

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

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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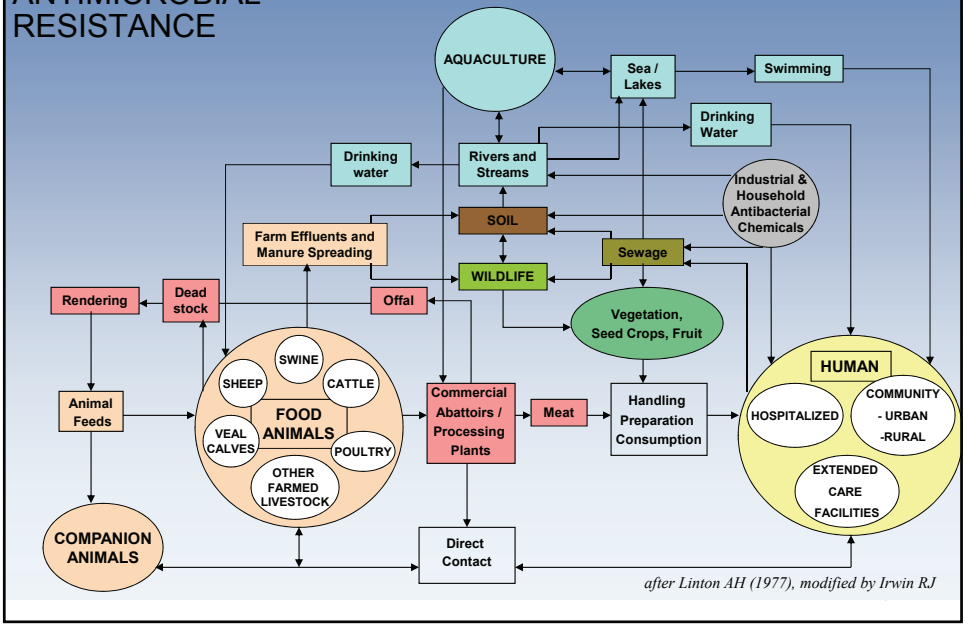
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Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)

