Public Health Support for Antimicrobial Stewardship

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HAI/AR Director
Nebraska DHHS
Disclosures

- None
Objectives

• Describe the purpose of the Division of Public Health (DPH) antimicrobial susceptibility registry

• Outline the changes in carbapenem-resistance *Enterobacteriaceae* (CRE) and antibiotic susceptibility rates in Nebraska

• Explain the DPH multidrug-resistant organisms (MDRO) outbreak detection and management protocols
HAI/AR Team Nebraska DHHS

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Goals of DHHS HAI Team

- Monitor and Reduce HAIs
- Support Stewardship
- Detect Outbreaks and Resistance
- Manage/Contain Resistance and Outbreaks
- Education for Public-website
- Educational Resources for HCWs
Support for Stewardship

Where to Focus Stewardship

- Individual cases of highly resistant organisms
- Outbreak Settings
- Clusters of resistance-via antibiogram
- Higher CDI Rates-via CDI Registry and NHSN data
- Hot spot antibiotic data (618, Medicare, IQVIA)
Reportable Diseases

Epidemiology

Reportable Diseases
Physicians, hospitals, and laboratories are required by law to submit reports of communicable disease and other situations that pose a threat to the public health. Chapter 1 of Control of Communicable Diseases Regulations in the Nebraska Administrative Code sets the reporting requirements for diseases, conditions, poisonings, organisms, and events.

What to Report?
- Nebraska Reportable Disease Chart
- Reportable diseases regulations (Title 173 Chapter 1)

Where to Report?
Douglas County physicians, hospitals & laboratories, submit reports to:
Douglas County Health Department
Epidemiology
1111 South 41st ST
Omaha, NE 68105
Phone: 402-444-7214

Lancaster County physicians, hospitals & laboratories, submit reports to:
Lincoln-Lancaster County Health Dept
Communicable Diseases
# Reportable Diseases-LAB Chart-Lab Relationship is Crucial!

## Nebraska Reportable Diseases Title 173 Regulations

**Immediate Notification:** Douglas Co. (402)444-7214 (after hrs 402-444-7000)  
Lancaster Co (402) 441-8053 (after hrs 402-440-1817)  
All Other Counties 402-471-1983  
Nebraska Public Health Laboratory 24/7 pager  402-888-5588

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### Updated 5/3/2017

<table>
<thead>
<tr>
<th>Condition</th>
<th>Labs automated ELR</th>
<th>Labs reporting manually</th>
<th>Healthcare providers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acinetobacter spp.</strong> (all species)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acquired Immunodeficiency Syndrome (AIDS)</strong>, as described in 173 NAC 1- 005.01C2</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adenovirus</strong></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Aeromonas spp</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Amebae-associated infection (Acanthamoeba spp, Entamoeba histolytica, and Naegleria fowleri)</strong></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Anthrax (Bacillus anthracis)</strong> *^</td>
<td>X</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Artoviral infections (including, but not limited to, West Nile virus, St. Louis encephalitis virus, Western Equine encephalitis virus, Chikungunya virus, Rift Valley fever virus, Zika and Dengue virus)</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td><strong>Astrovirus</strong></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Babesiosis (Babesia species)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Botulism (Clostridium botulinum)</strong> *</td>
<td>X</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td><em><em>Brucellosis (Brucella abortus</em>, B. melitensis</em>, and B. suis)****</td>
<td>X</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td><strong>Burkholderia (Pseudomonas) pseudomallei</strong> **</td>
<td>X</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

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*DEPT. OF HEALTH AND HUMAN SERVICES*

**Helping People Live Better Lives.**
CDI Datamart

- Captures and differentiates all CDI testing methods (PCR, culture, EIA, etc…)
- Updated automatically every day
- Ability to filter results on a very granular level: facility, patient, date, jurisdiction, infection, etc…
- Defines (when possible) cases as hospital-acquired, hospital-related visit, outpatient infection, etc…
- Results incorporate any comments from the lab (relevant information about test method, comments about specimens/symptoms, who/when positive results were reported)
- Implement antimicrobial stewardship efforts in areas with highest rates
Nursing Home Datamart

