR reporting: MDRO module

- ❑ **Multi-drug resistant organism/ *C. difficile* infection**
- ❑ **Laboratory-Identified (LabID) Event**
 - Relies almost exclusively on data obtained from the laboratory
 - Non-duplicate, clinical isolates, no prior positive (2 wks)
- ❑ **Targeted organisms**
 - Methicillin-Resistant *S. aureus* (MRSA) – can add MSSA option
 - Vancomycin-Resistant *Enterococcus* spp. (VRE)
 - **Multidrug-Resistant (MDR) *Klebsiella* spp., *E. coli***
 - Multidrug-Resistant (MDR) *Acinetobacter* spp.



NHSN for AR reporting: MDRO module

❑ Minimum reporting requirements

- All LabID Events for at least one MDRO
- At least one location in the healthcare facility (can be facility-wide)

❑ Standard reporting forms to track

- Numerators, Denominators, Patient days, Admissions, Outpatient Encounters

❑ Manual or automated data entry

- Usually by infection preventionists
- Batched monthly

❑ In use ~two years, can ask targeted questions

NHSN for AR reporting: Antimicrobial Use and Resistance (AUR) module

- ❑ **Report & analyze antimicrobial use and/or resistance**
 - Track resistant organisms
 - Risk-adjusted inter-/ intra-facility benchmarks of antimicrobial use
 - Evaluate trends of antimicrobial usage over time
- ❑ **All reporting is automated!**
 - ❑ Laboratory /pharmacy information systems data imported to NHSN using Health Level 7 Clinical Document Architecture
- ❑ **Eligible pathogens with susceptibility testing data**
 - Facility ID, Isolate data, Patient data, AST data
 - Denominator data report: Patient days, Admission count, Blood cultures performed
 - Isolate sources: Blood, Urine, Lower Respiratory, CSF
- ❑ **Newest system:** in process of validation

