The Resistance Persistence:
A Closer Look at
Antimicrobial Resistance
and Outbreaks in Texas

Texas Department of State Health Services
Healthcare Safety Team
Objectives

• Describe the clinical significance of detecting antimicrobial resistance
• Define the role of the HAI Epidemiologist during an HAI outbreak
CRE and MDR-A

Bobbiejean Garcia, MPH, CIC, FAPIC

- Multidrug resistant organisms across Texas
Quick History

- Official Reporting began April 20, 2014
- CRE: *Klebsiella* species and *E.coli*
- MDR-A: All *Acinetobacter baumannii*
- Case definition change in January 2015
CRE Through the Years

Incidence Rate of CRE in Texas by Residency, 2015

Incidence Rate of CRE in Texas by Residency, 2016

Incidence Rate of CRE in Texas by Residency, 2017

Source: Texas Department of State Health Services, Infectious Disease Control Unit.
Prepared: July, 2018
Incidence Rate of MDR-A in Texas by Residency, 2015
Incidence Rate of MDR-A in Texas by Residency, 2016
Incidence Rate of MDR-A in Texas by Residency, 2017

Source: Texas Department of State Health Services, Infectious Disease Control Unit.
Prepared: July, 2018
## Closer Look at 2017

<table>
<thead>
<tr>
<th>Organism</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total CRE</td>
<td>1,138</td>
</tr>
<tr>
<td>Total MDR-A</td>
<td>1,144</td>
</tr>
<tr>
<td>Total CRE &amp; MDR-A</td>
<td>2,282</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>CRE Breakdown</th>
<th>Count</th>
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<tbody>
<tr>
<td>CRE-E.coli</td>
<td>259</td>
</tr>
<tr>
<td>CRE-K.oxytoca</td>
<td>32</td>
</tr>
<tr>
<td>CRE-K.pneumoniae</td>
<td>845</td>
</tr>
<tr>
<td>Other Klebsiella spp</td>
<td>2</td>
</tr>
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## Closer Look at 2017

### Gender Count

<table>
<thead>
<tr>
<th>Gender</th>
<th>Count</th>
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<tbody>
<tr>
<td>Male</td>
<td>1,109</td>
</tr>
<tr>
<td>Female</td>
<td>1,173</td>
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<tr>
<td>Total</td>
<td>2,282</td>
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### Death Related to MDRO Count

<table>
<thead>
<tr>
<th>Death Related to MDRO</th>
<th>Count</th>
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<tbody>
<tr>
<td>Yes</td>
<td>50</td>
</tr>
<tr>
<td>No</td>
<td>21</td>
</tr>
<tr>
<td>Unknown/Blank</td>
<td>98</td>
</tr>
<tr>
<td><strong>Total Patients Deaths</strong></td>
<td><strong>169</strong></td>
</tr>
</tbody>
</table>
## Closer Look at 2017

<table>
<thead>
<tr>
<th>Admitted to HCF</th>
<th>Count</th>
</tr>
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<tbody>
<tr>
<td>Yes</td>
<td>1,837</td>
</tr>
<tr>
<td>No</td>
<td>431</td>
</tr>
<tr>
<td>Unknown</td>
<td>14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patient came from</th>
<th>Count</th>
</tr>
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<tbody>
<tr>
<td>Home</td>
<td>1,110</td>
</tr>
<tr>
<td>Long-term Care</td>
<td>542</td>
</tr>
<tr>
<td>Acute Care</td>
<td>302</td>
</tr>
<tr>
<td>LTAC</td>
<td>117</td>
</tr>
<tr>
<td>Other categories</td>
<td>79</td>
</tr>
<tr>
<td>Unknown</td>
<td>132</td>
</tr>
</tbody>
</table>
Antibiotic Resistance Laboratory Network (ARLN) Initiatives

Thi Dang, MPH, CHES, CIC
Gillian Blackwell, BSN, RN, CIC
Outline

• Antibiotic Resistance and Public Health Impact
• Detection Through Antibiotic Resistance Laboratory Network (ARLN)
• Containment Guidance
• Texas Data
• Texas Investigations
U.S. Antibiotic Resistance Threats