- **Strengths**
  - Updated automatically every day
  - 202 unique facilities captured (as of yesterday’s dataset) out of approximately 250
  - Ability to filter results on a very granular level: facility, patient, date, jurisdiction, infection, etc…

- **Gaps**
  - Unable to capture all PO boxes
  - Not typically notified if a facility moves addresses (requires updating SAS code to capture)
    - Can work with licensure to get up-to-date list

- **Plans for data**
  - Target facilities who have highest rates of HAI’s
  - Observe current infection control measures and implement practices where gaps are observed
Emerging Resistant Organisms

- All Potential CREs (Enterobacter, E.coli, Klebsiella, Citrobacter)
- CP-CRE
- CR-Pseudomonas
- Colistin resistance, Pan resistance
- VISA, VRSA
- Candida auris
Expanding the Reportable Disease List 2017-18

- All potential organisms with carbapenem resistance
  - Enterobacter
  - Klebsiella
  - E.coli
  - Citrobacter
  - Serratia
  - Providencia
  - Proteus
  - Morganella

- Other species capable of developing concerning resistance patterns
  - Acinetobacter
  - Pseudomonas
In accordance with Nebraska Title 173 the following must be reported immediately:

- Carbapenem resistant *Enterobacteriaceae* (suspected or confirmed)
- Staphylococcus aureus, vancomycin-intermediate/resistant suspected or confirmed
- Soon to add suspected or confirmed *C. auris*, colistin-resistant or pan-resistant organisms
And the following must be reported within seven days of detection or diagnosis:

- *Acinetobacter* spp., *Citrobacter* spp., *Enterobacter* spp., *Enterococcus* spp., *Escherichia coli*, *Klebsiella* spp., *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Streptococcus pneumoniae* (applies only to laboratories performing electronic lab reporting as described in 173 NAC 1-005.02C) soon to add *Serratia*, *Providencia* and *Morganella*.

- *Clostridium difficile* (antibiotic-associated colitis and pseudomembranous colitis)

- *Mycobacterium* spp. (including *M. tuberculosis* complex organisms [for genotyping] and all “atypical” species, to include culture, nucleic acid tests, or positive histological evidence indicative of tuberculosis infection or disease)
Descriptive Epidemiology

- 70,919 isolates from 28 facilities among all 20 local health departments and 8 out-of-state jurisdictions

- Approximately 6000 reports per month

- 62,265 isolates when restricted to 1 isolate per patient

- 101 different antimicrobials

- Over 50 species reported
## Reported Species

<table>
<thead>
<tr>
<th>Achromobacter spp</th>
<th>Enterobacter aerogenes</th>
<th>Leclercia spp</th>
<th>Serratia spp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acinetobacter spp</td>
<td>Enterobacter cloacae</td>
<td>Morganella spp</td>
<td>Shigella spp</td>
</tr>
<tr>
<td>Aerococcus spp</td>
<td>Enterobacter spp</td>
<td>Mycobacterium spp</td>
<td>Staphylococcus aureus</td>
</tr>
<tr>
<td>Aeromonas spp</td>
<td>Enterococcus spp</td>
<td>Mycobacterium spp (TB)</td>
<td>Staphylococcus spp</td>
</tr>
<tr>
<td>Alcaligenes spp</td>
<td>Escherichia coli</td>
<td>Pantoena spp</td>
<td>Stenotrophomonas maltophilia</td>
</tr>
<tr>
<td>Burkolderia cepaceia</td>
<td>Haemophilus influenzae</td>
<td>Pasturella spp</td>
<td>Stenotrophomonas spp</td>
</tr>
<tr>
<td>Campylobacter spp</td>
<td>Haemophilus parahaemolyticus</td>
<td>Plesiomonas spp</td>
<td>Streptococcus pneumoniae</td>
</tr>
<tr>
<td>Citrobacter spp</td>
<td>Kingella spp</td>
<td>Proteus spp</td>
<td>Streptococcus spp</td>
</tr>
<tr>
<td>Clostridium spp</td>
<td>Klebsiella oxytoca</td>
<td>Providencia spp</td>
<td>Vibrio alginolyticus</td>
</tr>
<tr>
<td>Coagulase-negative staphylococcus</td>
<td>Klebsiella pneumoniae</td>
<td>Pseudomonas aeruginosa</td>
<td></td>
</tr>
<tr>
<td>Corynebacterium spp</td>
<td>Klebsiella spp</td>
<td>Pseudomonas spp</td>
<td></td>
</tr>
<tr>
<td>Diptheroids spp</td>
<td>Kluyvera ascorbata</td>
<td>Raoultella spp</td>
<td></td>
</tr>
<tr>
<td>Elizabethkingia spp</td>
<td></td>
<td>Salmonella spp</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Serratia marcescens</td>
<td></td>
</tr>
</tbody>
</table>
Antibiotic Susceptibility Data Registry

