Government of Canada | Gouvernement du Canada

Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)

ANTIMICROBIAL RESISTANCE SHORT REPORT

2011

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

Canada

Healthy Canadians and communities in a healthier world

Public Health Agency of Canada

National Library of Canada Cataloguing in Publication:

Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) 2011 – Antimicrobial Resistance Short Report

Également disponible en français sous le titre:

Programme intégré canadien de surveillance de la résistance aux antimicrobiens (PICRA) 2011 – Rapport sommaire sur la résistance aux antimicrobiens

For further information or to provide comments please send an email to:

cipars-picra@phac-aspc.gc.ca

HP2-4/2-2011E-PDF

Suggested Citation

Government of Canada. Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) 2011 – Antimicrobial Resistance Short Report. Public Health Agency of Canada, Guelph, Ontario, 2012.

Contributors to CIPARS 2011

These acknowledgements are intended to identify and thank the numerous individuals and organizations that have contributed to the success of CIPARS in 2011.

Program Coordinators

Rita Finley,[1] Michael Mulvey,[2] and Rebecca Irwin[3]

Surveillance Component Leads

Surveillance of Human Clinical Isolates
Rita Finley and Michael Mulvey

Retail Meat Surveillance
Brent Avery[3]

Abattoir Surveillance
Anne Deckert[3]

Farm Surveillance (Antimicrobial Resistance and Antimicrobial Use)
Agnes Agunos,[3] Anne Deckert, Sheryl Gow,[3] and David Léger[3]

Surveillance of Animal Clinical Isolates
Anne Deckert

Antimicrobial Use Surveillance in Humans
Rita Finley

Antimicrobial Use Surveillance in Animals (National Distribution)
Richard Reid-Smith

Data Management, Analysis, and Reporting
Brent Avery, Lucie Dutil,[3] Antoinette Ludwig,[3] and Jane Parmley[3]

Laboratory Components

Laboratory for Foodborne Zoonoses, Saint-Hyacinthe
Surveillance Laboratory: Danielle Daignault
Antimicrobial Susceptibility Testing: Manon Caron

Laboratory for Foodborne Zoonoses, Guelph
Salmonella Typing: Linda Cole
Antimicrobial Susceptibility Testing:
Andrea Desruisseau and Chad Gill

National Microbiology Laboratory, Winnipeg
Salmonella Serotyping: Helen Tabor
Salmonella Phage Typing: Rafiq Ahmed
Antimicrobial Susceptibility Testing:
Michael Mulvey

Report Production

Michelle Tessier (coordinator)
Virginia Young

Authors/Analysts

Antimicrobial Resistance
Brent Avery
Rita Finley
Sheryl Gow
Colleen Murphy
Jane Parmley
Lisa Scott
Michelle Tessier

Antimicrobial Use
Carolee Carson
Rita Finley
Richard Reid-Smith
Lisa Scott
David Léger

---

[1] Centre for Foodborne, Environmental and Zoonotic Infectious Diseases

[2] National Microbiology Laboratory

[3] Laboratory for Foodborne Zoonoses

Reviewers

Internal
Brent Avery
Carolee Carson
Danielle Daignault
Anne Deckert
Andrea Desruisseau
Rita Finley
Sheryl Gow
David Léger
Jane Parmley
Lisa Scott
Virginia Young

External
Antimicrobial Resistance in the Agri-food sector:
Patrick Boerlin, Ontario Veterinary College
Xian-Zhi Li, Health Canada, Veterinary Drugs Directorate,
Jane MacDonald, Canadian Food Inspection Agency

Antimicrobial Use in Humans:
John Conly, University of Calgary
Jim Hutchinson, University of British Columbia
David Patrick, University of British Columbia, British Columbia Centres for Disease Control (BCCDC)
Lynora Saxinger, University of Alberta Hospital
Karl Weiss, University of Montreal

Editor

Sandra Lefebvre (English version)

Communications

Jennifer Baker
Carolee Carson

Provincial Public Health Laboratories

We gratefully acknowledge the provincial public health laboratories for their longstanding support and for providing data and bacterial isolates for CIPARS.

- Laboratory Services, British Columbia Centre for Disease Control (Judy Isaac-Renton)
- Provincial Laboratory for Public Health, Alberta (Marie Louie)
- Saskatchewan Laboratory and Disease Control Services (Greg Horsman)
- Cadham Provincial Laboratory, Manitoba (John Wylie)
- Central Public Health Laboratory, Public Health Laboratories Branch, Ontario Ministry of Health and Long-Term Care (Vanessa Allen)
- Laboratoire de santé publique du Québec de l'Institut national de santé publique du Québec (Sadjia Bekal)
- New Brunswick Enteric Reference Centre (Sameh El Bailey)

Provincial Public Health Laboratories (continued)

- Microbiology Laboratory, Queen Elizabeth II Health Sciences Centre, Nova Scotia (David Haldane)
- Laboratory Services, Queen Elizabeth Hospital, Prince Edward Island (Lei Ang)
- Newfoundland Public Health Laboratory (Lourens Robberts)

Retail Meat Surveillance Participants

We would like to extend our thanks to the following organizations for their participation in CIPARS *Retail Meat Surveillance*:

- University of Prince Edward Island, Atlantic Veterinary College (J.T. McClure, Carol McClure, Matthew Saab, Cynthia Mitchell, and Anne Muckle)
- Centre for Coastal Health

We also thank the following health unit managers, public health inspectors, and environmental health officers: Ken Adams, Renée Ansel, Lucy Beck, Bob Bell, Christopher Beveridge, Blake Gruszie, Kira Jang, Suzanne Lajoie, Shaun Malakoe, Ron Popoff, Diane Pustina, Doug Quibell, Jennifer Reid, Peter Richter, Troy Sampson, and Matthew Shumaker.

Abattoir-Industry Participants

We would like to thank the abattoir operators and the Canadian Food Inspection Agency's regional directors, inspection managers, and on-site staff, for their extensive voluntary participation in CIPARS *Abattoir Surveillance*.

Farm Surveillance Participants

We are grateful for the efforts and participation of the Alberta Ministry of Agriculture and Rural Development, as well as the sentinel-swine veterinarians and the producers who participated in *Farm Surveillance* by providing data and enabling collection of samples for bacterial culture.

Provincial Animal Health Laboratories

We gratefully acknowledge the provincial animal health laboratories for their longstanding support and for providing data and bacterial isolates for CIPARS.

- Animal Health Centre, British Columbia Ministry of Agriculture and Lands (Sean Byrne)
- Government of Alberta, Agriculture and Rural Development (Rashed Cassis)
- Saskatchewan Health, Saskatchewan (Paul Levett)
- Veterinary Services Branch Laboratory, Manitoba (Neil Pople)
- The Animal Health Laboratory, University of Guelph, Ontario (Durda Slavic)
- IDEXX Laboratories, Ontario (Hani Dick)
- Direction des laboratoires d'expertises du Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (Marie Nadeau)
- Provincial Veterinary Laboratory, Department of Agriculture, Fisheries, and Aquaculture, New Brunswick (Jim Goltz)
- Veterinary Pathology Laboratory, Nova Scotia (Grant J. Spearman)
- Diagnostic Services, Atlantic Veterinary College, Prince Edward Island (Jan Giles)

Other Participants

We gratefully acknowledge the efforts of field workers, laboratory technicians, and data managers for their contributions. The careful collection of samples, processing of isolates, and recording of results are essential to the ongoing success of CIPARS.

We are grateful to the US National Antimicrobial Resistance Monitoring System for sharing information and facilitating harmonization with CIPARS.

We would also like to thank the following individuals and organizations for their contribution to CIPARS 2011.

Public Health Agency of Canada

Ashleigh Andrysiak
Louise Bellai
Mark Blenkinsop
Manon Caron
Gail Christie
Sindy Cleary
Ann-Marie Cochrane
Denise Coleman
Marie-Claude Deshaies
Claudia Dulgheru
Georges Golding
Betul Gundogmus
Stefan Iwasawa
Nicol Janecko
Bernard Jackson
Mohamed Karmali
Ora Kendall
Lisa Landry
Stacie Langner
Laura Martin
Sarah Matz
Ryan McKarron
Ketna Mistry
Ali Moterassed
Manuel Navas
Linda Nedd-Gbedemah
Derek Ozunk
Ann Perets
Peter Pontbriand
Frank Plummer
Frank Pollari
Mark Raizenne
Susan Read
Tamara Reitsma
Julie Roy
Diane Sanjenko
Sarah Sanjenko
Sophia Sheriff
Chris de Spiegelaere
Lien Mi Tien
Anatoliy Trokhymchuk
Rama Viswanathan
Victoria Weaver
Betty Wilkie
Magdalena Zietarska

Canadian Food Inspection Agency

Jane MacDonald
Daniel Leclair
Marina Steele
Ashwani Tiwari

Health Canada, Veterinary Drugs Directorate

Shiva Ghimire
Xian-Zhi Li
Manisha Mehrotra
Michel Ntemgwa

Other Organizations

Canadian Animal Health Institute
Canadian Meat Council
Canadian Pork Council
CIPARS Farm Swine Advisory Committee
IMS Health Canada, Inc.

Table of Contents

List of Figures

List of Tables

Preamble

About CIPARS

The Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) is pleased to present this short report on the prevalence and trends (temporal variations) in antimicrobial resistance in select bacterial species isolated from humans and the agri-food sector for the 2011 calendar year.[1] The CIPARS short reports replace preliminary reports, as the short reports now contain final data rather than preliminary, unless otherwise specified.

CIPARS Objectives

- Provide a unified approach to monitor trends in antimicrobial resistance and antimicrobial use in humans and animals.
- Disseminate timely surveillance data.
- Facilitate assessment of the public health impact of antimicrobials used in humans and agricultural sectors.
- Allow accurate comparisons with data from other countries that use similar surveillance systems.

Surveillance of Human Clinical Isolates

The objective of the *Surveillance of Human Clinical Isolates* component of CIPARS is to provide a representative and methodologically unified approach to monitor temporal variations in the prevalence of antimicrobial resistance in *Salmonella* isolated from humans at the provincial/territorial level. This component was established in 2002.

Hospital-based or private clinical laboratories culture human *Salmonella* isolates in Canada. Although reporting is mandatory through laboratory notification of reportable diseases to the National Notifiable Disease Reporting System, forwarding of *Salmonella* cultures to the Provincial Public Health Laboratories (PPHLs) is voluntary and passive. A high proportion[2] of *Salmonella* isolates are forwarded to the PPHLs, but this proportion may vary among laboratories.

To ensure a statistically valid sampling plan, all human *Salmonella* isolates (outbreak-associated and non-outbreak-associated) received by the PPHLs in Saskatchewan, Manitoba, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador were forwarded to the National Microbiology Laboratory. The PPHLs in more populated provinces (British Columbia, Alberta, Ontario, and Québec) forwarded only the isolates received from the 1st to the 15th of each month. However, all PPHLs forwarded all human isolates of *S*. Typhi to the National Microbiology Laboratory due to the organism's clinical importance. The Yukon, Northwest Territories, and Nunavut, which do not have a PPHL counterpart, forwarded their isolates to one of the existing PPHLs. For this reason, data for the 3 territories are included in the overall number of isolates from the PPHL to which the isolates were submitted, unless the Territory was specified.

As of 2010, the antimicrobial susceptibility testing protocol of the human clinical isolates was modified and now includes testing for only 8 specific *Salmonella* serovars: I 4,[5],12:i:-, Enteritidis, Heidelberg,

[1] Any additional isolates received after completion of this short report and included in the 2011 Annual report will be highlighted.

[2] Report of the 2001 Canadian Laboratory Study, National Studies on Acute Gastrointestinal Illness, Division of Enteric, Foodborne and Waterborne Diseases, 2002.

Newport,[1] Paratyphi A, Paratyphi B, Typhi, and Typhimurium. For the more populated provinces (British Columbia, Alberta, Ontario, and Québec) only half of the Enteritidis isolates submitted during the first 15 days of the month were tested because of the high number of isolates submitted by their PPHLs. All other *Salmonella* serovars were stored and will be available for testing in the event of any future public health concerns.

Retail Meat Surveillance **(beef, chicken, and pork)**

The objectives of the CIPARS *Retail Meat Surveillance* component are to provide data on antimicrobial resistance and to monitor temporal variations in the prevalence of resistance among selected bacteria found in raw meat at the provincial/region level. *Retail Meat Surveillance* began in 2003 in Ontario and Québec, followed by establishment of routine retail sampling activities in other provinces as resources became available (Saskatchewan in 2005, British Columbia in 2007, and the Maritimes in 2008, a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island). Retail food represents a logical sampling point for surveillance of antimicrobial resistance because it is the endpoint of food animal production, and thus is indicative of human exposure. Retail surveillance provides a measure of human exposure to antimicrobial-resistant bacteria through consumption of meat products from selected commodities. The scope of the surveillance framework can be modified (e.g. food commodities, bacteria, or geographic region) as necessary and functions as a research platform for investigation of specific questions regarding antimicrobial resistance in the agri-food sector.

The commodities of interest for this component were raw meat products most commonly consumed by Canadians. These commodities and the products sampled included poultry (chicken legs or wings [skin on]), pork (chops), and beef (ground beef). The unit of analysis in *Retail Meat Surveillance* was the bacterial isolate recovered from raw meat. Bacteria of interest in chicken were *Campylobacter*, *Salmonella*, and generic *Escherichia coli*. As of January 1, 2010, no attempt has been made to isolate *Enterococcus* from retail-level chicken samples as no vancomycin-resistant enterococci, which are strains of particular public health concern, have been detected in retail isolates since CIPARS began. From beef and pork, only *E. coli* was cultured and then tested for antimicrobial susceptibility given the low prevalence of *Campylobacter* and *Salmonella* in these commodities at the retail level, as determined during the early phases of the program. *Salmonella* was isolated from pork, primarily to provide recovery estimates for this commodity for other Public Health Agency of Canada programs. These *Salmonella* strains were also submitted for antimicrobial susceptibility testing; however, given the low numbers recovered annually, results are not presented on an annual basis. Instead, those results have been pooled and are presented over a multi-year period[2] in the interest of precision.

The sampling protocol primarily involved continuous weekly submission of samples of retail meat from randomly selected geographic areas (i.e. census divisions defined by Statistics Canada), weighted by population, in each participating province/region. In 2011, retail meat samples were ideally collected on a weekly basis in Ontario and Québec and bi-weekly in British Columbia, Saskatchewan, and the Maritimes. Prevalence estimates were used to determine the number of samples to be collected, which was based on an expected yield of 100 isolates per commodity per province/region per year plus 20% to account for lost or damaged samples. Because sampling was less frequent in British Columbia, Saskatchewan, and the Maritimes relative to sampling in Ontario and Québec, the target of 100 isolates per year may not have always been achieved in those provinces/region.

Abattoir Surveillance **(beef cattle, chickens, and pigs)**

The objectives of the CIPARS *Abattoir Surveillance* component are to provide nationally representative, annual antimicrobial resistance data for bacteria isolated from animals as they entered the food supply

[1] The antimicrobial susceptibility testing protocol of the human clinical isolates was modified in 2010 and now includes Newport isolates.

[2] Data from 2003-2008, 2008 CIPARS Annual Report.

and to monitor temporal variations in the prevalence of antimicrobial resistance in these bacteria. *Abattoir Surveillance* includes only animals that originated from premises within Canada.

For this component, the unit of analysis was the bacterial isolate, each of which was cultured from the caecal contents (not carcasses) of slaughtered food animals. Caecal contents were used to avoid misinterpretation related to cross-contamination and to better reflect antimicrobial resistance in bacteria that originated from the farm. Established in September 2002, this component initially targeted generic *Escherichia coli* and *Salmonella* from the meat commodities with the highest per capita consumption: beef cattle, broiler chickens, and pigs. In 2003, the component was refined to discontinue *Salmonella* isolation from beef cattle because of the low prevalence of *Salmonella* in that population. *Campylobacter* surveillance was initiated in beef cattle in late 2005 to include a human pathogen in beef cattle surveillance and, following the approval of a fluoroquinolone for use in cattle, to provide information on fluoroquinolone resistance. *Campylobacter* surveillance was initiated in broiler chickens in 2010 out of concern about fluoroquinolone and ceftiofur resistance in isolates previously recovered from chicken through CIPARS *Retail Meat Surveillance*. The sampling method was designed with the goal that, across Canada, 100 isolates of *Campylobacter* and 150 isolates each of *Salmonella* and *E. coli* would be recovered from each animal species over a 12-month period to avoid any potential seasonal bias in bacteria prevalence and antimicrobial susceptibility.

Over 90% of all food-producing animals in Canada are slaughtered in federally inspected abattoirs annually. Forty-two federally inspected slaughter plants (6 beef cattle plants, 24 poultry plants, and 12 swine plants) from across Canada participated in 2011.

Farm Surveillance **(pigs)**

The objectives of the CIPARS *Farm Surveillance* component are to provide data on antimicrobial use and resistance, monitor temporal variations in the prevalence of antimicrobial resistance, investigate associations between antimicrobial use and resistance in isolates from swine farms, and provide data for human-health risk assessments.