- Estimated more than 2 million antibiotic-resistant infections resulting in at least 23,000 deaths in US each year
- Urgent threat: Carbapenem-resistant Enterobacteriaceae (CRE)
- Serious threats: Extended-Spectrum Beta-lactamase producers (ESBLs), multidrug-resistant *Pseudomonas aeruginosa*, multidrug-resistant *Acinetobacter*
- Emergence of new multidrug-resistance organisms (MDROs)
Carbapenemases

- Enzymes that degrade carbapenem antibiotics
- Enzymes of primary public health concern
  - K. pneumoniae carbapenemase (KPC)
  - New Delhi Metallo-β-lactamase (NDM)
  - Verona Integron Mediated Metallo-β-lactamase (VIM)
  - Imipenemase (IMP)
  - OXA-48-type
  - mcr-1, mcr-2
Why are these mechanisms a public health priority?

• Cause infections associated with high mortality rates
• Resistance is highly transmissible
  o Between organisms
  o Between patients
• Treatment options are limited
  o Pan-resistant strains identified
  o Could be years before new agents are available to treat
• Potential for spread into the community
• Has spread rapidly (CP-CRE) throughout US and world
States with KPC-CRE Reported to CDC

2001

2016
CP-CRE reported to the CDC as of December 2017

https://www.cdc.gov/hai/organisms/cre/trackingcre.html
CP-CRE reported to the CDC as of December 2017

OXA-48

https://www.cdc.gov/hai/organisms/cre/trackingcre.html
CP-CRE reported to the CDC as of December 2017

https://www.cdc.gov/hai/organisms/cre/trackingcre.html
CP-CRE reported to the CDC as of December 2017

https://www.cdc.gov/hai/organisms/cre/trackingcre.html
Detection of Targeted MDROs
Detection

- Restricted capacity to detect and respond to emerging resistance if CDC is the only sentinel surveillance program for AR
- Limited state capacity for AR testing
- In clinical labs, data is not often connected to public health action
Solution

- Antibiotic Resistance Laboratory Network (ARLN)
- Transform the national lab infrastructure with regional laboratories and local labs with gold-standard methods and technology
- Enhanced testing capacity in all 50 states and five local jurisdictions
- Faster detection for rapid and improved public health response
- Communication channels to engage clinical laboratory partners
ARLN Locations

CDC Antibiotic Resistance Laboratory Network: 7 Regional Labs

WEST
- Washington State Public Health Laboratories
  - Core Testing
  - Candida
  - N. gonorrhoeae

CENTRAL
- Minnesota Department of Health PHL
  - Core Testing
  - Candida
  - C. difficile
  - Reflex Culture Pilot
  - S. pneumoniae

MOUNTAIN
- Texas DSHS Laboratory
  - Core Testing
  - N. gonorrhoeae

MIDWEST
- Wisconsin State Laboratory of Hygiene
  - Core Testing
  - Reflex Culture Pilot
  - S. pneumoniae

NORTHEAST
- Wadsworth Center Bacteriology Laboratory
  - Core Testing
  - Candida

MID- ATLANTIC
- Maryland Public Health Laboratory
  - Core Testing
  - N. gonorrhoeae

SOUTHEAST
- Tennessee State Public Health Laboratory
  - Core Testing
  - Candida
  - N. gonorrhoeae
  - Reflex Culture Pilot
Carbapenem-Resistant (CR) Organisms of Interest

• CRE to include:
  • *Escherichia coli*
  • *Klebsiella pneumoniae*
  • *Klebsiella oxytoca*
  • *Enterobacter* species
• CR-*Acinetobacter baumannii* (CRAb)
• CR-*Pseudomonas aeruginosa* (CRPA)
• ESBL
Goal:
Slow spread of novel or rare multidrug-resistant organisms or mechanisms
Containment

