Public Health and One Health

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PACCARB
Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria

Public Health and One Health

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PACCARB Meeting
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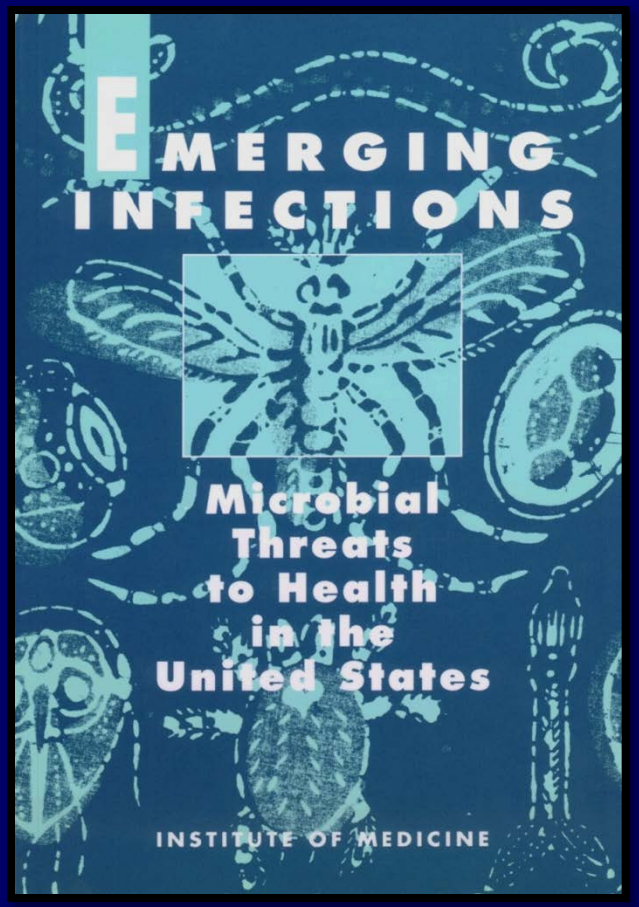
EMORY UNIVERSITY