This initiative is based on a sentinel farm framework that provides herd-level data on antimicrobial use and pooled fecal samples collected from pens of grower-finisher pigs for bacterial isolation and antimicrobial susceptibility testing. For this component, the unit of analysis for the antimicrobial resistance data was the bacterial isolate. These data were adjusted for clustering at the herd-level. The bacteria of interest were *Salmonella* and generic *Escherichia coli*. Recovery of *Enterococcus* isolates from farm samples was discontinued in 2011. This was decision was taken because no vancomycin-resistant enterococci have been ever been detected in the farm samples and this modification makes the farm program consistent with the other CIPARS components with regard to Enterococcus isolation.

In 2006, the CIPARS *Farm Surveillance* component was implemented in swine herds across the 5 major pork-producing provinces of Canada (Alberta, Saskatchewan, Manitoba, Ontario, and Québec). The swine industry was selected as the pilot commodity for development of the surveillance infrastructure because the Canadian Quality Assurance (CQA®) program had been extensively implemented by the industry, there had not been a recent outbreak of foreign animal disease in pigs, and there was a similar initiative in swine in the United States (Collaboration in Animal Health and Food Safety Epidemiology).

In 2011, 23 swine veterinarians enrolled 96 client producers with CQA® validated operations that produced more than 2,000 market pigs per year, and were representative of the demographic and geographic distribution of herds in the veterinarian's swine practice. Criteria for exclusion were as follow: herds regarded as organically raised, herds in which edible residual material was fed, or herds that were raised on pasture. These criteria helped ensure that the herds enrolled were representative of the majority of swine operations in Canada. In each of the participating provinces, the number of CIPARS sentinel sites was proportional to the national total of grower-finisher units. An exception was Alberta, where additional herds were enrolled with provincial support.

Surveillance of Animal Clinical Isolates (cattle, chickens, pigs, turkeys, and horses)

The objective of the CIPARS *Surveillance of Animal Clinical Isolates* component is to detect emerging antimicrobial resistance patterns as well as new serovar/resistance pattern combinations in *Salmonella*. This component of CIPARS is based on submissions from veterinarians or producers to veterinary diagnostic laboratories. Sample collection and submission practices, as well as *Salmonella* isolation protocols, vary among laboratories.

Salmonella isolates were sent by private veterinary and provincial animal health laboratories from across the country to the *Salmonella* Typing Laboratory at the Laboratory for Foodborne Zoonoses (LFZ), Guelph, Ontario. An exception was Québec, where isolates from animal health laboratories were sent to the Direction des laboratoires d'expertises du Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec, Saint-Hyacinthe for serotyping. Isolates and serotyping results from Québec were then forwarded to the LFZ to undergo phage typing and antimicrobial susceptibility testing.

Unlike the *Surveillance of Human Clinical Isolates* component, the proportion of *Salmonella* isolates forwarded to the LFZ from private and provincial animal health laboratories was not determined by a national sampling scheme and therefore varied within and between provinces. As well, isolates were not solely of clinical origin; some may also have been collected from animal feed, the animal's environment, or non-diseased animals from the same herd. The results for cattle, chickens, pigs, turkeys, and horses are reported in this report. Cattle isolates could have originated from dairy cattle, milk-fed or grain-fed veal, or beef cattle. Chicken isolates were largely from layer hens and broiler chickens, but may have originated from primary layer breeders or broiler breeder birds as well.

Feed and Feed Ingredients

Data from the *Feed and Feed Ingredients* component of CIPARS were obtained from various sources, including monitoring programs of the CFIA and provincial authorities. Information on specimen collection methods was only available for the CFIA monitoring programs.

The CFIA collects samples of animal feed under 2 different programs: Program 15A (Monitoring Inspection – *Salmonella*) and Program 15E (Directed Inspection – *Salmonella*). Under Program 15A, feeds produced at feed mills, rendering facilities, ingredient manufacturers, and on-farm facilities are sampled and tested for *Salmonella*. Although this program makes use of a random sampling process, extra attention is paid to feeds that are more likely to have a higher degree of *Salmonella* contamination, such as those that contain rendered animal products, oilseed meals, fishmeals, grains, and mashes. Program 15E targets feeds or ingredients from establishments that (i) produce rendered animal products, other feeds containing ingredients in which *Salmonella* could be a concern (e.g. oilseed meal or fishmeal), or a significant volume of poultry feed; (ii) are known to have repeated problems with *Salmonella* contamination; or (iii) have identified a *Salmonella* serovar that is highly pathogenic (e.g. Typhimurium, Enteritidis, or Newport). Program 15E is a targeted program; samples are not randomly selected.

What's New in 2011

Changes to CIPARS Antimicrobial Resistance Surveillance Component

- Bacterial culture and antimicrobial susceptibility testing of *Enterococcus* isolates from *Farm Surveillance* in pigs was discontinued as of January 1, 2011. Antimicrobial resistance surveillance of this bacterial species at the farm level may be reintroduced at a later date.

Methodological Changes

- In 2011, a new Enterobacteriaceae plate, CMV2AGNF,[1] replaced the CMV1AGNF plate. This new plate now includes azithromycin (Category II) in the panel and excludes amikacin (Category II).
- Upcoming in the 2011 Annual Report: Adoption of the new CLSI[2] breakpoint of ≥ 1 µg/mL for ciprofloxacin resistance in *Salmonella* and *E. coli* isolates. The decision by CIPARS to expand the breakpoint change to other *Salmonella* serovars and to *E. coli* was based upon the desire to keep the breakpoints harmonized across the Enterobacteriaceae we monitor, due to their close biological similarities and ease of sharing of resistance genes. Specifically for *E. coli*, using the same breakpoint reinforces its role as a commensal indicator of the pool of resistance genes available for exchange with more pathogenic organisms. Furthermore, the ciprofloxacin breakpoints were the same in the past for both genera (at ≥ 4 µg/mL); keeping them the same but now at ≥ 1 µg/mL maintains the precedence previously set. Some comparative highlights between the new ≥ 1 µg/mL breakpoint with the ≥ 4 µg/mL breakpoint used in this short report will be presented in the 2011 Annual Report.

Important Notes

Antimicrobial Groupings

- Category of importance in human medicine: Antimicrobials were categorized on the basis of importance in human medicine (Veterinary Drugs Directorate, Health Canada; categories revised in April 2009).[3]

Additional Notes

- Additional human and animal clinical isolates might be tested after the publication of this report. In this case, updated results will be presented in the 2011 Annual Report.
- *Surveillance of Animal Clinical Isolates* and antimicrobial resistance figures: Confidence intervals are not displayed for this component because samples are not obtained randomly and may not represent independent observations. Therefore, the results may not reflect true prevalence of antimicrobial resistance, but can be used to highlight the occurrence of emerging resistance.

[1] http://www.trekds.com/products/sensititre/vet_pltformats.asp
[2] Clinical Laboratory Standards Institute (CLSI) M100-S22. For reporting *S.* Typhi and extraintestinal *Salmonella* spp. only.
[3] http://www.hc-sc.gc.ca/dhp-mps/consultation/vet/consultations/amr_ram_hum-med-rev-eng.php

Antimicrobial Resistance

Humans

Salmonella I 4,[5],12:i:-

(n = 104)

Table 1. Resistance to antimicrobials in *Salmonella* I 4,[5],12:i:- isolates; *Surveillance of Human Clinical Isolates*, 2011.

	Antimicrobial	Number (%) of isolates resistant										Canada[a]
		BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL	
		n = 8	n = 17	n = 13	n = 12	n = 23	n = 21	n = 3	n = 7	n = 0	n = 0	%
I	Amoxicillin-clavulanic acid	2 (25)	1 (6)	1 (8)	2 (17)	4 (17)	0 (0)	0 (0)	2 (29)			11
	Ceftiofur	2 (25)	1 (6)	1 (8)	2 (17)	4 (17)	0 (0)	0 (0)	2 (29)			11
	Ceftriaxone	2 (25)	1 (6)	1 (8)	2 (17)	4 (17)	0 (0)	0 (0)	2 (29)			11
	Ciprofloxacin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0
II	Ampicillin	5 (63)	3 (18)	3 (23)	3 (25)	10 (43)	10 (48)	1 (33)	3 (43)			38
	Azithromycin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0
	Cefoxitin	2 (25)	1 (6)	1 (8)	2 (17)	4 (17)	0 (0)	0 (0)	2 (29)			11
	Gentamicin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0
	Kanamycin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (10)	0 (0)	0 (0)			2
	Nalidixic acid	1 (13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			1
	Streptomycin	1 (13)	2 (12)	1 (8)	1 (8)	6 (26)	11 (52)	1 (33)	1 (14)			25
	Trimethoprim-sulfamethoxazole	1 (13)	1 (6)	0 (0)	0 (0)	0 (0)	1 (5)	0 (0)	0 (0)			3
III	Chloramphenicol	1 (13)	1 (6)	0 (0)	0 (0)	0 (0)	2 (10)	0 (0)	0 (0)			5
	Sulfisoxazole	1 (13)	3 (18)	1 (8)	0 (0)	6 (26)	11 (52)	1 (33)	1 (14)			26
	Tetracycline	5 (63)	10 (59)	3 (23)	0 (0)	7 (30)	11 (52)	1 (33)	1 (14)			41
IV												

Roman numerals I to IV indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.
Provincial abbreviations are defined in the Appendix.
No *Salmonella* I 4,[5],12:i:- isolates were received from Prince Edward Island or Newfoundland.
[a] Estimated percentages for Canada have been corrected for non-proportional submission protocols among provinces (see Appendix A of the 2008 CIPARS Annual Report).

Salmonella Enteritidis

(n = 951)

Table 2. Resistance to antimicrobials in *Salmonella* Enteritidis isolates; *Surveillance of Human Clinical Isolates*, 2011.

	Antimicrobial	Number (%) of isolates resistant										Canada[a]
		BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL	
		n = 155	n = 130	n = 69	n = 73	n = 236	n = 109	n = 48	n = 92	n = 15	n = 24	%
I	Amoxicillin-clavulanic acid	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	< 1
	Ceftiofur	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	< 1
	Ceftriaxone	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	< 1
	Ciprofloxacin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
II	Ampicillin	7 (5)	5 (4)	4 (6)	2 (3)	6 (3)	7 (6)	2 (4)	2 (2)	0 (0)	0 (0)	4
	Azithromycin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	Cefoxitin	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	1 (1)	0 (0)	0 (0)	< 1
	Gentamicin	2 (1)	0 (0)	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	< 1
	Kanamycin	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)	2 (2)	0 (0)	0 (0)	0 (0)	0 (0)	< 1
	Nalidixic acid	21 (14)	8 (6)	4 (6)	7 (10)	50 (21)	27 (25)	8 (17)	14 (15)	3 (20)	4 (17)	16
	Streptomycin	2 (1)	3 (2)	2 (3)	2 (3)	3 (1)	5 (5)	1 (2)	1 (1)	0 (0)	0 (0)	2
	Trimethoprim-sulfamethoxazole	0 (0)	1 (1)	1 (1)	1 (1)	5 (2)	6 (6)	2 (4)	3 (3)	0 (0)	0 (0)	2
III	Chloramphenicol	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	2 (2)	0 (0)	1 (1)	0 (0)	0 (0)	< 1
	Sulfisoxazole	2 (1)	4 (3)	3 (4)	3 (4)	6 (3)	10 (9)	2 (4)	4 (4)	0 (0)	0 (0)	4
	Tetracycline	2 (1)	6 (5)	3 (4)	3 (4)	10 (4)	8 (7)	2 (4)	5 (5)	0 (0)	1 (4)	4
IV												

Roman numerals I to IV indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.
Provincial abbreviations are defined in the Appendix.

[a] Estimated percentages for Canada have been corrected for non-proportional submission protocols among provinces. For BC, AB, ON and QC only half of the S. Enteritidis isolates submitted during the first 15 days of the month were tested due to the high number of isolates submitted by their provincial public health laboratories.

Salmonella Heidelberg

(n = 382)

Table 3. Resistance to antimicrobials in *Salmonella* Heidelberg isolates; *Surveillance of Human Clinical Isolates*, 2011.

	Antimicrobial	Number (%) of isolates resistant										Canada[a]
		BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL	
		n = 17	n = 25	n = 11	n = 25	n = 140	n = 84	n = 43	n = 21	n = 1	n = 15	%
I	Amoxicillin-clavulanic acid	2 (12)	7 (28)	6 (55)	7 (28)	49 (35)	30 (36)	11 (26)	6 (29)	0 (0)	8 (53)	33
	Ceftiofur	2 (12)	7 (28)	6 (55)	7 (28)	49 (35)	30 (36)	11 (26)	6 (29)	0 (0)	8 (53)	33
	Ceftriaxone	2 (12)	7 (28)	6 (55)	7 (28)	49 (35)	30 (36)	11 (26)	6 (29)	0 (0)	8 (53)	33
	Ciprofloxacin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
II	Ampicillin	4 (24)	11 (44)	8 (73)	11 (44)	61 (44)	31 (37)	13 (30)	8 (38)	0 (0)	8 (53)	40
	Azithromycin	0 (0)	0 (0)	0 (0)	1 (4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	< 1
	Cefoxitin	2 (12)	7 (28)	6 (55)	7 (28)	49 (35)	30 (36)	11 (26)	6 (29)	0 (0)	8 (53)	33
	Gentamicin	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)	2 (2)	1 (2)	0 (0)	0 (0)	0 (0)	1
	Kanamycin	0 (0)	0 (0)	1 (9)	0 (0)	1 (1)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	< 1
	Nalidixic acid	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	Streptomycin	1 (6)	2 (8)	1 (9)	2 (8)	4 (3)	5 (6)	1 (2)	1 (5)	0 (0)	0 (0)	4
	Trimethoprim-sulfamethoxazole	0 (0)	0 (0)	0 (0)	1 (4)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	< 1
III	Chloramphenicol	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	< 1
	Sulfisoxazole	0 (0)	0 (0)	1 (9)	1 (4)	3 (2)	5 (6)	1 (2)	0 (0)	0 (0)	0 (0)	3
	Tetracycline	0 (0)	0 (0)	1 (9)	0 (0)	2 (1)	3 (4)	0 (0)	0 (0)	0 (0)	0 (0)	2
IV												

Roman numerals I to IV indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.
Provincial abbreviations are defined in the Appendix.

[a] Estimated percentages for Canada have been corrected for non-proportional submission protocols among provinces (see Appendix A of the 2008 CIPARS Annual Report).

Salmonella Newport

(n = 188)

Table 4. Resistance to antimicrobials in *Salmonella* Newport isolates; *Surveillance of Human Clinical Isolates*, 2011.

	Antimicrobial	Number (%) of isolates resistant										Canada
		BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL	
		n = 14	n = 20	n = 2	n = 3	n = 101	n = 44	n = 2	n = 0	n = 0	n = 2	%
I	Amoxicillin-clavulanic acid	3 (21)	3 (15)	0 (0)	0 (0)	3 (3)	4 (9)	0 (0)			0 (0)	7
	Ceftiofur	3 (21)	3 (15)	0 (0)	0 (0)	3 (3)	4 (9)	0 (0)			0 (0)	7
	Ceftriaxone	3 (21)	3 (15)	0 (0)	0 (0)	3 (3)	4 (9)	0 (0)			0 (0)	7
	Ciprofloxacin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0 (0)	0
II	Ampicillin	3 (21)	3 (15)	0 (0)	0 (0)	3 (3)	5 (11)	0 (0)			0 (0)	8
	Azithromycin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0 (0)	0
	Cefoxitin	3 (21)	3 (15)	0 (0)	0 (0)	3 (3)	4 (9)	0 (0)			0 (0)	7
	Gentamicin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0 (0)	0
	Kanamycin	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	3 (7)	0 (0)			0 (0)	2
	Nalidixic acid	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0 (0)	0
	Streptomycin	2 (14)	4 (20)	0 (0)	0 (0)	3 (3)	4 (9)	0 (0)			0 (0)	7
	Trimethoprim-sulfamethoxazole	1 (7)	2 (10)	0 (0)	0 (0)	2 (2)	3 (7)	0 (0)			0 (0)	4
III	Chloramphenicol	2 (14)	3 (15)	0 (0)	0 (0)	3 (3)	4 (9)	0 (0)			0 (0)	7
	Sulfisoxazole	3 (21)	4 (20)	0 (0)	0 (0)	6 (6)	4 (9)	0 (0)			0 (0)	9
	Tetracycline	3 (21)	4 (20)	0 (0)	0 (0)	7 (7)	4 (9)	0 (0)			0 (0)	10
IV												

Roman numerals I to IV indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.
Provincial abbreviations are defined in the Appendix.
No *S*. Newport isolates were received from Nova Scotia or Prince Edward Island.

Salmonella Paratyphi A and Paratyphi B

(n = 12)

Table 5. Resistance to antimicrobials in *Salmonella* Paratyphi A and B isolates; *Surveillance of Human Clinical Isolates*, 2011.