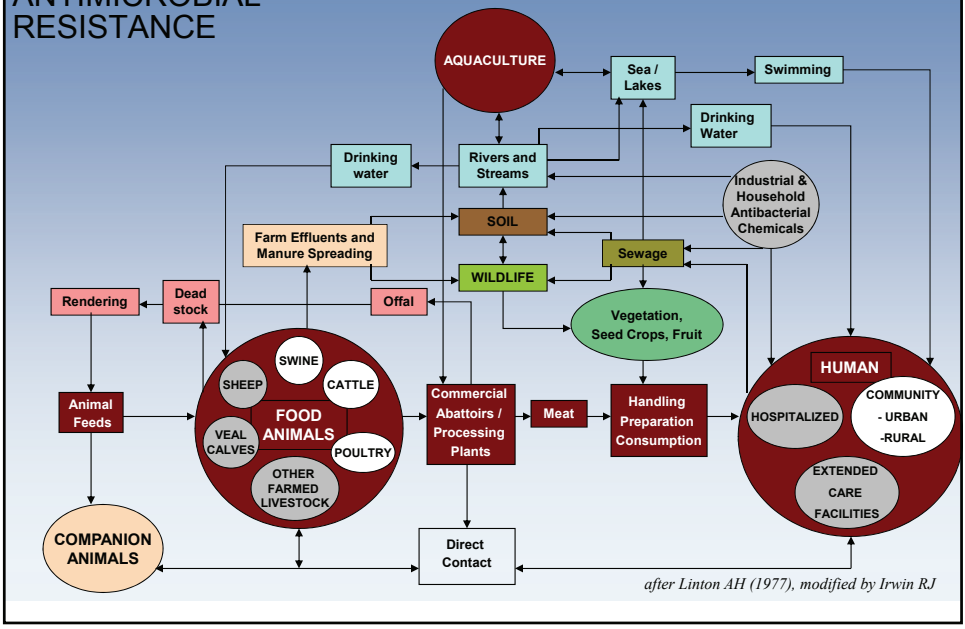
- Identify trends: prevalence of over time
 - Detect emerging resistance
 - Integration of data - human, animal, food; resistance and use
 - Compatible with NARMS
 - Source of information for risk assessment
 - Identify areas for interventions/risk management to reduce the risk of acquiring infectious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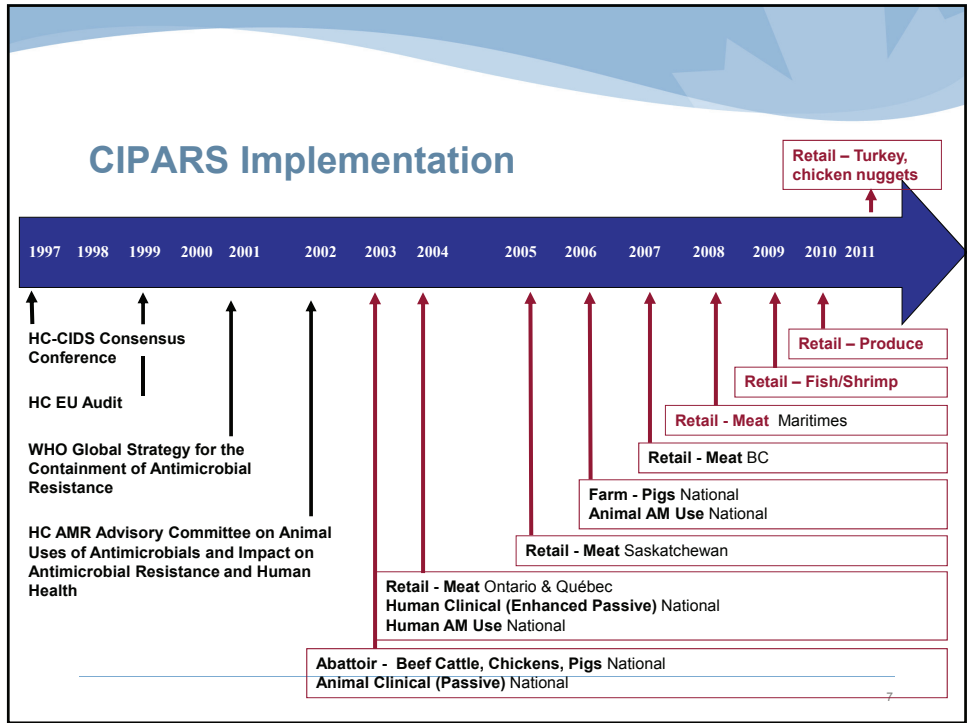
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EPIDEMIOLOGY OF ANTIMICROBIAL RESISTANCE



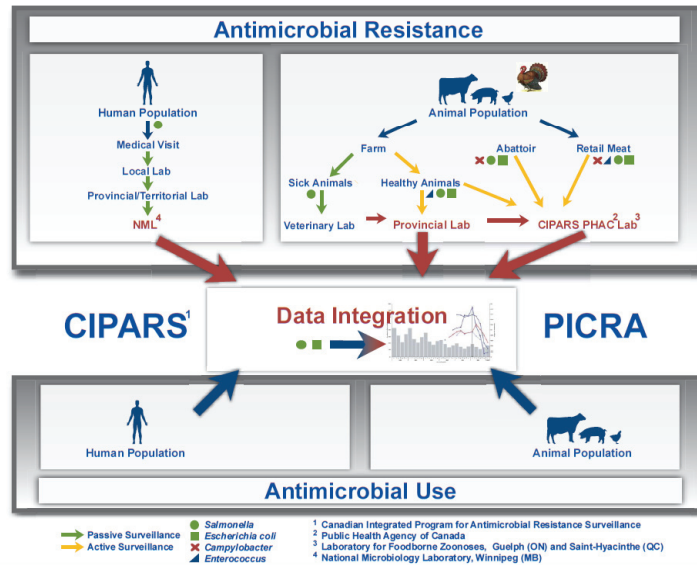
EPIDEMIOLOGY OF ANTIMICROBIAL RESISTANCE