OUTLINE

- The Problem
- The Challenges
- The Opportunities

The Problem

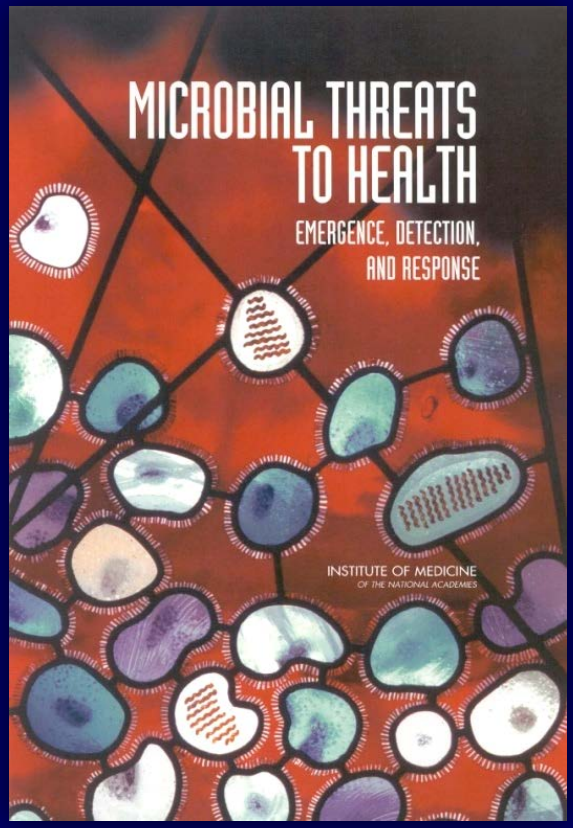
IOM Definition of Emerging Infections



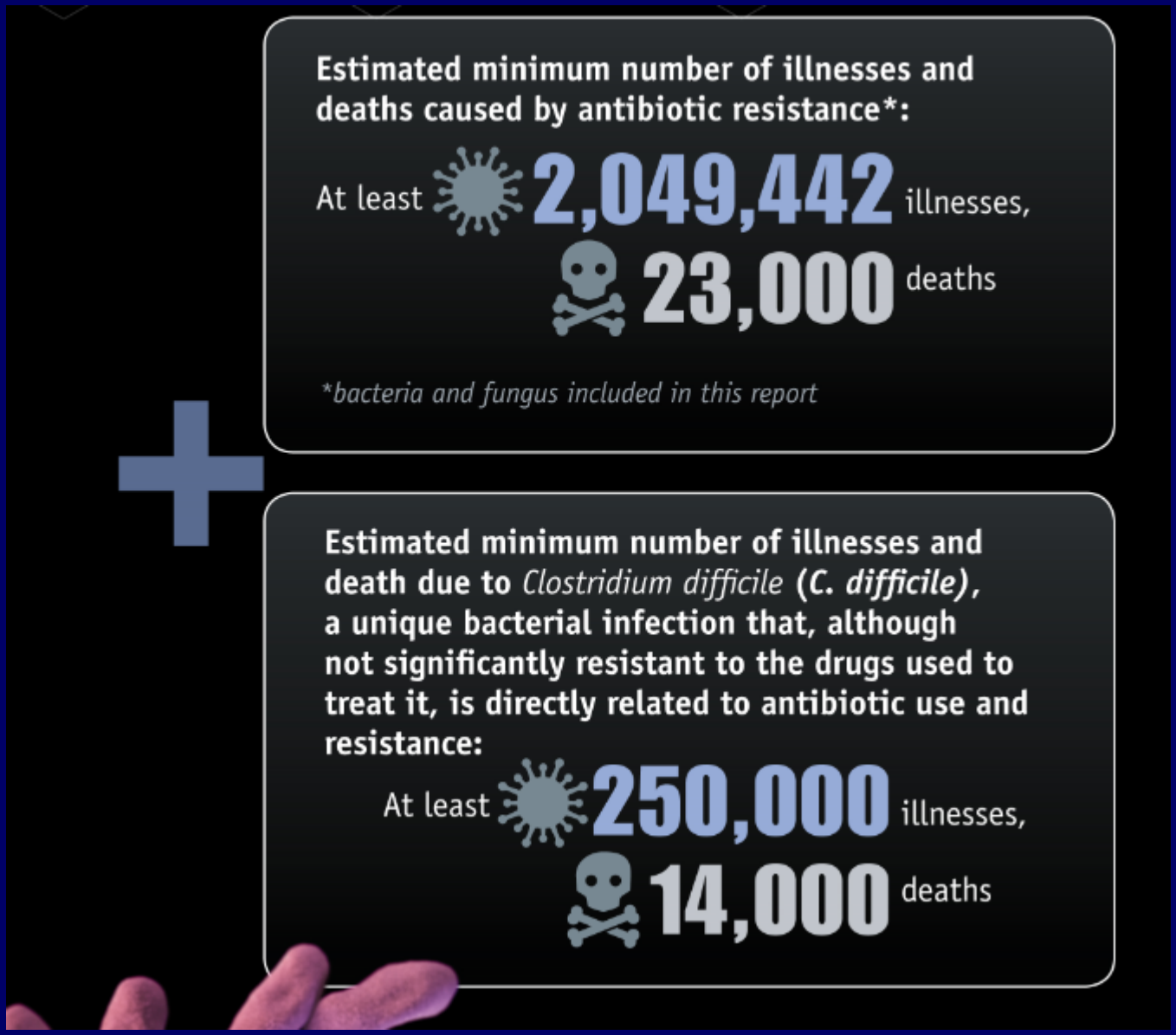
1992

New, reemerging or **drug-resistant infections** whose incidence in humans has increased within the past two decades or whose incidence threatens to increase in the near future.

