

# Antimicrobial Resistance Surveillance in Canada

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## Recent Issues

- Canada – CBC Marketplace  
Feb. 2011, parliamentary committee
- US – declaration of MDR Salmonella as adulterant  
(S. Newport, S. Heidelberg); move to remove AGP  
claims from market
- Europe – EFSA – recommendations to control  
emergence of ESBL (e.g. NDM-1)
- CODEX – Guidance document for antimicrobial  
resistance risk analysis



## AMR not adequately addressed as a food safety hazard

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### Antimicrobial Resistance

- **Microbial hazard** Resistant bacteria/genes are isolated from the meat or milk of an animal
- Dissemination of resistant bacteria/genes continues beyond the residue WD period

### Antimicrobial Residue

- **Chemical hazard** Antimicrobial drug present in the meat or milk of an animal
  - WD period: Antimicrobial molecule < MRL
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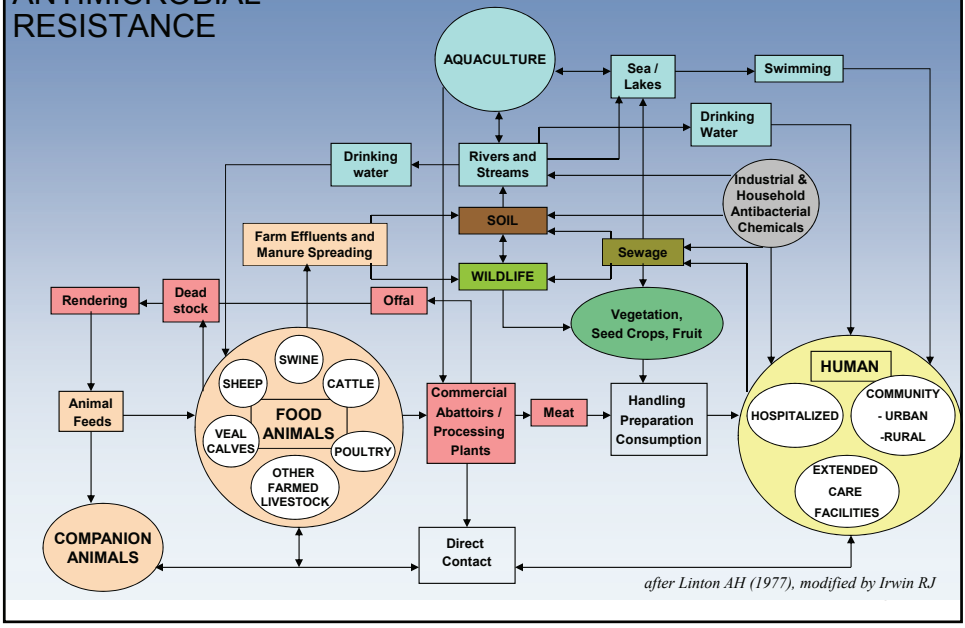
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## Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)

