One Health: The Intersection of Animal and Human Health

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Health Form of West Michigan, December 1st 2017

Antibiotic resistance

- Does it really get from the environment to humans?

- 3 examples
  - Vancomycin-resistant *Enterococcus faecium*
  - Ceftriaxone-resistant *Salmonella spp.*
  - Antibiotic resistant *Campylobacter spp.*

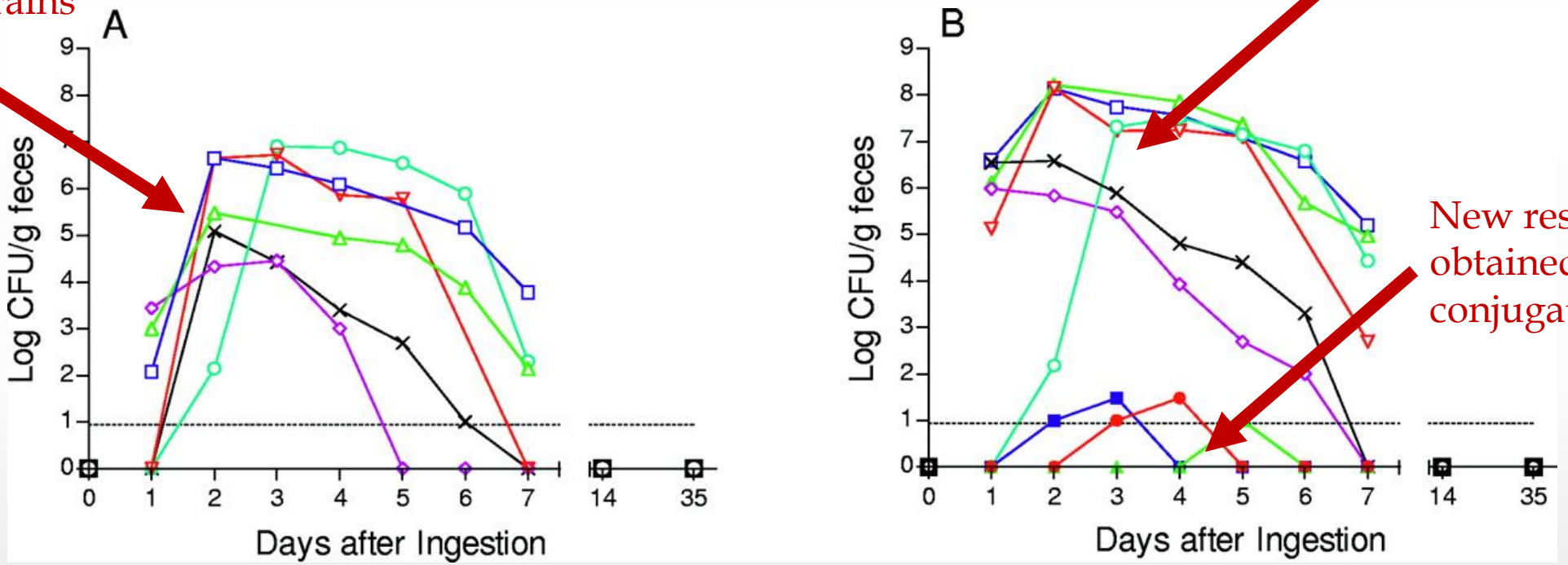
Vancomycin-resistant *Enterococcus faecium (VRE)* Camilla Lester et al.

- Antimicrobials in food animals since 1950s
- VRE began to show up in feed animals in 1990s
- *vanA* gene cluster selected for by avoparcin (glycopeptide)
- It was unknown if these genes can be transmitted from food animals to humans
- 6 healthy volunteers
  - Ingested VRE and susceptible strains of *Enterococcus faecium*
  - 3/6 recipients had evidence of direct conjugation
  - Transient

VRE strains ingested 3 hours after sensitive strains

Fecal excretion of strains by the six volunteers.
Camilla H. Lester et al. Antimicrob. Agents Chemother. 2006;50:596-599

Sensitive *Enterococcus faecium* ingested at baseline



New resistance obtained by direct conjugation

Fecal excretion of strains by the six volunteers. (A) Donor strain (open symbols). (B) Recipient strain (open symbols) and transconjugants (solid symbols). Each curve shows the results for one volunteer. Each volunteer is represented by one color. Transconjugants were excreted by only three volunteers. Results from stool samples obtained within 48 h before ingestion of the bacteria are plotted as day zero. The minimal detectable level is shown by the dashed line. The solid black squares with open centers (days 0, 14, and 35) represent the superposition of results from all six volunteers.