	Antimicrobial	Number (%) of isolates resistant										Canada[a]
		BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL	
		n = 1	n = 0	n = 1	n = 3	n = 3	n = 2	n = 1	n = 1	n = 0	n = 0	%
I	Amoxicillin-clavulanic acid	0 (0)		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0
	Ceftiofur	0 (0)		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0
	Ceftriaxone	0 (0)		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0
	Ciprofloxacin	0 (0)		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0
II	Ampicillin	0 (0)		0 (0)	1 (33)	0 (0)	0 (0)	0 (0)	0 (0)			6
	Azithromycin	0 (0)		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0
	Cefoxitin	0 (0)		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0
	Gentamicin	0 (0)		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0
	Kanamycin	0 (0)		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0
	Nalidixic acid	1 (100)		0 (0)	1 (33)	2 (67)	0 (0)	0 (0)	1 (100)			44
	Streptomycin	0 (0)		0 (0)	1 (33)	0 (0)	0 (0)	0 (0)	0 (0)			6
	Trimethoprim-sulfamethoxazole	0 (0)		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)			0
III	Chloramphenicol	0 (0)		0 (0)	1 (33)	0 (0)	0 (0)	0 (0)	0 (0)			6
	Sulfisoxazole	0 (0)		0 (0)	1 (33)	0 (0)	0 (0)	0 (0)	0 (0)			6
	Tetracycline	0 (0)		0 (0)	1 (33)	0 (0)	0 (0)	0 (0)	0 (0)			6
IV												

Roman numerals I to IV indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.
Provincial abbreviations are defined in the Appendix.
Salmonella Paratyphi B does not include *S*. Paratyphi B var. L (+) tartrate+, formerly called *S*. Paratyphi var. Java. The biotype of *S*. Paratyphi B included here is tartrate- and associated with severe typhoid-like fever. *Salmonella* Paratyphi B var. L (+) tartrate+ is commonly associated with gastrointestinal illness.
No *S*. Paratyphi A and B isolates were received from Alberta, Newfoundland and Labrador, or Prince Edward Island.

[a] Estimated percentages for Canada have been corrected for non-proportional submission protocols among provinces (see Appendix A of the 2008 CIPARS Annual Report).

Salmonella Typhi

(n = 196)

Table 6. Resistance to antimicrobials in *Salmonella* Typhi isolates; *Surveillance of Human Clinical Isolates*, 2011.

	Antimicrobial	Number (%) of isolates resistant									Canada
		BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL	
		n = 45	n = 13	n = 3	n = 11	n = 103	n = 18	n = 0	n = 0	n = 0	n = 3	%
I	Amoxicillin-clavulanic acid	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)				0 (0)	< 1
	Ceftiofur	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)				0 (0)	< 1
	Ceftriaxone	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)				0 (0)	0
	Ciprofloxacin	0 (0)	0 (0)	0 (0)	0 (0)	4 (4)	0 (0)				0 (0)	2
II	Ampicillin	8 (18)	4 (31)	2 (67)	2 (18)	31 (30)	3 (17)				2 (67)	26
	Azithromycin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)				0 (0)	0
	Cefoxitin	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)				0 (0)	< 1
	Gentamicin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)				0 (0)	0
	Kanamycin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)				0 (0)	0
	Nalidixic acid	40 (89)	13 (100)	3 (100)	0 (0)	93 (90)	9 (50)				1 (33)	84
	Streptomycin	8 (18)	5 (38)	2 (67)	2 (18)	29 (28)	2 (11)				2 (67)	25
	Trimethoprim-sulfamethoxazole	8 (18)	4 (31)	2 (67)	2 (18)	33 (32)	3 (17)				2 (67)	27
III	Chloramphenicol	8 (18)	4 (31)	2 (67)	2 (18)	33 (32)	3 (17)				2 (67)	27
	Sulfisoxazole	8 (18)	4 (31)	2 (67)	2 (18)	33 (32)	3 (17)				2 (67)	27
	Tetracycline	1 (2)	0 (0)	0 (0)	0 (0)	2 (2)	1 (6)				1 (33)	2
IV												

Roman numerals I to IV indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.
Provincial abbreviations are defined in the Appendix.
No *S.* Typhi isolates were received from New Brunswick, Nova Scotia, or Prince Edward Island.

Salmonella Typhimurium

(n = 364)

Table 7. Resistance to antimicrobials in *Salmonella* Typhimurium isolates; *Surveillance of Human Clinical Isolates*, 2011.

	Antimicrobial	Number (%) of isolates resistant										Canada[a]
		BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL	
		n = 27	n = 39	n = 23	n = 20	n = 157	n = 68	n = 16	n = 7	n = 0	n = 7	%
I	Amoxicillin-clavulanic acid	1 (4)	2 (5)	0 (0)	4 (20)	1 (1)	2 (3)	0 (0)	0 (0)		0 (0)	2
	Ceftiofur	1 (4)	2 (5)	0 (0)	4 (20)	1 (1)	2 (3)	0 (0)	0 (0)		0 (0)	2
	Ceftriaxone	1 (4)	2 (5)	0 (0)	4 (20)	1 (1)	2 (3)	0 (0)	0 (0)		0 (0)	2
	Ciprofloxacin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)		0 (0)	0
II	Ampicillin	11 (41)	12 (31)	3 (13)	9 (45)	29 (18)	19 (28)	1 (6)	1 (14)		2 (29)	24
	Azithromycin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)		0 (0)	0
	Cefoxitin	1 (4)	2 (5)	0 (0)	4 (20)	1 (1)	2 (3)	0 (0)	0 (0)		0 (0)	2
	Gentamicin	1 (4)	1 (3)	1 (4)	2 (10)	2 (1)	1 (1)	0 (0)	0 (0)		0 (0)	2
	Kanamycin	3 (11)	14 (36)	1 (4)	0 (0)	9 (6)	9 (13)	0 (0)	0 (0)		1 (14)	11
	Nalidixic acid	2 (7)	2 (5)	0 (0)	3 (15)	4 (3)	2 (3)	0 (0)	1 (14)		0 (0)	4
	Streptomycin	11 (41)	14 (36)	5 (22)	10 (50)	36 (23)	21 (31)	0 (0)	1 (14)		2 (29)	28
	Trimethoprim-sulfamethoxazole	2 (7)	2 (5)	0 (0)	4 (20)	5 (3)	2 (3)	1 (6)	0 (0)		0 (0)	4
III	Chloramphenicol	11 (41)	6 (15)	3 (13)	8 (40)	27 (17)	12 (18)	1 (6)	1 (14)		2 (29)	19
	Sulfisoxazole	12 (44)	15 (38)	4 (17)	10 (50)	42 (27)	23 (34)	1 (6)	1 (14)		3 (43)	31
	Tetracycline	10 (37)	15 (38)	3 (13)	8 (40)	36 (23)	23 (34)	1 (6)	2 (29)		3 (43)	28
IV												

Roman numerals I to IV indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.
Provincial abbreviations are defined in the Appendix.
No *S.* Typhimurium isolates were received from Prince Edward Island.

[a] Estimated percentages for Canada have been corrected for non-proportional submission protocols among provinces (see Appendix A of the 2008 CIPARS Annual Report).

Table 8. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates; *Surveillance of Human Clinical Isolates*, 2011.

Province / serovar	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial													
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia																					
Enteritidis	155 (58.1)	132	16	5	2		2	2	2	7					2			1		21	2
Typhi	45 (16.9)	5	32		7	1			8	8					8	8		8		40	1
Typhimurium	27 (10.1)	14	1	1	11		1	3	11	11	1	1	1	1	12	2		11		2	10
Heidelberg	17 (6.4)	13	3	1					1	4	2	2	2	2							
Newport	14 (5.2)	9	3		2				2	3	3	3	3	3	3	1		2			3
I 4,[5],12:i:-	8 (3.0)	1	4	2		1			1	5	2	2	2	2	1	1		1		1	5
Paratyphi A and B	1 (0.4)		1																	1	
Total	**267 (100)**	**174**	**60**	**9**	**22**	**2**	**3**	**5**	**25**	**38**	**8**	**8**	**8**	**8**	**26**	**12**		**23**		**65**	**21**
Alberta																					
Enteritidis	130 (53.3)	117	7	3	3				3	5	1	1	1	1	4	1				8	6
Typhimurium	39 (16.0)	18	1	9	11		1	14	14	12	2	2	2	2	15	2		6		2	15
Heidelberg	25 (10.2)	14	9	2					2	11	7	7	7	7							
Newport	20 (8.2)	16		1	3				4	3	3	3	3	3	4	2		3			4
I 4,[5],12:i:-	17 (7.0)	6	8	1	2				2	3	1	1	1	1	3	1		1			10
Typhi	13 (5.3)		8	1	4				5	4					4	4		4		13	
Total	**244 (100)**	**171**	**33**	**17**	**23**		**1**	**14**	**30**	**38**	**14**	**14**	**14**	**14**	**30**	**10**		**14**		**23**	**35**
Saskatchewan																					
Enteritidis	69 (56.6)	62	4	1	2				2	4					3	1				4	3
Typhimurium	23 (18.9)	18	1	1	3		1	1	5	3					4			3			3
I 4,[5],12:i:-	13 (10.7)	8	4		1				1	3	1	1	1	1	1						3
Heidelberg	11 (9.0)	3	6	1	1			1	1	8	6	6	6	6	1						1
Typhi	3 (2.5)		1		2				2	2					2	2		2		3	
Newport	2 (1.6)	2																			
Paratyphi A and B	1 (0.8)	1																			
Total	**122 (100)**	**94**	**16**	**3**	**9**		**1**	**2**	**11**	**20**	**7**	**7**	**7**	**7**	**11**	**3**		**5**		**7**	**10**
Manitoba																					
Enteritidis	73 (49.7)	63	7	1	2				2	2					3	1				7	3
Heidelberg	25 (17)	14	8	3					2	11	7	7	7	7	1	1	1				
Typhimurium	20 (13.6)	9	1	2	5	3	2		10	9	4	4	4	4	10	4		8		3	8
I 4,[5],12:i:-	12 (8.2)	9	2	1					1	3	2	2	2	2							
Typhi	11 (7.5)		9		2				2	2					2	2		2		11	
Newport	3 (2.0)	3																			
Paratyphi A and B	3 (2.0)	1	1		1				1	1					1			1		1	1
Total	**147 (100)**	**99**	**28**	**7**	**10**	**3**	**2**		**18**	**28**	**13**	**13**	**13**	**13**	**17**	**8**	**1**	**11**		**22**	**12**
Ontario																					
Enteritidis	236 (30.9)	175	51	9	1		1		3	6					6	5				50	10
Typhimurium	157 (20.6)	111	4	13	28	1	2	9	36	29	1	1	1	1	42	5		27		4	36
Heidelberg	140 (18.3)	77	58	4	1		2	1	4	61	49	49	49	49	3	1		2			2
Typhi	103 (13.5)	10	59	2	32				29	31	1		1	1	33	33		33	4	93	2
Newport	101 (13.2)	94	1	3	3			1	3	3	3	3	3	3	6	2		3			7
I 4,[5],12:i:-	23 (3.0)	13	3	1	6				6	10	4	4	4	4	6						7
Paratyphi A and B	3 (0.4)	1	2																	2	
Total	**763 (100)**	**481**	**178**	**32**	**71**	**1**	**5**	**11**	**81**	**140**	**58**	**57**	**58**	**58**	**96**	**46**		**65**	**4**	**149**	**64**
Québec																					
Enteritidis	109 (31.5)	76	20	9	2	2		2	5	7	1	1	1	1	10	6		2		27	8
Heidelberg	84 (24.3)	48	30	6			2	1	5	31	30	30	30	30	5			1			3
Typhimurium	68 (19.7)	41	3	6	17	1	1	9	21	19	2	2	2	2	23	2		12		2	23
Newport	44 (12.7)	39	1		4			3	4	5	4	4	4	4	4	3		4			4
I 4,[5],12:i:-	21 (6.1)	9	1	2	9			2	11	10					11	1		2			11
Typhi	18 (5.2)	8	7		3				2	3					3	3		3		9	1
Paratyphi A and B	2 (0.6)	2																			
Total	**346 (100)**	**223**	**62**	**23**	**35**	**3**	**3**	**17**	**48**	**75**	**37**	**37**	**37**	**37**	**56**	**15**		**24**		**38**	**50**
New Brunswick																					
Enteritidis	48 (42.5)	38	8	1	1				1	2					2	2				8	2
Heidelberg	43 (38.1)	29	13	1			1		1	13	11	11	11	11	1						
Typhimurium	16 (14.2)	15			1					1					1	1		1			1
I 4,[5],12:i:-	3 (2.7)	2			1				1	1					1						1
Newport	2 (1.8)	2																			
Paratyphi A and B	1 (0.9)	1																			
Total	**113 (100)**	**87**	**21**	**2**	**3**		**1**		**3**	**17**	**11**	**11**	**11**	**11**	**5**	**3**		**1**		**8**	**4**

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.
Salmonella Paratyphi B does not include *S.* Paratyphi B var. L (+) tartrate+, formerly called *S*. Paratyphi var. Java. The biotype of *S.* Paratyphi B included here is tartrate (-) and is associated with severe typhoid-like fever. *Salmonella* Paratyphi B var. L (+) tartrate+ is commonly associated with gastrointestinal illness.

Table 8 (continued). Number of antimicrobial classes in resistance patterns of *Salmonella* isolates; *Surveillance of Human Clinical Isolates*, 2011.

Province / serovar	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial												
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones	Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Nova Scotia																					
Enteritidis	92 (69.2)	70	18	3	1				1	2			1		4	3		1		14	5
Heidelberg	21 (15.8)	12	9						1	8	6	6	6	6							
I 4,[5],12:i:-	7 (5.3)	4	2		1				1	3	2	2	2	2	1						1
Typhimurium	7 (5.3)	5	1			1			1	1					1			1		1	2
Newport	5 (3.8)	5																			
Paratyphi A and B	1 (0.8)		1																	1	
Total	**133 (100)**	**96**	**31**	**3**	**2**	**1**			**4**	**14**	**8**	**8**	**9**	**8**	**6**	**3**		**2**		**16**	**8**
Prince Edward Island																					
Enteritidis	15 (93.8)	12	3																	3	
Heidelberg	1 (6.3)	1																			
Total	**16 (100)**	**13**	**3**																	**3**	
Newfoundland and Labrador																					
Enteritidis	24 (47.1)	19	5																	4	1
Heidelberg	15 (29.4)	7	8							8	8	8	8	8							
Typhimurium	7 (13.7)	4		1	2			1	2	2					3			2			3
Typhi	3 (5.9)	1			2				2	2					2	2		2		1	1
Newport	2 (3.9)	2																			
Total	**51 (100)**	**33**	**13**	**1**	**4**			**1**	**4**	**12**	**8**	**8**	**8**	**8**	**5**	**2**		**4**		**5**	**5**

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.
Salmonella Paratyphi B does not include *S.* Paratyphi B var. L (+) tartrate+, formerly called *S*. Paratyphi var. Java. The biotype of *S.* Paratyphi B included here is tartrate (-) and is associated with severe typhoid-like fever. *Salmonella* Paratyphi B var. L (+) tartrate+ is commonly associated with gastrointestinal illness.

Figure 1. Temporal variation in resistance to selected antimicrobials in human *Salmonella* serovars; *Surveillance of Human Clinical Isolates*, 2003–2011.