- ## 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, ceftiofur)
- Category III:** Medium Importance
(e.g., chloramphenicol, sulfisoxazole, tetracycline)
- Category IV:** Low Importance
(e.g., ionophores)

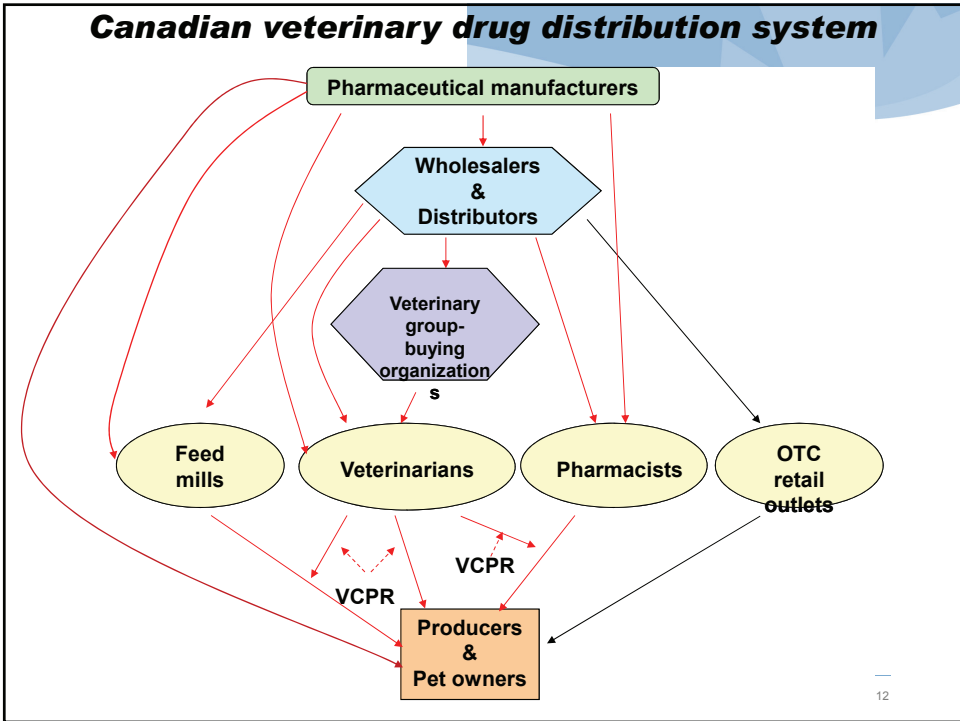
* Veterinary Drug Directorate, Health Canada
http://www.hc-sc.gc.ca/dhp-mpps/consultation/vet/consultations/amr_ram_hum-med_e.html

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Antimicrobials Approved for Use in Food Animals in Canada

Category	Category I	Category II	Category III	Category IV
Growth Promotion	Arsanilic acid Bacitracin Bambermycin Chlortetracycline	Erythromycin Neomycin Lincomycin Oxytetracycline	Penicillin Salinomycin Sulfamethazine Tylosin	
Prophylaxis	Bacitracin Chlortetracycline Erythromycin Gentamicin Lincomycin	Neomycin Nitrofurazone Oxytetracycline Penicillin Spectinomycin Streptomycin	Sulfaguanidine Sulfamethazine Tetracycline Tiamulin Tylosin Virginiamycin	
Therapy	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 kg¹ (doesn't include hospital use)
 Animal - 1,617,747 kg² (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)