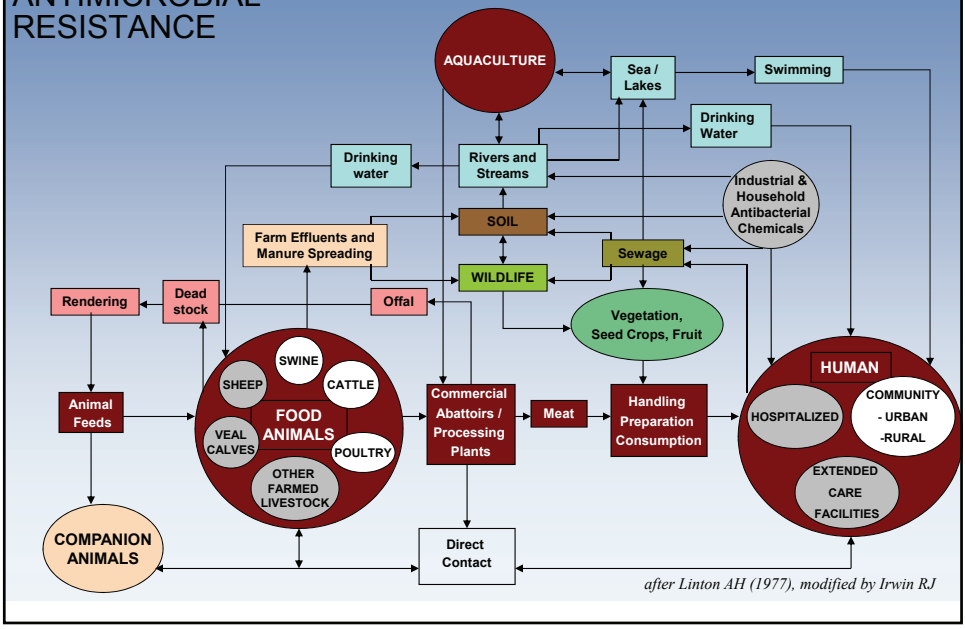
- Identify trends: prevalence of over time
  - Detect emerging resistance
  - Integration of data - human, animal, food; resistance and use
  - Compatible with NARMS
  - Source of information for risk assessment
  - Identify areas for interventions/risk management to reduce the risk of acquiring infectious enteric diseases in Canada, and to reduce the burden of resistant infectious disease
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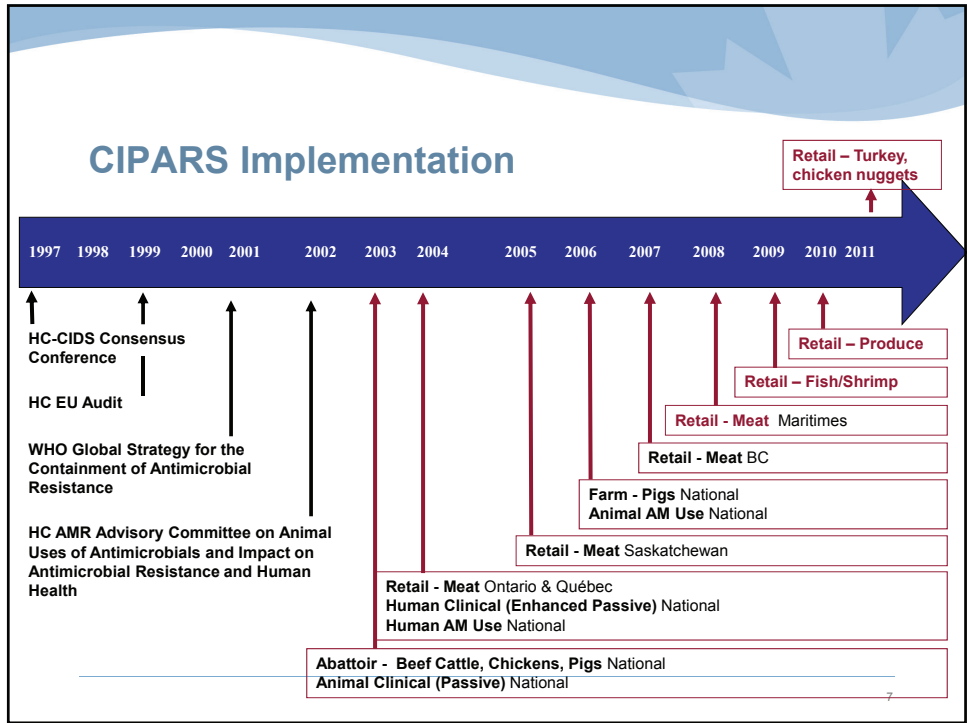
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# EPIDEMIOLOGY OF ANTIMICROBIAL RESISTANCE



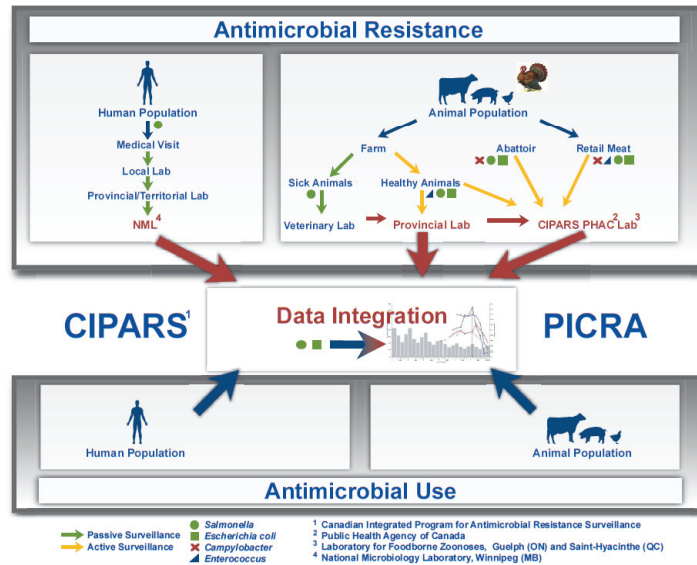
# EPIDEMIOLOGY OF ANTIMICROBIAL RESISTANCE





- ## CIPARS
- **Public Health Agency of Canada (PHAC)**
    - Lab for Foodborne Zoonoses (LFZ)
    - Centre for Food-borne Environmental and Zoonotic Infectious Diseases (CFEZID)
    - National Microbiology Lab (NML)
  - **Health Canada-Veterinary Drugs Directorate**
  - **Canadian Food Inspection Agency (CFIA)**
    - abattoir support
  - **CIPARS Public Health Partnership**
    - human *Salmonella* (*Campylobacter*)
  - **Prov Ministries of Ag.** (QC, SK, AB, BC)
  - **Industry** (abattoirs, farm)
  - **Academia & NGOs** (CAHI)

