

Carbapenem-Resistant *Enterobacteriaceae* (CRE) Surveillance and Prevention

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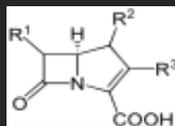
Enterobacteriaceae

- Enteric organisms (intestinal colonizers)
- Facultative anaerobic, gram-negative bacilli
- Genera: *Klebsiella*, *Escherichia*, *Enterobacter*, *Morganella*, *Proteus*, *Citrobacter*, *Salmonella*, *Serratia*, *Shigella*
- Pathogens responsible for
 - Urinary tract infections
 - Bacteremia
 - Pneumonia
 - Wound infections



Carbapenems

- Class of broad-spectrum, β -lactam antibiotics
- Act by inhibiting cell wall synthesis
- Most effective against gram negative infections
- Examples of carbapenems
 - Ertapenem
 - Doripenem
 - Imipenem
 - Meropenem



- Agents of last resort – one of the few remaining effective therapies

Mechanisms of Carbapenem Resistance

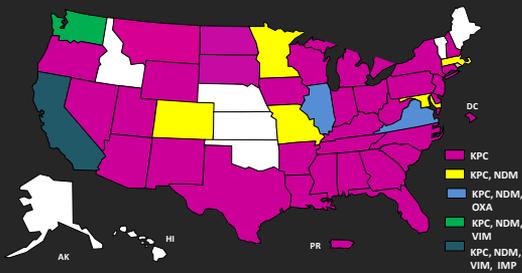
1. Carbapenemases
2. Acquired resistance
3. Naturally imipenem-resistant *Enterobacteriaceae*

• **Not all CRE are carbapenemase producers...**

Carbapenemases

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

Carbapenemase-producing CRE in the United States



Patel, Raszheed, Kitchel. 2009. Clin Micro News
MMWR MMWR Morb Mortal Wkly Rep. 2010 Jun 25;59(24):750.
MMWR Morb Mortal Wkly Rep. 2010 Sep 24;59(37):1212.
CDC, unpublished data

Laboratory Detection of CRE

- **Screening**
 - Labs use automated systems for antimicrobial susceptibility testing (AST)
- **Confirmation**
 - Modified Hodge test (MHT)
 - Phenotypic test to detect carbapenemase production
 - Polymerase chain reaction (PCR)
 - Molecular test to confirm presence of specific resistance genes (e.g., *bla_{KPC}* gene)



Patient Risk Factors

- **Antimicrobial exposure (and duration)**
 - 3rd/4th generation Cephalosporins
 - Fluoroquinolones
 - Aminoglycosides
 - Penicillins
- **Increased number of co-morbid conditions**
 - Cardiovascular disease, renal failure, diabetes, chronic lung disease
- **Invasive devices**
 - Central lines, urinary catheters, mechanical ventilation
- **Previous healthcare exposures**
 - Acute care, LTAC, LTC or other...

Public Health Threat

- **Treatment options are limited**
 - New antibiotics are slow to develop
 - Pan-resistant strains identified
- **CRE infections associated with high mortality rates**
- **Resistance is highly transmissible**
 - Between organisms – plasmids
 - Between patients – hands, healthcare workers
- **Potential for spread into the community**
 - E. coli a common cause in community infection

CRE Surveillance and Prevention Initiative

CRE Surveillance and Prevention Initiative

- Enrolled **17 acute care** and **4 long-term acute care** facilities (21 total)
- Facilities submit case information and denominator data every month (admissions and patient-days)
- CRE Prevention Plans
 - Facilities chose interventions
 - Implementation began March 1, 2013

CRE Surveillance and Prevention Initiative

- **Overall goal**
 - Understand and describe CRE epidemiology
 - To build regional partnerships within healthcare and public health communities to reduce the spread of CRE in Michigan

Data Highlights
September 2012 – April 2014

Surveillance

- **Surveillance Definition**
 - *Klebsiella pneumoniae* or *Escherichia coli*
 - Reported as non-susceptible (R or I) to **ANY** carbapenem
 - Yes – case reported
 - No – check MICs of carbapenems

Surveillance

- **Baseline Period**
 - September 1, 2012 – February 28, 2013
- **CRE Prevention Plans Implemented**
 - March 1, 2013
- **Intervention Period**
 - March 1, 2013 – August 31, 2014

