An Update: Carbapenem resistant Enterobacteriaceae (CRE)

Lynn Ramirez-Avila
Clinical Epidemiology and Infection Prevention
May 26, 2014
Outline

• Definitions
• Epidemiology
• Outcomes
• Treatment
• Prevention
• CRE in the UCLA HealthSystem
What are Enterobacteriaceae?

- Enterobacteriaceae
  - Normal flora that inhabit the GI tract
  - Gram negative rods
  - Can cause infections in the community & healthcare setting
  - More than 70 species
    - *Klebsiella pneumoniae*
    - *Escherichia coli*
    - *Enterobacter sp.*
    - Does not include
      - Acinetobacter or
      - Pseudomonas
Enterobacteriaceae

- Account for >21% of device-related infections
- Beta-lactam antibiotics have been the primary treatment of these organisms
  - Penicillin derivatives such as cephalosporins, penicillin/beta-lactamase combinations, carbapenems
- Resistance to the Beta-lactam antibiotics emerged several years ago
• Carbapenem resistant Enterobacteriaceae (CRE) uncommon prior to 1992

• First described in 1996 in North Carolina as part of an outbreak investigation
Carbapenem resistant Enterobacteriaceae (CRE)

http://articles.washingtonpost.com/2012-08-22/national/35493591_1_superbug-ar
resistant-hospital-borne-infections; http://www.cdc.gov/mmwr/pdf/wk/mm6209.p
http://www.washingtontimes.com/news/2013/mar/6/cdc-says-nightmare-bacteria-cre-
superbug-killing-h/
CRE

• CDC Definition
  – Nonsusceptible meropenem, imipenem, doripenem
  – Resistant to 3rd generation cephalosporins
    • Ceftriaxone, cefotaxime, ceftazadime

• Most common CRE in the United States
  – *Carbapenem resistant Klebsiella pneumonia* (CRKP)
    • CRKP produce Klebsiella pneumonia carbapenemase (KPC)
Enterobacteriaceae

CRE
- KPC
- NDM-1
- IMP
- VIM
- OXA

Not a CRE
- Amp-C
- ESBL

Other Gram negative rods
- Pseudomonas Acinetobacter
Enterobacteriaceae

Other Gram negative rods

CRE

Not a CRE

KPC
NDM-1
IMP
VIM
OXA

Amp-C
ESBL

Pseudomonas Acinetobacter
Enterobacteriaceae

- CRE
  - KPC
  - NDM-1
  - IMP
  - VIM
  - OXA

- Not a CRE
  - Amp-C
  - ESBL

Other Gram negative rods

- Pseudomonas Acinetobacter
  - Have different resistance mechanisms that confer resistance to broad spectrum antibiotics

Other

- Produce beta-lactamases that confer resistance to broad spectrum antibiotics
Carbapenemases

• Are enzymes that breakdown the antibiotic
• Different types
  – Class A, B, D, MBL
• Most common is a Class A enzyme →
  – **KPC** plasmid based enzyme
    • Most common clone ST258

http://www.cell.com/cms/attachment/2002995576/2011441548/gr1.jpg
Global Spread of CRE

Molton et al CID 2013
CRE: A National Problem

Geographical Distribution of *Klebsiella pneumoniae* carbapenemase (KPC) Infections

[Image showing map comparison between 2001 and 2012, highlighting states with KPC producing organisms.]

CDC, Get Smart Campaign http://www.cdc.gov/getsmart/campaign-materials/week/images/kpc-states.png
CRE Incidence

<table>
<thead>
<tr>
<th>Organism</th>
<th>2001</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Klebsiella pneumoniae</em></td>
<td>1.6%</td>
<td>11%</td>
</tr>
<tr>
<td><em>E coli</em></td>
<td>1%</td>
<td>1-2%</td>
</tr>
<tr>
<td>Enterobacter spp.</td>
<td>1.4%</td>
<td>3.6%</td>
</tr>
</tbody>
</table>
Making Health Care Safer
Stop Infections from Lethal CRE Germs Now

Untreatable and hard-to-treat infections from CRE germs are on the rise among patients in medical facilities. CRE germs have become resistant to all or nearly all the antibiotics we have today. Types of CRE include KPC and NDM. By following CDC guidelines, we can halt CRE infections before they become widespread in hospitals and other medical facilities and potentially spread to otherwise healthy people outside of medical facilities.