- Approximately 1,300 reports per week
- Approximately 40 species
- 25 antimicrobials
- 34 facilities reporting
Antibiotic Susceptibility Data Registry

- Creation of a database containing susceptibility patterns for all reportable organisms

- Requires appropriate receipt of HL7 formatted messages from hospital to secure servers

- End result is a line list
  - Screen for resistant organisms (CRE, VISA/VRSA, etc)
  - Detect clusters of MDROs
  - Follow development of resistance over time
Antibiogram

- Previous 365 days of reports from all specimen sources
- Based on report of interpretation (S, I, R) from laboratory
- One isolate per patient per analysis period
- Only susceptibilities for which >/=30 isolates were tested
- Populates nightly
  - 5 gram positive organisms
  - 14 gram negative organisms
<table>
<thead>
<tr>
<th>Gram Positives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Percent Susceptible (Number tested)</strong></td>
</tr>
<tr>
<td><strong>Enterococcus faecalis</strong></td>
</tr>
<tr>
<td><strong>Enterococcus faecium</strong></td>
</tr>
<tr>
<td><strong>MRSA</strong></td>
</tr>
<tr>
<td><strong>MSSA</strong></td>
</tr>
<tr>
<td><strong>Streptococcus pneumoniae</strong></td>
</tr>
<tr>
<td>Gram Negatives</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Acinetobacter spp</td>
</tr>
<tr>
<td>Campylobacter spp</td>
</tr>
<tr>
<td>Citrobacter freundii</td>
</tr>
<tr>
<td>Citrobacter koseri</td>
</tr>
<tr>
<td>Enterobacter aerogenes</td>
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<tr>
<td>Enterobacter cloaceae</td>
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<tr>
<td>Escherichia coli</td>
</tr>
<tr>
<td>Haemophilus influenzae</td>
</tr>
<tr>
<td>Klebsiella oxytoca</td>
</tr>
<tr>
<td>Klebsiella pneumoniae</td>
</tr>
<tr>
<td>Proteus mirabilis</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
</tr>
<tr>
<td>Salmonella spp</td>
</tr>
<tr>
<td>Serratia marcescens</td>
</tr>
</tbody>
</table>
Extended Spectrum Beta Lactamases

- TEM and SHV beta lactamases-amino acid substitutions- inactivate the penicillins and narrow spectrum cephalosporins
- CTX-M beta lactamases-plasmid acquired-mediated
  - Inactivate 3rd gen ceph, cefotaxime the most
  - US hosp. isolates 12% E.coli, 16% K.pneumoniae, 5% Proteus
  - Nebraska isolates 5% E.coli, 4% K.pneumoniae, 4% Proteus, 15% Enterobacter
  - Asia, Mexico, Middle East up to 50%
- Best treatment carbapenems
- Risk factors-prolonged antibiotic use, in HCF, GI exposure from food source?
- Can cause outbreaks in hosp, in geographic region
Carbapenem Resistance

- Carbapenem Resistant Enterobacteriaceae (CRE) – resistant to one or more of the carbapenems through the presence of a carbapenemase or due to the presence of other resistance mechanisms

- Carbapenemase Producing Organism (CPO) – an organism that encodes a carbapenemase

* Slide from Dr. Caitlin Murphy, Nebraska Public Health Laboratory
Carbapenem Resistance