# CIPARS



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## Veterinary Drug Directorate\* Antimicrobial Classification System

### Categories of human health importance

- Category I:** Very High Importance  
(e.g., amoxicillin-clavulanic acid, ciprofloxacin, ceftiofur, ceftriaxone)
- Category II:** High Importance  
(e.g., amikacin, gentamicin, nalidixic acid, ampicillin, cefoxitin)
- Category III:** Medium Importance  
(e.g., chloramphenicol, sulfisoxazole, tetracycline)
- Category IV:** Low Importance  
(e.g., ionophores)

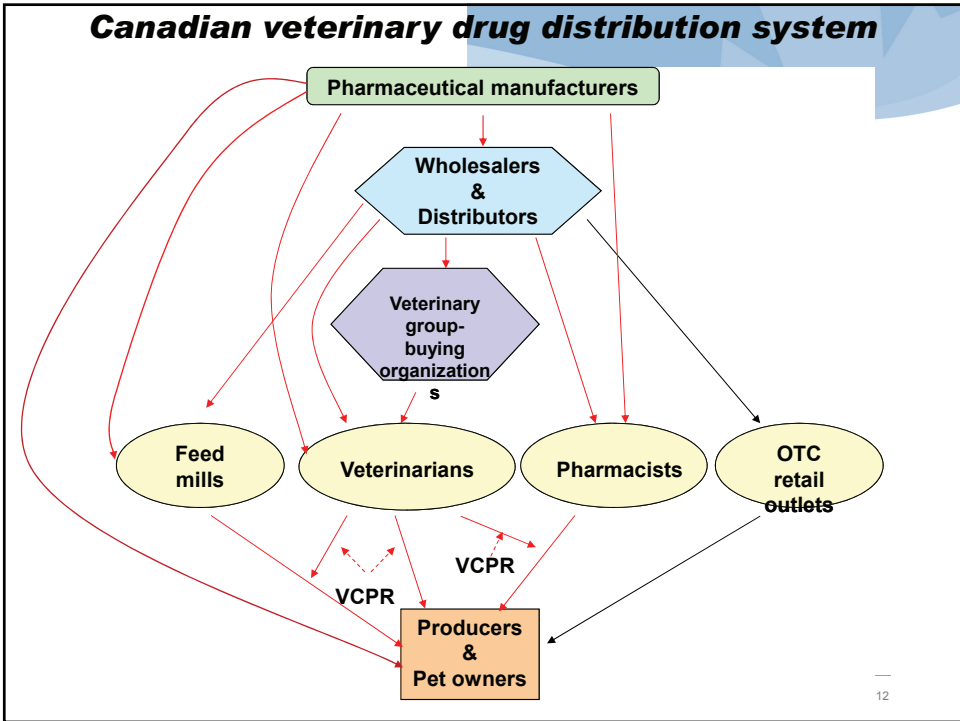
\* Veterinary Drug Directorate, Health Canada  
[http://www.hc-sc.gc.ca/dhp-mps/consultation/vet/consultations/amr\\_ram\\_hum-med\\_e.html](http://www.hc-sc.gc.ca/dhp-mps/consultation/vet/consultations/amr_ram_hum-med_e.html)

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### Antimicrobials Approved for Use in Food Animals in Canada

Category	Category I	Category II	Category III	Category IV
<b>Growth Promotion</b>	Arsanilic acid Bacitracin Bambermycin Chlortetracycline	Erythromycin Neomycin Lincomycin Oxytetracycline	Penicillin Salinomycin Sulfamethazine Tylosin	
<b>Prophylaxis</b>	Bacitracin Chlortetracycline Erythromycin Gentamicin Lincomycin	Neomycin Nitrofurazone Oxytetracycline Penicillin Spectinomycin Streptomycin	Sulfaguanidine Sulfamethazine Tetracycline Tiamulin Tylosin Virginiamycin	
<b>Therapy</b>	Ampicillin Apramycin Chlortetracycline Ceftiofur Cephapirin Cloxacillin Enrofloxacin Erythromycin Florfenicol Gentamicin	Lincomycin Neomycin Nitrofurazone Ormethorpin Oxytetracycline Pirlimycin Penicillin Polymixin B Spectinomycin Streptomycin	Sulfadiazine Sulfaguanidine Sulfamethoxine Sulfamethazine Tetracycline Tilmicosin Trimethoprim Tylosin Virginiamycin	

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## Estimated Use of Antimicrobials in Canada

### 2007 CIPARS Annual Report

Human - 195,651 kg<sup>1</sup> (doesn't include hospital use)  
 Animal - 1,617,747 kg<sup>2</sup> (doesn't include own-use or API)

- Approximately 88% of the total volume (by weight of active ingredient) of antimicrobials distributed for sale in Canada are for animal use.
- Two-thirds are of antimicrobials considered important in human medicine (HC – VDD categorization scheme)