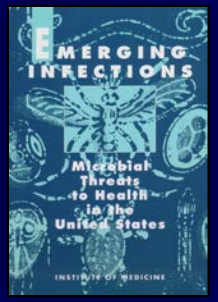
"A robust public health system— in its science, capacity, practice, and through its **collaborations with clinical and veterinary medicine, academia, industry and other public and private partners**—is the best defense against any microbial threat."



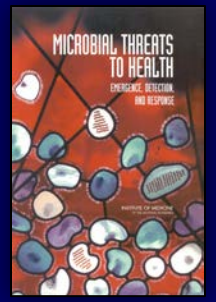
2003



$ 55 – 70B in direct and indirect costs



The Challenges
Factors Contributing to the Emergence of Infectious Diseases



1992

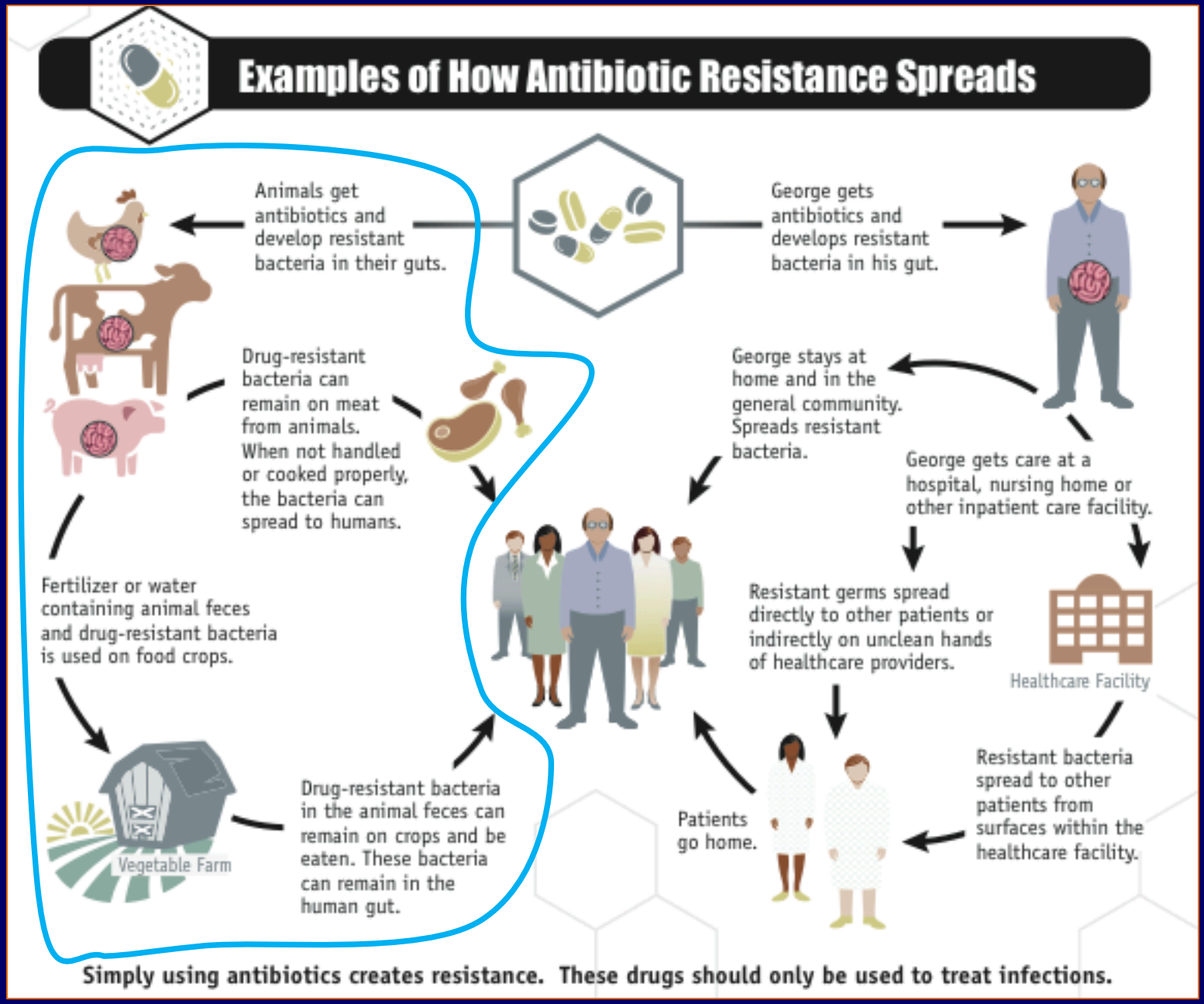
- **Human demographics and behavior**
- **Technology and industry**
- **Economic development and land use change**
- **International travel and commerce**
- **Microbial adaptation and change**
- **Breakdown of public health measures**

