A public health viewpoint

Antibiotic Symposium
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Two complementary human health systems

- Health care
  - Outpatient clinics
  - Primary hospitals
  - Referral hospitals
  - Clinical research institutes
- Public health
  - Local health departments
  - State health departments
  - National health department
  - US Public Health Service and CDC

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Federal agency roles and responsibilities in food safety

CDC

- Non-regulatory
- National disease surveillance
- Detect and investigate outbreaks to determine vehicle and source
- Track burden, trends, attribution
- Improve public health methods and practices

- Problem identification

- Provide information to guide action

FDA, FSIS/USDA

- Regulatory
- Food safety policies
- Inspect, monitor, enforce
- Product recall and traceback
- Investigation of farm and production facilities

- Problem management

- Regulation and enforcement

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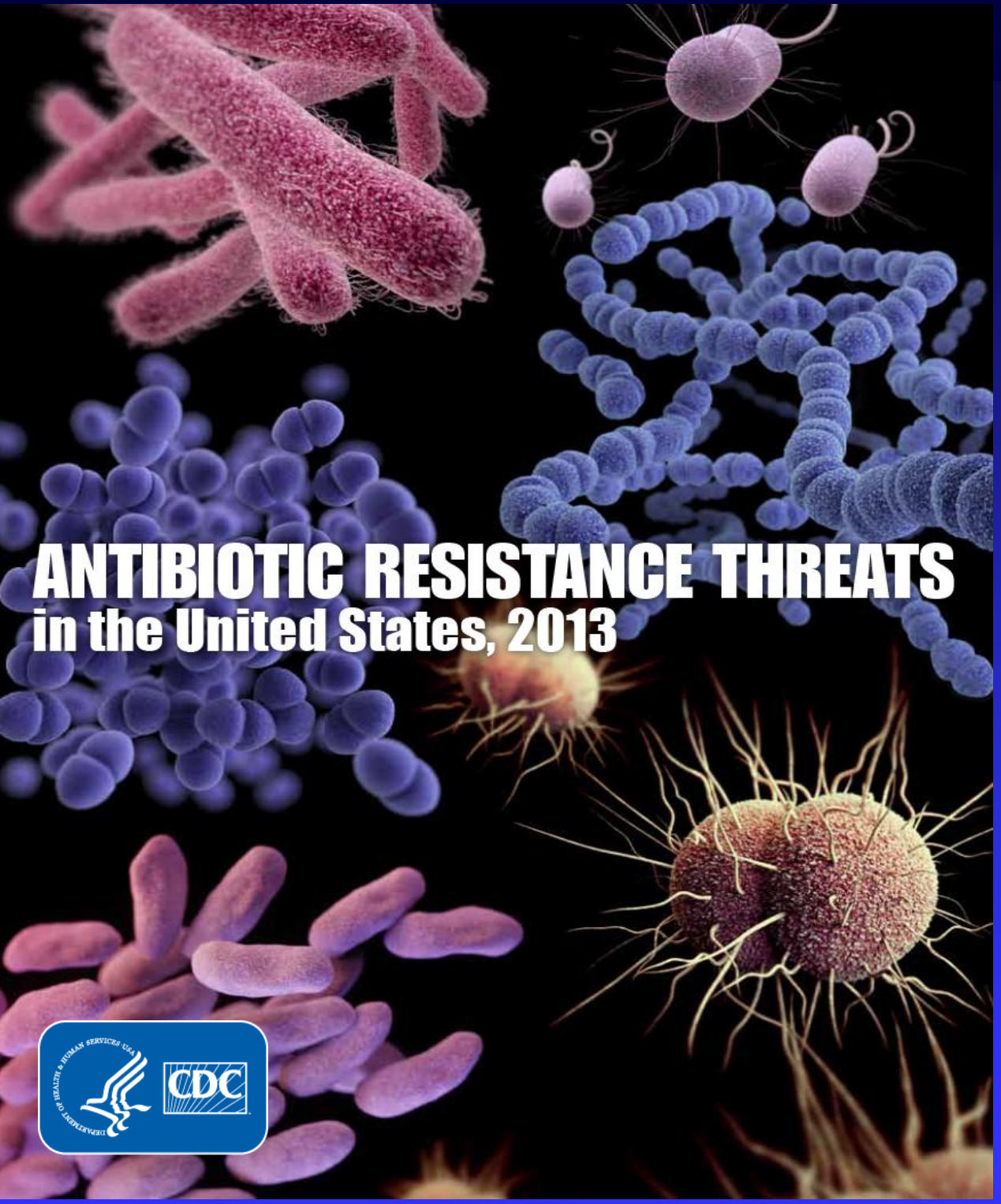
Antibiotic treatments have been critical in human and veterinary medicine since the 1940s

