Multi-Drug Resistant Organisms (MDROs)

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Infection Prevention & Control
Boot Camp For Long-Term Care Facility
Infection Preventionists

Defining the Problem

- **MDRO**—multi-drug resistant organisms:
- Microorganisms that are resistant to at least one class of antibiotics or one specific antibiotic
- Present challenges for individual patient management and containment in acute and long term care facilities

[1] Centers for Disease Control. Healthcare infection control practices advisory committee (HICPAC) MDRO Guideline. http://www.cdc.gov/hicpac/mdro/mdro_2.html Accessed October 2016

Background

- Each year in the U.S., at least 2 million people acquire serious infections with a multi-drug resistant organism (MDRO)
- Almost 250,000 people each year require hospitalization for Clostridium difficile infections alone
- It is estimated about 23,000 people die each year as a direct result of MDRO infections
- Global problem-bugs without borders
- Many forms of resistance spread quickly

[2] Centers for Disease Control. Antibiotic Resistance Threats in the United States. 2013. https://www.cdc.gov/hai/organisms/cre/TrackingCRE.html

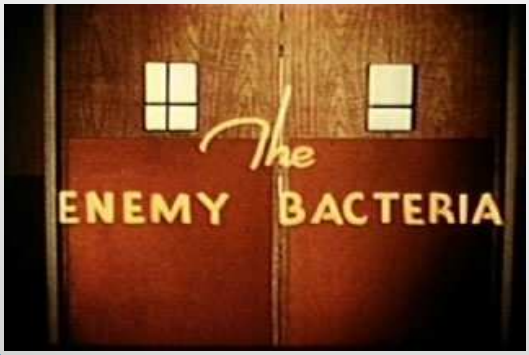
Multi-Drug Resistant Organisms (MDROs)

Infection

- Presence of pathogen
- Organism growth & invasion of host
- Presence of clinical signs & symptoms

Colonization

- Presence of microorganism
- No tissue invasion
- Absence of clinical signs & symptoms



Significant Pathogens

- MRSA (methicillin resistant staphylococcus aureus
- VRE (vancomycin resistant enterococcus)
- ESBL (extended spectrum beta lactamase)
- ABC (acinetobacter baumanii complex)
- Clostridium Difficile
- CRKP (KPC or CRE)
- NDM1 (New Delhi Metallo beta-lactamase)
- mcr1 gene (gene mediated Colistin-resistant E. coli)

Multi-Drug Resistant Organisms (MDROs)

Mechanisms of Antibiotic Resistance

- Drug destruction by enzyme within organism (inactivation of drug)
- Alteration of drug receptor/target sites
- Decreased drug permeability or active efflux of the antibiotic
- Chromosomal drug resistance occurs by spontaneous mutation in the gene locus that controls susceptibility to a drug

[3] Medscape. Insights into Antibiotic Resistance Through Metagenomic Approaches. http://www.medscape.com/viewarticle/736318_2 Last accessed October 2, 2016.

MRSA

- *Staphylococcus aureus* is a bacteria carried by healthy people in a variety of body sites (30% on skin, 20-30% in nares)
- One of the most prominent pathogens associated with community, hospital and livestock-associated infections
- Within two years after introduction of Methicillin, resistance was observed
- Transmitted by direct or indirect contact with persons harboring the organism or from the environment
- *Staphylococcus aureus* is a frequent asymptomatic colonizer of humans
- Mild-to-severe skin infections are amongst the most common MRSA related diseases

[4] Chatterjee SS, Otto M. Improved understanding of factors driving methicillin-resistant Staphylococcus aureus epidemic waves. Clinical Epidemiology.2013;:205-217. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3702418/ Accessed October 4, 2016

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VRE

- Vancomycin Resistant *Enterococcus* (faecalis or faecium)
- *Enteroccci* are commonly found in the intestinal tract of humans
- Can be transmitted through fecal-oral route
- Can cause life threatening infections like endocarditis (heart valves)
- A hearty organism that can survive on environmental surfaces for a long time (5 days to 46 months)