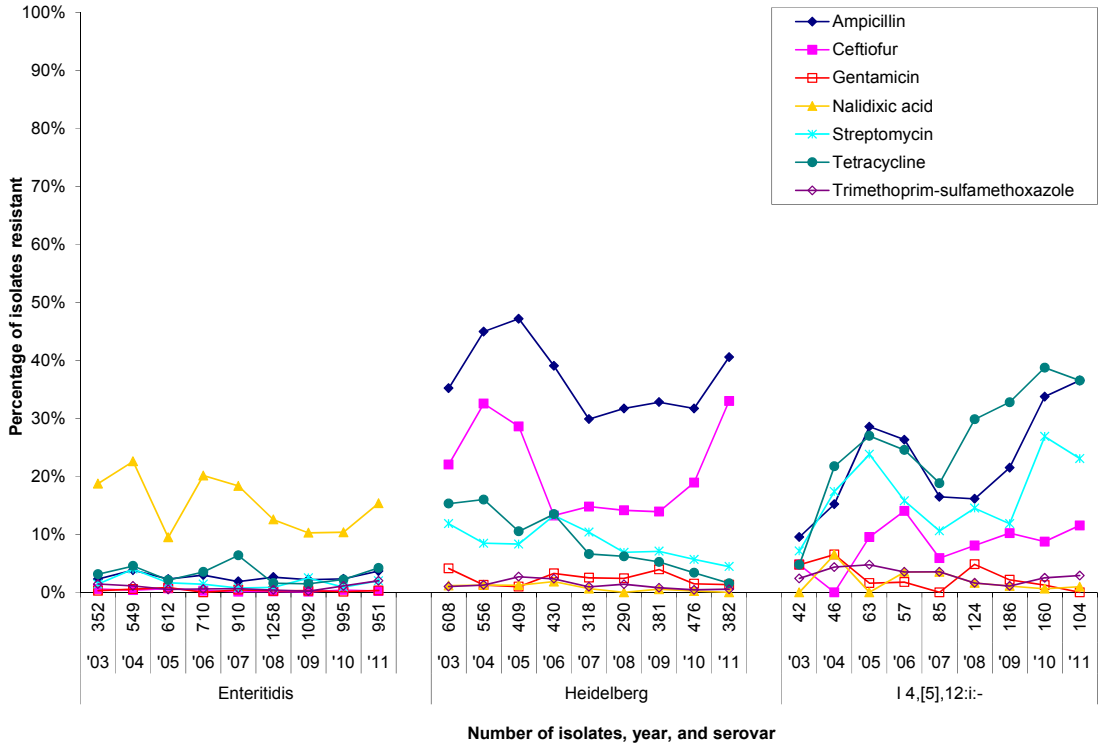
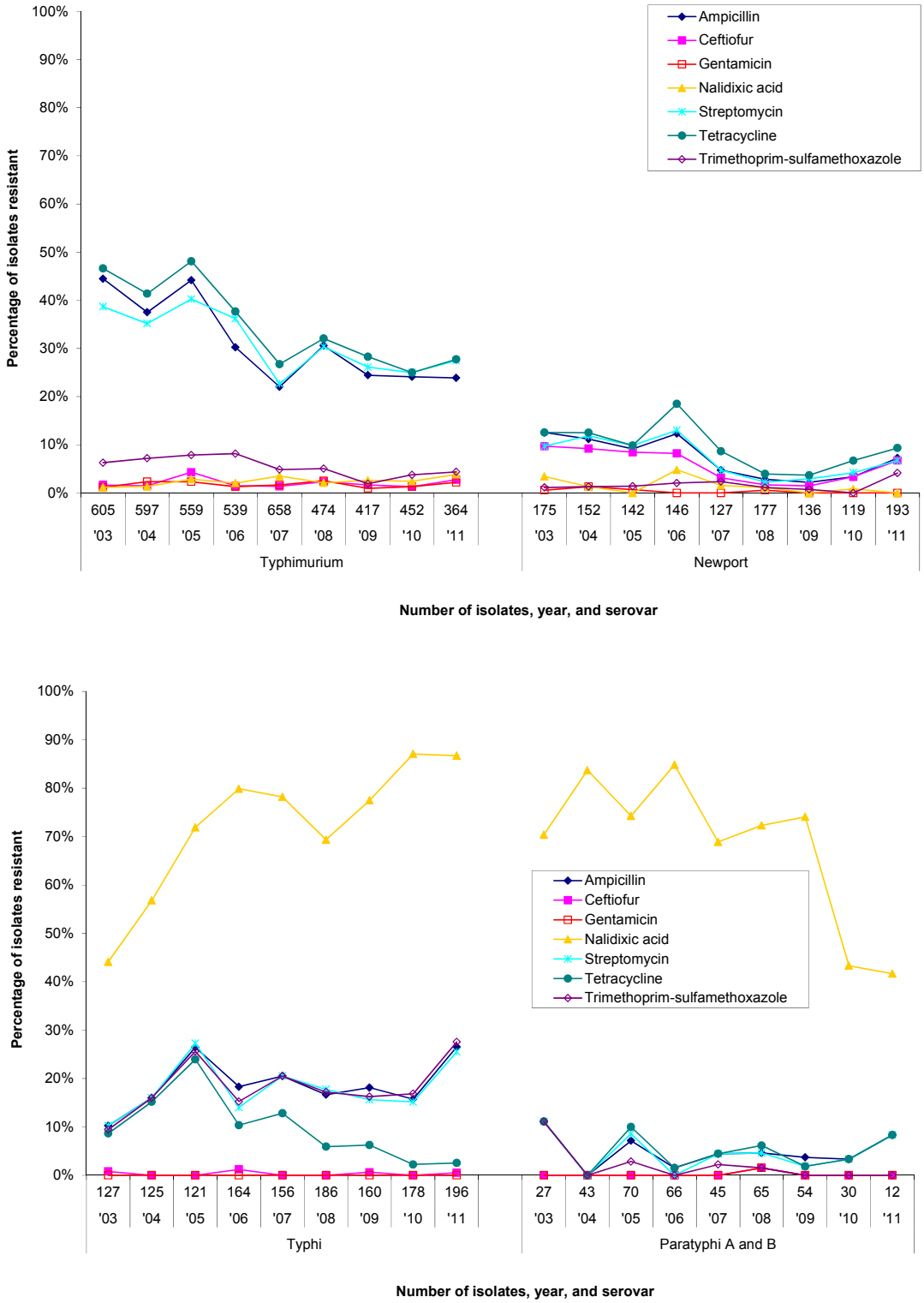


Figure 1 (continued). Temporal variation in resistance to selected antimicrobials in human *Salmonella* serovars; *Surveillance of Human Clinical Isolates*, 2003–2011.



Salmonella Paratyphi B does not include *S.* Paratyphi B var. L (+) tartrate+, formerly called *S.* Paratyphi var. Java. The biotype of *S.* Paratyphi B included here is tartrate (-) and is associated with severe typhoid-like fever. *Salmonella* Paratyphi B var. L (+) tartrate+ is commonly associated with gastrointestinal illness.

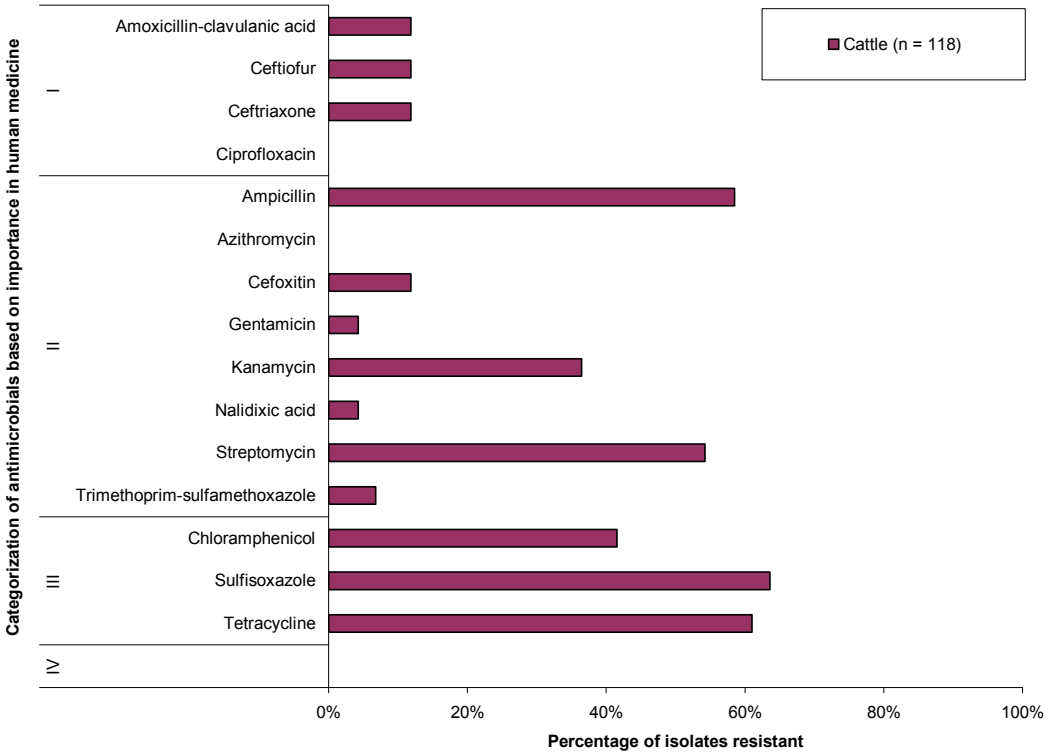
Beef Cattle

Salmonella

Surveillance of Animal Clinical Isolates

(n = 118)

Figure 2. Resistance to antimicrobials in *Salmonella* isolates from cattle; *Surveillance of Animal Clinical Isolates*, 2011.



Confidence intervals are not displayed for animal clinical data because samples were not obtained randomly and may not represent independent observations and true estimates of the prevalence.

Table 9. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from cattle; *Surveillance of Animal Clinical Isolates*, 2011.

Serovar	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial												
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Typhimurium var. 5-	43 (36.4)	5			38			31	35	38					38	1		21			38
Typhimurium	30 (25.4)	8	3	2	17			5	17	17	3	3	3	3	22	5		16			19
Dublin	7 (5.9)				5	2	1	1	7	6	6	6	6	6	7			7		2	7
I 4,[5],12:i:-	5 (4.2)	4			1			1	1	1					1						1
Enteritidis	4 (3.4)				1	3	3	4	1	4	4	4	4	4	4			4		3	4
I 6,14,18:-:-	4 (3.4)	4																			
Thompson	4 (3.4)	4																			
Uganda	3 (2.5)	3																			
Less common serovars	18 (15.3)	14	1	1	2		1	1	3	3	1	1	1	1	3	2		1			3
Total	**118 (100)**	**42**	**4**	**3**	**64**	**5**	**5**	**43**	**64**	**69**	**14**	**14**	**14**	**14**	**75**	**8**		**49**		**5**	**72**

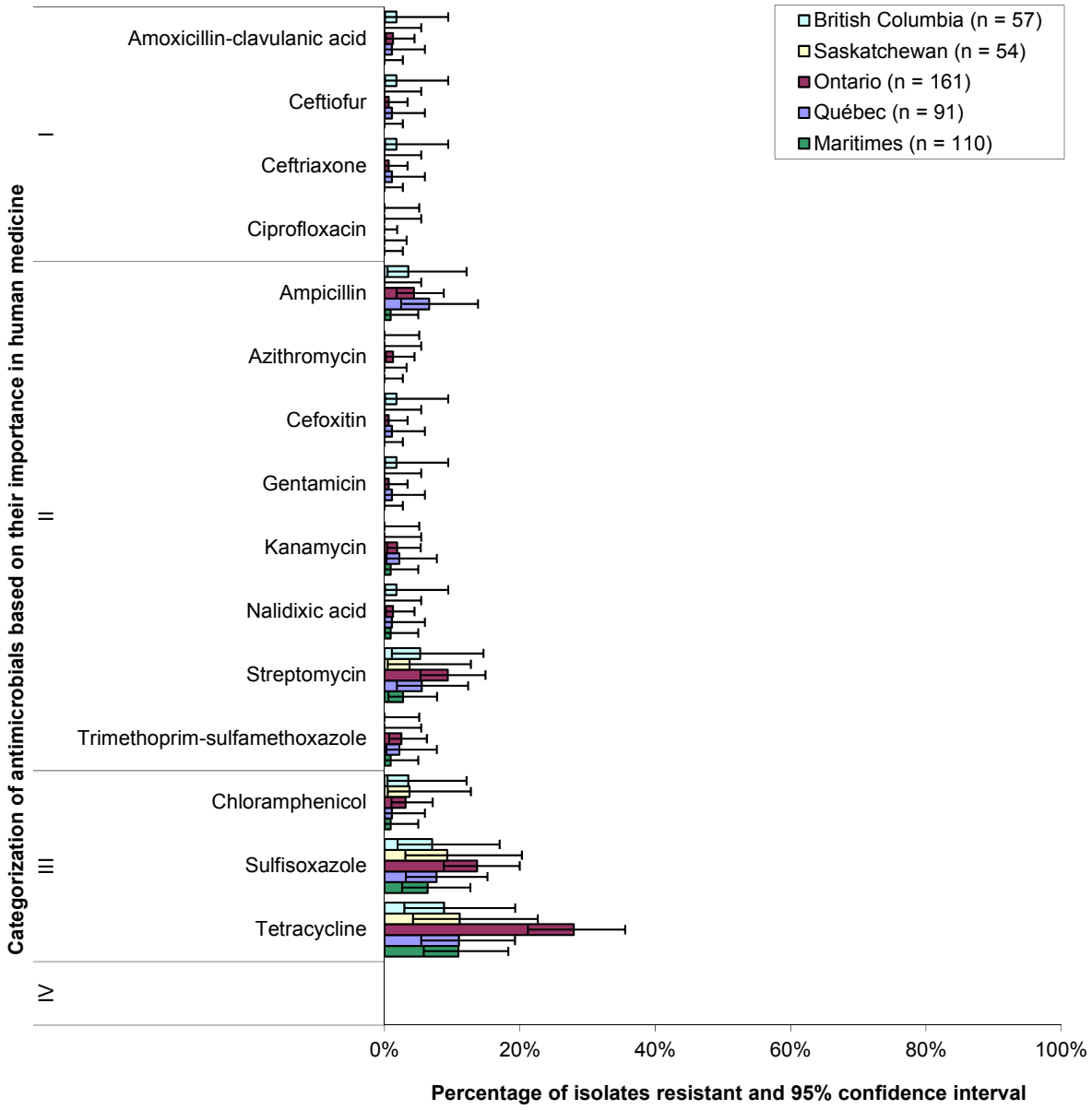
Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.
Serovars represented by less than 2% of isolates were classified as “Less common serovars”.

Escherichia coli

Retail Meat Surveillance[1]

(n = 473)

Figure 3. Resistance to antimicrobials in *Escherichia coli* isolates from beef; *Retail Meat Surveillance*, 2011.



The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

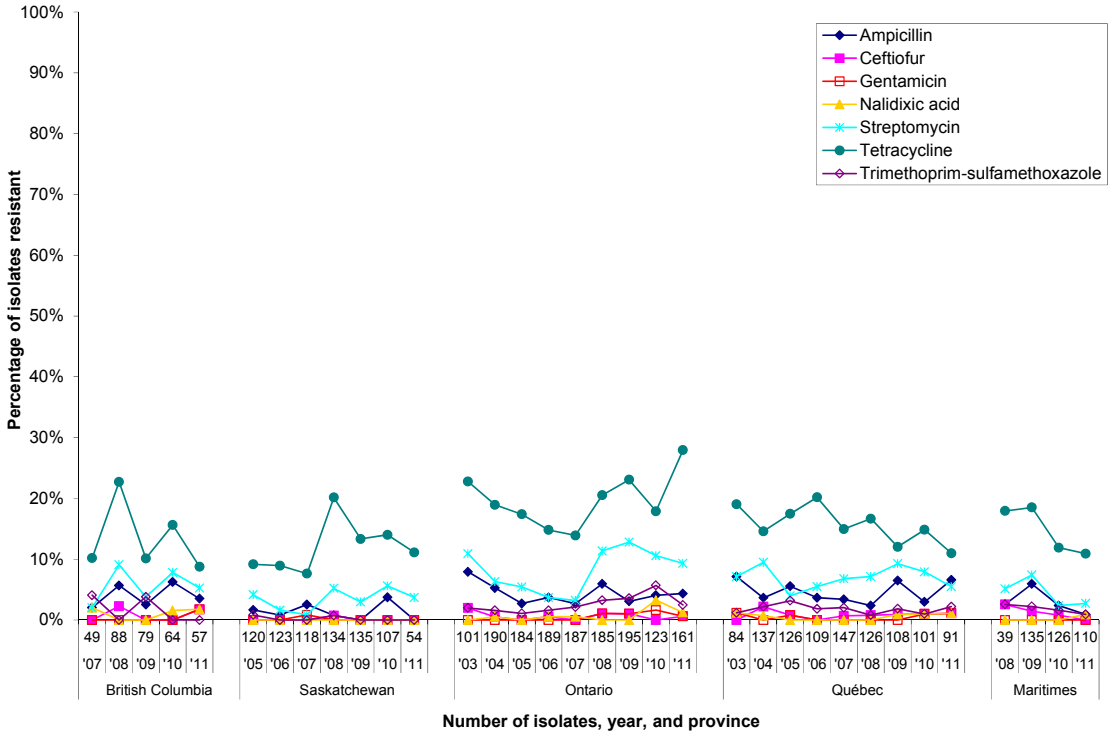
[1] In 2011, due to an unforeseeable pause in retail sampling in Saskatchewan of approximately 3 months, the expected number of samples was not met and thus, results for this province should be interpreted with caution.

Table 10. Number of antimicrobial classes in resistance patterns of *Escherichia coli* isolates from beef; *Retail Meat Surveillance*, 2011.

Province or region	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial												
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia	57 (12.1)	50	3	2	2		1		3	2	1	1	1	1	4			2		1	5
Saskatchewan	54 (11.4)	48	1	4	1				2						5			2			6
Ontario	161 (34.0)	116	16	24	5		1	3	15	7	2	1	1	1	22	4	2	5		2	45
Québec	91 (19.2)	79	4	5	3		1	2	5	6	1	1	1	1	7	2		1		1	10
Maritimes	110 (23.3)	96	7	6	1			1	3	1					7	1		1		1	12

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.
The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

Figure 4. Temporal variation in resistance to selected antimicrobials in *Escherichia coli* isolates from beef; *Retail Meat Surveillance*, 2003–2011.



The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

Abattoir Surveillance

(n = 139)

Figure 5. Resistance to antimicrobials in *Escherichia coli* isolates from beef cattle; *Abattoir Surveillance*, 2011.