2003

- **Human susceptibility to infection**
- **Climate and weather**
- **Changing ecosystems**
- **Poverty and social inequality**
- **War and famine**
- **Lack of political will**
- **Intent to harm**

Institute of Medicine

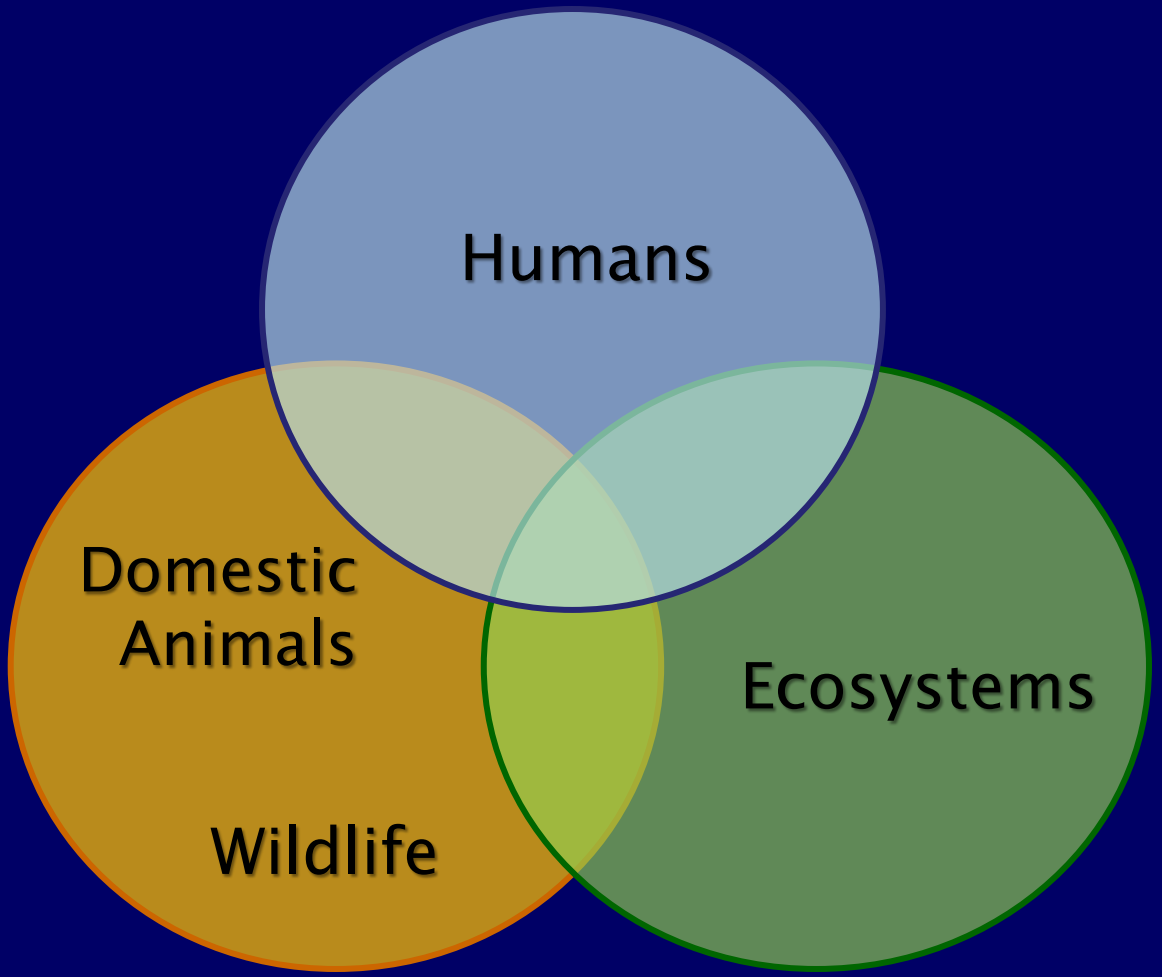
Factors in **bold** favor the emergence of antimicrobial resistance