[5] Centers for Diseae Control. Healthcare associated infections https://www.cdc.gov/HAI/organisms/vre/vre.html Accessed October 4, 2016

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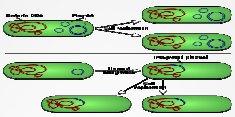
ESBL



- Extended-spectrum beta lactamase-this is an enzyme developed by the organism
- Mostly found in gram negative organisms enterobacteriacea like *E. coli* and *Klebsiella pneumoniae*.
- This enzyme is carried on plasmids (DNA of the organism) which can be transferred to another organism
- This is a mutation whereby an enzyme produced by the organism inactivates certain antibiotics by adding an H2O molecule (called hydrolysis) e.g., penicillins and cephalosporins

[6] DeBusscher J, Zhang L, Buxton M, et al. Persistent extended-spectrum B-Lactamase urinary tract infection. Emerging Infectious Diseases 2009. November. http://wwwnc.cdc.gov/eid/article/15/11/08-1501 Accessed October 4, 2016

ACINETOBACTER

- Also called ABC (*acinetobacter baumanii* complex)
- This organism is found naturally in the soil and water
- This organism has an inherent resistance to antibiotics
- Outbreaks caused by this organism typically happens in ICUs or sub-acute units
- This organism can live on the skin and can survive on the environment for months
- *Acinetobacter* infections usually involve organ systems that have a high fluid content e.g., respiratory tract, urinary tract, peritoneal fluid

[7] Cunha BA, Bronze MS, et al. Acinetobacter. Medscape. http://emedicine.medscape.com/article/216891-overview Accessed October 4, 2016

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Background

- The first case of carbapenem-resistant enterobacteriacea (CRE) was identified in the U.S in 2001 in North Carolina[8]
- The director of the CDC, Tom Frieden, has referred to CRE as a "nightmare bacteria"
- According to the CDC, the CRE bacterium are one of the top 3 urgent threats in the US[8]
- According to LAC Public Health CRE is endemic in LA County
- Mortality rates from CRE may be as high as 50%[8,9]
- Limited treatment options for treating CRE infection[8,9]

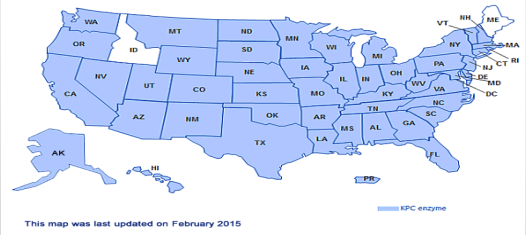
[8] Carbapenem-resistant Enterobacteriacea (CRE) Control and Prevention Toolkit. http://www.ahrq.gov/professionals/quality-patient-safety/patient-safety-resources/resources/cretoolkit/cretoolkits.html

[9] Watkins RR, Bonomo RA. Increasing prevalence of carbapenem-resistant Enterobacteriacea and strategies to avert a looming crisis. Expert Review of Anti-Infective Therapy 2013;11(6):543-545 http://www.Medscape.com/viewarticle/806505_2 Last accessed July 2016

Background (continued)

- Experts believe the main reasons for increase in this resistant strain of organism is due to[9]:
  - Over-use or inappropriate use of antibiotics
  - Poor hygienic conditions and lack of adequate environmental cleaning and disinfection
  - Organisms contain mobile genetic material (plasmids) that contain antibiotic (ATB) resistance genes (easily transferred to other organisms)
  - Travel

CRE Cases Reported to CDC by February 2015



Centers for Disease Control and Prevention. Healthcare-Associated Infections (HAI). Tracking CRE. http://www.cdc.gov/hai/organisms/cre/TrackingCRE.html. Last accessed 12-31-15.