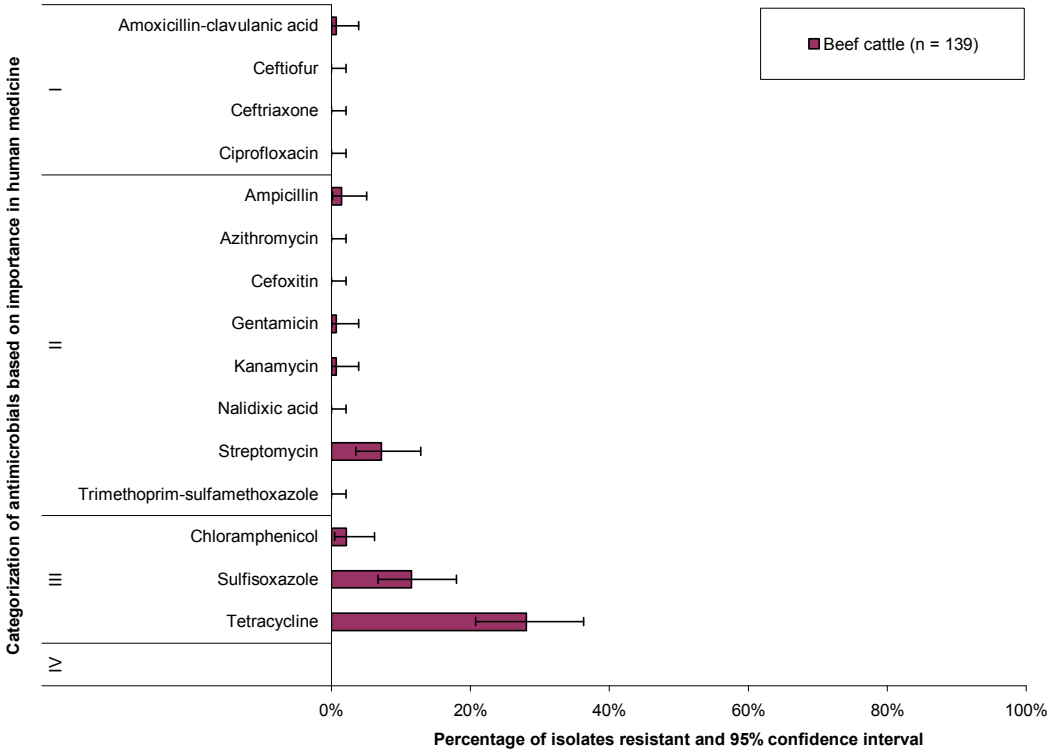
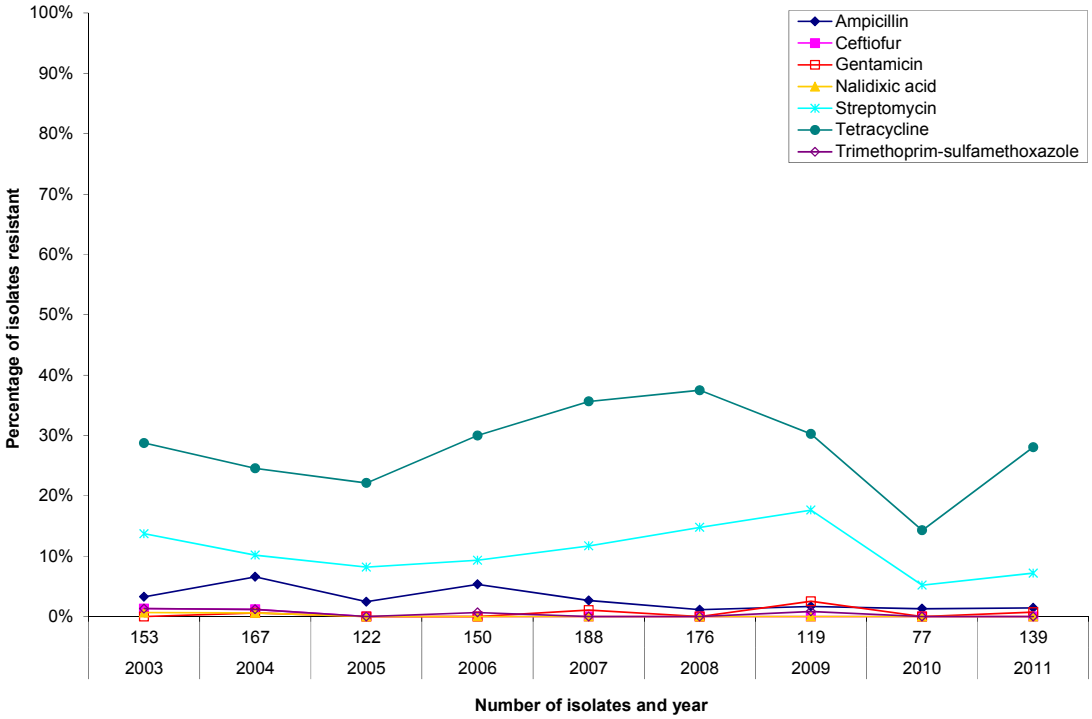


Table 11. Number of antimicrobial classes in resistance patterns of *Escherichia coli* isolates from beef cattle; *Abattoir Surveillance*, 2011.

Species	Number of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial												
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Beef cattle	139	96	25	16	2		1	1	10	2	1				16			3			39

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.

Figure 6. Temporal variation in resistance to selected antimicrobials in *Escherichia coli* isolates from beef cattle; *Abattoir Surveillance*, 2003–2011.



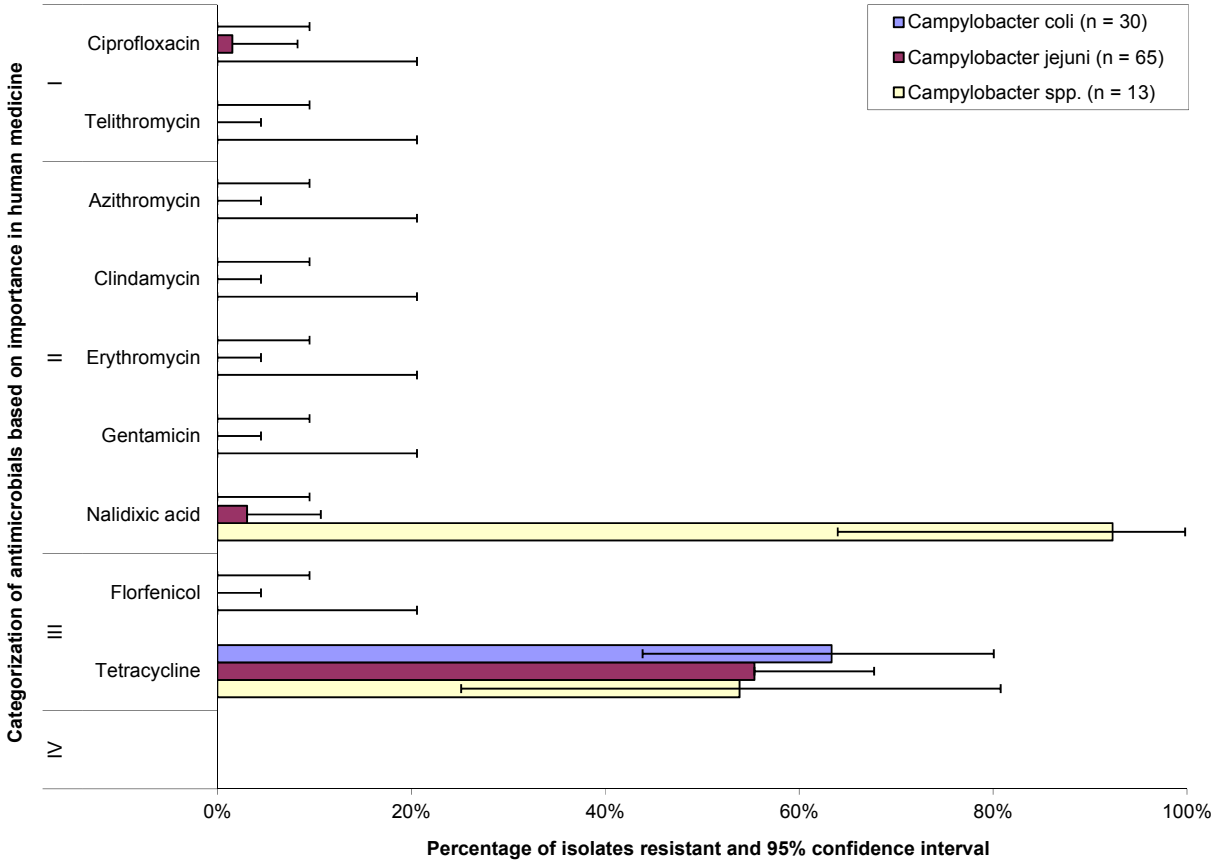
In 2010, the number of samples received from abattoir beef cattle was much lower than anticipated due to a 55% drop in submissions related to unavoidable operational issues at 2 major participating abattoirs.

Campylobacter

Abattoir Surveillance

(n = 108)

Figure 7. Resistance to antimicrobials in *Campylobacter* isolates from beef cattle; *Abattoir Surveillance*, 2011.



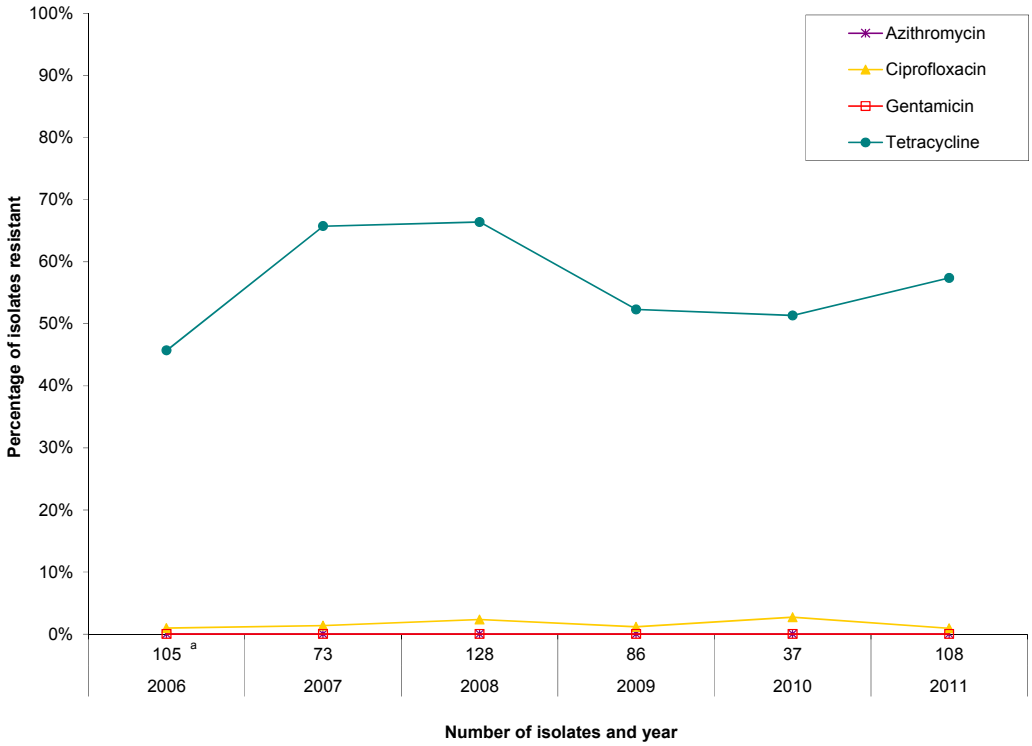
Campylobacter spp. include unidentified species, some of which may be intrinsically resistant to nalidixic acid.

Table 12. Number of antimicrobial classes in resistance patterns of *Campylobacter* isolates from beef cattle; *Abattoir Surveillance*, 2011.

Species	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial							
							Aminoglycosides	Ketolides	Lincosamides	Macrolides		Phenicols	Quinolones	Tetracyclines
		0	1	2–3	4–5	6–7	GEN	TEL	CLI	AZM	ERY	FLR	CIP	NAL	TET
Campylobacter jejuni	65 (60.2)	28	36	1									1	2	36
Campylobacter coli	30 (27.8)	11	19												19
Campylobacter spp.	13 (12.0)	1	5	7										12	7
Total	**108 (100)**	**40**	**60**	**8**									**1**	**14**	**62**

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.
Campylobacter spp. include unidentified species, some of which may be intrinsically resistant to nalidixic acid.

Figure 8. Temporal variation in resistance to selected antimicrobials in *Campylobacter* isolates from beef cattle; *Abattoir Surveillance*, 2006–2011.



In 2010, the number of samples received from abattoir beef cattle was much lower than anticipated due to a 55% drop in submissions related to unavoidable operational issues at 2 major participating abattoirs.
[a] This number of isolates includes isolates from the end of year 2005 (n = 23).

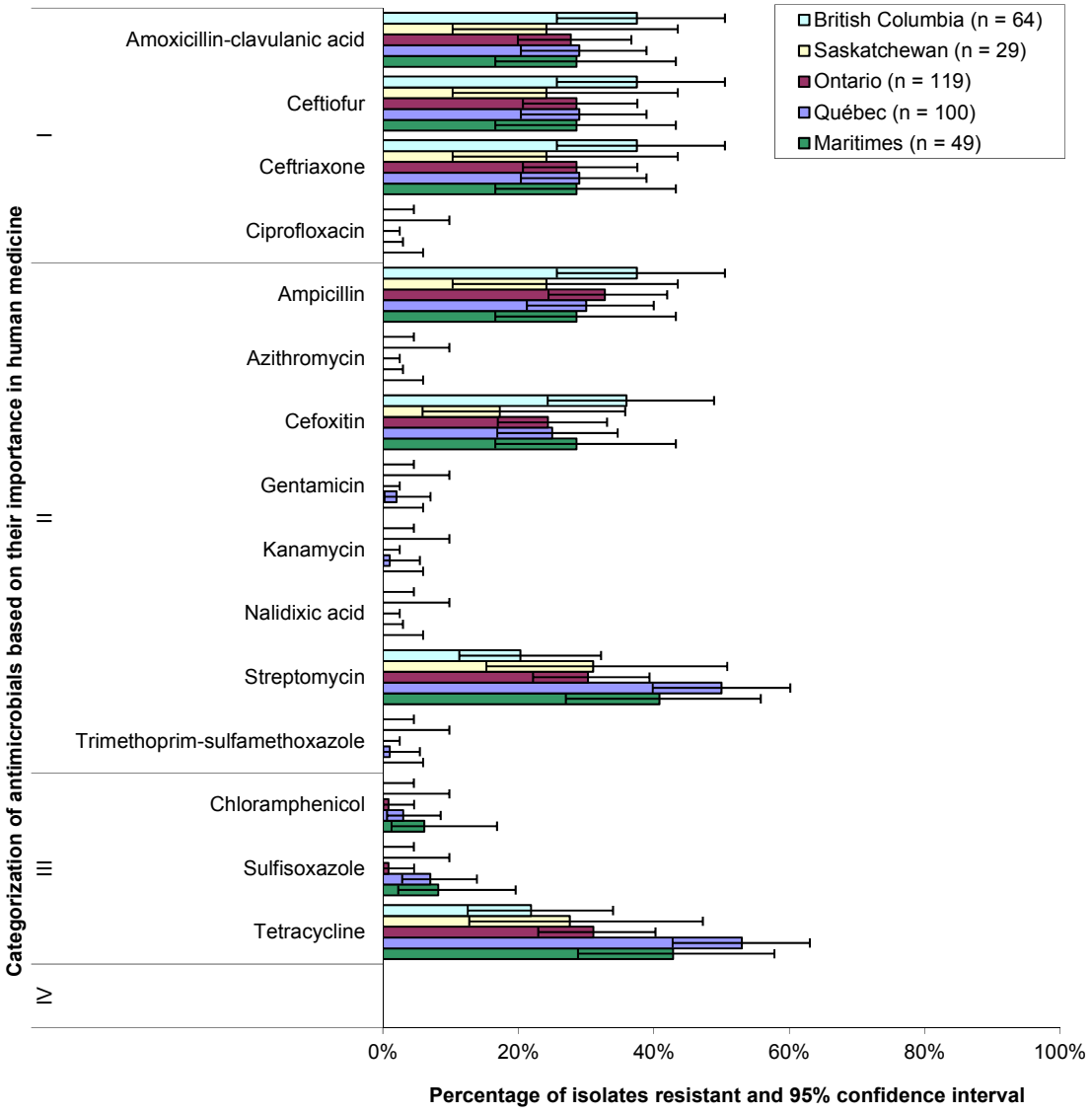
Chickens

Salmonella

Retail Meat Surveillance[1]

(n = 361)

Figure 9. Resistance to antimicrobials in *Salmonella* isolates from chicken; *Retail Meat Surveillance*, 2011



The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

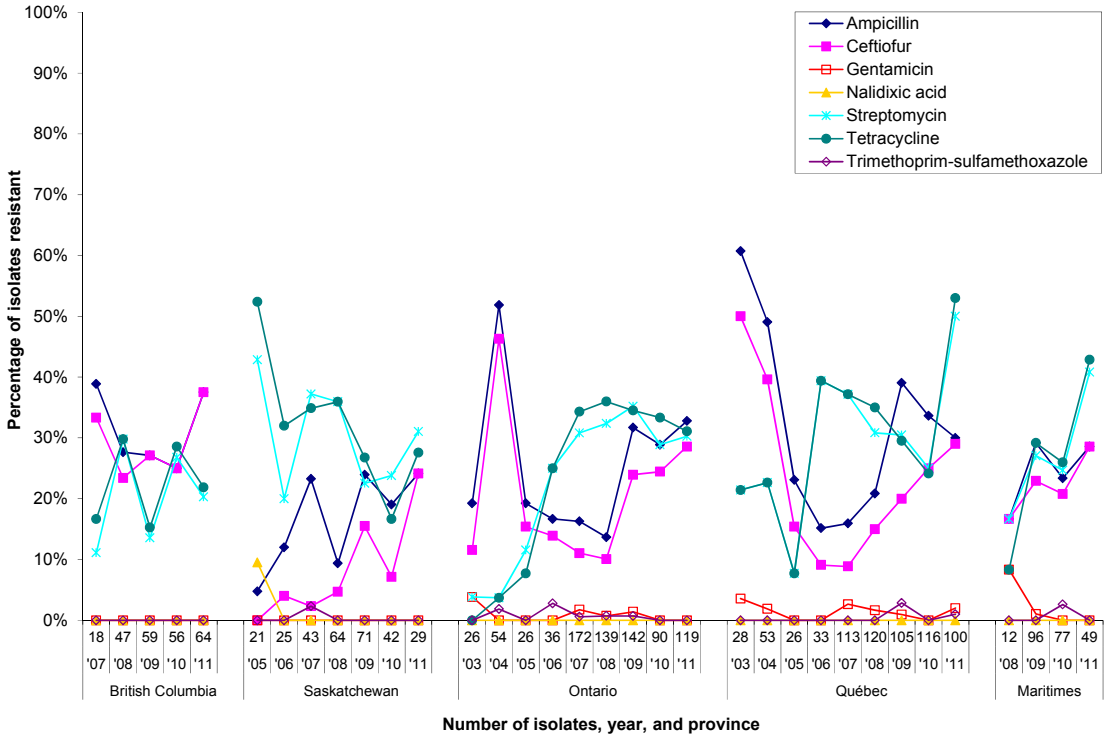
[1] In 2011, due to an unforeseeable pause in retail sampling in Saskatchewan of approximately 3 months, the expected number of samples was not met and thus, results for this province should be interpreted with caution.