Epidemiology of antimicrobial resistant *Campylobacter spp.* isolated in retail meats in Canada

- Narvaez-Bravo et al.
- *Campylobacter* represents 11.8% of enteric pathogens and top foodborne pathogen
- 606 samples from chicken, pork, turkey, and ground beef
- Positive samples
  - Chicken (23.5% of samples)
  - Turkey (14.2% of samples)
  - Beef and Pork no positives
  - Positive in 9.2% of total samples

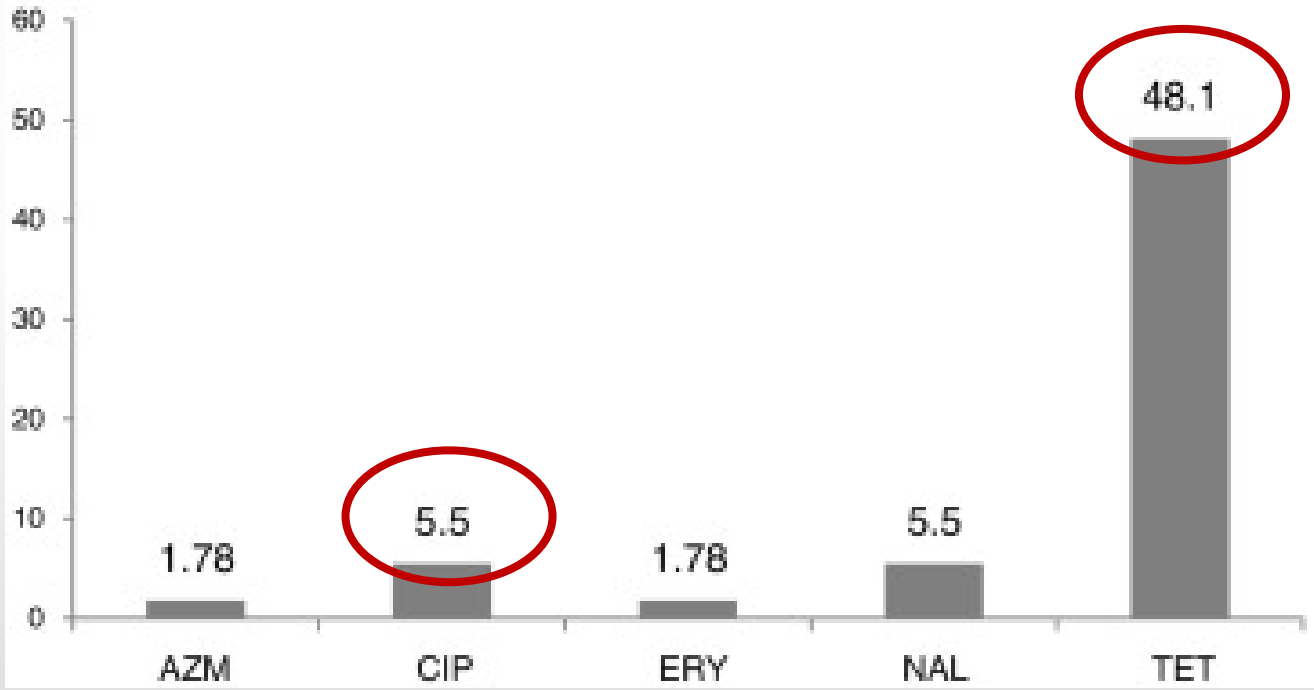
Table 1
Prevalence of *Campylobacter* spp. in retail meat samples purchased in Alberta, Canada.

