Containment of Multidrug-Resistant Organisms

Tabletop Exercise 2018
Estimated minimum number of illnesses and deaths caused by antibiotic resistance*:

At least \(2,049,442\) illnesses, \(23,000\) deaths

* bacteria and fungus included in this report
A Superbug That Resisted 26 Antibiotics

January 17, 2017 - 3:01 PM ET

SUSAN BRINK

This illustration depicts *Klebsiella pneumoniae* bacteria, which can cause different types of infections, including pneumonia, bloodstream infections and meningitis.

CDC
Mechanisms of Resistance to Antibiotics

Antibiotic Resistance — Simplified

How Antibiotic Resistance Happens

1. Lots of germs. A few are drug resistant.

2. Antibiotics kill bacteria causing the illness, as well as good bacteria protecting the body from infection.

3. The drug-resistant bacteria are now allowed to grow and take over.

4. Some bacteria give their drug-resistance to other bacteria, causing more problems.
Spread of Antimicrobial Resistance

George stays at home and in the general community. Spreads resistant bacteria.

George gets care at a hospital, nursing home or other inpatient care facility.

Resistant germs spread directly to other patients or indirectly on unclean hands of healthcare providers.

Healthcare Facility

Resistant bacteria spread to other patients from surfaces within the healthcare facility.

Patients go home.
Carbapenem-resistant Enterobacteriaceae (CRE)
CRE—one of many MDROs

CARBAPENEM-RESISTANT ENTEROBACTERIACEAE

9,000 DRUG-RESISTANT INFECTIONS PER YEAR
600 DEATHS

CARBAPENEM-RESISTANT KLEBSIELLA SPP. 7,900
CARBAPENEM-RESISTANT E. COLI 1,400

CRE HAVE BECOME RESISTANT TO ALL OR NEARLY ALL AVAILABLE ANTIBIOTICS

THREAT LEVEL URGENT
This bacteria is an immediate public health threat that requires urgent and aggressive action.
Members of Family of Enterobacteriaceae

More Common Genera of Enterobacteriaceae

- **Escherichia**
- **Enterobacter**
- **Klebsiella**
- **Proteus**
- **Providencia**
- **Salmonella**
- **Serratia**
- **Shigella**

Other Genera of Enterobacteriaceae

- Alishewanella
- Alterococcus
- Aquamonas
- Aranicola
- Arsenophonus
- Azotivirga
- Blochmannia
- Brenneria
- Buchnera
- Budvicia
- Buttiauxella
- Cedecea
- Cedecea
- Citrobacter
- Cronobacter
- Dickeya
- Edwardsiella
- Erwinia
- Ewingella
- Ewingella
- Grimontella
- Hafnia
- Kluyvera

- Leclercia
- Leminorella
- Moellerella
- Morganella
- Obesumbacterium
- Pantoea
- Pectobacterium
- Phlomobacter
- Photorhabdus
- Poodoomaamaana
- Plesionomas
- Pragia
- Rahnella
- Raoultella
- Samsonia
- Sodalis
- Tatamella
- Trabulsiella
- Wigglesworthia
- Xenorhabdus
- Yersinia
- Yokenella
## Case Definition

### CLSI Break Points for Reporting CRE

<table>
<thead>
<tr>
<th>MIC (µg/ml)</th>
<th>Susceptible</th>
<th>Intermediate</th>
<th>Resistant</th>
</tr>
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<tbody>
<tr>
<td>Ertapenem</td>
<td>&lt;1</td>
<td>1</td>
<td>&gt;=2</td>
</tr>
<tr>
<td>Meropenem</td>
<td>&lt;=1</td>
<td>2</td>
<td>&gt;=4</td>
</tr>
<tr>
<td>Imipenem</td>
<td>&lt;=1</td>
<td>2</td>
<td>&gt;=4</td>
</tr>
<tr>
<td>Doripenem</td>
<td>&lt;=1</td>
<td>2</td>
<td>&gt;=4</td>
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</table>
Carbapenemase-producing CRE (CP-CRE)

Five Known Types

KPC (*Klebsiella pneumoniae* carbapenemase) ★
NDM (New Delhi metallo-β-lactamase)
IMP (Imipenemase)
VIM (Verona integron-encoded metallo-β-lactamase) ★
OXA-48 (Oxacillinase)

Bacterial Conjugation
Clinical Symptoms

Pneumonia, urinary tract infections, and serious bloodstream or wound infections

Common **signs and symptoms** may include:

- Severe urinary tract infections
- High fever
- Bloodstream infections
- Sepsis
- Septic shock
Colonized patients are thought to be a source of transmission.

Spread thru direct contact on hands of healthcare workers or contaminated surfaces.