CDC AMR in the US 2013

The Opportunities

"One Health"



http://www.onehealthcommission.org/

Common Ground
for Medical and Veterinary Communities

- Antimicrobial resistance and usage
- Avian, animal, and pandemic influenza
- Other zoonotic diseases including those associated with exotic pet and wildlife trade
- Foodborne disease
- Healthcare-associated infections
- Blood, organ, tissue safety
- Pathogen discovery
- New diagnostics
- Drug and vaccine development
- Disease eradication
- Biosafety / Biosecurity
- Bioterrorism / Biodefense

Microbial Adaptation

Emergence of a new antibiotic resistance mechanism in India, Pakistan, and the UK: a molecular, biological, and epidemiological study

Karthikeyan K Kumarasamy, Mark A Toleman, Timothy R Walsh, Jay Bagaria, Fafhana Butt, Ravikumar Balakrishnan, Uma Chaudhary, Michel Doumith, Christian G Giske, Seema Irfan, Padma Krishnan, Anil V Kumar, Sunil Maharjan, Shazad Mushtaq, Tabassum Noorie, David L Paterson, Andrew Pearson, Claire Perry, Rachel Pike, Bhargavi Rao, Ujjwayini Ray, Jayanta B Sarma, Madhu Sharma, Elizabeth Sheridan, Mandayam A Thirunarayan, Jane Turton, Supriya Upadhyay, Marina Warner, William Welfare, David M Livermore, Neil Woodford

Summary

Background Gram-negative Enterobacteriaceae with resistance to carbapenem conferred by New Delhi metallo-β-lactamase 1 (NDM-1) are potentially a major global health problem. We investigated the prevalence of NDM-1, in multidrug-resistant Enterobacteriaceae in India, Pakistan, and the UK.

for more information about the article on Microbial Adaptation visit
http://www.sciencedirect.com/science/article/pii/S1473309910701432

- *NDM-1 (New Delhi metallo-β-lactamase-1) in Enterobacteriaceae*
- *Pan-resistant except tigecycline and colistin*
- *Clonally diverse strains*
- *Most on plasmids and transferable*
- *Some infections associated with medical tourism*

Lancet Inf Dis 2010; 10:597–602

Dissemination of NDM-1 positive bacteria in the New Delhi environment and its implications for human health: an environmental point prevalence study

Timothy R Walsh, Janis Weeks, David M Livermore, Mark A Toleman

Summary

Background Not all patients infected with NDM-1-positive bacteria have a history of hospital admission in India, and extended-spectrum β-lactamases are known to be circulating in the Indian community. We therefore measured the prevalence of the NDM-1 gene in drinking water and seepage samples in New Delhi.