- Resistance a challenge for almost as long
- Emerges in settings where antimicrobials are used
- In a variety of bacteria, viruses, fungi, parasites
- Sometimes spreads from one bacterial strain to another
- Stewardship is central to managing infections and preserving effectiveness of antibiotics



CDC report released September 17, 2013

18 pathogens

Burden
- 2,049,000 illnesses
- 23,000 deaths

Foodborne pathogens
- 4 of the 18 often transmitted through foods

- 2 with animal reservoirs
- 2 with human reservoirs

http://www.cdc.gov/drugresistance/threat-report-2013

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Annual burden of human illness and death caused by resistant infections often spread through food

- Resistant to important drugs used for treatment

Pathogen	Percent Resistant	# illnesses/ year	# deaths/ Year
Campylobacter	24%	310,000	28
Non-typhoidal *Salmonella*	8%	100,000	38
Salmonella Typhi	67%	3,800	<5
Shigella	6%	27,000	<5
Total		441,000	66-70

CDC 2013 Antibiotic Resistance Threats

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Reservoirs for bacterial foodborne pathogens

- *Salmonella* Typhi - *humans*
- *Shigella* spp - *humans*
- *Campylobacter* – poultry, other birds, cattle
- *E. coli* O157:H7 - cattle and other ruminants (swine?)
- *Salmonella* – poultry, cattle, swine, reptiles, and others
  - Enteritidis - poultry
  - Heidelberg - poultry
  - MDR Newport - cattle
  - MDR Dublin - cattle
- *Vibrio* – shellfish
- *Yersinia enterocolitica* – swine
- Often not associated with animal illness

Why are resistant strains of particular concern?

- When treatment is needed, early empiric treatment may fail, and treatment choices will be limited

- Increased morbidity and mortality
  - Longer illnesses
  - More invasive infections
  - More likely to be hospitalized
  - More deaths

- Treatment for another condition with an agent to which *Salmonella* is resistant can convert silent carriage into overt disease

- When multiple resistance genes are grouped, use of any one of the antibiotics can co-select for all the resistance genes

- Resistance on a mobile genetic element may be transferred to other bacteria horizontally

Mølbak 2005 Clin Infect Dis 41:1613-20

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CDC addresses the challenge of resistant foodborne infections

- Track resistance through the National Antimicrobial Resistance Monitoring System (NARMS) collaboration
  - CDC tests isolates from ill people (1 in 20 *Salmonella*)
  - FDA tests isolates from meat and poultry
  - FSIS tests isolates from animals at slaughter

- Make real time resistance data part of outbreak investigations

- Make more information more quickly available (CDC NARMS Now website)

- Refine understanding of sources and spread of
  - resistant bacterial strains
  - resistance genes and plasmids

- Estimate the health impact of resistance

- Work with partners to prevent foodborne infections

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Trends in antimicrobial resistance in non-typhoidal *Salmonella* in the United States: NARMS, 2013