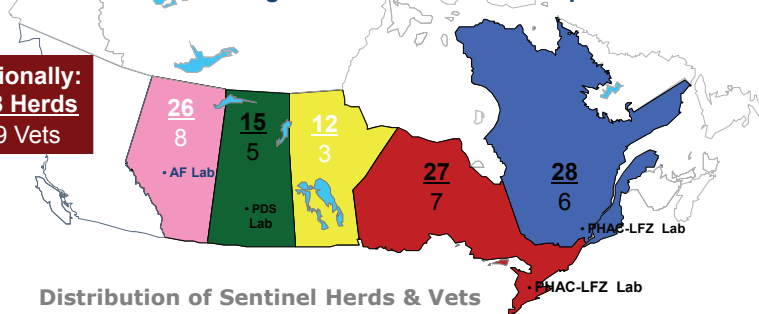
¹ IMS Health – Canadian CompuScript (CCS) dataset

² 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

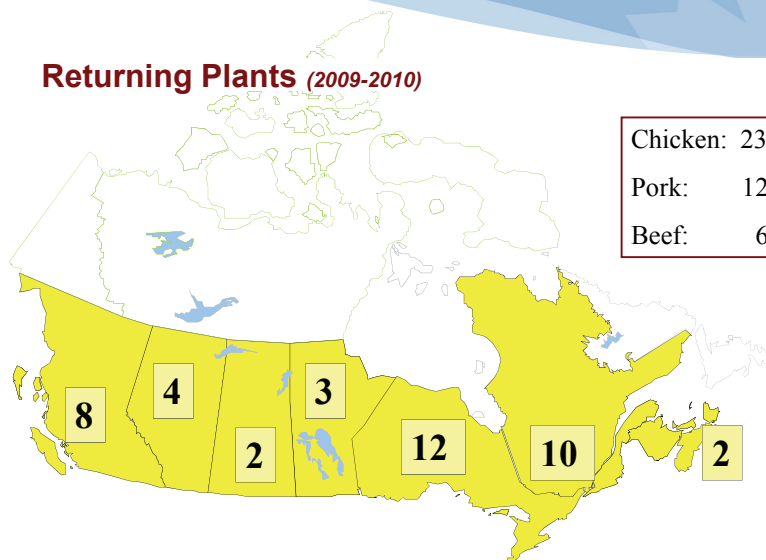
Abattoir Surveillance

- 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)



Chicken:	23
Pork:	12
Beef:	6

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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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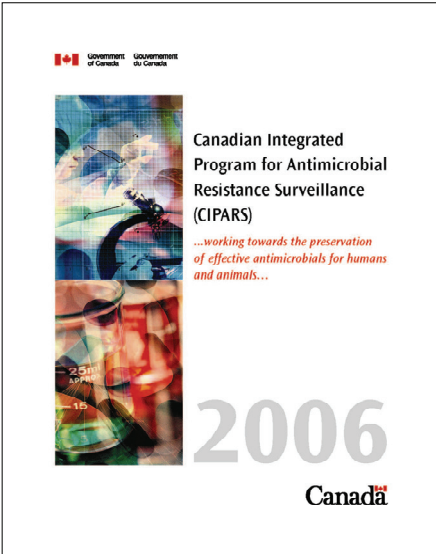
Human Surveillance

- 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

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?

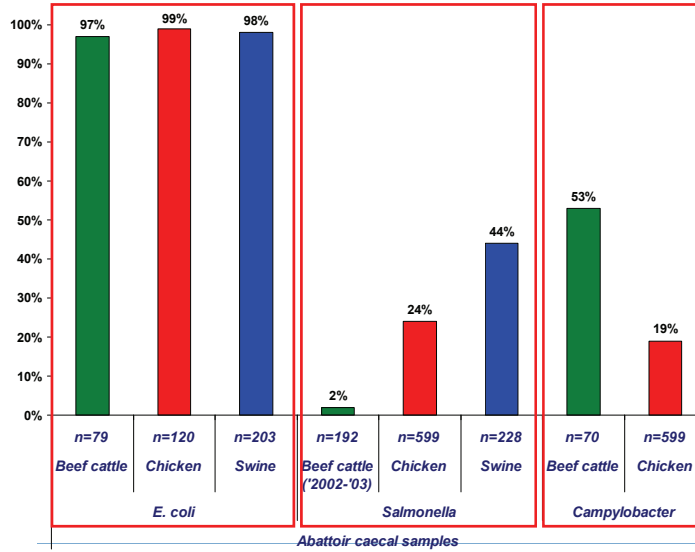
- **Retail raw chicken meat represents a significant potential exposure source for human Salmonella and Campylobacter infections**
- **Resistance to antimicrobials is more prevalent among chicken isolates, than either beef or pork**
- **CIPARS has identified that resistance to Category I antimicrobials 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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Chicken is a source of Salmonella &
Campylobacter in Canada