Health Care Providers can
- Know if patients in your facility have CRE.
  - Request immediate alerts when the lab identifies CRE.
  - Alert the receiving facility when a patient with CRE transfers, and find out when a patient with CRE transfers into your facility.
- Protect your patients from CRE.
  - Follow contact precautions and hand hygiene recommendations when treating patients with CRE.
  - Dedicate rooms, staff, and equipment to patients with CRE.
  - Prescribe antibiotics wisely.
- Remove temporary medical devices such as catheters and ventilators from patients as soon as possible.

*Long-term acute care hospitals provide complex medical care, such as ventilation or wound care, for long periods of time.

See page 4
Want to learn more? Visit http://www.cdc.gov/vitalsigns/
CDC Antibiotic Resistance Threat Report 2013

CRE at UCLA

Table 21B. Carbapenem-resistant *Enterobacteriaceae*: RRUMC and SMH-UCLA, 2009–2011

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CRKP</td>
<td>6</td>
<td>12</td>
<td>10</td>
<td>11</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Other CRE</td>
<td>11</td>
<td>0</td>
<td>8</td>
<td>11</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Note: CRKP = carbapenem-resistant K. pneumoniae (CRKP)
How are CRE identified?
## Susceptibility Profile

<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>Interpretation</th>
<th>Antimicrobial</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amikacin</td>
<td>I</td>
<td>Chloramphenicol</td>
<td>R</td>
</tr>
<tr>
<td>Amox/clav</td>
<td>R</td>
<td>Ciprofloxacin</td>
<td>R</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>R</td>
<td>Ertapenem</td>
<td>R</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>R</td>
<td>Gentamicin</td>
<td>R</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>R</td>
<td>Imipenem</td>
<td>R</td>
</tr>
<tr>
<td>Cefpodoxime</td>
<td>R</td>
<td>Meropenem</td>
<td>R</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>R</td>
<td>Piperclillin/Tazo</td>
<td>R</td>
</tr>
<tr>
<td>Cetotetan</td>
<td>R</td>
<td>Tobramycin</td>
<td>R</td>
</tr>
<tr>
<td>Cefoxitin</td>
<td>R</td>
<td>Trimeth/Sulfa</td>
<td>R</td>
</tr>
<tr>
<td>Ceftazidime</td>
<td>R</td>
<td>Polymyxin B</td>
<td>MIC &gt;4μg/ml</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>R</td>
<td>Colistin</td>
<td>MIC &gt;4μg/ml</td>
</tr>
<tr>
<td>Cefepime</td>
<td>R</td>
<td>Tigecycline</td>
<td>S</td>
</tr>
</tbody>
</table>

CLSI 2012 Breakpoints

Appendix A: Previous and Current Clinical and Laboratory Standards Institute Interpretive Criteria for Carbapenems and Enterobacteriaceae

<table>
<thead>
<tr>
<th>Agent</th>
<th>Previous Breakpoints (M100-S19) MIC (µg/mL)</th>
<th>Current Breakpoints (M100-S22) MIC (µg/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Susceptible</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Doripenem</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ertapenem</td>
<td>≤2</td>
<td>4</td>
</tr>
<tr>
<td>Imipenem</td>
<td>≤4</td>
<td>8</td>
</tr>
<tr>
<td>Meropenem</td>
<td>≤4</td>
<td>8</td>
</tr>
</tbody>
</table>

Phenotypic Testing

- Modified Hodge Test (MHT)
  - Not used anymore

Figure 1. The MHT performed on a 100 mm MHA plate. (1) *K. pneumoniae* ATCC BAA 1705, positive result (2) *K. pneumoniae* ATCC BAA 1706, negative result; and (3) a clinical isolate, positive result.
Who gets CRE?
**Demographics**