Immunocompromised, ICU care, indwelling medical devices, history of antibiotic treatment lead to a greater risk for infection or colonization.
Interactive iDashboard Gallery: Carbapenem-resistant *Enterobacteriaceae* (CRE) Surveillance Data

iDashboard Demonstration
https://healthwebaccess.tn.gov/idashboards/?guestuser=guest&dashID=815&c=0

Department of Health HAI Website
https://www.tn.gov/health/cedep/hai.html
Composite CRE Gallery

Statewide Surveillance of Carbapenem-resistant Enterobacteriaceae (CRE) in Tennessee

2017 Distribution of CRE
- Incidence Rates
- 30 Day and 90 Days CRE counts

2016 Distribution of CRE
- Incidence Rates
- Case Counts
- Monthly Case Counts
- Organism Trends

2015 Distribution of CRE
- Incidence Rates
- Case Counts
- Monthly Case Counts
- Organism Trends

Isolate Submission
- Proportion of CRE isolates submitted to the State Public Health Lab
Dashboard Detail

CRE by Residence, TN, 2017

KPC, NDM Carbapenemase-producing (CP) CRE, by Residence, TN, 2017

Annualized Incidence Rates per 100,000 persons

Number of CRE Cases By County

<table>
<thead>
<tr>
<th>County</th>
<th>Year to Date</th>
<th>Last 30 Days</th>
<th>Last 60 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANDERSON COUNTY</td>
<td>3</td>
<td>0</td>
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</table>

Number of KPC, NDM CP-CRE Cases By County

<table>
<thead>
<tr>
<th>County</th>
<th>Year to Date</th>
<th>Last 30 Days</th>
<th>Last 60 Days</th>
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</thead>
<tbody>
<tr>
<td>ANDERSON COUNTY</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Dashboard Detail

KPC, NDM Carbapenemase-producing (CP) CRE, by Residence, TN, 2017

Number of CP-CRE Cases (YR to Date*)

0
1 - 4
5 - 9
10 - 14
15 - 19
20 and Above

Number of KPC, NDM CP-CRE Cases By County

<table>
<thead>
<tr>
<th>County</th>
<th>Year to Date*</th>
<th>Last 30 Days*</th>
<th>Last 90 Days*</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHELBY COUNTY</td>
<td>42</td>
<td>1</td>
<td>7</td>
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Tennessee CRE cases reported by Year, 2012–2017

<table>
<thead>
<tr>
<th>Year</th>
<th>No of cases</th>
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<tbody>
<tr>
<td>2012</td>
<td>241</td>
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<tr>
<td>2013</td>
<td>216</td>
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<tr>
<td>2014</td>
<td>233</td>
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<tr>
<td>2015</td>
<td>427</td>
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<tr>
<td>2016</td>
<td>711</td>
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<tr>
<td>2017</td>
<td>755</td>
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</tbody>
</table>
KPC gene detection rate among tested isolates, 2017 (n=572)

755 total cases for 2017
572 isolates submitted
76% isolate submission

<table>
<thead>
<tr>
<th>Result</th>
<th>Frequency</th>
<th>Percent</th>
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<tr>
<td>Detected</td>
<td>224</td>
<td>39.2%</td>
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</table>
Report within 1 week using PH-1600 (paper or electronic). Include antimicrobial susceptibility results when reporting.

Isolate submission **required** to the State Lab

**Reasons for Surveillance**

- Implement timely prevention measures
- Monitor impact of prevention strategies
- Identification of disease trends and characterize strains
- Identify geographical and temporal changes in prevalence
- Detect and investigate outbreaks
2018 List of Reportable Diseases in Tennessee

For Healthcare Providers

The diseases, events, and conditions reportable to Tennessee Department of Health (TDH) by healthcare providers are listed below for 2018. Laboratories in healthcare facilities should refer to Page 2 of this document. The reporting form (PH-1600) and associated documentation may be faxed directly to the local or regional health office (see https://www.tn.gov/health/health-program-areas/localdepartments.html) or the Communicable and Environmental Diseases and Emergency Preparedness (CEDEP) Division at (615) 741-3857. The PH-1600 also is available for completion online at https://redcap.health.tn.gov/redcap/surveys/?s=XTJTN4MD3D. More information about reporting is available on the Reportable Diseases website at https://apps.health.tn.gov/ReportableDiseases. For questions, contact CEDEP at (615) 741-7247 or (800) 404-3006.