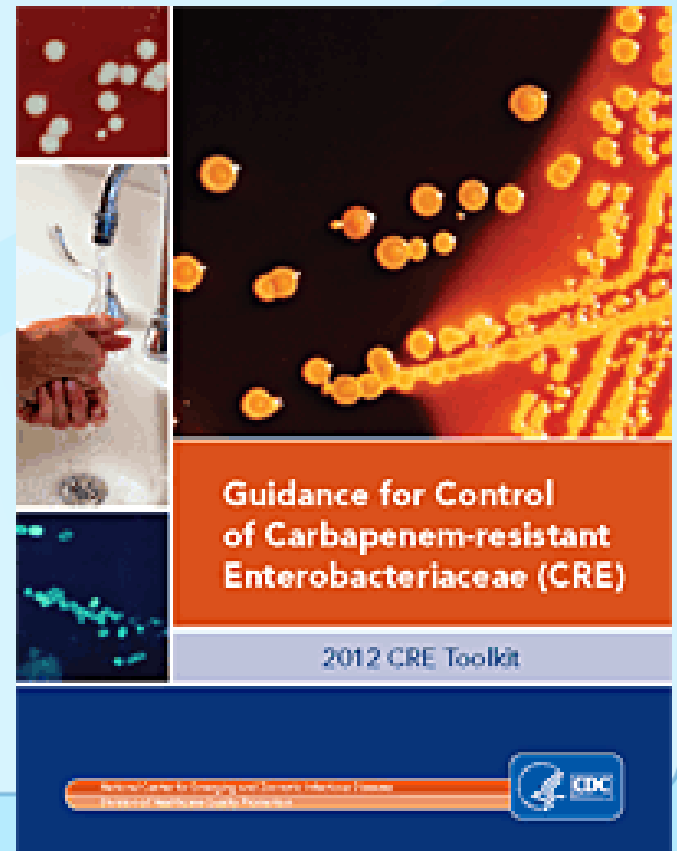
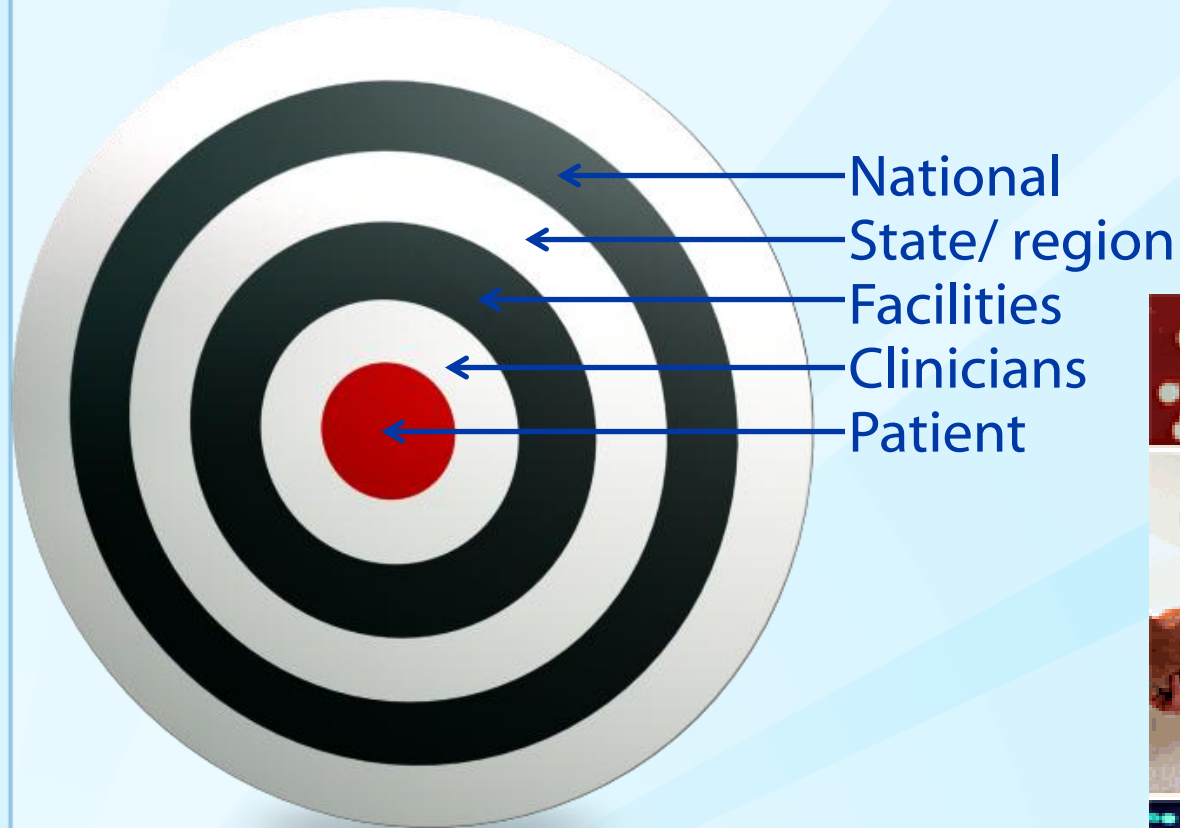
Multi-Site Resistant Gram-Negative Bacilli Surveillance Initiative (MuGSI)

- ❑ **Through CDC's Emerging Infections Program**
- ❑ **5 EIP sites: CO, GA, MD, MN, OR; 11.5 Million people**
- ❑ **Carbapenem nonsusceptible *and* extended-spectrum cephalosporin resistant *E. coli, Klebsiella, Enterobacter***
- ❑ **From normally sterile site or Urine**
- ❑ **Resident of catchment area**
- ❑ **Classification as hospital-onset, healthcare-associated community onset, or community-associated**
- ❑ **Isolates collected, submitted to CDC**

CRE Laboratory Studies

- ❑ **Standard test battery:**
 - Broth microdilution AST
 - Metallo- β -lactamase screen, Modified Hodge test
 - PCR for KPC, NDM, OXA-48 (others if warranted)
 - (ESBL mechanism and plasmid AmpC)
- ❑ **CREDS study**
 - best phenotypic indicators of carbapenemase production
- ❑ **Molecular epidemiology of KPC-pos *K. pneumoniae***
 - International isolate collection, collab. with TGeN
- ❑ **Whole genome analysis for outbreak investigations**
- ❑ **Evaluate methods for detecting CRE colonization**

Targeted CRE Interventions



Healthcare-associated Infections Resources

Website

FAQs

Vital Signs

Fact sheets

U.S. CRE Map

Tool kit

Templates

Algorithms

Carbapenem-resistant Enterobacteriaceae (CRE)

CRE, which stands for carbapenem-resistant Enterobacteriaceae, are a family of germs that are difficult to treat because they have high levels of resistance to antibiotics. *Klebsiella* species and *Escherichia coli* (*E. coli*) are examples of Enterobacteriaceae, a normal part of the human gut bacteria, that can become carbapenem-resistant. Types of CRE are sometimes known as KPC (*Klebsiella pneumoniae* carbapenemase) and NDM (New Delhi Metallo-beta-lactamase). KPC and NDM are enzymes that break down carbapenems and make them ineffective.