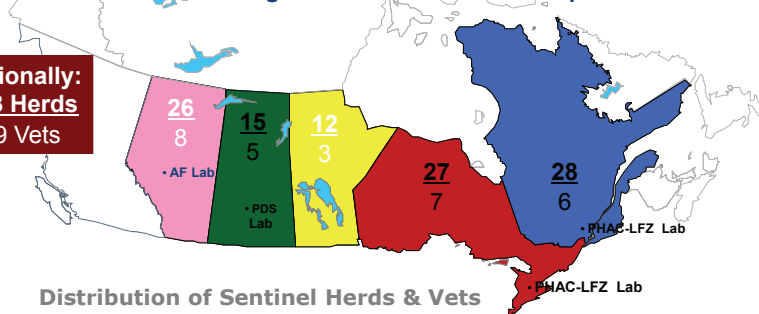
<sup>1</sup> IMS Health – Canadian CompuScript (CCS) dataset

<sup>2</sup> Canadian Animal Health Institute

## Farm surveillance – Swine pilot

- At implementation, herds were allocated per province proportional to the number of *Grower/Finisher Units* in each province
- Provincial funding provided 10 additional herds in Alberta and Saskatchewan during the 2006-07 surveillance periods

**Nationally:**  
108 Herds  
 29 Vets



Distribution of Sentinel Herds & Vets

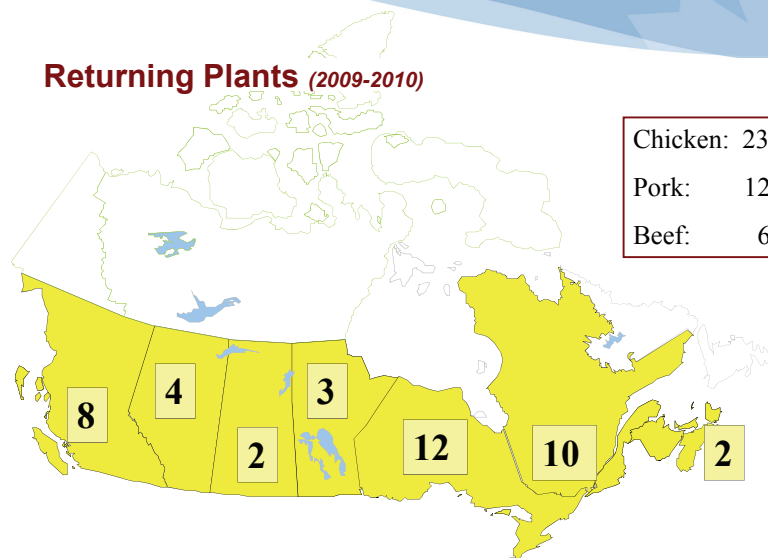
## Abattoir Surveillance

- Implementation in fall of 2002 (51 plants)
- Federally registered abattoirs
- Random selection based on slaughter volume
- Cattle - beef (& cull dairy cattle)
  - generic *E. coli*, *Campylobacter*
- Swine - market hogs
  - *Salmonella*, generic *E. coli*, (*Campylobacter*)
- Chickens – broilers
  - *Salmonella*, generic *E. coli*
- Sample size calculated to generate 150 isolates of *Salmonella* & *E. coli*, 100 isolates of *Campylobacter*



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## Returning Plants (2009-2010)



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## Retail Food Surveillance

- 7 (of 10) provinces
  - Ontario, Québec (2003), Saskatchewan (2005), British Columbia (2006), Nova Scotia/New Brunswick/PEI\* (2007)
- Continuous sampling
  - Weekly or every other weekly sampling in each province (\* sampled as one province)
  - 280 (ON, QC)/140 samples/commodity/province/year



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## Retail Food Surveillance

- Samples
  - Chicken *leg* (C)
  - Pork *chop* (P)
  - Beef *ground* (B)
  - Turkey ground (pilot)
- Bacteria
  - generic *E. coli* (C/P/B), *Campylobacter* (C), *Salmonella* (C/P\*), *Enterococcus* (C)
  - Goal: 100 isolates/commodity/province/year for antimicrobial susceptibility testing



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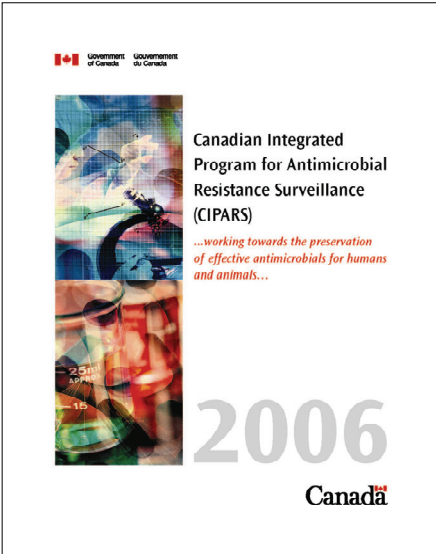
## Human Surveillance