Sample origin	Sample number	Positive (%)	*Campylobacter* spp.
Chicken	204	48 (23.5)	*C. jejuni* 97.9% (47/48) *C. coli* 2.0% (1/48)
Turkey	110	8 (14.2)	*C. jejuni* 75% (6/8) *C. coli* 25% (2/8)
Beef	145	0 (0)	N/A
Pork	147	0 (0)	N/A
Total	606	56 (9.2)	N/A

Epidemiology of antimicrobial resistant *Campylobacter spp.* isolated in retail meats in Canada

- When resistance was present
  - Tetracycline
  - Ciprofloxacin

- Cluster analysis revealed connection between water isolates, poultry isolates, and clinical isolates



Ceftriaxone-Resistant Nontyphoidal Salmonella from Humans, Retail Meats, and Food Animals in the United States, 1996–2013

Martha Iwamoto, Jared Reynolds, Beth E. Karp, Heather Tate, Paula J. Fedorka-Cray, Jodie R. Plumblee, Robert M. Hoekstra, Jean M. Whichard, and Barbara E. Mahon

- NARMS
  - National antimicrobial resistance monitoring system
  - FDA, CDC, USDA
- FoodNet
  - Surveillance in 10 areas covering 15% population
- Spearman rank correlation to examine relationships

Ceftriaxone-Resistant Nontyphoidal Salmonella from Humans, Retail Meats, and Food Animals in the United States, 1996–2013

