



## Plasmid-Mediated Colistin Resistance: U.S. Government Findings and Response

Beth P. Bell, MD, MPH

Director

National Center for Emerging and Zoonotic Infectious Diseases

U.S. Centers for Disease Control and Prevention

Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria

Public Meeting #3

June 21, 2016

# Plasmid-Mediated Colistin Resistance

- Colistin is used as a last-resort drug to treat patients with multidrug-resistant infections, including CRE
- The *mcr-1* gene makes bacteria resistant to colistin
  - Exists on a plasmid, a small piece of DNA that can move from one bacterium to another
- Plasmids could spread antibiotic resistance among bacterial species

## Searching for the *mcr-1* gene

- First reported in China, November 2015
- CDC, FDA and USDA began searching for *mcr-1* in bacterial samples from human, retail meat, and food animal sources
  - National Antimicrobial Resistance Monitoring System (NARMS)
  - Screened over 55,000 genomes, none contained the gene
- CDC screened 735 genomes from healthcare-associated pathogen surveillance, outbreak, and special study and reference collections
  - All human isolates to date tested negative for *mcr-1*

## Discovery of the *mcr-1* gene in the United States

- Through a special study in NARMS, USDA discovered *mcr-1* in *E. coli* isolates collected from the intestines of two pigs
  - Sequencing found *mcr-1* gene on a plasmid
  - The *E. coli* isolate from one pig was also resistant to other antibiotics, but those resistance genes were not on the plasmid carrying the *mcr-1* gene
  - The *E. coli* isolate from the second pig was not resistant to other antibiotics
- DoD announced first discovery of the *mcr-1* gene in bacteria isolated from a U.S. patient, May 2016
  - Found in urine sample, no recent travel outside the U.S.
  - Human isolate different from both pig isolates
- Both pig plasmids have the same incompatibility type as plasmids reported from China by Liu et al; however the human plasmid is not the same incompatibility type

## Public Health Response to Discovery of *mcr-1*

- Ongoing coordinated public health investigation
  - Led by CDC and Pennsylvania Department of Health
  - Identifying and screening close contacts of the patient to determine whether they might carry bacteria with the *mcr-1* gene
- Patient did not have CRE; bacteria identified from the patient is not resistant to all antibiotics
- Deploying a rapid PCR test so that clinical labs conducting colistin-resistance testing can also look for this gene

## Ongoing U.S. Government Response

- Continue investigating the first discovery of *mcr-1* gene in a U.S. patient (CDC, DoD)
- Continue searching for *mcr-1* gene in existing bacterial isolate collections (CDC, FDA, USDA, DoD)
- Phase in NARMS whole genome sequencing (WGS) on all *E. coli* and *Salmonella* isolates from animals and foods and all *Salmonella* isolates from humans (FDA, USDA, CDC)
- Continue WGS on all resistant clinical samples via the Multidrug Resistant Organism Repository and Surveillance Network (MRSN) reference lab (DoD)
- Expand infrastructure and lab capacity to detect resistant organisms recovered from human samples and new forms of resistance via AR Lab Network (CDC)
- Curate a colistin-resistant isolate panel for the AR Isolate Bank to challenge and test new diagnostics and therapeutics (CDC, FDA)
- Explore ways to measure microbiome disruption (CDC) as well as opportunities to address restoration of microbiome (CDC, NIH, BARDA)
- Host assembled genomes on NCBI website, availing to researchers for further study (NIH)

For more information, contact CDC  
1-800-CDC-INFO (232-4636)  
TTY: 1-888-232-6348   [www.cdc.gov](http://www.cdc.gov)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