- January 1, 2003
- Provincial public health laboratories forwarding human *Salmonella* isolates to NML, Winnipeg
  - BC, Alberta, Ontario, Québec: all isolates received from the 1st to 15th each month; + all *S. Typhi*
  - Saskatchewan, Manitoba, New Brunswick, Newfoundland, Nova Scotia, PEI: All human *Salmonella* isolates received
  - As of 2010, antimicrobial susceptibility testing is only being conducted on *S. Enteritidis*, *S. Heidelberg*, *S. Typhimurium*, *S. Typhi*, *S. Paratyphi A*, *S. Paratyphi B*, and spp. 4,5,12:i:-.

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**CIPARS** Canadian Integrated Program for Antimicrobial Resistance Surveillance **PICRA**  
Programme Canadien Intégré de Résistance aux Antimicrobiens



Government of Canada / Gouvernement du Canada

Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)

...working towards the preservation of effective antimicrobials for humans and animals...

**2006**  
Canada

**CIPARS Reports** available in English and French at:

[www.phac-aspc.gc.ca/cipars-picra/index-eng.php](http://www.phac-aspc.gc.ca/cipars-picra/index-eng.php)

[www.phac-aspc.gc.ca/cipars-picra/index-fra.php](http://www.phac-aspc.gc.ca/cipars-picra/index-fra.php)

Annual reports  
Short reports  
Issue papers

... working towards the preservation of effective antimicrobials in humans and animals

## What has 10 years of CIPARS told us?

- **Retail raw chicken meat represents a significant potential exposure source for human Salmonella and Campylobacter infections**
- **Resistance to antimicrobials is more prevalent among chicken isolates, than either beef or pork**
- **CIPARS has identified that resistance to Category I antimicrobials is related to ELDU of Category I drugs**
- **CIPARS collected evidence of a successful intervention (ceftiofur ban) by the poultry industry in Quebec to minimize human AMR. This voluntary intervention was not maintained and PHAC now has evidence of re-emergence of AMR in human Salmonella**

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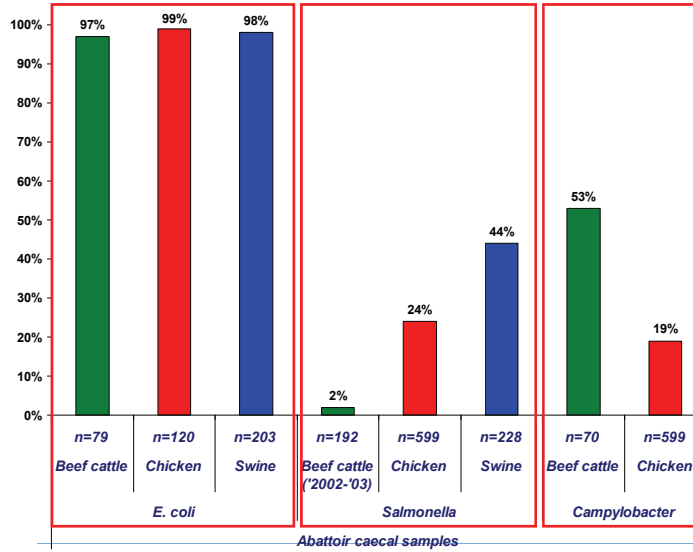
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Chicken is a source of Salmonella &  
Campylobacter in Canada

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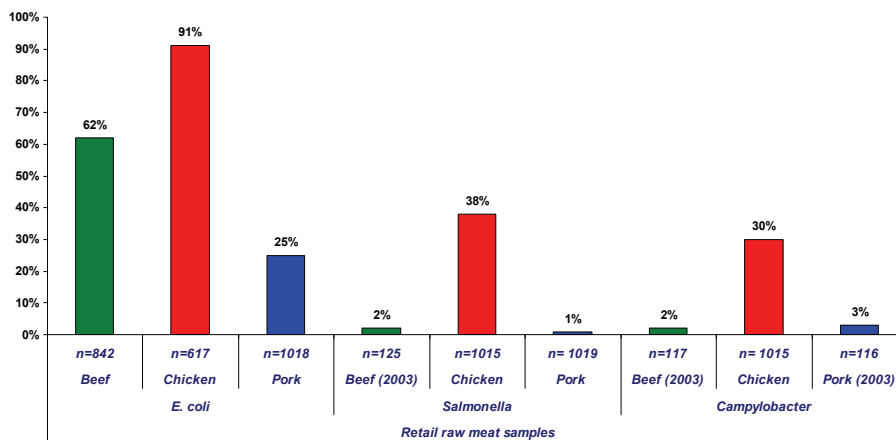
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### Bacteria prevalence in abattoir samples, 2009 -measure of farm level AMR



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### 2010 CIPARS Retail Bacterial Recovery -measure of potential human exposure