Table 13. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from chicken; *Retail Meat Surveillance*, 2011.

Province or region / serovar	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial													
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia																					
Enteritidis	30 (46.9)	30																			
Kentucky	20 (31.3)	1	5	14					13	16	16	16	15	16							14
Heidelberg	6 (9.4)		6							6	6	6	6	6							
Hadar	3 (4.7)	3																			
Less common serovars	5 (7.8)	3	2							2	2	2	2	2							
Total	**64 (100)**	**37**	**13**	**14**					**13**	**24**	**24**	**24**	**23**	**24**							**14**
Saskatchewan																					
Enteritidis	11 (37.9)	11																			
Kentucky	7 (24.1)	1		6					6	4	4	4	2	4							6
Braenderup	2 (6.9)	1	1							1	1	1	1	1							
Hadar	2 (6.9)			2					2												2
Infantis	2 (6.9)	2																			
I 6,7:r:-	1 (3.4)		1							1	1	1	1	1							
Montevideo	1 (3.4)		1							1	1	1	1	1							
Oranienburg	1 (3.4)	1																			
Senftenberg	1 (3.4)	1																			
Typhimurium	1 (3.4)		1						1												
Total	**29 (100)**	**17**	**4**	**8**					**9**	**7**	**7**	**7**	**5**	**7**							**8**
Ontario																					
Kentucky	48 (40.3)	15	4	29					29	17	16	17	13	17							30
Heidelberg	34 (28.6)	23	11							11	8	8	7	8							
Hadar	8 (6.7)	1		7					6	2											7
Kiambu	5 (4.2)	1	3	1					1	3	3	3	3	3	1			1			
Enteritidis	4 (3.4)	4																			
Schwarzengrund	4 (3.4)	4																			
Thompson	3 (2.5)	3																			
Less common serovars	13 (10.9)	7	6							6	6	6	6	6							
Total	**119 (100)**	**58**	**24**	**37**					**36**	**39**	**33**	**34**	**29**	**34**	**1**			**1**			**37**
Québec																					
Kentucky	44 (44.0)	4	2	38					38	14	14	14	11	14							39
Heidelberg	22 (22.0)	13	7	1	1				1	9	9	9	9	9	2			1			1
Hadar	6 (6.0)		1	5					5												6
Thompson	6 (6.0)	6																			
Schwarzengrund	3 (3.0)	2	1																		1
Agona	2 (2.0)	2																			
Infantis	2 (2.0)	1			1		1		1	1	1	1	1	1	1			1			1
Kiambu	2 (2.0)			2						2	1	1	1	1	1	1		1			
Worthington	2 (2.0)	2																			
Less common serovars	11 (11.0)	3	2	6			1	1	5	4	4	4	3	4	3						5
Total	**100 (100)**	**33**	**13**	**52**	**2**		**2**	**1**	**50**	**30**	**29**	**29**	**25**	**29**	**7**	**1**		**3**			**53**
Maritimes																					
Kentucky	17 (34.7)	2		15					15	6	6	6	6	6							15
Heidelberg	11 (22.4)	5	5	1						6	6	6	6	6	1			1			
Hadar	5 (10.2)	1	1	3					3												4
Agona	3 (6.1)	2	1						1												
Enteritidis	2 (4.1)	2																			
Kiambu	2 (4.1)			2						2	2	2	2	2	2			2			
Worthington	2 (4.1)	2																			
I 4,[5],12:i:-	1 (2.0)			1											1						1
I 8,20:-:z6	1 (2.0)			1					1												1
I Rough:i:z6	1 (2.0)	1																			
Indiana	1 (2.0)	1																			
Infantis	1 (2.0)	1																			
Litchfield	1 (2.0)	1																			
Thompson	1 (2.0)	1																			
Total	**49 (100)**	**19**	**7**	**23**					**20**	**14**	**14**	**14**	**14**	**14**	**4**			**3**			**21**

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.
Serovars represented by less than 2% of isolates were classified as “Less common serovars”.
The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

Figure 10. Temporal variation in resistance to selected antimicrobials in *Salmonella* isolates from chicken; *Retail Meat Surveillance*, 2003–2011.



The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

Abattoir Surveillance

(n = 140)

Figure 11. Resistance to antimicrobials in *Salmonella* isolates from chickens; *Abattoir Surveillance*, 2011.

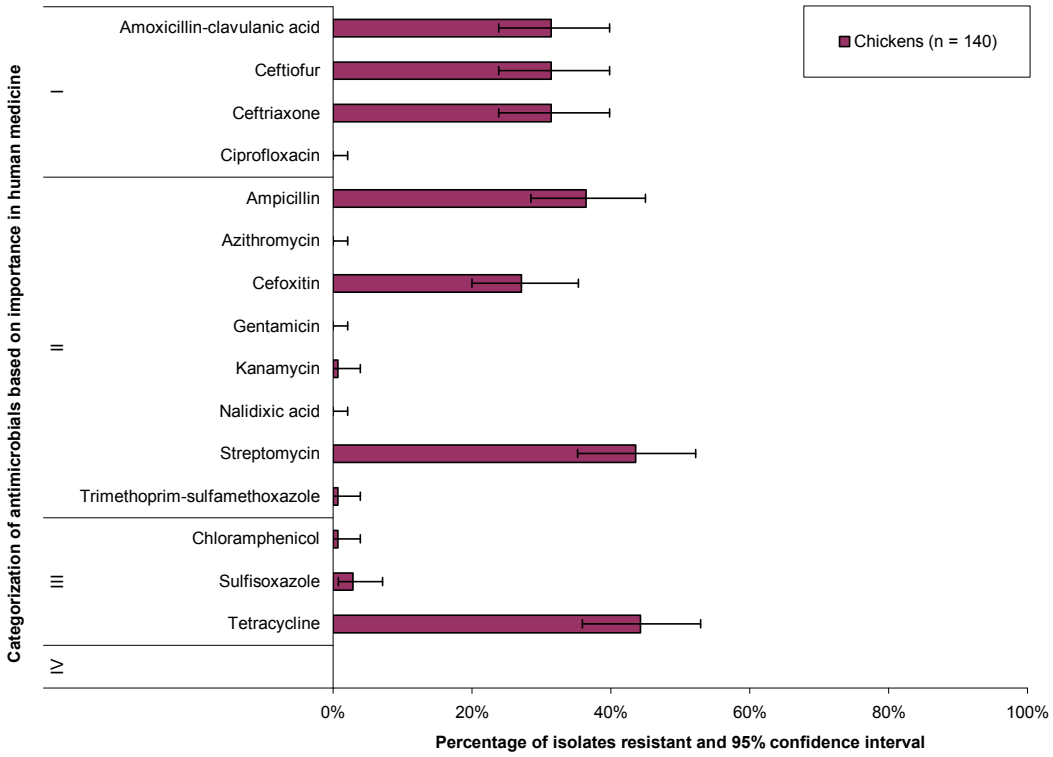
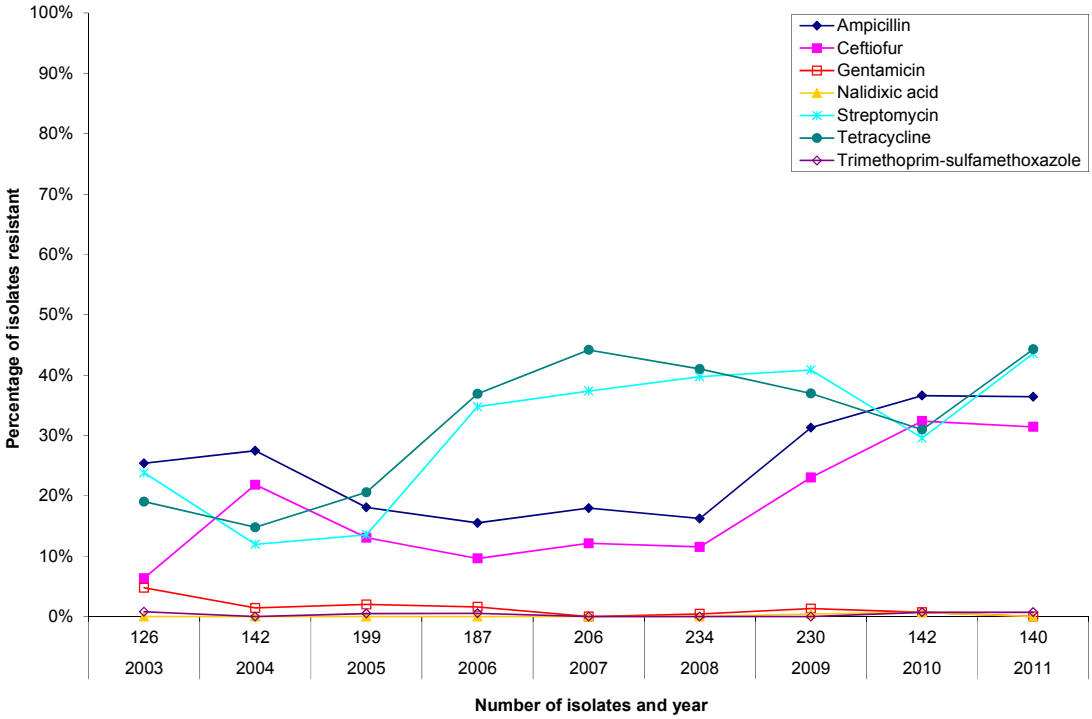


Table 14. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from chickens; *Abattoir Surveillance*, 2011.

Serovar	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial											
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Kentucky	58 (41.4)	9	3	46					46	33	33	33	28	33							46
Enteritidis	28 (20.0)	28																			
Heidelberg	19 (13.6)	11	7	1					1	7	5	5	5	5	1			1			
Hadar	11 (7.9)	2	3	6					6	4	3	3	2	3							6
I 4,[5],12:i:-	4 (2.9)	1	1		2				2	3	1	1	1	1	2						2
Less common serovars	20 (14.3)	12		8			1		6	4	2	2	2	2	1	1					8
Total	**140 (100)**	**63**	**14**	**61**	**2**		**1**		**61**	**51**	**44**	**44**	**38**	**44**	**4**	**1**		**1**			**62**

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.
Serovars represented by less than 2% of isolates were classified as “Less common serovars”.

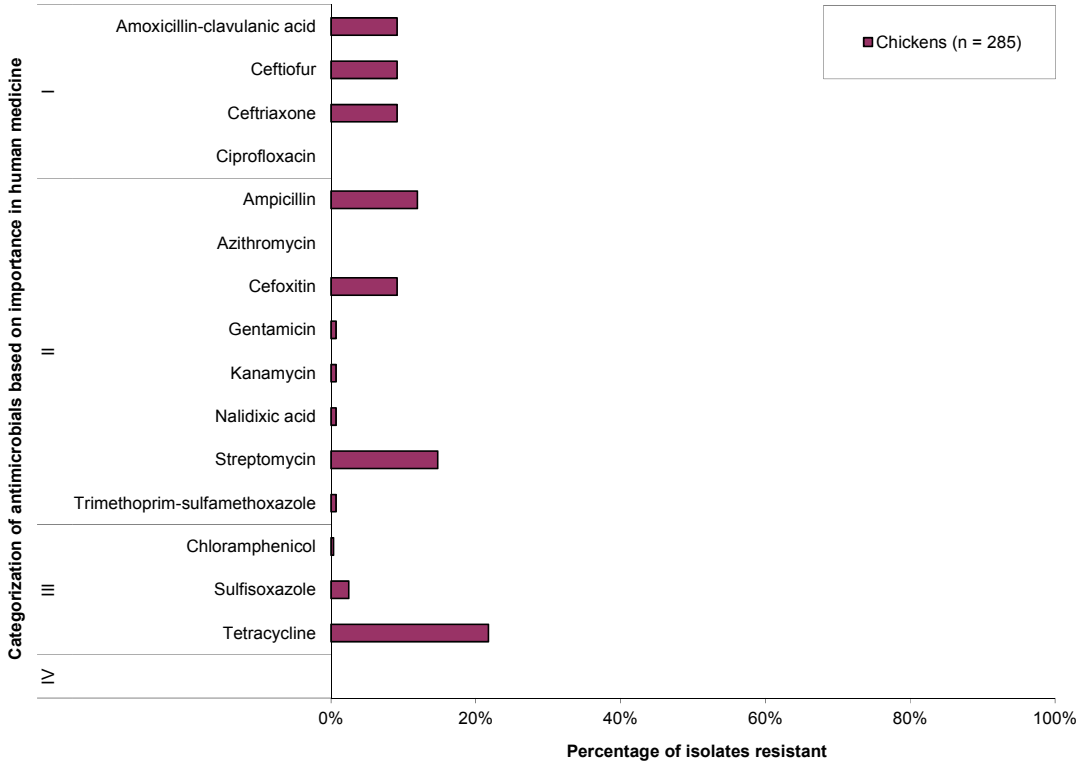
Figure 12. Temporal variation in resistance to selected antimicrobials in *Salmonella* isolates from chickens; *Abattoir Surveillance*, 2003–2011.



Surveillance of Animal Clinical Isolates

(n = 285)

Figure 13. Resistance to antimicrobials in *Salmonella* isolates from chickens; *Surveillance of Animal Clinical Isolate*s, 2011.



Confidence intervals are not displayed for animal clinical data because samples were not obtained randomly and may not represent independent observations and true estimates of the prevalence.

Table 15. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from chickens; *Surveillance of Animal Clinical Isolates*, 2011.

Serovar	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial												
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones	Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Enteritidis	124 (43.7)	123		1			1								1						
Heidelberg	65 (22.9)	49	12	4				1	1	14	9	9	9	9	2	2					3
Kentucky	51 (18.0)	7	9	33	2				34	12	12	12	12	12						2	42
Agona	9 (3.2)		8	1						1	1	1	1	1							9
Less common serovars	35 (12.3)	23	4	7	1		1	1	7	7	4	4	4	4	4			1			8
Total	**284 (100)**	**202**	**33**	**46**	**3**		**2**	**2**	**42**	**34**	**26**	**26**	**26**	**26**	**7**	**2**		**1**		**2**	**62**

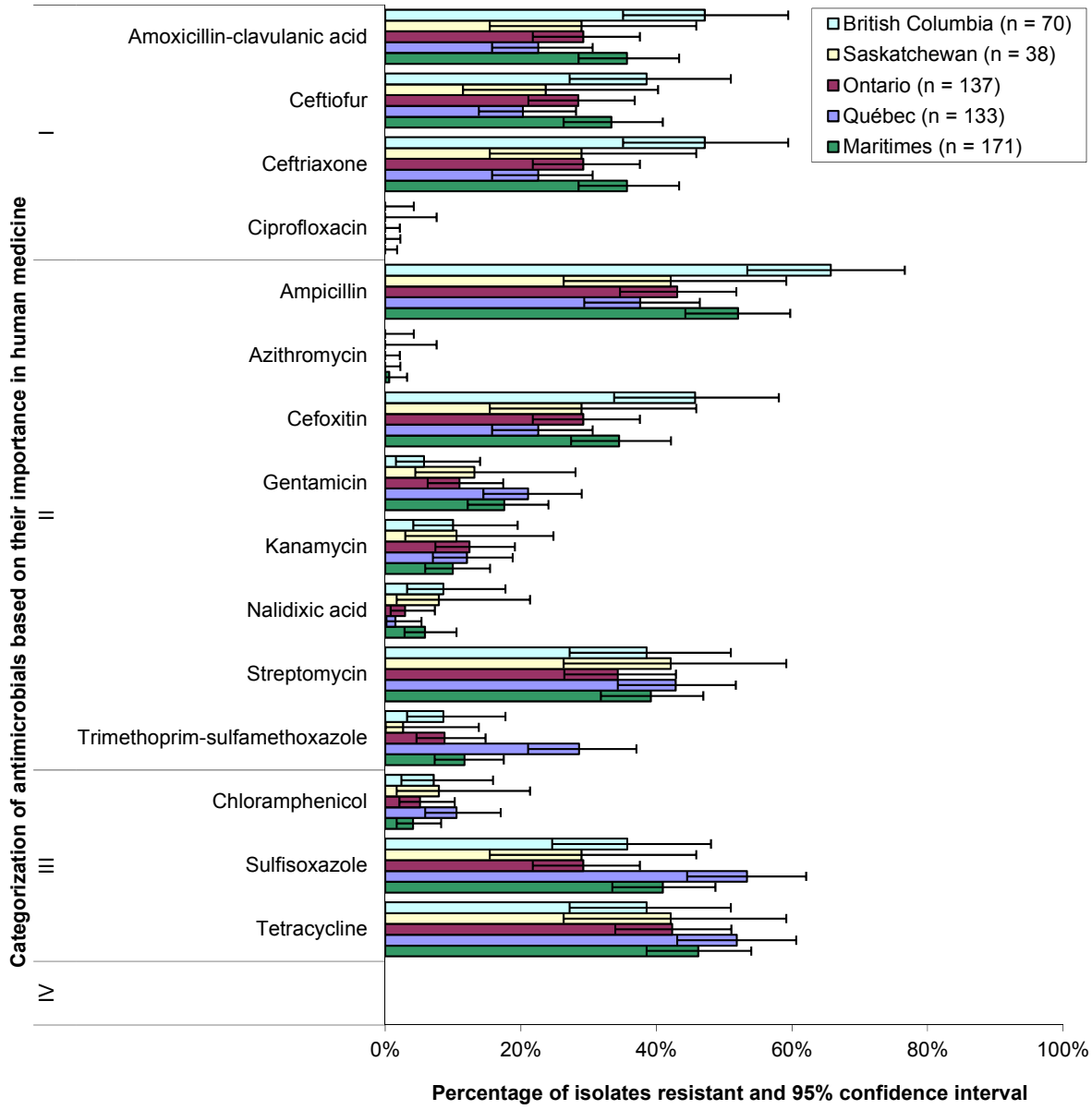
Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.
Serovars represented by less than 2% of isolates were classified as “Less common serovars”.
Results from one isolate were not presented in this table due to incomplete serotyping information.

