Public Health and One Health

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Public Health and One Health

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PACCARB Meeting
March 31, 2016
OUTLINE

- The Problem
- The Challenges
- The Opportunities
The Problem

IOM Definition of Emerging Infections

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.

1992
“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.”
Estimated minimum number of illnesses and deaths caused by antibiotic resistance*:
At least 2,049,442 illnesses, 23,000 deaths

* bacteria and fungus included in this report

Estimated minimum number of illnesses and death due to Clostridium difficile (C. difficile), a unique bacterial infection that, although not significantly resistant to the drugs used to treat it, is directly related to antibiotic use and resistance:
At least 250,000 illnesses, 14,000 deaths

$ 55 – 70B in direct and indirect costs
The Challenges
Factors Contributing to the Emergence of Infectious Diseases

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

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<td>Human demographics and behavior</td>
<td>Human susceptibility to infection</td>
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<td>Technology and industry</td>
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<td>Economic development and land use change</td>
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<td>International travel and commerce</td>
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<td>Breakdown of public health measures</td>
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*Institute of Medicine*

Factors in **bold** favor the emergence of antimicrobial resistance
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.
- Simply using antibiotics creates resistance. These drugs should only be used to treat infections.

George gets antibiotics and develops resistant bacteria in his gut.

George stays at home and in the general community. Spreads resistant bacteria.

George gets care at a hospital, nursing home or other inpatient care facility.

George gets antibiotics and develops resistant bacteria in his gut.

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.

Patients go home.
The Opportunities

“One Health”

Humans

Domestic Animals

Wildlife

Ecosystems

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


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

- 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
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

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.
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_antibiotic-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