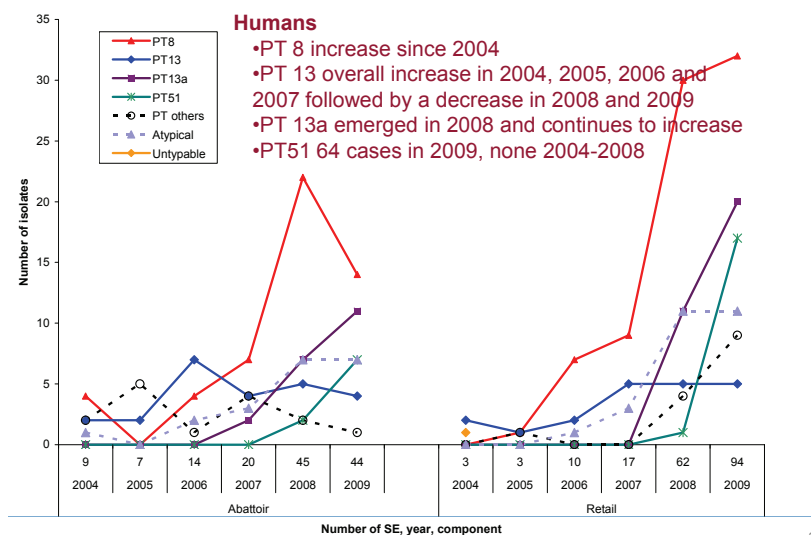
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## Salmonella Enteritidis

- Increase in prevalence in abattoir, retail and human cases
- 99% of abattoir and retail isolates are susceptible to all antimicrobials
  - Only one isolate resistant to TET
- Human samples:
  - 81% susceptible
    - Mix of travel and domestic cases (C-Enternet)
  - 16% resistant to nalidixic acid
    - Mostly travel related

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## S. Enteritidis phage types recovered from chicken at slaughter and retail, (2004-2009)

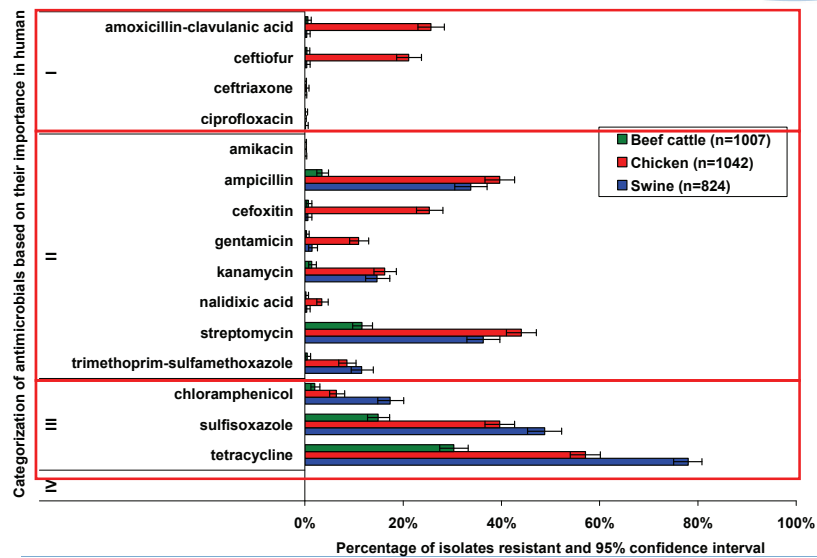


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Chicken isolates demonstrate significant resistance to antimicrobials with certain *Salmonella* serovars mirroring patterns in chicken and human isolates

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### AMR in *E. coli* abattoir isolates, 2002-2008\*

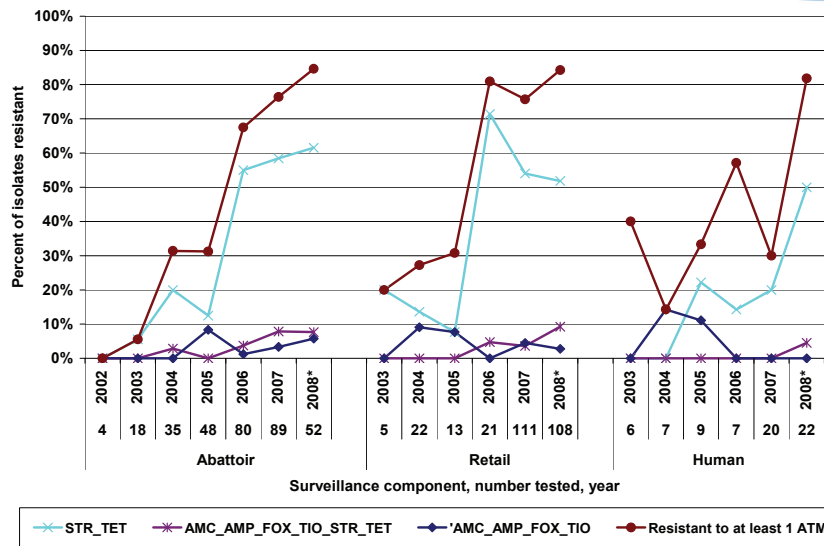


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Chicken production practices appear to have contributed to the emergence of resistance in *Salmonella* Kentucky recovered from chickens and humans in Canada