<table>
<thead>
<tr>
<th>Case Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total no. confirmed</td>
<td>675</td>
</tr>
<tr>
<td>Female sex</td>
<td>379 (56)</td>
</tr>
<tr>
<td>Age, mean (range), years</td>
<td>73 (1–103)</td>
</tr>
<tr>
<td>Reported from</td>
<td></td>
</tr>
<tr>
<td>Acute care hospital</td>
<td>387 (57)</td>
</tr>
<tr>
<td>Long-term acute care hospital</td>
<td>231 (34)</td>
</tr>
<tr>
<td>Skilled nursing facility</td>
<td>57 (8)</td>
</tr>
<tr>
<td>Specimens with admit date</td>
<td>598 (89)</td>
</tr>
<tr>
<td>Hospital onset</td>
<td>363 (61)</td>
</tr>
<tr>
<td>Community onset</td>
<td>235 (39)</td>
</tr>
<tr>
<td>From skilled nursing facility</td>
<td>154 (66)</td>
</tr>
<tr>
<td>Collected on admission</td>
<td>141 (60)</td>
</tr>
</tbody>
</table>

NOTE. Data are no. (%), unless otherwise indicated.
FIGURE 1. Monthly carbapenem-resistant *Klebsiella pneumoniae* (CRKP) pooled mean rate of infection by facility type for long-term acute care hospitals (LTACs; n = 8) and acute care hospitals (ACHs; n = 57) in Los Angeles County (excluding skilled nursing facilities and out-of-county reporting facilities).
Risk Factors for CRE

• Increased hospitalizations
• Prior extended-spectrum cephalosporin and fluoroquinolone use
  – Other studies have associated vancomycin
• Invasive procedures
• ICU stay
• Poor functional status

Patel et al ICHE 2008
<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Case patients (n=99)</th>
<th>Control patients (n=99)</th>
<th>Univariable analysis</th>
<th>Multivariable analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>P</td>
<td>OR (95% CI)</td>
<td>P</td>
</tr>
<tr>
<td>Patient-specific risk factor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>27 (27)</td>
<td>20 (20)</td>
<td>1.45 (0.75–2.82)</td>
<td>.27</td>
</tr>
<tr>
<td>HIV infection</td>
<td>2 (2)</td>
<td>5 (5)</td>
<td>0.40 (0.08–2.14)</td>
<td>.29</td>
</tr>
<tr>
<td>Heart disease</td>
<td>23 (23)</td>
<td>16 (16)</td>
<td>1.52 (0.72–3.20)</td>
<td>.27</td>
</tr>
<tr>
<td>Liver disease</td>
<td>39 (39)</td>
<td>29 (29)</td>
<td>1.67 (0.90–3.08)</td>
<td>.10</td>
</tr>
<tr>
<td>Renal insufficiency</td>
<td>34 (34)</td>
<td>23 (23)</td>
<td>1.75 (0.94–3.27)</td>
<td>.08</td>
</tr>
<tr>
<td>Transplant recipient</td>
<td>41 (41)</td>
<td>14 (14)</td>
<td>5.70 (2.65–12.16)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Healthcare-associated factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of CVC</td>
<td>90 (91)</td>
<td>55 (56)</td>
<td>8.32 (3.74–18.53)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Receipt of mechanical ventilation</td>
<td>65 (66)</td>
<td>22 (22)</td>
<td>6.62 (3.53–12.43)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>ICU stay</td>
<td>68 (69)</td>
<td>33 (33)</td>
<td>4.45 (2.45–8.11)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Length of stay before infection, days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>25.19 ± 24.9</td>
<td>6.44 ± 10.1</td>
<td>1.09 (1.06–1.12)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Median</td>
<td>21</td>
<td>1</td>
<td>1.05 (1.01–1.08)</td>
<td>.01</td>
</tr>
<tr>
<td>Prior antibiotic therapy with anti–gram negative activity</td>
<td>98 (99)</td>
<td>55 (56)</td>
<td>78.17 (10.48–583.10)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Class of antibiotic used</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cephalosporin</td>
<td>63 (64)</td>
<td>31 (31)</td>
<td>3.82 (2.11–6.91)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>β-lactam and/or β-lactamase inhibitor</td>
<td>54 (55)</td>
<td>33 (33)</td>
<td>2.30 (1.30–4.10)</td>
<td>&lt;.005</td>
</tr>
<tr>
<td>Fluoroquinolone</td>
<td>36 (36)</td>
<td>23 (23)</td>
<td>1.87 (1.00–3.48)</td>
<td>.05</td>
</tr>
<tr>
<td>Carbapenem</td>
<td>54 (55)</td>
<td>6 (6)</td>
<td>19.25 (7.61–48.70)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Monobactam</td>
<td>6 (6)</td>
<td>1 (1)</td>
<td>7.04 (0.82–60.68)</td>
<td>.08</td>
</tr>
<tr>
<td>Aminoglycoside</td>
<td>14 (14)</td>
<td>3 (3)</td>
<td>5.44 (1.49–19.85)</td>
<td>.01</td>
</tr>
</tbody>
</table>
Risk of CRE Infections