Lancet Infect Dis 2011; 11: 355–62

Published Online April 7, 2011

- New Delhi: 171 surface water (SW) and 50 tap water (TW) samples
- NDM-1 gene in 51 (30 %) of SW and 2 of 50 (4%) of TW samples
- NDM-1 gene found in 11 "new" species of bacteria

Lancet Inf Dis 2011; 11:355–362

Colistin resistance: a major breach in our last line of defence

Emergence of plasmid-mediated colistin resistance mechanism MCR-1 in animals and human beings in China: a microbiological and molecular biological study

Yi-Yun Liu, Yang Wang*, Timothy R Walsh, Ling-Xian Yi, Rong Zhang, James Spencer, Yohei Doi, Guobao Tian, Baolei Dong, Xianhui Huang, Lin-Feng Yu, Danxia Gu, Hongwei Ren, Xiaojie Chen, Luchao Lv, Dandan He, Hongwei Zhou, Zisen Liang, Jian-Hua Liu, Jianzhong Shen*

Summary

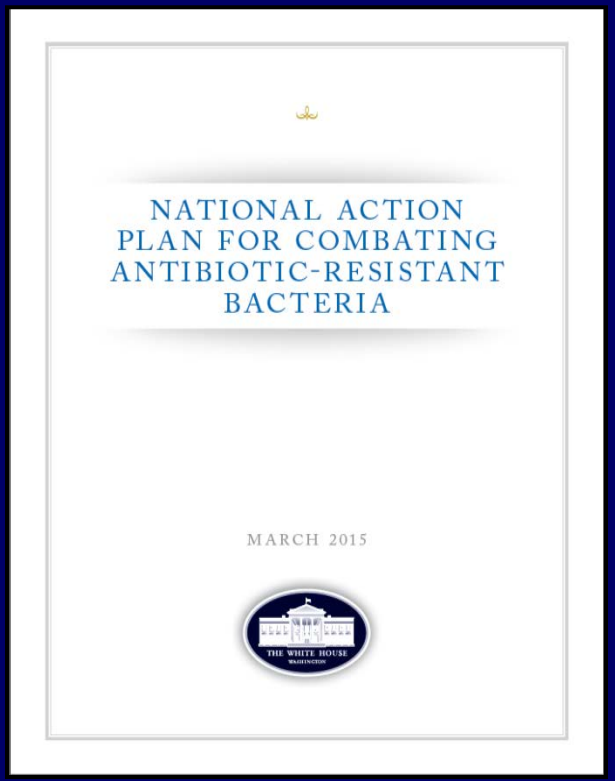
Background Until now, polymyxin resistance has involved chromosomal mutations but has never been reported via horizontal gene transfer. During a routine surveillance project on antimicrobial resistance in commensal *Escherichia coli* from food animals in China, a major increase of colistin resistance was observed. When an *E coli* strain, SHP45, possessing colistin resistance that could be transferred to another strain, was isolated from a pig, we conducted further analysis of possible plasmid-mediated polymyxin resistance. Herein, we report the emergence of the first plasmid-mediated polymyxin resistance mechanism, MCR-1, in Enterobacteriaceae.

Lancet Inf Dis 2016;16:132 and 161–168.

National Action Plan For Combating Antibiotic-Resistant Bacteria March 2015

Goals

- Slow emergence / prevent spread
  - **Foster antibiotic stewardship**
- **Strengthen "One Health" surveillance**
- Develop rapid diagnostics
- Accelerate basic and applied R&D
  - New antibiotics
  - Other therapeutics
- Improve international collaboration



https://www.whitehouse.gov/sites/default/files/docs/national_action_plan_for_combating_antibotic-resistant_bacteria.pdf

Addressing the Barriers

- Move beyond “the blame game” to trust and transparency
- Respond to and leverage Executive Order, CARB National Strategy, and PCAST recommendations
- Shared commitment to antimicrobial stewardship
- Shared commitment to develop better data on usage and resistance in various settings
- Development and implementation of a collaborative research agenda
- Shared commitment to communication and collaboration with professional societies, public / private sector partners, and the public

Collaborative Research Agenda

Some Possible Elements

- Assessment of stewardship approaches in human and animal settings
- Quantitation of relationship between agricultural use and resistance in humans
- Assessment of possible role of food in community transmission of resistant organisms (e.g., CRE, ESBL, MRSA, C. diff)
- Environmental risk assessments of resistant organisms and antibiotic residues
  - Soil, water, human and animal waste