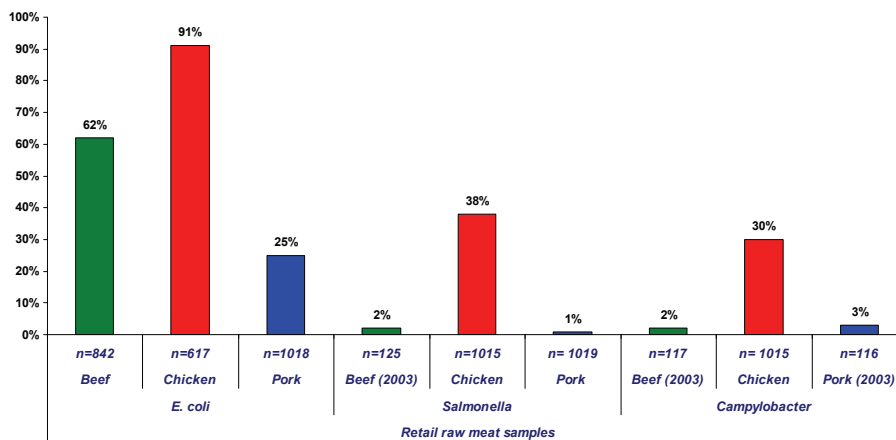
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Bacteria prevalence in abattoir samples, 2009 -measure of farm level AMR



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2010 CIPARS Retail Bacterial Recovery -measure of potential human exposure



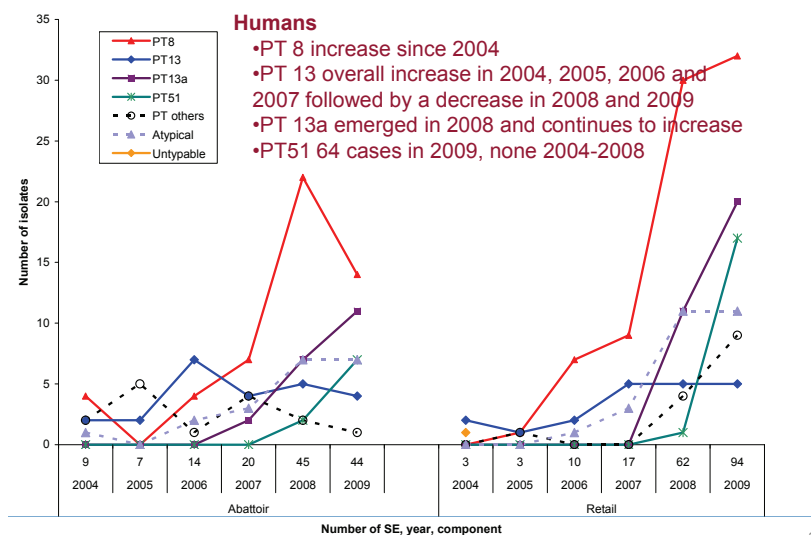
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Salmonella Enteritidis

- 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)