1. Local Short-Stay Hospital
   - Jan has a stroke and is in the hospital. She is stable but needs long-term critical care at another facility.

2. Long-Term Acute Care Hospital
   - Other patients in this facility have CRE. A nurse doesn't wash his hands, and CRE are spread to Jan. She develops a fever and is put on antibiotics without proper testing.

3. Local Short-Stay Hospital
   - Jan becomes unstable and goes back to the hospital, but her new doctors don't know she has CRE. A doctor doesn't wash her hands after treating Jan. CRE are spread to other patients.

How CRE Take Over

1. Lots of germs, 1 or 2 are CRE
2. Antibiotics kill off good germs
3. CRE grow
4. CRE share genetic defenses to make other bacteria resistant

SOURCE: CDC Vital Signs, 2013

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.

Why are CRE Clinically Important?
Why are CRE Clinically Important?

- High mortality rates associated with CRE and CRKP infection
CRE and Outcomes

Mortality

Overall Mortality
OR 3.71 (1.97-7.01)
48 (CRKP)
20 (CSKP)

Attributable Mortality
OR 4.5 (2.16-9.35)
38 (CRKP)
12 (CSKP)

p<0.001
Why are CRE Clinically Important?

• Mortality
  – 50% mortality associated with CRE blood stream infections
  – Pan-resistant CRE strains cause 75% mortality

• Mortality
  – Risk factors age, mechanical ventilation, malignancy, heart disease, and ICU stay
  – Removal of the focus of infection (device, debridement, or drainage) associated with survival

Gupta et al CID 2011
Why are CRE Clinically Important?

• Limited treatment options
Bad Bugs, No Drugs: Current Resistance Trends
CRE Treatment Options

- Limited treatment options
  - Colistin
  - Polymixin B
  - Tigecycline

- Many KPC are ‘pan-resistant’
  - Aminoglycosides
  - Fluoroquinolones
New Antibacterial Agents Approved 1983-2012

Timeline for Development of a New Medication

Challenges for Antibiotic Research and Development

• Smaller market:
  – Antibiotics work well and fast
  – Compared with chronic, long-term conditions

• Limited long-term potential
  – Bacteria become resistant!
Bad Bugs, No Drugs

Infectious Diseases Society of America (IDSA) 2010

10 × ’20 Progress—Development of New Drugs Active Against Gram-Negative Bacilli: An Update From the Infectious Diseases Society of America
Why are CRE Epidemiologically Important?
Why are CRE Epidemiologically Important

• Resistance is highly transmissible
  – Between organisms: plasmids and transposons
  – Between patients: HANDS!

• These organisms are common causes of infection
  – *E. coli* and urinary tract infections
  – Acuity of patient population has increased dramatically in recent decade
    – Increase number of transplant and oncology patients

• CRE have been documented in the community setting
Examples of How Antibiotic Resistance Spreads

- Animals get antibiotics and develop resistant bacteria in their guts.
- Drug-resistant bacteria can remain on meat from animals. When not handled or cooked properly, the bacteria can spread to humans.
- Fertilizer or water containing animal feces and drug-resistant bacteria is used on food crops.
- Drug-resistant bacteria in the animal feces can remain on crops and be eaten. These bacteria can remain in the human gut.
- George gets antibiotics and develops resistant bacteria in his gut.
- George stays at home and in the general community. Spreads resistant bacteria.
- Resistant germs spread directly to other patients or indirectly on unclean hands of healthcare providers.
- Resistant bacteria spread to other patients from surfaces within the healthcare facility.
- Healthcare Facility
- Patients go home.
- George gets care at a hospital, nursing home or other inpatient care facility.