Total number of Salmonella isolates from humans

Percentage resistant to ceftriaxone

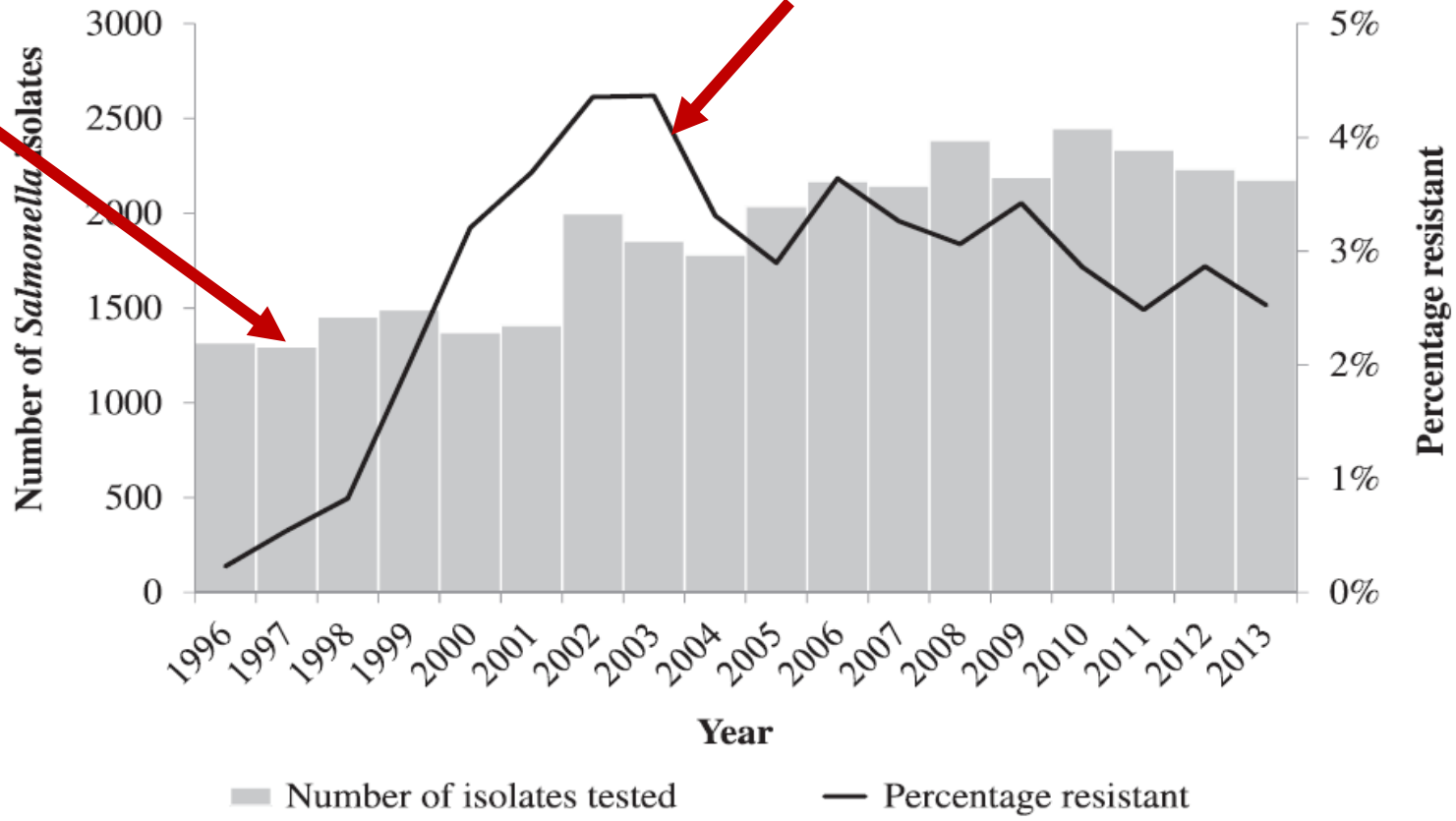


FIG. 1. Number of nontyphoidal *Salmonella* isolates from humans tested and percentage resistant to ceftriaxone, by year, 1996–2013.

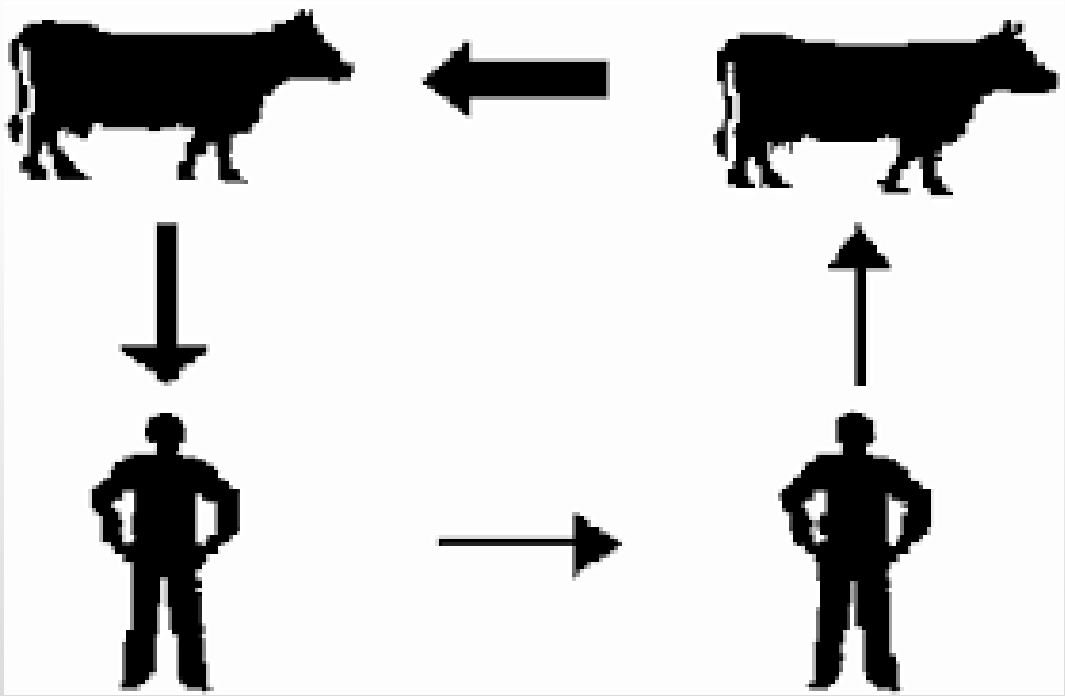
Ceftriaxone-Resistant Nontyphoidal Salmonella from Humans, Retail Meats, and Food Animals in the United States, 1996–2013

- Total of 978 (2.9%) of 34,100 *Salmonella* isolates resistant to ceftriaxone
- 40% from children younger than 18
- 3 predominant serotypes with high correlations
  - Human and ground beef Newport isolates (r=.83)
  - Human and cattle Typhimurium (r=.57)
  - Human and chicken Heidelberg (r=.65)
  - Human and turkey Heidelberg (r=.67)

- Food animals are important reservoirs of ceftriaxone-resistant *Salmonella* that cause human illness in the Unites States

- 3 examples illustrating human stewardship of animal resources impacting human health