- Systematic, aggressive response to single cases of high concern antimicrobial resistance
- Focus on stopping transmission
- Response activities have tiered approach based on organism/mechanism attributes
- Complements existing guidance
  - CRE Toolkit
  - Vancomycin Resistant *Staphylococcus aureus* (VRSA) Investigation Guide
# Containment Response Elements

<table>
<thead>
<tr>
<th>Containment Elements</th>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection Control Assessment</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Prospective Surveillance</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Lab Lookback</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Screening of Healthcare Roommates</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Broader Screening of Healthcare Contacts</td>
<td>Yes</td>
<td>Sometimes</td>
<td>No</td>
</tr>
<tr>
<td>Household Contact Screening</td>
<td>Yes</td>
<td>Sometimes</td>
<td>No</td>
</tr>
<tr>
<td>Environmental Sampling</td>
<td>Sometimes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Healthcare Personnel Screening</td>
<td>Sometimes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
Figure 1: Approach to screening healthcare contacts following identification of novel or targeted multidrug-resistant organisms

Source Patient with target MDRO

On Contact Precautions for entire stay

Screen Roommates

Tier 1 Organism: Novel Pathogen
  - Broader Contact Screening is Recommended

Tier 1 Other Organism or Tier 2 Organism
  - Screening contacts is generally not recommended, but could be considered in specific instances

Tier 3 Organism
  - Broader Contact Screening is not Recommended

Not On Contact Precautions for entire stay

Screen Roommates

Tier 1 or 2 Organism
  - Broader Contact Screening is Recommended

Tier 3 Organism
  - Screening contacts is generally not recommended, but could be considered in specific instances

https://www.cdc.gov/hai/outbreaks/mdro/index.html
### ARLN Results
**June 2017-March 2018**

<table>
<thead>
<tr>
<th>CRE</th>
<th>CRPA</th>
<th>CRAb</th>
<th>ESBL</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>244</td>
<td>485</td>
<td>188</td>
<td>163</td>
<td>1080</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CP-CRE</th>
<th>CP-CRPA</th>
<th>CP-CRAb</th>
<th>Total CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>115</td>
<td>27</td>
<td>0</td>
<td>142</td>
</tr>
</tbody>
</table>
2017-2018 Texas ARLN Isolate Submission Counts
Carbapenemase-resistant Enterobacteriaceae

- Carbapenem-resistant Enterobacteriaceae
- Carbapenemase-producing Carbapenem-resistant Enterobacteriaceae
ARLN Results
CRPA

2017-2018 Texas ARLN Isolate Submission Counts
Carbapenem-resistant *Pseudomonas aeruginosa*

- Carbapenem-resistant *Pseudomonas aeruginosa*
- Carbapenemase-producing Carbapenem-resistant *Pseudomonas aeruginosa*
Mechanisms Identified in Texas Facilities

- NDM
- mcr-1
- VIM
- OXA-48
- KPC
- IMP
## Colonization Studies
### June 2017-March 2018

<table>
<thead>
<tr>
<th>Resistance Mechanism</th>
<th>Studies Conducted</th>
<th>Specimens Tested</th>
<th>Total Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDM</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>mcr-1</td>
<td>2</td>
<td>26</td>
<td>0</td>
</tr>
<tr>
<td>VIM</td>
<td>4</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>OXA-48</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>KPC</td>
<td>9</td>
<td>160</td>
<td>19</td>
</tr>
<tr>
<td>IMP</td>
<td>1</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td><em>C. auris</em></td>
<td>3</td>
<td>41</td>
<td>0</td>
</tr>
</tbody>
</table>

12/10/2018
Texas Investigations
IMP-PA

- 4 MDR-\textit{Pseudomonas} cases among pediatric patients at burn hospital
  - 2 patients identified with IMP-\textit{Pseudomonas aeruginosa} (PA)
  - Investigation suggests importation and transmission
mcr-1

- *mcr-1* from ESBL *E. coli* in urine from a 49-year-old male without international travel
  - 20th U.S. case (1st in TX)
  - Admitted to:
    - 2 acute care hospitals
    - 1 long-term acute care care hospital
    - 2 inpatient rehabilitation facilities
OXA-48