Escherichia coli

Retail Meat Surveillance[1]

(n = 549)

Figure 14. Resistance to antimicrobials in *Escherichia coli* isolates from chicken; *Retail Meat Surveillance*, 2011.



The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

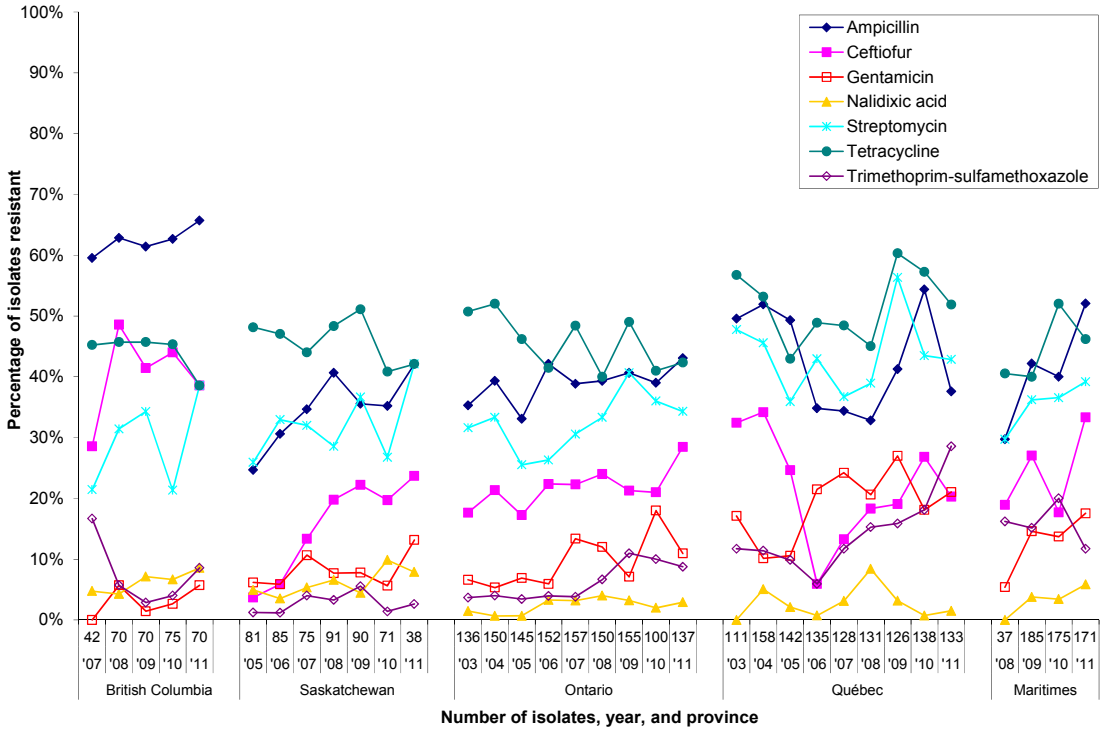
[1] In 2011, due to an unforeseeable pause in retail sampling in Saskatchewan of approximately 3 months, the expected number of samples was not met and thus, results for this province should be interpreted with caution.

Table 16. Number of antimicrobial classes in resistance patterns of *Escherichia coli* isolates from chicken; *Retail Meat Surveillance*, 2011.

Province or region	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial												
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia	70 (12.8)	15	15	28	12		4	7	27	46	33	33	32	27	25	6		5		6	27
Saskatchewan	38 (6.9)	12	8	12	5	1	5	4	16	16	11	11	11	9	11	1		3		3	16
Ontario	137 (25.0)	45	27	44	21		15	17	47	59	40	40	40	39	40	12		7		4	58
Québec	133 (24.2)	30	20	58	24	1	28	16	57	50	30	30	30	27	71	38		14		2	69
Maritimes	171 (31.1)	36	37	69	27	2	30	17	67	89	61	61	59	57	70	20	1	7		10	79

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.
The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

Figure 15. Temporal variation in resistance to selected antimicrobials in *Escherichia coli* isolates from chicken; *Retail Meat Surveillance*, 2003–2011.



The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

Abattoir Surveillance

(n = 164)

Figure 16. Resistance to antimicrobials in *Escherichia coli* isolates from chickens; *Abattoir Surveillance*, 2011.

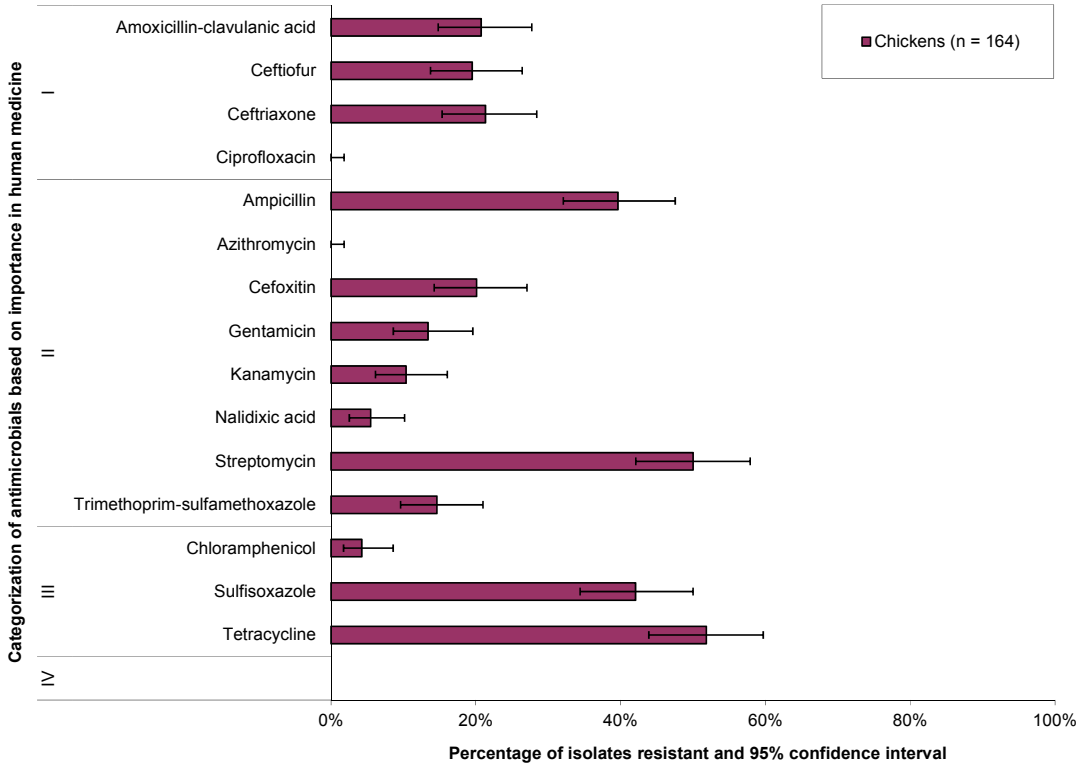
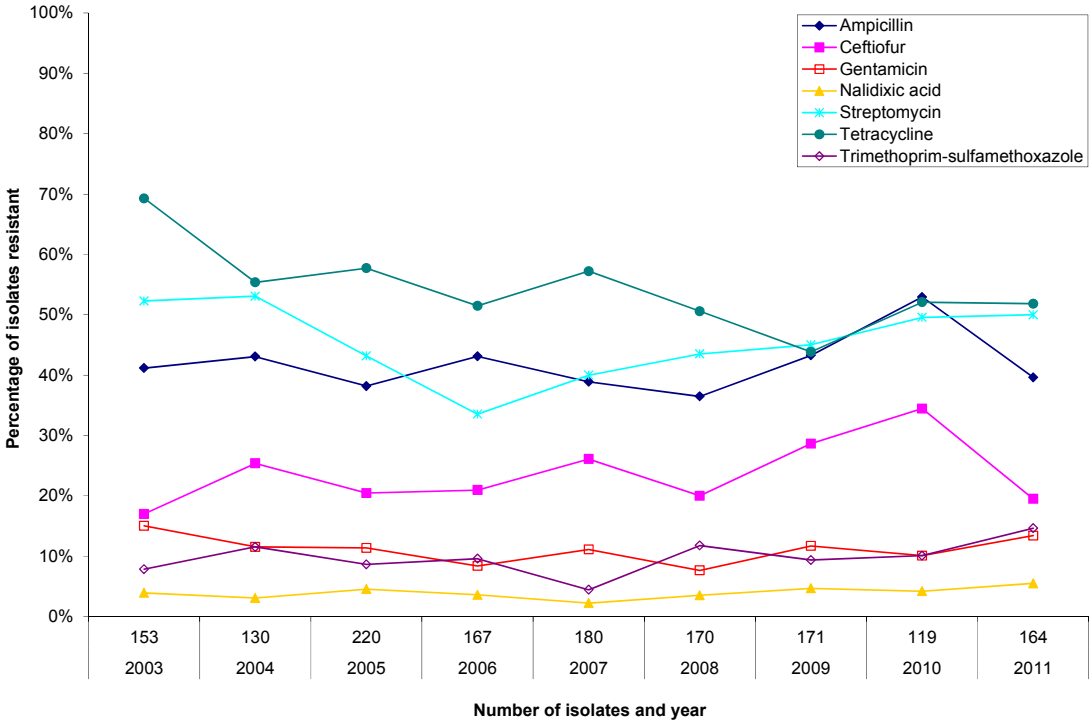


Table 17. Number of antimicrobial classes in resistance patterns of *Escherichia coli* isolates from chickens; *Abattoir Surveillance*, 2011.

Species	Number of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial												
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Chickens	164	40	18	82	24		22	17	82	65	34	35	33	32	69	24		7		9	85

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.

Figure 17. Temporal variation in resistance to selected antimicrobials in *Escherichia coli* isolates from chickens; *Abattoir Surveillance*, 2003–2011.

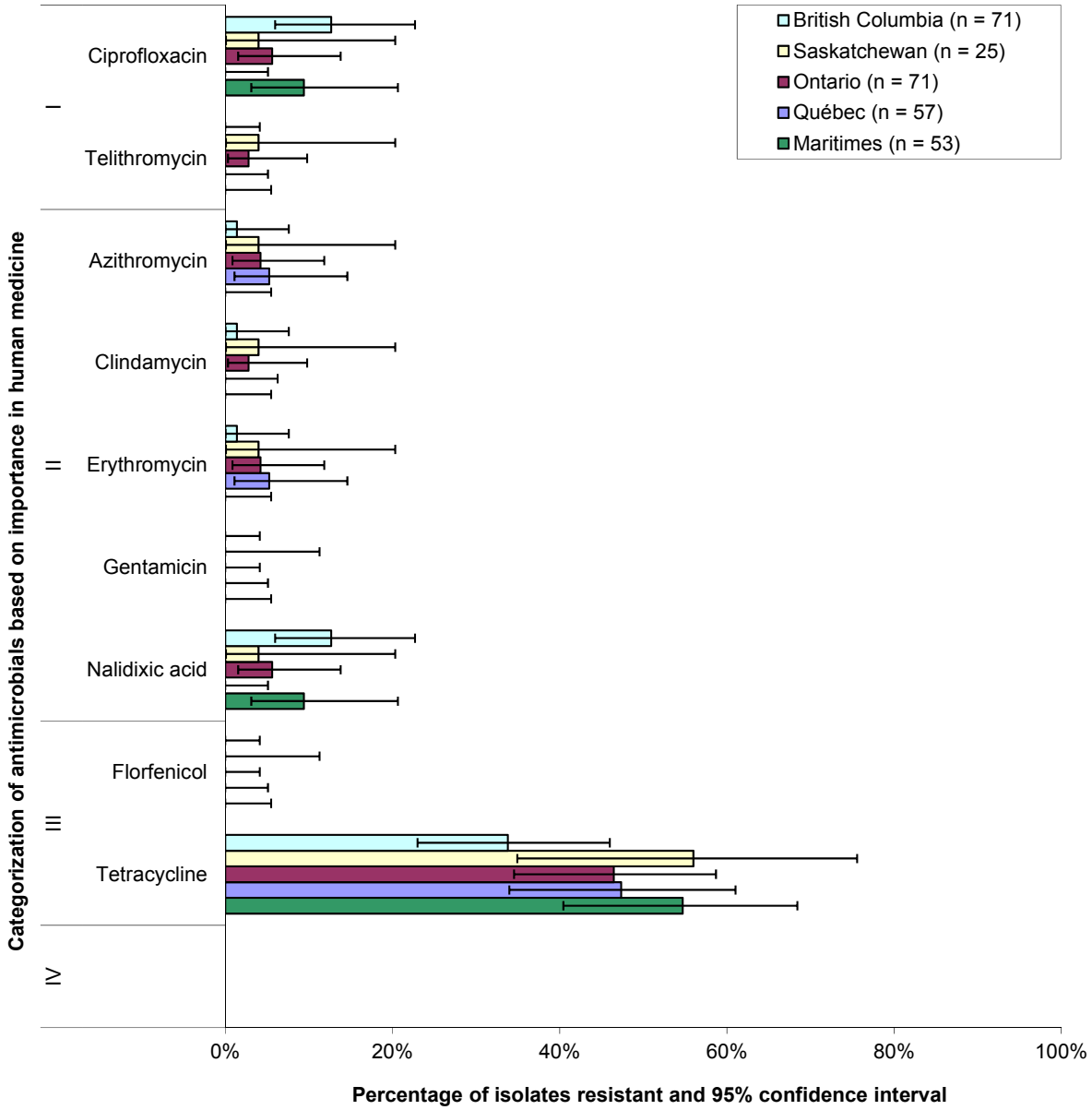


Campylobacter

Retail Meat Surveillance[1]

(n = 277)

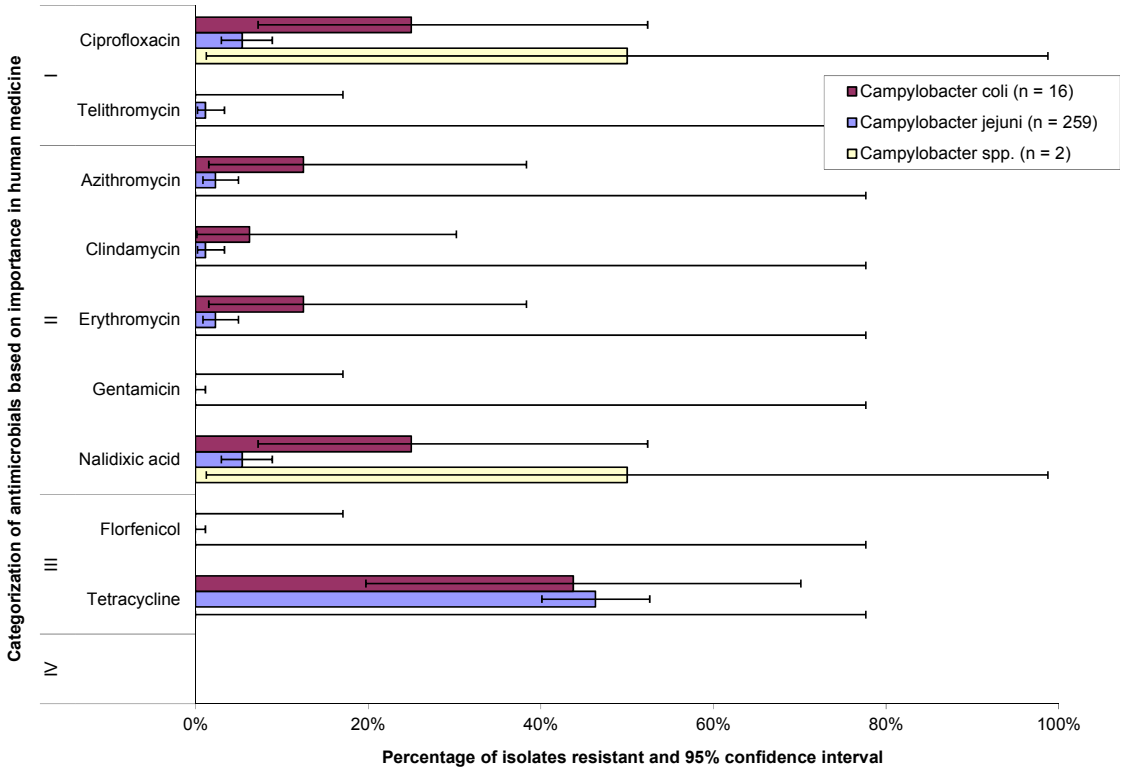
Figure 18. Resistance to antimicrobials in *Campylobacter* isolates from chicken by province/region; *Retail Meat Surveillance*, 2011.