Healthy people usually do not get CRE infections. In healthcare settings, CRE infections most commonly occur among patients who are receiving treatment for other conditions. Patients whose care requires devices like ventilators (breathing machines), urinary (bladder) catheters, or intravenous (vein) catheters, and patients who are taking long courses of certain antibiotics are most at risk for CRE infections.

Some CRE bacteria have become resistant to most available antibiotics. Infections with these germs are very difficult to treat, and can be deadly—one report cites they can contribute to death in up to 50% of patients who become infected.

Resources for...



Patients



Clinicians

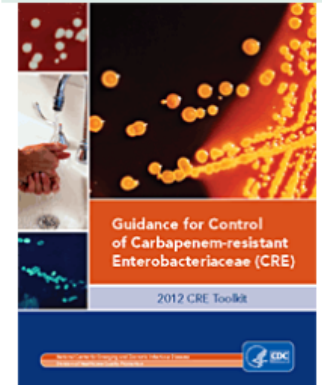


Facilities/Settings



State Health Departments

CRE Prevention Toolkit



This document expands on the 2009 CDC recommendations and continues to be updated as new information becomes available.

CRE Transmission

Prevention: Patients

- Tell your doctor about **previous hospitalizations**
- **Antibiotics only as prescribed**
- Expect **all healthcare providers to perform hand hygiene** before and after touching you
- If they do not, **ask them to do so**
- **Wash your own hands** often
- **Ask questions.** Understand what is being done to you, the risks and benefits

Patients

Carbapenem-resistant Enterobacteriaceae (CRE) Infection

CRE infections are most commonly seen in people with exposure to healthcare settings like hospitals and long-term care facilities, such as skilled nursing facilities, and long-term acute care hospitals. In healthcare settings, CRE infections occur among sick patients who are receiving treatment for other conditions. Patients whose care requires devices like ventilators (breathing machines), urinary (bladder) catheters, or intravenous (vein) catheters, and patients who are taking long courses of certain antibiotics are among those at risk for CRE infections.

Some CRE bacteria have become resistant to almost all available antibiotics and can be deadly—one report cites they can contribute to death in up to 50% of patients who become infected.

Frequently Asked Questions

General Information about CRE

Patients should:

- Tell your doctor if you have been hospitalized in another facility or country.
- Take antibiotics only as prescribed.
- Expect all doctors, nurses and other healthcare providers wash their hands with soap and water or an alcohol-based hand rub before and after touching your body or tubes going into your body.
- Clean your own hands often, especially:
 - Before preparing or eating food
 - Before touching your eyes, nose, or mouth
 - Before and after changing wound dressings or bandages or handling medical devices
 - After using the bathroom
 - After blowing your nose, coughing, or sneezing
- Ask questions. Understand what is being done to you, the risks and benefits.

Carbapenem-resistant Enterobacteriaceae (CRE) Infection

Clinicians play a critical role in slowing the spread of CRE. Rapidly identifying patients colonized or infected with these organisms and placing them in Contact Precautions when appropriate, using antibiotics wisely, and minimizing device use are all important parts of preventing CRE transmission.

Reports

- Notes from the Field: Hospital Outbreak of Carbapenem-Resistant *Klebsiella pneumoniae* Producing New Delhi Metallo-Beta-Lactamase — Denver, Colorado, 2012. MMWR February 15, 2013 / 62(06);108-108
- Carbapenem-Resistant *Enterobacteriaceae* Containing New Delhi Metallo-Beta-Lactamase in Two Patients — Rhode Island, March 2012. MMWR June 22, 2012 / 61(24);446-448
- Carbapenem-Resistant *Klebsiella pneumoniae* Associated with a Long-Term--Care Facility --- West Virginia, 2009—2011. MMWR October 21, 2011 / 60(41);1418-1420
- Notes from the Field: Detection of *bla*NDM-1 Carbapenem Resistance in a Clinical Isolate of *Providencia stuartii* in a U.S./Coalition Medical Facility --- Afghanistan, 2011. MMWR June 10, 2011 / 60(22);756
- Update: Detection of a Verona Integron-Encoded Metallo-Beta-Lactamase in *Klebsiella pneumoniae* — United States, 2010. MMWR September 24, 2010 / 59(37);1212
- Detection of *Enterobacteriaceae* Isolates Carrying Metallo-Beta-Lactamase — United States, 2010. MMWR June 25, 2010 / 59(24);7503