Simply using antibiotics creates resistance. These drugs should only be used to treat infections.
Prevention
What do we do now?

• CRE are not endemic in most of the United States
  – How do we keep it that way...
Prevention

• Need to practice comprehensive infection control measures. Per CDC:
  – Hand hygiene
  – Contact precautions
  – Education of healthcare workers
  – Cohort staff/patients
  – Notify laboratory
  – Antimicrobial Stewardship
  – CRE contact screening
  – Consider
    • Active surveillance cultures
    • Chlorhexidine bathing

CDC Guidance for Control of CRE 2012 CRE Toolkit
Transmission Pathways

Nosocomial and healthcare related infections


Munoz-Price et al, Curr Opin 2013
Most important source of transmission of pathogens in the hospital setting

Healthcare worker hands
# Hand Hygiene Adherence in Hospitals

<table>
<thead>
<tr>
<th>Year of Study</th>
<th>Adherence Rate</th>
<th>Hospital Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994 (1)</td>
<td>29%</td>
<td>General and ICU</td>
</tr>
<tr>
<td>1995 (2)</td>
<td>41%</td>
<td>General</td>
</tr>
<tr>
<td>1996 (3)</td>
<td>41%</td>
<td>ICU</td>
</tr>
<tr>
<td>1998 (4)</td>
<td>30%</td>
<td>General</td>
</tr>
<tr>
<td>2000 (5)</td>
<td>48%</td>
<td>General</td>
</tr>
</tbody>
</table>

Efficacy of Hand Hygiene Preparations in Killing Bacteria

- Good: Plain Soap
- Better: Antimicrobial Soap
- Best: Alcohol-based handrub
Contact Precautions

• CDC
  – Any person colonized or infected with CRE should be placed on Contact Precautions
  – CRE colonization duration unknown though some studies report prolonged period (>6 mo)
    • Risk factors: exposure to antibiotics, admission from another healthcare facility, and <3mos since first CRE test

• UCLA HealthSystem
  – Any carbapenem resistant Enterobacteriaceae
    – *Klebsiella pneumoniae*
    – *E. coli*
    – *Enterobacter sp.*
  • Contact isolation for the hospitalization and subsequent hospitalizations
  • No clearance protocol available

CDC Guidance for Control of CRE 2012 CRE Toolkit
Other Prevention Measures

- Healthcare personnel education
  - Focus on hand hygiene and Contact precautions
- Minimize the use of devices
- Patient and staff cohorting
  - Single patient room
  - Dedicated staff to care for them
- Laboratory Notification
  - Laboratory to notify infection prevention of any CRE
- CRE Screening
  - Of any epidemiologically linked patient of CRE infected/colonized patient

CDC Guidance for Control of CRE 2012 CRE Toolkit
Antibiotic Stewardship programs (ASP)

• Limited studies for CRE prevention
  – Two studies include ASP as part of CRE bundle
  – One study evaluated ASP as the sole intervention
    • Reduction in the use of beta-lactams ineffective in reducing CRE acquisition
    • Use of fluorquinolones associated with higher acquisition of fluorquinolone resistant CREs

• More studies needed to evaluate ASP
  – Current goal to decrease total volume of antibiotics prescribed

Munoz-Price et al, Curr Opin 2013
Antimicrobial Stewardship Program

- Infection Prevention Department
- Pharmacy
- Microbiology
- Infectious Diseases Division
- Patient Safety
- Hospital Leadership
- P&T Committee
- Director, Information Systems
UCLA ASP

‘Back end’ ASP program

• Adult: Started July 2010
• Pediatric: Started March 2013
– Targeted prospective audit with feedback
– Education/marketing
– Availability of expertise at the point of care
  – Antibiotic handbook
  – Antibiotic hotline
– Data monitoring
  – Streamlining/de-escalation
  – IV to PO
  – Redundant coverage
UCLA Adult Antibiotic Use

- Hospital-wide email
- Website created with guidelines
- Antimicrobial Stewardship Program
The Environment

Nosocomial and healthcare related infections


Munoz-Price et al, Curr Opin 2013
Supplemental Strategies

• Active surveillance testing
  – Of any patient who may not be epidemiologically linked but who meet certain pre-specified criteria
    • Admission from a long-term care facility
    • Admission to a high risk setting