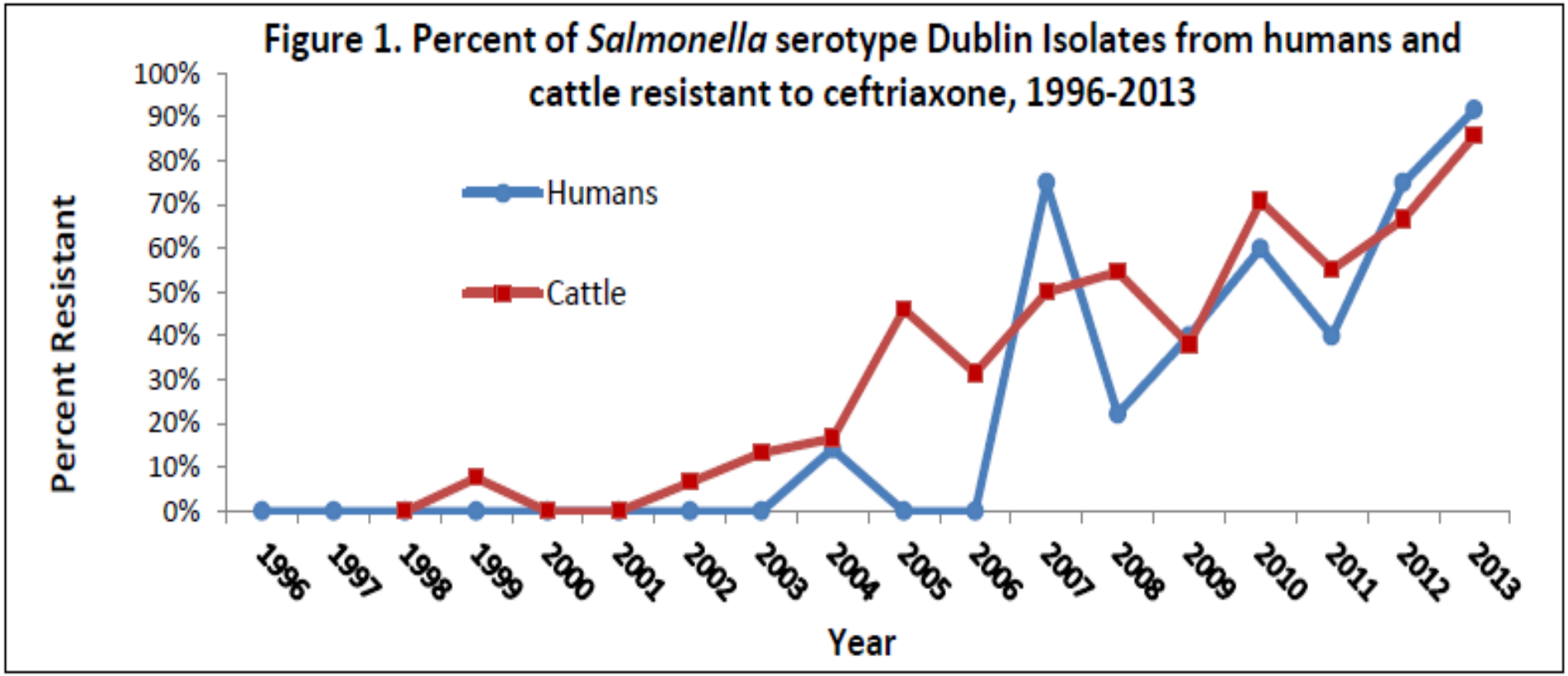
- Multi-drug resistance (≥ 3 agent classes) in isolates from humans
  - 1996-2001: 16%
  - : 2003-2007: 12%
  - 2013: 10%
  - 70% of this is the 4 most resistant serotypes:
    - Dublin (92% are resistant)
    - I:4,5,12:i:- (51%)
    - Heidelberg (33%)
    - Typhimurium (17%)

- Ceftriaxone resistance:
  - 3% of all non-typhoidal *Salmonella*,
    - Dublin (92%)
    - Heidelberg (15%)

- Quinolone resistance (including reduced susceptibility):
  - 3% of all non-typhoidal *Salmonella*,
    - Enteritidis (6%)
    - now seeing plasmid-mediated quinolone resistance

http://www.cdc.gov/narms

Trends in antimicrobial resistance in *Salmonella* Dublin in the United States: NARMS, 1996-2013