Tools

- 2012: CRE Toolkit Guidance for Control of Carbapenem-resistant Enterobacteriaceae
- Laboratory protocol: Multiplex Real-Time PCR Detection of *Klebsiella pneumoniae* carbapenemase and New Delhi metallo- β -Lactamase genes  [PDF - 110 KB]

Frequently Asked Questions

CDC Expert Commentaries

[Outbreaks of Carbapenem-Resistant Enterobacteriaceae](#) 



[Carbapenem-Resistant Enterobacteriaceae Infection: New Guidelines](#) 

[Preventing Carbapenem-Resistant Enterobacteriaceae](#) 

Steps Clinicians Should Take:

- Know if patients with CRE are hospitalized at your facility, and stay aware of CRE infection rates. Ask if a patient has received medical care somewhere else, including another country.
- Place patients currently or previously colonized or infected with CRE on Contact Precautions. Whenever possible, dedicate rooms, equipment, and staff to CRE patients.
- Wear a gown and gloves when caring for patients with CRE.
- Perform hand hygiene — use alcohol-based hand rub or wash hand with soap and water before and after contact with patient or their environment.
- Alert the receiving facility when you transfer a CRE patient, and find out when a patient with CRE transfers into your facility.
- Make sure labs immediately alert clinical and infection prevention staff when CRE are identified.
- Prescribe and use antibiotics wisely.
- Discontinue devices like urinary catheters as soon as no longer necessary.

Steps Facilities Should Take

CRE Transmission Prevention: Clinicians

- **Know if CRE-positive patients are in your facility**
- **Ask about medical care elsewhere, including another country**
- **Contact Precautions**
- **Cohort rooms, equipment, and staff**
- **Hand hygiene**
- **Facility-level notification on transfer of CRE patients**
- **Immediately alert** clinicians & infection prevention when CRE isolated/ identified
- **Use antibiotics wisely**
- **Discontinue devices** like urinary catheters as soon as no longer necessary

CRE Transmission Prevention: Facilities

Detect CRE within the facility

- Ensure lab can reliably detect CRE
- Establish **communication plan**: Detection, reporting, tracking

Prevent CRE spread within facility

- Implement contact precautions
- Promote abx stewardship

Prevent CRE spread between facilities

- **Notify** facilities when CRE patients are **transferred**
- Participate in **regional prevention efforts**
- **Notify health department** of outbreaks

Facilities/Settings

Carbapenem-resistant Enterobacteriaceae (CRE) Infection

Due to the movement of patients throughout the healthcare system, if CRE are a problem in one facility, then typically they are a problem in other facilities in the region as well. Regional approaches to controlling these organisms are important especially when they first are recognized in a region.




Tools

- 2012: CRE Toolkit Guidance for Control of Carbapenem-Resistant Enterobacteriaceae
- Inter-facility Infection Control Transfer Form  [PDF - 178 KB]

Guidelines

- Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings, 2007
- Management of Multidrug-Resistant Organisms In Healthcare Settings, 2006

More Resources

- Laboratory protocol: Multiplex Real-Time PCR Detection of *Klebsiella pneumoniae* carbapenemase and New Delhi metallo- β -Lactamase genes
- Options for Evaluating Environmental Cleaning also available for download  [PDF - 389 KB]
- Appendices to the Conceptual Program Model for Environmental Evaluation
- CDC Environmental Checklist for Monitoring Terminal Cleaning  [PDF - 99KB]
- Environmental Cleaning Eval Worksheet  [Excel - 63 KB]

[Core Prevention Measures for Acute and Long-Term Care Facilities](#)

[Supplemental Prevention Measures for Healthcare Facilities](#)

[Recommendations for Facilities with No or Rare CRE](#)

[Summary of Prevention Strategies for Acute and Long-Term Care Facilities](#)

Health Care Facilities Should:

- Require and strictly enforce CDC guidance for CRE detection, prevention, tracking, and reporting
- Make sure their lab can accurately identify CRE
- Promote antimicrobial stewardship
- Recognize these organisms as important to patient safety
- Understand their prevalence in the facility and in the region
- Identify colonized and infected patients in the facility and ensure precautions are implemented
- When transferring a patient, require staff to notify the other facility about infections, including CRE.
- Participate in regional and facility-based prevention efforts designed to stop the transmission of these organisms
- Notify health departments of outbreaks

Steps Clinicians Should Take

<http://www.cdc.gov/hai/organisms/cre/cre-facilities.html>

State Health Departments

Health departments have the ability to work with many types of healthcare facilities, and therefore have a unique opportunity to develop, coordinate, and implement comprehensive local and regional prevention strategies in their state or area.