- Amp-C or ESBL + loss of porins

- Carbapenemases - movable genetic components
  - Klebsiella pneumoniae Carbapenemase (KPC)
  - New Delhi Metallo-B-lactamase (NDM)
  - Verona Integron-encoded metallo-B-lactamase (VIM)
  - Oxacilinases-48-type carbapenemase (OXA-48)
  - Imipenem metallo-B-lactamase (IMP)
Lab Detection of Carbapenemase

- **Phenotypic Testing**
  - Carba NP
  - mCIM

- **Molecular Testing**
  - Real Time PCR
  - Cepheid Xpert Carba-R
### CP-CRE in Nebraska

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRE</td>
<td>45</td>
<td>46</td>
<td>72</td>
</tr>
<tr>
<td>CP-CRE</td>
<td>7</td>
<td>7</td>
<td>11</td>
</tr>
</tbody>
</table>
CRE in Nebraska 2017-Present

- 185 isolates resistant to carbapenems
- 25 positive for CP
  - 13 urine, 3 sputum, 4 wound, 3 rectal swab, 1 blood
- 4 E.coli, 10 Klebsiella, 4 Enterobacter, 1 Serratia, 4 Citrobacter, 1 Providencia, 1 Morganella

Carbapenemase Type
- 15 KPC
- 7 NDM*
- 2 IMI
- 1 OXA*
- 1 SME

* 1 Klebsiella NDM and OXA
<table>
<thead>
<tr>
<th>Carbapenemase Producing</th>
<th>CRE N-6891 No. (%)*</th>
<th>CRPA N=3699 No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>* &gt;100%-some isolates more than 1 CP)</td>
<td></td>
</tr>
<tr>
<td>Carbapenemase Producing</td>
<td>2311 (34)</td>
<td>98 (3)</td>
</tr>
<tr>
<td>KPC</td>
<td>2056 (89)</td>
<td>11 (11)</td>
</tr>
<tr>
<td>NDM</td>
<td>185 (9)</td>
<td>3 (3)</td>
</tr>
<tr>
<td>OXA-48-type 77</td>
<td>4 (0)</td>
<td>0</td>
</tr>
<tr>
<td>VIM</td>
<td>24 (1)</td>
<td>52 (53)</td>
</tr>
<tr>
<td>IMP</td>
<td>24 (1)</td>
<td>8 (8)</td>
</tr>
</tbody>
</table>

*Courtesy of Sarah Malik, CDC*
### Types of Carbapenemases

#### National vs Central Region

<table>
<thead>
<tr>
<th>Carbapenemase</th>
<th>National 6891 (CP%)</th>
<th>Central Region 654 (CP%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KPC</td>
<td>2056 (30%)</td>
<td>97 (15%)</td>
</tr>
<tr>
<td>NDM</td>
<td>185 (3%)</td>
<td>15 (2%)</td>
</tr>
<tr>
<td>OXA-48-like 77</td>
<td>77 (1%)</td>
<td>11 (2%)</td>
</tr>
<tr>
<td>VIM</td>
<td>26 (&lt;1%)</td>
<td>4 (&lt;1%)</td>
</tr>
<tr>
<td>IMP</td>
<td>24 (9&lt;1%)</td>
<td>11 (2%)</td>
</tr>
<tr>
<td>Total</td>
<td>2368 (34%)</td>
<td>138 (21%)</td>
</tr>
</tbody>
</table>

Sarah Malik, CDC
Non Big 3

#1-Citrobacter-mostly KPC
#2-Providencia-mostly IMP
#3-Proteus
#4-Serratia
Non KPC carbapenemases-33% from Non Big 3
Containment
Facility Guidance for Control of Carbapenem-resistant Enterobacteriaceae (CRE)

November 2015 Update - CRE Toolkit

Facility Guidance for Control of Carbapenem-resistant Enterobacteriaceae (CRE)

November 2015 Update - CRE Toolkit
Public Health Management

- Detection of any single carbapenemase-producing organism in Nebraska will be considered an outbreak that requires investigation — CALL US!