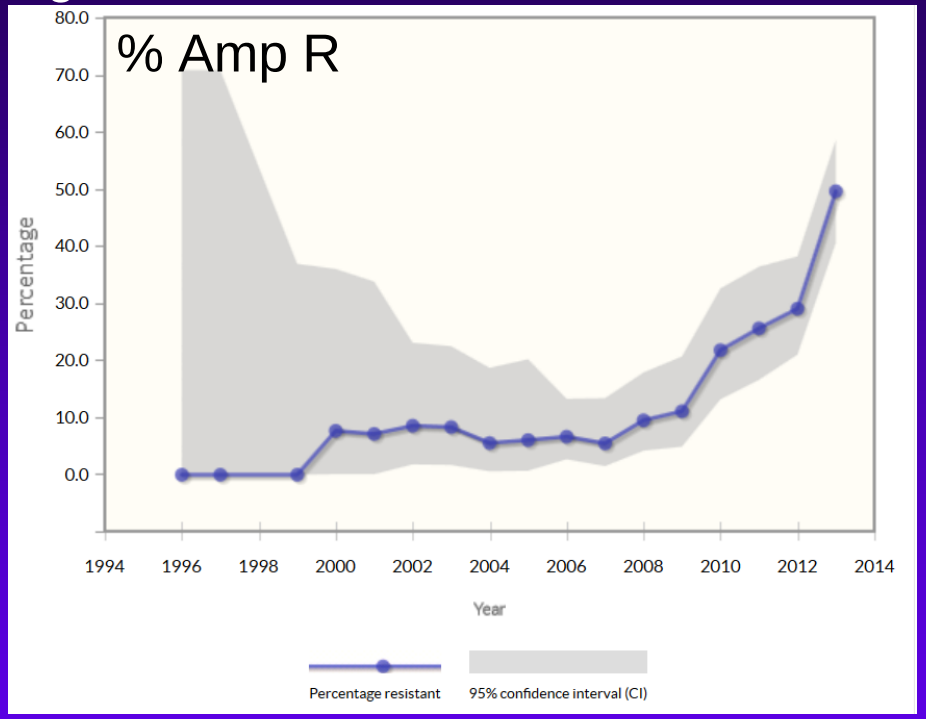


- All are MDR, and in 2013, almost all are ACSSuTAuCx resistant.
- 9 human strains since 2007 had lower susceptibility to fluoroquinolones, and 6 of those 9 were also Cx resistant

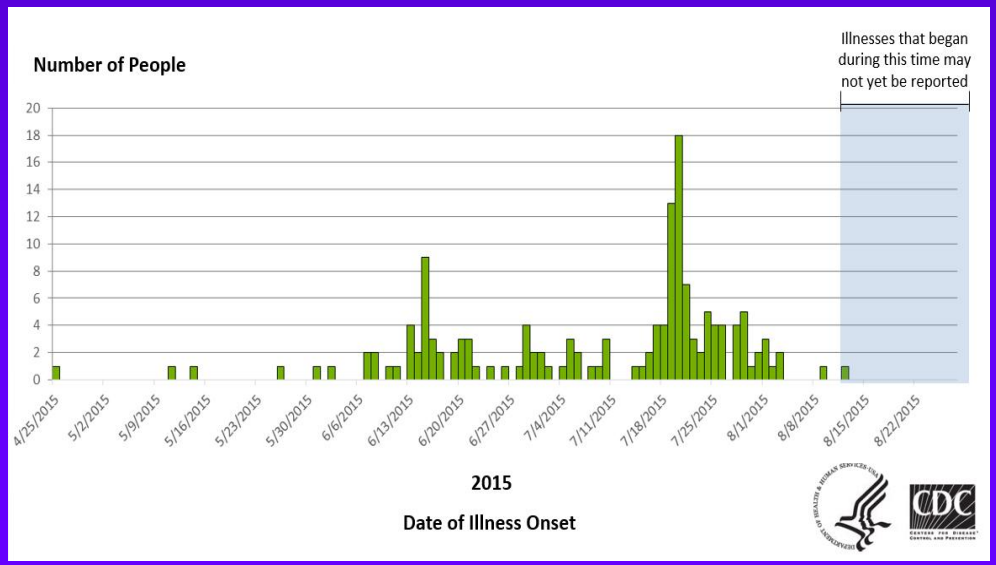
NARMS Integrated Report 2013 + preliminary CDC data

Multi-drug resistant *Salmonella* I:4,5,12:i:-

- Serotype that evolved from Typhimurium
- #5 among human strains in 2012, increasing
- Becoming more resistant:
- 51% MDR resistant in 2013



- Present in swine and beef cecal samples
  - and on pork chops (NARMS retail meat)



- Recent outbreak related to swine
- 2015, Washington State, 152 cases
- MDR strain: ASSuT
- Roast and other pork from one plant
- Recall, plant closed to revise process