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### Change of resistance pattern in *S. Kentucky*



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**Extra-label drug use of Category 1 (highly important in humans) antimicrobials has lead to resistance to Category 1 antimicrobials in Salmonella and Campylobacter.**

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### **Extra-label use of Ceftiofur & S. Heidelberg**

#### **Ceftiofur**

- Can be used in many animal species
- NOT labelled for use in chicken in Canada
  - Used extra-label for the control of *E. coli* omphalitis in broilers

#### **Salmonella Heidelberg**

- Notifiable - Frequent: Top 3 serovars in humans in Canada since 1995
- Diarrhea, vomiting, fever, malaise
- Invasive: Can cause septicemia, myocarditis, extra-intestinal infections, and death.

#### **Treatment concern**

- Resistance to **ceftiofur** = resistance to **ceftriaxone**; one of the drugs of choice for treatment of pregnant women and children

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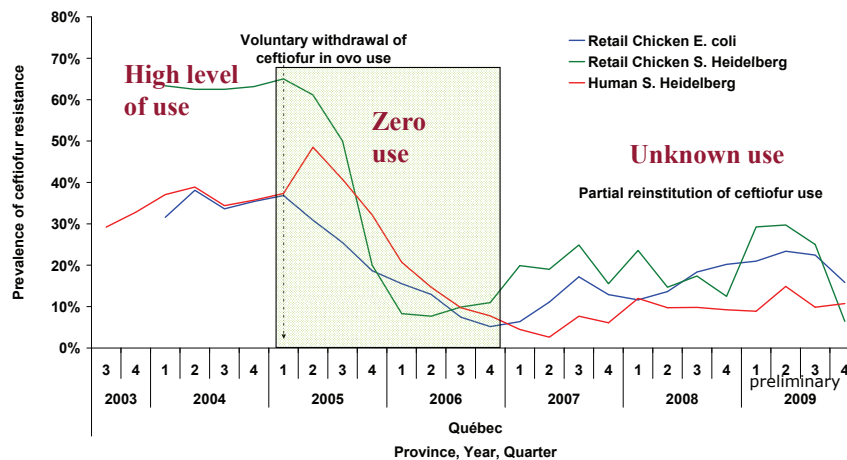
## Ceftiofur Resistance in CIPARS isolates

- **Abattoir across animal species**
  - *E. coli* = Beef: 0.4%; Swine: 0.5%, Chicken: 22%
  - *Salmonella* = Swine: 0.3%; Chicken: 14%
- **Retail**
  - *E. coli* = Beef: 0.7%; Swine: 1.2%, Chicken: 22%
  - *Salmonella* = Pork: 4%; Chicken: 17%
- **Diagnostic clinical *Salmonella***
  - Turkey: 25%
  - Chicken (includes broiler and layer): 8%
    - Including one *S. Enteritidis* isolate

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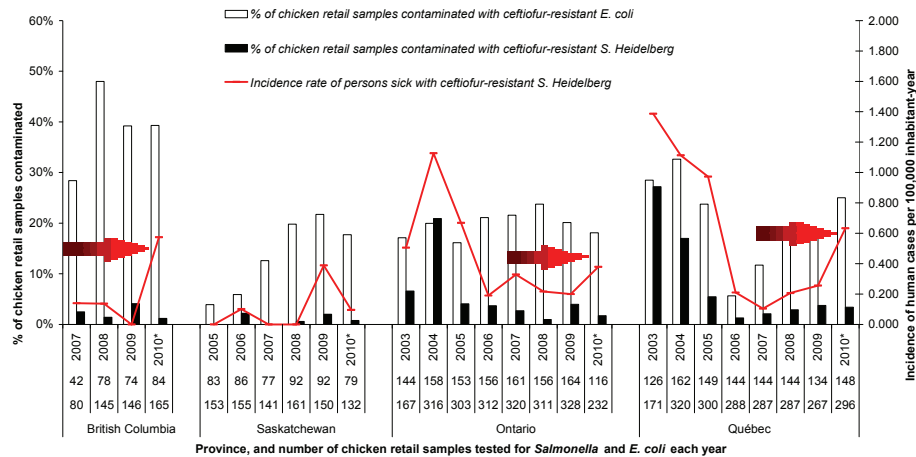
## Ceftiofur Resistance in Chicken *E. coli* and Human and Chicken *S. Heidelberg* (Québec) - CIPARS 2003-2009