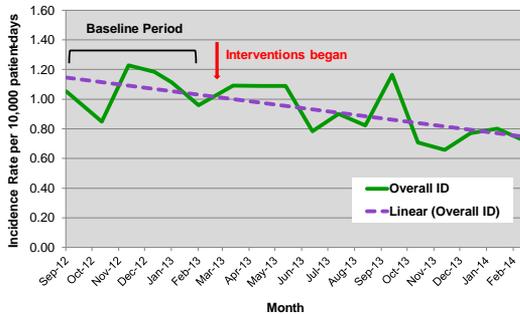
Patient Demographics

- **Total of 267 cases reported**
- **Age**
 - Median: 66 y/o
 - Range: 1-97 y/o
- **Sex**
 - 52% Female
- **Patient Type**
 - Inpatient ICU: 39%
 - Inpatient Non-ICU: 49%
 - Outpatient: 11%
 - Referral patient: 1%

CRE Incidence in Michigan

- **Baseline (Sept 2012 – Feb 2013)**
 - 102 cases
 - 957, 220 patient-days
 - 1.07 cases per 10,000 p-d
- **Intervention (March 2013 – present)**
 - 165 cases
 - 1,861,587 patient-days
 - 0.88 cases per 10,000 p-d

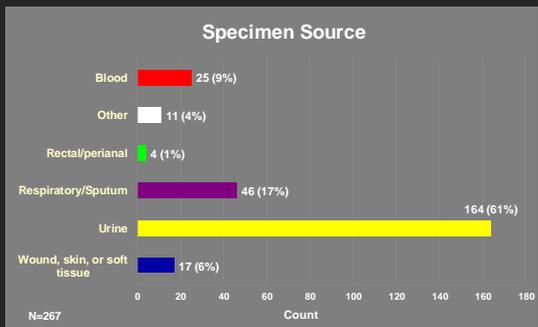
**Overall CRE Incidence
September 2012 – February 2014**



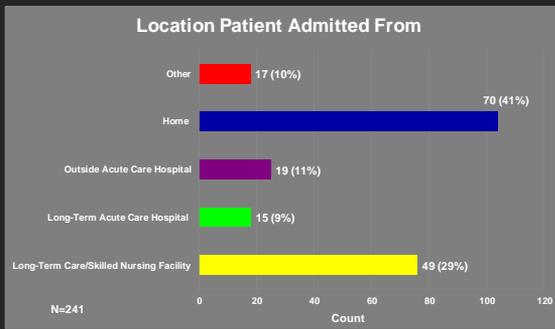
Laboratory Testing and Micro

- **Organism**
 - *Klebsiella pneumoniae*: 90%
 - *Escherichia coli*: 10%
- **Specimen Type**
 - Clinical culture: 98%
 - Surveillance culture or screen: 2%

Laboratory Testing – Specimen Source



Location Patient Admitted From



CRE Prevention

CDC 2012 CRE Toolkit

- Guidance for Control of Carbapenem-resistant *Enterobacteriaceae* - Released June 2012
 - **Part 1:** Recommendations for healthcare facilities – expands on March 2009 guidance for acute care facilities
 - **Part 2:** Reviews the role of public health in the control of CRE

8 Core Prevention Measures

- Hand Hygiene
- Contact Precautions
- Healthcare Personnel Education
- Minimize the Use of Invasive Devices
- Patient and Staff Cohorting
- Laboratory Notification
- Promote Antimicrobial Stewardship
- CRE Screening

Examples of CRE Prevention Plans

- Flagging of CRE patients in IC surveillance system – isolated more quickly
- Development of practitioner-specific reports to describe infectious disease specialist approval of carbapenem usage
- Education (clinical staff and physicians) on CRE
- Rapid communication between lab, infection control, and infectious disease physicians
- Prompt discontinuance of unnecessary invasive devices
- Educating patient services regarding compliance with signage and how to prevent transmission of CRE

Public Health Engagement

- Good sense of what is going on in the jurisdiction
- LHDs unique position to interface with different types of facilities
 - Acute care
 - Skilled nursing
 - MDCH
- Assist in coordination of local and state response to CRE (MDROs)

We are making progress!

- Established a baseline incidence rate for CRE
- Current CRE incidence rate has decreased since baseline
 - 1.07 cases to 0.88 case per 10,000 p-d
- Since September 2012
 - Michigan has prevented 51 infections of CRE
 - 19 infections of CRE were prevented in LTACs

For more information

- Visit website for presentations, updates and training opportunities
 - www.michigan.gov/hai
 - Scroll down to the green banner boxes
 - MDCH SHARP HAI Prevention Initiatives
 - MRSA/CDI
 - CRE



Thank you

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