



## 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.