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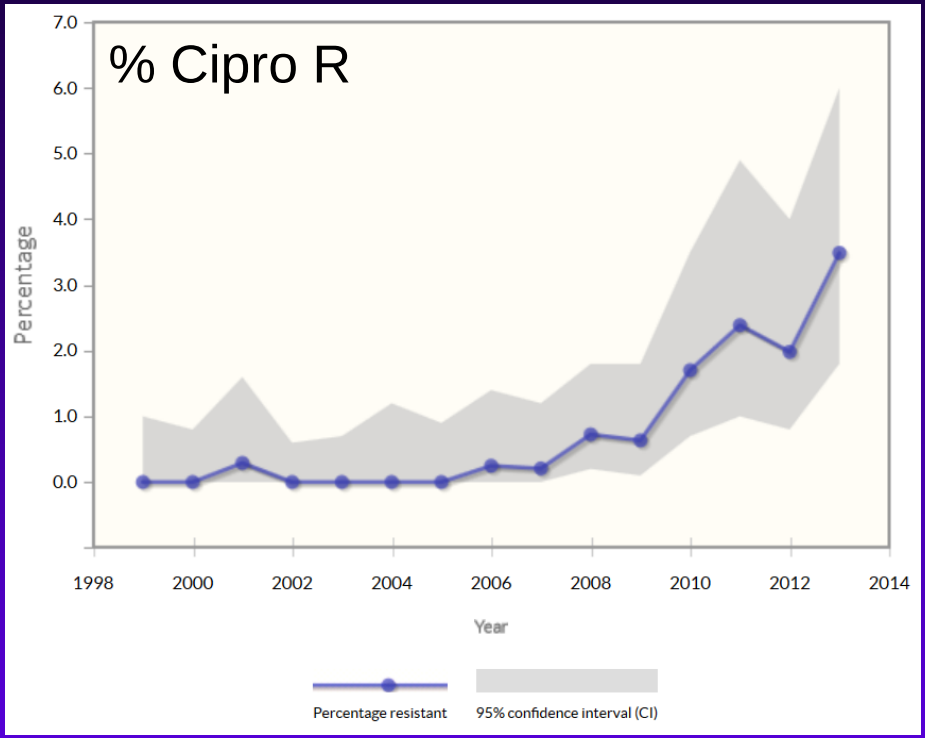
MDR *Salmonella* Kentucky in Africa/Asia/Europe

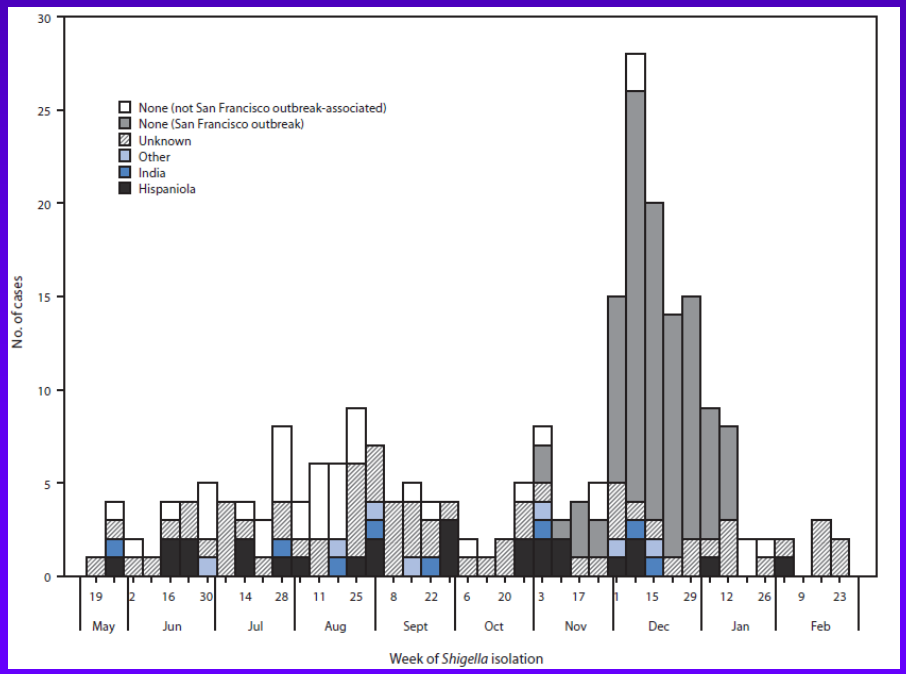
- Starting in 1960, Pasteur Institute tracks one strain of *Salmonella* Kentucky
  - 1960's: travelers from Tunisia
  - 1990's: from Egypt
  - 2000's: from India
  - Progressive increase in resistance (since 1990's)
- 2008: Appeared in Polish turkey flocks, meat and consumers
  - Since then in turkey flocks and meat in Germany and France
- One genetic lineage: now R to ASSuTTmpGentCip, and sometimes Cx
- 2009-2012: Began appearing in the US
  - 6 times in NARMS, all from travelers to North Africa or Asia
  - 2 hospitalized, one died