### Rolling Average



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## Percentage of Retail Chicken Contaminated with Ceftiofur-Resistant *E. coli* and *S. Heidelberg*, and Incidence based on Submitted Human Cases with Ceftiofur-Resistant *S. Heidelberg* – CIPARS 2003-2010



\* 2010 data are preliminary

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## Extra-label use of Fluoroquinolones

### Ciprofloxacin

- A fluoroquinolone antimicrobial
- Considered very important to human medicine
  - To treat respiratory, urinary, gastrointestinal, skin and bone/joint infections

### Veterinary Fluoroquinolones

- Enrofloxacin (Baytril® 100, Bayer); Danofloxacin (A180®, Pfizer)
  - Prescription drugs;
  - Available as injectable solutions for treating bovine respiratory disease;
  - These drugs are **NOT** labelled for use in poultry in Canada

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## Campylobacter & Fluoroquinolones

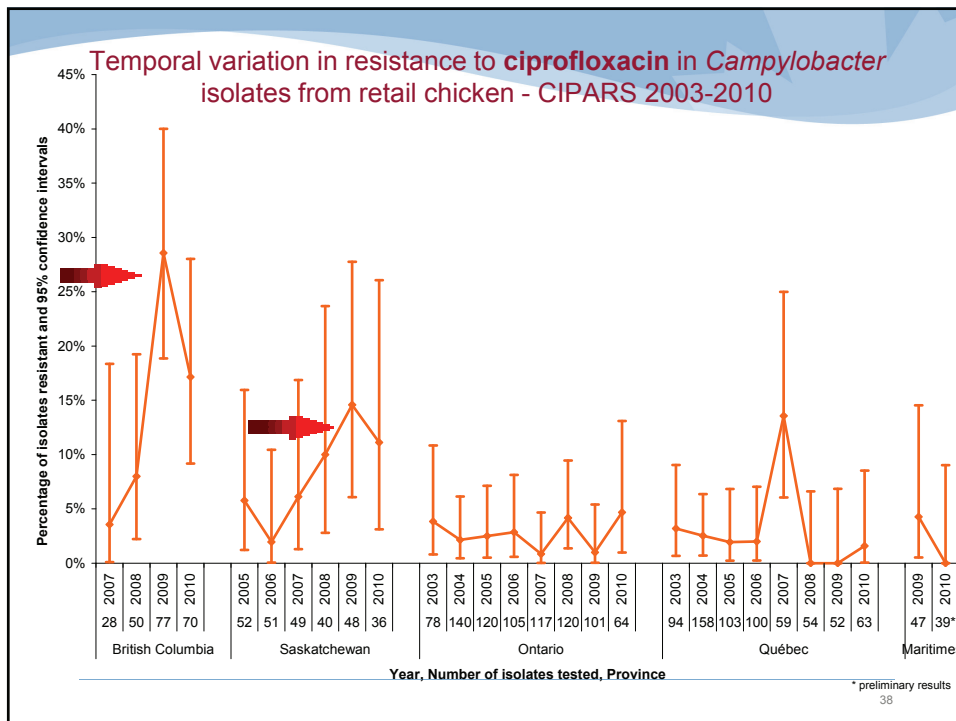
### Campylobacter

- Notifiable
- Most common bacterial foodborne pathogen in Canada causing gastroenteritis -diarrhea, fever and abdominal pain; Guillain-Barré syndrome
- Poor kitchen hygiene and/or under-cooking of poultry products

### Fluoroquinolone-resistant *Campylobacter*

- Link between chicken isolates and infections in people
- May be more severe illness than infections with susceptible strains
- Fluoroquinolone-resistance in *Campylobacter* can persist and become stable, even following fluoroquinolone withdrawal
- Horizontal transmission from the environment
- Possible vertical transmission
- Regional increases in fluoroquinolone-resistance may be related to fluoroquinolone use in the broiler or broiler breeder sectors to treat *Salmonella (Enteritidis)*

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## Acknowledgements

### **Public Health Agency of Canada, CIPARS**

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### **Provincial Public Health Laboratories**

- British Columbia Centre for Disease Control
- Provincial Laboratory of Public Health, Alberta
- Saskatchewan Laboratory and Disease Control Services
- Cadham Provincial Laboratory, Manitoba
- Ontario Ministry of Health and Long-Term Care
- Institut national de santé publique du Québec
- New Brunswick Enteric Reference Centre
- Microbiology Laboratory, Queen Elizabeth II Health Sciences Centre, Nova Scotia
- Laboratory Services, Queen Elizabeth Hospital, Prince Edward Island
- Newfoundland Public Health Laboratory

### **Canadian Food Inspection Agency**

**Health Canada, Veterinary Drugs Directorate**

### **Abattoir-Industry Participants**

**Retail Meat Surveillance Participants**

**Canadian Animal Health Institute**

### **Provincial Animal Health Labs**

**Other collaborating laboratories**

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## Thank you

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