- First OXA-48 identified in *E. coli* from a wound culture at a rehab facility
  - Screened 3 healthcare contacts in close proximity to patient’s room (all negative)
### KPC

- 9 positive specimens identified in 2 facilities from December 2017 – March 2018
  - 8 *Klebsiella pneumoniae* KPC
  - 1 *Serratia marcescens* KPC

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Infections Identified by ARLN</th>
<th>Number of Colonization Studies</th>
<th>Colonization Screenings performed</th>
<th>Number Colonized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Care Hospital</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Skilled Nursing Facility</td>
<td>0</td>
<td>2</td>
<td>34</td>
<td>6</td>
</tr>
</tbody>
</table>
Review

- Antibiotic Resistance and Public Health Impact
- Detection Through Antibiotic Resistance Laboratory Network (ARLN)
- Containment Guidance
- Texas Data
- Texas Investigations
HAI Outbreaks

Sandi Arnold, RN, CIC
Annie Nutt, MPH, CIC
HAI Outbreak Detection

Simple Definition:
An increase in the number of hospital-acquired or healthcare facility-acquired cases of disease among patients or staff over & above the expected number of cases
HAI Outbreak Detection

• Notifiable Conditions: Texas Administrative Code §97.3 (2016)
• Alerts from clinical, reference, and public health labs of increases in isolates
• National alerts of multi-state outbreaks, sometimes linked to contaminated products
• Alerts from regulatory agencies

In addition to specified reportable conditions, any outbreak, exotic disease, or unusual group expression of disease that may be of public health concern should be reported by the most expeditious means available.
HAI Outbreak Detection

- Influenza: 1 laboratory-confirmed case along with other cases of respiratory infection in a unit of a long-term care facility (3 day period)

- Norovirus: A Norovirus outbreak is defined as onset of 2 or more epidemiologically linked cases within a three day period, where a case is defined as someone with 2 or more episodes of vomiting or 3 or more episodes of diarrhea within 24 hours.
A Multidrug Resistant Organism (MDRO) outbreak is defined as an increase in the number of facility-acquired MDRO cases above and beyond the endemic (baseline) level in a certain facility/unit during a specific time period, and may include an increase in cases of MRSA, VRE, CRE, MDR-A or any other multidrug resistant organism.
HAI Outbreak Detection

A single case may constitute an outbreak, for example:

- VISA or VRSA
- Any unusual or novel MDRO or MDRO with an unusual resistance pattern conferring resistance to critical antibiotic(s)
- Legionellosis if the patient has been in the healthcare facility for the entire incubation period (10 days) or association was defined as any exposure to a health care facility for a portion of the 10 days preceding symptom onset.
- Post-procedure infection with an unusual organism (e.g. invasive fungal infection after an epidural procedure in an immunocompetent patient.)
2017 HAI Outbreaks

2017 HAI Outbreaks by Month of Notification

Jan 11  Feb 16  Mar 14  Apr 12  May 5  Jun 3  Jul 4  Aug 9  Sep 3  Oct 6  Nov 4  Dec 23
2017 HAI Outbreaks by Healthcare Facility Type

- Acute Care Hospital: 65%
- Long-Term Care Facility: 5%
- Outpatient: 3%
- Multiple HCF Types: 25%
Lab Assistance for HAI Outbreaks

- Identification
- PFGE
- ARLN
2017 HAI Outbreaks - Highlights

• The first case of mcr-1 detected in Texas
• Brucellosis investigation

Morbidity and Mortality Weekly Report (MMWR)

Notes from the Field: Brucella abortus Vaccine Strain RB51 Infection and Exposures Associated with Raw Milk Consumption – Wise County, Texas, 2017

Weekly / March 9, 2018 / 67(9):286
2017 HAI Outbreaks – Highlights, continued

- The first case of *Candida auris* detected in Texas
- Mumps outbreaks
Thank you