- A little bit more about *Mycobacterium bovis*



Mycobacterium bovis

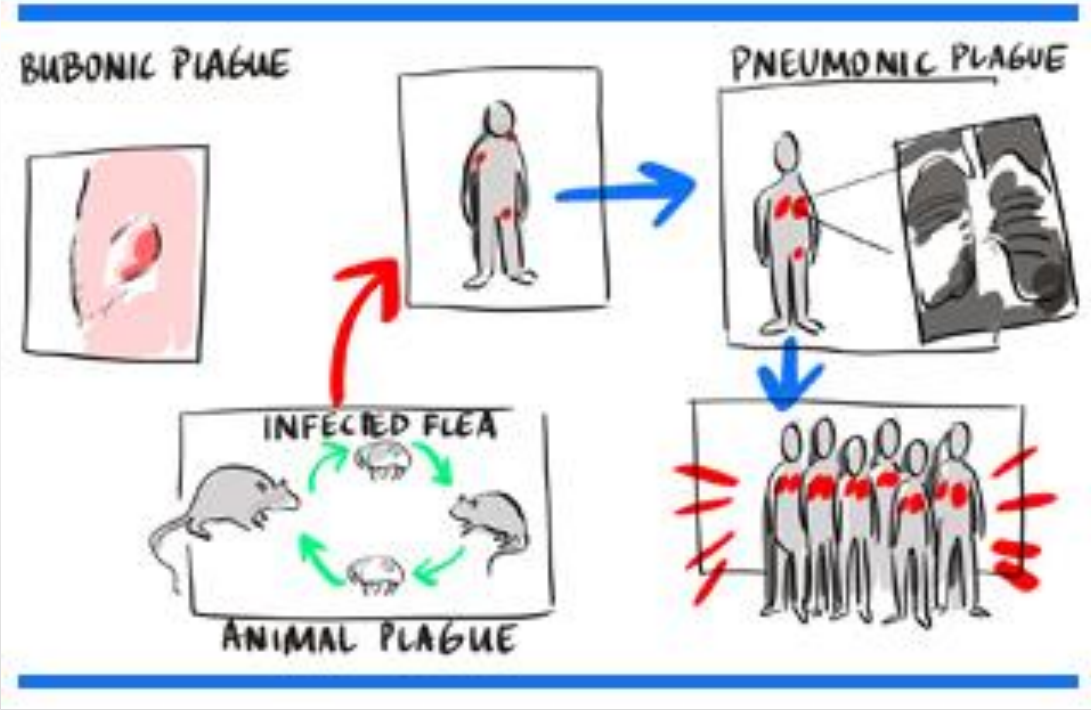
- TB due to *M bovis* clinically indistinguishable from TB due to *M tuberculosis*
- Acquired by ingestion or inhalation
- Fevers, weight loss, night sweats, hemoptysis.
- Causes 1.4-2.8% of tuberculosis cases worldwide
- Intrinsic resistance to pyrazinamide helps trigger awareness.
- Spread from animals to humans
- Human to human has been described

- Now for 2 additional examples of animal health directly impacting humans
  - Plague
  - Seoul virus

Pneumonic plague outbreak hits cities in Madagascar

Zosia Kmietowicz

- 10 cities have been hit by pneumonic plage
  - Caused by *Yersinia pestis*
  - Small mammals and their fleas (Xenopsylla spp)
  - 1800 suspected, probable, or confirmed cases
  - 127 deaths
- Causes bubonic, septicaemic or pneumonic




Bottom Line UP FRONT:
NCEZID created a test for a virus found in pet rats that sickened 17 people in the United States.
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Notes from the Field: Multiple Cases of Seoul Virus Infection in a Household with Infected Pet Rats- Tennessee, Dec 2016-Apr 2017

MMWR Oct 13, 2017

- 18 year old woman developed a fever, chills, anorexia, nausea, and hematuria in Dec 2016 (fully recovered)
- Jan 2017 Seoul Virus outbreak among rat breeders in Illinois and Wisconsin
  - 17 people in 7 states confirmed with diagnosis
  - Hanta virus (hemorrhagic fever with renal failure)
  - 1-2% fatality rate
  - Transmitted in the droppings, urine, saliva, and nesting materials from the brown Norway rat.
- The 18 year old woman confirmed to have Seoul virus but refused to euthanize the rat
- In April 2017, the mother of the 18 year old developed high fevers, pneumonia, and mild renal failure. Confirmed to be Seoul virus infection by PCR
  - Interestingly, very little contact with rat. Cleaned droppings from a bathtub 3 weeks previous to the infection.

One Health

The health of people is connected to the health of animals and the environment

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