<table>
<thead>
<tr>
<th>Disease Outbreaks (e.g., foodborne, healthcare-associated, waterborne)</th>
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<tbody>
<tr>
<td>Anaplasmosis</td>
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<td>Anthrax</td>
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<td>Babesiosis</td>
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<tr>
<td>Birth Defects</td>
<td>REDCap</td>
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<tr>
<td>Botulism: Foodborne, Wound</td>
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<tr>
<td>Botulism: Infant</td>
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<tr>
<td>Brucellosis</td>
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<tr>
<td>California/LaCrosse Serogroup Virus Infection</td>
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<tr>
<td>Campylobacteriosis</td>
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<tr>
<td>Candida auris (includes false-out)</td>
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<tr>
<td>Carbapenem-Resistant Enterobacteriaceae, all genera</td>
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<tr>
<td>Hansen's Disease (Leprosy)</td>
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<tr>
<td>Healthcare Associated Infections: NOS</td>
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<tr>
<td>Catheter-Associated Urinary Tract Infections</td>
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<td>Central Line Associated Bloodstream Infections</td>
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<td>Clostridium difficile</td>
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<tr>
<td>Dialysis Events</td>
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<td>Healthcare Personnel Influenza Vaccination</td>
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<tr>
<td>Methicillin-Resistant <em>Staphylococcus aureus</em></td>
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<td>Surgical Site Infections</td>
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<tr>
<td>Ventilator Associated Events</td>
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<tr>
<td>Hemolytic Uremic Syndrome</td>
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<tr>
<td>Hepatitis, Viral, Type A</td>
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<tr>
<td>Hepatitis, Viral, Type B: Acute</td>
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<tr>
<td>Hepatitis, Viral, Type B: Perinatal (age ≤24 months), Pregnant Female (each pregnancy)</td>
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<tr>
<td>Poliomyelitis</td>
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<td>Psittacosis</td>
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<td>Q Fever</td>
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<td>Rabies: Animal, Human</td>
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<td>Ricin Poisoning</td>
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<td>Rubella</td>
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<tr>
<td>St. Louis Encephalitis Virus Infection</td>
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<td>Salmonellosis: Typhoid Fever</td>
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<tr>
<td>Salmonellosis: All other species</td>
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<tr>
<td>Shiga toxin-producing <em>Escherichia coli</em></td>
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<tr>
<td>Shigellosis</td>
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<td>Smallpox</td>
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<td>Spotted Fever Rickettsiosis</td>
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<tr>
<td><em>Staphylococcus aureus</em>: Enterotoxin B</td>
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Why is Containment Critical?

KPC, the first type of CRE found in the U.S., spread from 2 states in 2001 to 45 states, DC, and Puerto Rico in 13 years.

- **2001**: Initial states with KPC
- **2005**: Expansion to more states
- **2006**: Further spread
- **2008**: Significant increase in affected states
- **2010**: Continued spread
- **2012**: Majority of states affected
- **2014**: Almost all states affected

States with *Klebsiella pneumoniae* carbapenemase (KPC)-producing Carbapenem-resistant Enterobacteriaceae (CRE) confirmed by CDC
Containment Strategy

- Interim Guidance for a Health Response to Contain Novel or Targeted MDROs

https://www.cdc.gov/hai/outbreaks/docs/Health-Response-Contain-MDRO.pdf
Goals

• Provide specific, standardized recommendations for public health response to single cases:
  – Determine if transmission is occurring
  – Identify affected patients
  – Ensure appropriate control measures are implemented
  – Better characterize organism to guide future responses
Response Tiers

• Tier 1
  – Resistance mechanisms novel to the U.S. (i.e., not or only very rarely identified in the U.S.) or poorly understood
  – Organisms for which no current treatment options exist (pan-resistant)

• Tier 2

• Tier 3
Response Tiers

• Tier 1
• Tier 2
  – MDROs primarily found in healthcare settings but not found regularly in the region; these organisms might be found more commonly in other areas of the U.S.
• Tier 3
Response Tiers

• Tier 1
• Tier 2
• Tier 3
  - MDROs targeted by the facility/region that are already established in the U.S. and have been identified before in the region but are not thought to be endemic
## Tiered Response Following MDRO Detection

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<tr>
<th></th>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
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<td>Lab lookback</td>
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<tr>
<td>Prospective surveillance</td>
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<tr>
<td>Healthcare roommate screening</td>
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<tr>
<td>Broader healthcare contact screening</td>
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<tr>
<td>Household contact screening</td>
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<tr>
<td>Healthcare personnel screening</td>
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*Legend: Yes - Green, No - Red, Sometimes - Yellow*
### Tiered Response Following MDRO Detection

**Today’s Exercise!**

<table>
<thead>
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</tbody>
</table>

Legend:
- **Yes**
- **No**
- **Sometimes**
Patient Sharing Network and Antimicrobial Resistant Organisms
How Antimicrobial Resistance Spreads
Social network analysis (SNA) is the mapping and measuring of relationships between people, groups, or organizations.

Borgatti et al, 2003
Patient Sharing Between TN Facilities within 365 days

EMS Regions by Color
- Northeast TN
- East TN
- Southeast TN
- Upper-Cumberland TN
- Mid-Cumberland TN
- South Central TN
- West TN
- Memphis-Delta TN

Facility Types
- Acute Care/Critical Care Hospital
- Nursing Homes
- Long-term acute care hospital
- Inpatient Rehab Facility
CLEAN HANDS SAVE

www.cdc.gov/HandHygiene
Questions?

Marion.Kainer@tn.gov

Or

Pamela.talley@tn.gov

Or

HAI.health@tn.gov