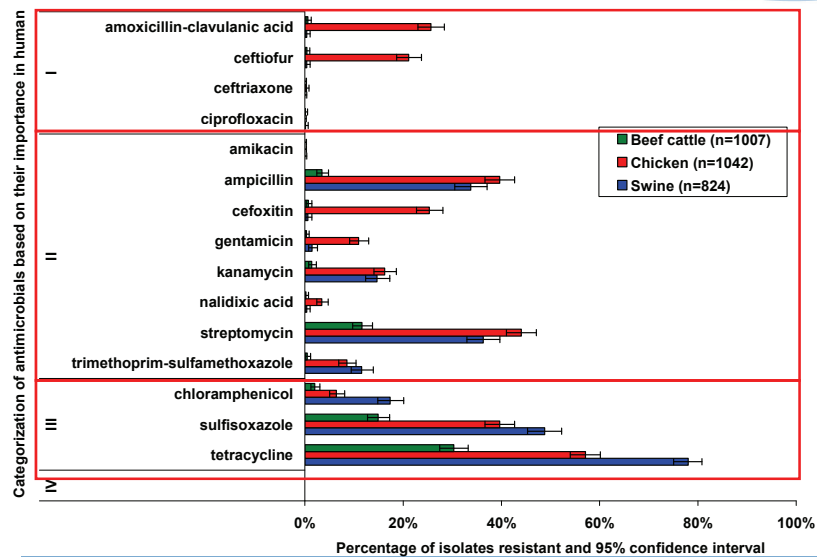


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Chicken isolates demonstrate significant resistance to antimicrobials with certain *Salmonella* serovars mirroring patterns in chicken and human isolates

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

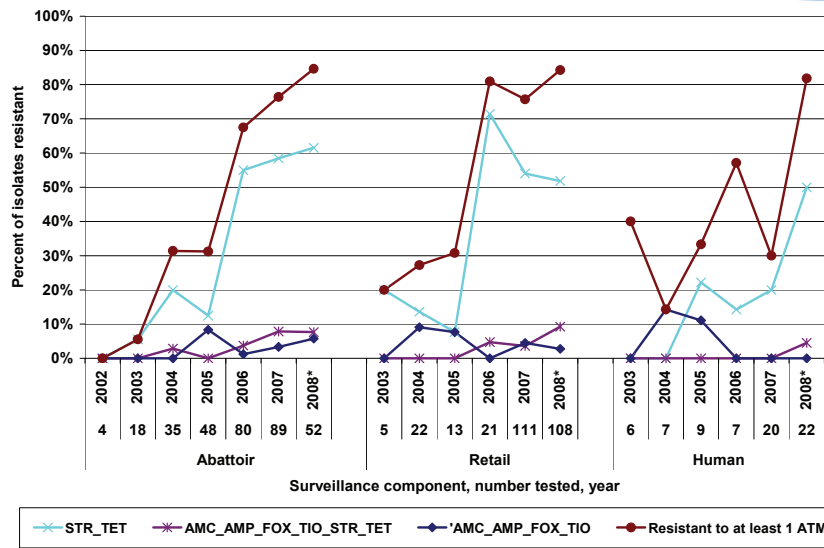


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Chicken production practices appear to have contributed to the emergence of resistance in *Salmonella* Kentucky recovered from chickens and humans in Canada

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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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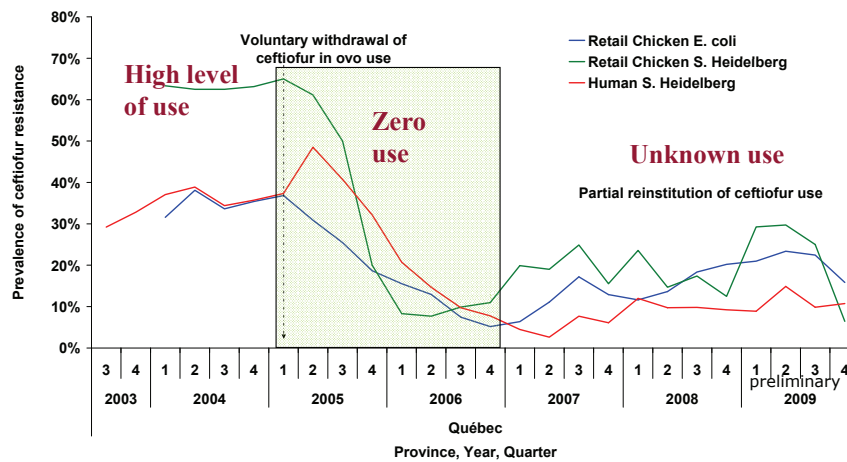
Ceftiofur Resistance in CIPARS isolates