Ideally for CRE, state health departments would take the lead and coordinate with local health departments. However, depending on the region targeted, prevention strategies may also require coordination between states.

Tools

- [2012: CRE Toolkit Guidance for Control of Carbapenem-Resistant Enterobacteriaceae](#)

Collaboration Primer

- [Collaboration Primer: Establishing HAI Prevention Collaboratives](#)

Guidelines

- [Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings, 2007](#)
- [Management of Multidrug-Resistant Organisms In Healthcare Settings, 2006](#)

More Resources

- [Example of a Carbapenem-Resistant Enterobacteriaceae \(CRE\) Survey for Administering to Acute Care and Long-term Acute Care Facilities](#)
- [Inter-facility Infection Control Transfer Form](#) [PDF - 176 KB]



[Top](#)

State Health Departments Should:

- Understand the prevalence or incidence of CRE in their jurisdiction by performing some form of regional surveillance for these organisms. Areas not yet or rarely affected by CRE infections can be proactive in CRE prevention efforts.
- Increase awareness among health care facilities of the regional prevalence of CRE.
- Provide a [standardized form](#) [PDF - 176 KB] for facilities to use during patient transfers, especially between hospitals and long-term care facilities.
- Consider including CRE infections on your state's Notifiable Diseases List.
- Include a range of facility types when developing regional CRE prevention projects.
- Be a resource for health care facilities on appropriate infection prevention measures and antimicrobial stewardship.

CRE Transmission Prevention: State Health Departments

HAI prevention is **relatively new for most state health departments**

Goals:

Situational awareness of CRE rates

- Acute care facilities
- Long-term care facilities

Promote **communication between facilities**

- Standard data form for patient transfer

Provide **education** on

- infection control
- antimicrobial stewardship

Promote **aggressive detection and control** measures in **low-prevalence regions**

DETECT AND PROTECT

Stop Deadly Drug Resistant Infections

Emerging healthcare-associated infection pathogens, especially highly drug resistant pathogens, pose a significant public health threat. CDC must detect highly drug resistant "superbugs" such as carbapenem-resistant Enterobacteriaceae (CRE) and protect patients from their spread.



Threat:

Drug resistant infections are on the rise.



Some of these infections are virtually untreatable with currently available drugs.

Solution:

Implementing "detect and protect" strategies that identify pathogens and stop transmission within and between facilities in a region.

DETECT if Patients Have Drug Resistant Infections



1. Use electronic data sources like CDC's National Healthcare Safety Network to detect superbugs
2. Request alerts every time the lab identifies a patient infected with a superbug
3. When receiving or transferring patients, find out if the patient has a drug resistant infection

PROTECT Patients from Drug Resistant Infections



1. Follow contact and other precautions when treating patients with drug resistant infections
2. Dedicate rooms, equipment, and staff to patients with highly drug resistant infections
3. Take out temporary medical devices like catheters as soon as possible
4. Prescribe antibiotics carefully; monitor antibiotic use with tools such as CDC's National Healthcare Safety Network's Antimicrobial Use module

Detect and Protect Works:

Medical facilities in several states have reduced CRE infection rates by following CDC's prevention guidelines and some states are early adopters of regional prevention strategies.

Oregon created the Drug-Resistant Organism Prevention and Coordinated Regional Epidemiology (DROP-CRE) Network



- Developing a statewide multidrug-resistant organism database
- Promoting CRE education statewide
- Conducting rapid regional identification of CRE
- Providing real-time epidemiologic outbreak assistance to facilities with CRE cases
- Tracking CRE statewide across the spectrum of care

Action is needed now to stop these deadly infections

For more information please visit: <http://www.cdc.gov/hai>

CS239746-B



U.S. Department of
Health and Human Services
Centers for Disease
Control and Prevention



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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.