• Chlorhexidine (CHG)
  – Has been used in CRE outbreak situations
    • 3 studies have included CHG as part of their CRE bundle
    • Difficult to assess utility of CHG in these studies as it was part of a package intervention
    • Consider in certain settings

CDC Guidance for Control of CRE 2012 CRE Toolkit; Munoz-Price et al, Curr Opin 2013
Case Study:
CRE in the UCLA HealthSystem
General Methods

• CRE defined as any of the Enterobacteriaceae that are resistant to meropenem
• For analysis, used cultures Jan 1, 2011-Dec 31, 2012
  – Reviewed patient charts to obtain additional data
  – Each organism per patient was considered to be a separate event; all others were excluded from analysis
Overview of CDC LabID Method

• Method for collecting and tracking positive lab results
  – Does not take into consideration whether a culture represents colonization or true infection
• Used to assess burden of disease
• Separate events are considered to be organisms per patient per calendar month per hospital unit per specimen source
• Used different method for analysis to adapt data to be more relevant for RR/SM patient population
Monthly number of cultures by facility by year

- **RR**: 76 cultures (35 from 2011; 41 from 2012)
- **SM**: 93 cultures (42 from 2011; 51 from 2012)

Serling-Boyd, UCLA, 2013
Cultures by hospital unit (inpatients only)

- RR: 64 inpatients
- Only takes into consideration discharge condition of admission encompassing positive culture (death during later admission not counted in this measure)
Cultures by hospital unit (inpatients only)

- SM: 84 inpatients
- Only takes into consideration discharge condition of admission encompassing positive culture (death during later admission not counted in this measure)
Patients with recent discharge from same facility in past 30 days

- RR: 76 cultures
- SM: 93 cultures
- Recent discharge from other facility or transfer from other hospital not included in this measure

Serling-Boyd, UCLA, 2013
Admitting location (for inpatients only)

- RR: 64 inpatient cultures, SM: 84 inpatient cultures
- Location obtained either from admission H&P or patient demographic information, when available
- Other/unknown include homeless patients (2 from SM) and various other types of homes

Serling-Boyd, UCLA, 2013
Distribution of days from admission to positive culture

- **RR**: 64 inpatient cultures
  - Mean time from admission to culture: 25 days
- **SM**: 84 inpatient cultures
  - Mean time from admission to culture: 11 days

Serling-Boyd, UCLA, 2013
Discharge condition (in hospital mortality) for inpatients only

- **RR**: 64 inpatient cultures
- **SM**: 84 inpatient cultures
- Only takes into consideration discharge condition of admission encompassing positive culture (death during later admission not counted in this measure)

Serling-Boyd, UCLA, 2013
60 and 90 day mortality (all patients)

- RR: 76 cultures
- SM: 93 cultures
- Takes into consideration any date of death included in CareConnect
- Used date to calculate number of days from time of culture

Serling-Boyd, UCLA, 2013
UCLA Response

• Change in policy/practice
  – Santa Monica Hospital
    • Screen all geriatric patients via rectal swab
      – All patients admitted from certain longterm care facilities, such as GoldStar placed on empiric contact precautions pending results of rectal swabs
  – Ronald Reagan Medical Center
    • CRE infected population different
      – Long-term hospitalized patients
      – Importance of robust infection prevention practices and judicious antibiotic use

Serling-Boyd, UCLA, 2013
In Summary

- Carbapenem resistant Enterobacteriaceae (CRE) is growing problem
- Most common CRE is the Carbapenem Resistant Klebsiella pneumoniae (CRKP) that produces a Klebsiella pneumonia carbapenemase (KPC)
- Clinically
  - Risk factors include hospitalization, antibiotic exposure, invasive devices, long-term acute care facility (LTAC), and increased acuity
  - CRE associated with increased mortality
  - Few treatment options exist
- Epidemiologically
  - CRE resistance mechanisms can spread amongst bacteria
  - CRE can spread amongst people
- Prevention via a bundled approach is key to halting the spread
  - Adequate hand washing
  - Contact precautions
  - Cohorting
  - Antibiotic Stewardship
  - Contact tracing versus active surveillance