LeHello 2013 Lancet Infectious Disease 13:652-679
Wasyl 2012 Food Research Int 45:958-961
Hartman and Folster 2014 Emerg Infect Dis 20: 910-911

Ciprofloxacin-resistant *Shigella*

- Spreads from human to human via
  - Food, water, direct contact
  - Settings with poor hygiene
- Can become resistant rapidly
- 54% Multi-drug resistant in 2013
  - Amp, Trimethoprim/sulfa
- Ciprofloxacin is 1st choice for adults
- Recently resistance is increasing
- Was mostly seen in travelers





- *S. sonnei* outbreak in 2014-2015
- San Francisco homeless population
- Resistant to ciprofloxacin
- Promote hygiene, access to toilets
- Guidelines for use are needed
- Reserve antibiotics for patients with severe illness, immunocompromise

CDC NARMS Now website; MMWR 2015, 64:318-320

Antibiotic use in humans

- Antibiotics are among the most commonly prescribed drugs used in human medicine
- As much as 50% of antibiotics prescribed for people are not needed or are not the best choice
- Antibiotic stewardship is critical to prolong usefulness of antibiotics

Core elements of antibiotic stewardship in a hospital setting (a preview)

- Define the program with leaders and accountability
- Implement interventions to improve use
  - Require prior authorization for certain agents
  - Revisit empiric treatment decisions routinely after 48 hours
  - Conduct care audits with feedback
  - Optimize dose and duration practices
- Track patterns of antibiotic use and resistance
- Report regularly on use and resistance
- Educate practitioners and staff

www.cdc.gov/getsmart/healthcare/implementation/core-elements.html

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Expertise in animal health and management is vital to address resistant foodborne zoonotic infections

- Reduce introduction of resistant strains or genes via
  - Breeding stock, hatcheries
  - Animal feed sources
  - Water, environment, employees, etc.

- Reduce spread and selection of resistant genes or strains
  - Policies that reduce selective pressure
  - Practices that prevent spread of infection among animals

- Implement antibiotic stewardship and prevention measures
  - Judicious antimicrobial use policies
  - Tracking antibiotic use
  - Alternate treatment and prevention measures
  - Measures that reduce contamination of food

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Antimicrobial resistance in foodborne infections in the 21st century

- Substantial and changing challenge to human and animal health
- Not necessarily irreversible
- Related to both agricultural and human uses
- Multidisciplinary networks and partnerships vital to progress
- Limiting emergence of resistance, prolong utility of current antibiotics
- Improving stewardship and tracking of human and agricultural uses
- Collective goals:
  - Food to be safer
  - Those who eat it to be healthier
  - People to have more confidence in food supply
  - Effective agents to be available for humans and animals who need them

Thank you

The findings and conclusions in this presentation are those of the author and do not necessarily represent the views of the Centers for Disease Control and Prevention

Our websites

Antimicrobial resistance:
www.cdc.gov/drugresistance/index.html

Our Programs:
NARMS: www.cdc.gov/NARMS
FoodNet: www.cdc.gov/foodnet
PulseNet: www.cdc.gov/pulsenet
FoodCORE: www.cdc.gov/ncezid/dfwed/orpb/foodcore/index.html

Specific pathogens:
E. coli: www.cdc.gov/ecoli
Salmonella: www.cdc.gov/salmonella
Listeria: www.cdc.gov/listeria

Multistate foodborne outbreaks:
www.cdc.gov/outbreaknet/outbreaks.html

General information about foodborne diseases:
www.cdc.gov/foodsafety
www.foodsafety.gov