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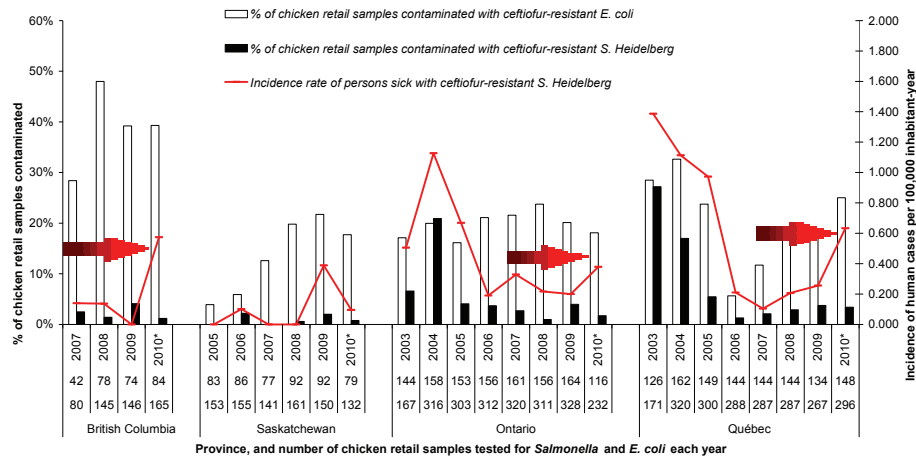
Ceftiofur Resistance in Chicken *E. coli* and Human and Chicken *S. Heidelberg* (Québec) - CIPARS 2003-2009

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

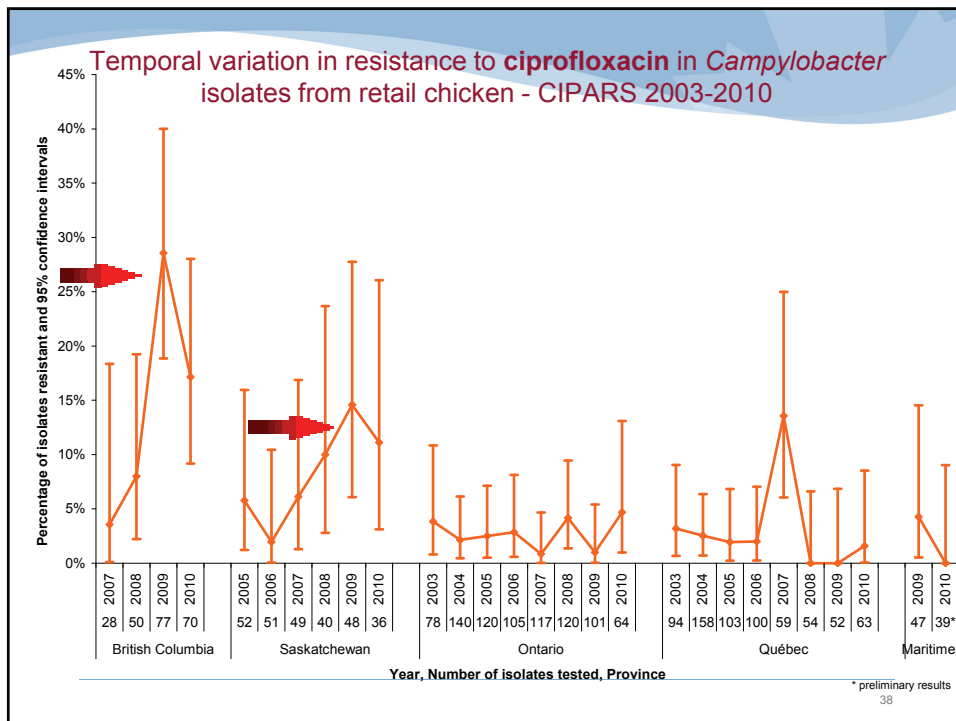
Campylobacter

- 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

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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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