- Epidemiologic information collected for any submitted CRE:
  - Patient demographics (name, date of birth, location)
  - Local health department jurisdiction
  - Ordering and reporting facility
  - Inpatient/facility status

- Additional information collected for carbapenemase-producing organisms:
  - History of prior contact with healthcare facilities, especially outside the United States within the past 6 months
  - Antibiotic treatment course and duration as well as repeat testing
  - Procedures with reusable devices
  - Travel history
  - Occupation
Infection Control Recommendations

- Confirm appropriate hand hygiene practices are being followed
- Confirm use of contact precautions (gowns and gloves available and used correctly)
- Private room if at all possible, cohorting if not possible
- Minimize device utilization where possible (indwelling lines, endotracheal tubes, urinary catheters, etc)
- Facility should examine need for special precautions if patient has a procedure with a reusable device
- Ensure appropriate antimicrobials are being used (stewardship)
Infection Control Recommendations

- Cohort affected patients with minimal shared staff when possible
- Establish clear communication methods if inter-facility transfer is needed (Nebraska Interfacility Transfer Form can be used if there is not a current method in place)
- Ensure appropriate environmental cleaning is performed
- Perform screening/surveillance cultures if needed
- Identify a primary care provider to coordinate follow-up with test of cure culture 10 to 14 days after completion of antibiotics
Screening and Surveillance Cultures

- Ring approach, using epidemiologic and clinical characteristics to identify those at risk

- Screening to identify unrecognized colonization (rectal swab)

- Identify transmission

- Social network/shared facility analysis
Screening and Surveillance Cultures

- Discuss with IP at facility the level of state epidemiology support they would like
  - Facility can run internal screening program with notification to state if carrier found
  - Facility can run internal screening program with guidance from state
- Identify appropriate epidemiologic contacts for screening
  - Consider facility layout, timing of contact precautions and antibiotics for risk determination
  - Roommates
  - Patient on the same hallway for 3 or more days of shared admission with index patient
  - Pursue outpatient screening only for highest risk patients (particularly roommates)
  - Can perform screening for at-risk contacts every other week while case is admitted in facility
- Obtain appropriate swabs to be sent directly to facility (from NPHL or ARLN)
  - NPHL screening performed by rectal swab for routine stool culture
  - ARLN screening performed by rectal swab with Cepheid-specific swab
Screening and Surveillance Cultures

- Swabs will be sent to either NPHL or ARLN for testing (facilitated by NDHHS)
- NPHL or ARLN will notify the facility and NDHHS HAI program with results
- Establish method for communication CRE status upon transfer of patients to other facilities
- NDHHS HAI program and NPHL will work with CDC/ARLN as needed for notification/support
- If transmission is identified, perform follow-up point prevalence surveys until two sequential surveys are negative (no additional cases identified)
- Consider performing active surveillance cultures upon admission to a unit if transmission is identified
- Consider use of daily 2% chlorhexidine bathing for patients in high-risk settings/units
Outbreak Detection and Management

- Define outbreaks and investigation protocols
- Coordinate with LHDs, NPHL, and ARLN
- Provide education to facilities
- Provide guidance on screening for colonization when needed
- ICAR to assess IP practices
Outbreak Lab Support

• NPHL
  • Confirm CRE, CP-CRE
  • Determine Type of CP
  • PFGE
  • WGS in certain circumstances

• ARLN
  • CRE Colonization Testing
  • Special AST testing

• CDC
  • WGS
  • ?environmental testing
Applications

- Surveillance system for detection of CREs
- Staph and influenza: able to provide information on resistant patterns state-wide
- Screening of data for unusual resistance patterns in outbreak settings
Future Directions

- Further develop antibiograms to make available regionally

- Development of Screening for CREs from higher risk facilities
  - Healthcare outside of US
  - Healthcare from higher rate metropolitan areas within US
  - From facilities with higher rates within NE

- Surveillance and response protocol for other multi-drug resistant organisms (C. auris)

- Isolation for ESBLs
Maureen Tierney. MD, MSc
Director, HAI/AR Program

Maureen.Tierney@Nebraska.gov
The DPH antimicrobial susceptibility registry can be used to track resistance rates over time.

- True
- False
Assessment Question 2

When should a facility screen a patient for the presence of CRE?

a. At admission after recent hospitalization in another country
b. After their roommate recently tested positive for a CP-CRE
c. After transmission of CP-CRE has been proven on a ward in a long-term care facility
d. All of the above