The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

[1] In 2011, due to an unforeseeable pause in retail sampling in Saskatchewan of approximately 3 months, the expected number of samples was not met and thus, results for this province should be interpreted with caution.

Figure 19. Resistance to antimicrobials in *Campylobacter* isolates from chicken by species; *Retail Meat Surveillance*, 2011.



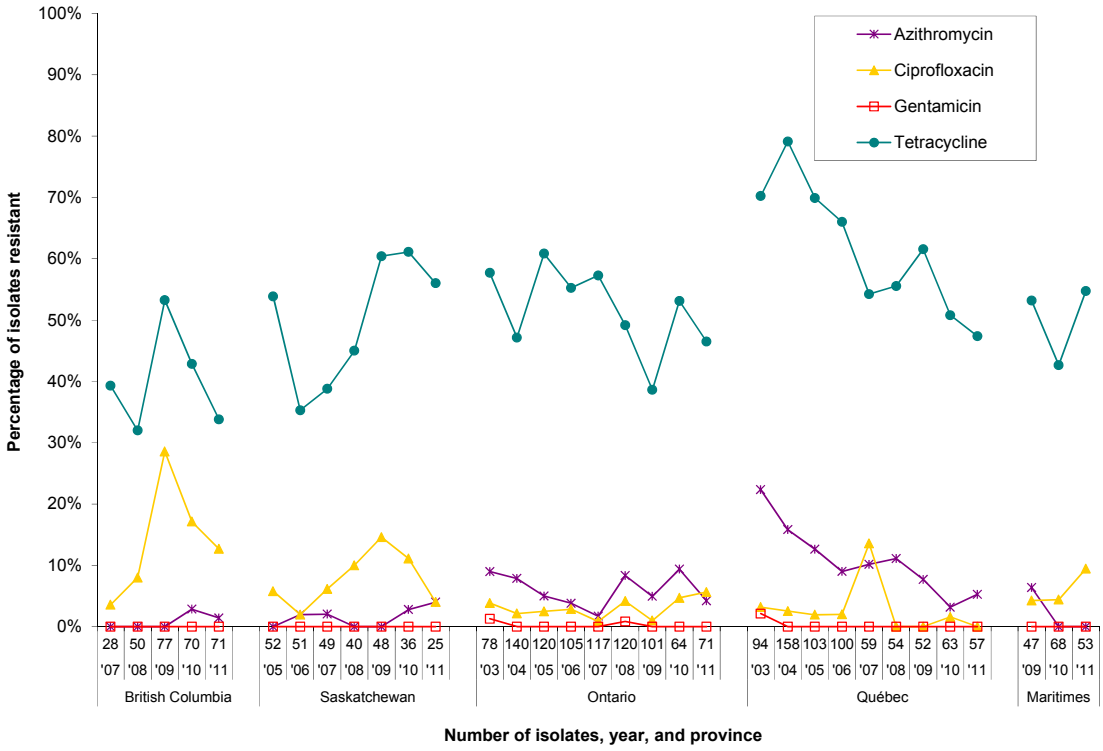
Campylobacter spp. includes unidentified species, some of which may be intrinsically resistant to nalidixic acid.

Table 18. Number of antimicrobial classes in resistance patterns of *Campylobacter* isolates from chicken; *Retail Meat Surveillance*, 2011.

Province or region / species	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial							
							Aminoglycosides	Ketolides	Lincosamides	Macrolides		Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	TEL	CLI	AZM	ERY	FLR	CIP	NAL	TET
British Columbia															
Campylobacter jejuni	65 (91.5)	39	24	2									6	6	22
Campylobacter coli	6 (8.5)	2	1	3					1	1	1		3	3	2
Total	**71 (100)**	**41**	**25**	**5**					**1**	**1**	**1**		**9**	**9**	**24**
Saskatchewan															
Campylobacter jejuni	25 (100)	10	13	2				1	1	1	1		1	1	14
Total	**25 (100)**	**10**	**13**	**2**				**1**	**1**	**1**	**1**		**1**	**1**	**14**
Ontario															
Campylobacter jejuni	63 (88.7)	29	29	5				2	2	3	3		3	3	31
Campylobacter coli	6 (8.5)	4	2												2
Campylobacter spp.	2 (2.8)	1	1										1	1	
Total	**71 (100)**	**34**	**32**	**5**				**2**	**2**	**3**	**3**		**4**	**4**	**33**
Québec															
Campylobacter jejuni	54 (94.7)	29	23	2						2	2				25
Campylobacter coli	3 (5.3)	1	1	1						1	1				2
Total	**57 (100)**	**30**	**24**	**3**						**3**	**3**				**27**
Maritimes															
Campylobacter jejuni	52 (98.1)	21	30	1									4	4	28
Campylobacter coli	1 (1.9)			1									1	1	1
Total	**53 (100)**	**21**	**30**	**2**									**5**	**5**	**29**

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.
The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.
Campylobacter spp. includes unidentified species, some of which may be intrinsically resistant to nalidixic acid.

Figure 20. Temporal variation in resistance to selected antimicrobials in *Campylobacter* isolates from chicken; *Retail Meat Surveillance*, 2003–2011.

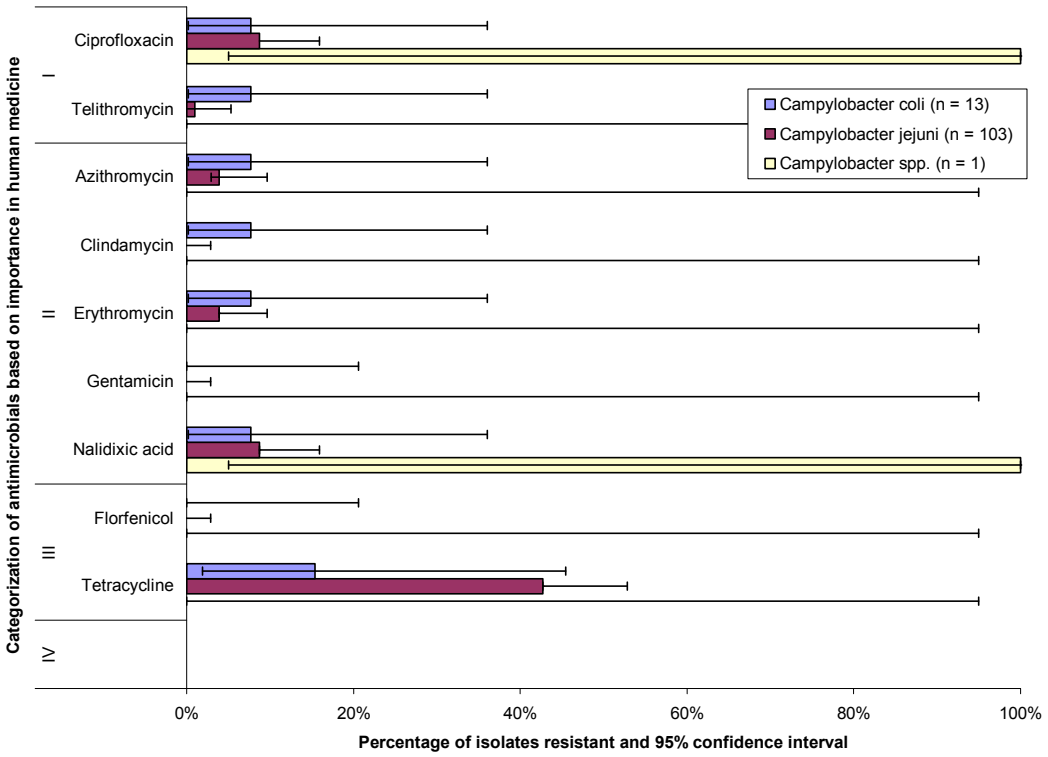


The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.
Although routine retail surveillance began in the Maritime region in 2008, no results are displayed for that year due to concerns regarding harmonization of laboratory methods.

Abattoir Surveillance

(n = 117)

Figure 21. Resistance to antimicrobials in *Campylobacter* isolates from chickens; *Abattoir Surveillance*, 2011.



Campylobacter spp. includes unidentified species, some of which may be intrinsically resistant to nalidixic acid.

Table 19. Number of antimicrobial classes in resistance patterns of *Campylobacter* isolates from chickens; *Abattoir Surveillance*, 2011.

Species	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial							
							Aminoglycosides	Ketolides	Lincosamides	Macrolides		Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	TEL	CLI	AZM	ERY	FLR	CIP	NAL	TET
Campylobacter jejuni	103 (88.0)	55	38	10				1		4	4		9	9	44
Campylobacter coli	13 (11.1)	11		1	1			1	1	1	1		1	1	2
Campylobacter spp.	1 (0.9)		1										1	1	
Total	**117 (100)**	**66**	**39**	**11**	**1**			**2**	**1**	**5**	**5**		**11**	**11**	**46**

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.
Campylobacter spp. includes unidentified species, some of which may be intrinsically resistant to nalidixic acid.

Pigs

Salmonella

Abattoir Surveillance

(n = 165)

Figure 22. Resistance to antimicrobials in *Salmonella* isolates from pigs; *Abattoir Surveillance*, 2011.

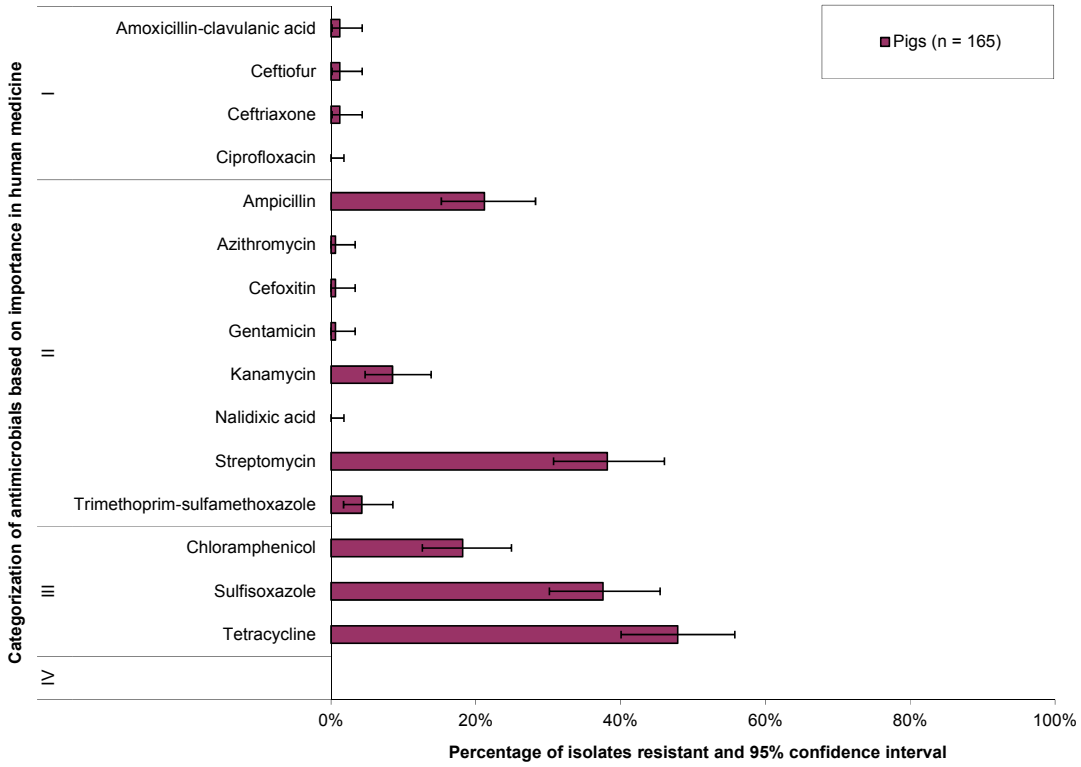
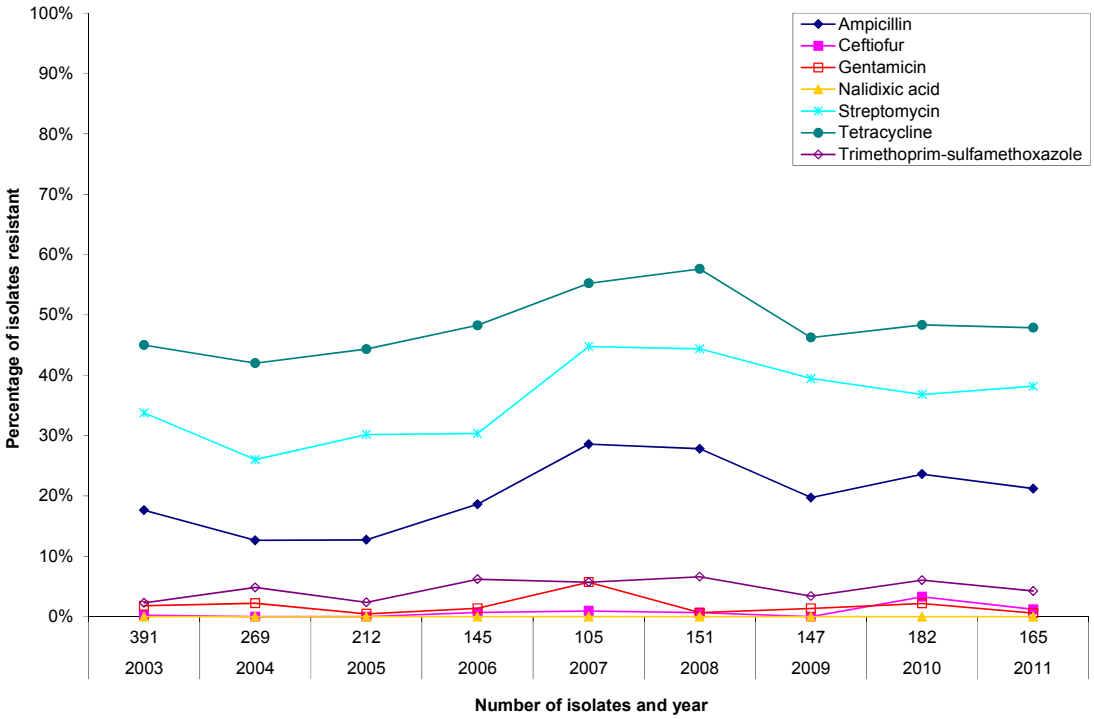


Table 20. Number of antimicrobial classes in resistance patterns of Salmonella isolates from pigs; Abattoir Surveillance, 2011.

Serovar	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial												
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Derby	43 (26.1)	11	8	21	3				20	2					23			5			28
Typhimurium var. 5-	20 (12.1)	2	1	4	13		1	4	17	14					17	2		13			15
Infantis	19 (11.5)	15	1	3				3	3	3	1	1		1							4
Brandenburg	11 (6.7)	6	3	1	1			2	1	1	1	1	1	1	1	1	1				4
Bovismorbificans	10 (6.1)	8		2						2											2
Typhimurium	10 (6.1)			4	6			1	7	7					10	2		6			8
Worthington	6 (3.6)	2	3	1											1	1		1			3
Heidelberg	5 (3.0)			5					4						1			1			5
Give	4 (2.4)	4																			
I 4,[5],12:i:-	4 (2.4)				4			3	4	4					4			3			4
Uganda	4 (2.4)	4																			
Less common serovars	29 (17.6)	20	4	4	1			1	7	2					5	1		1			6
Total	**165 (100)**	**72**	**20**	**45**	**28**		**1**	**14**	**63**	**35**	**2**	**2**	**1**	**2**	**62**	**7**	**1**	**30**			**79**

Antimicrobial abbreviations are defined in the Appendix.
Serovars represented by less than 2% of isolates were classified as “Less common serovars”.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.

Figure 23. Temporal variation in resistance to selected antimicrobials in *Salmonella* isolates from pigs; *Abattoir Surveillance*, 2003–2011.



Farm Surveillance

(n = 77)

Figure 24. Resistance to antimicrobials in *Salmonella* isolates from pigs; *Farm Surveillance*, 2011.

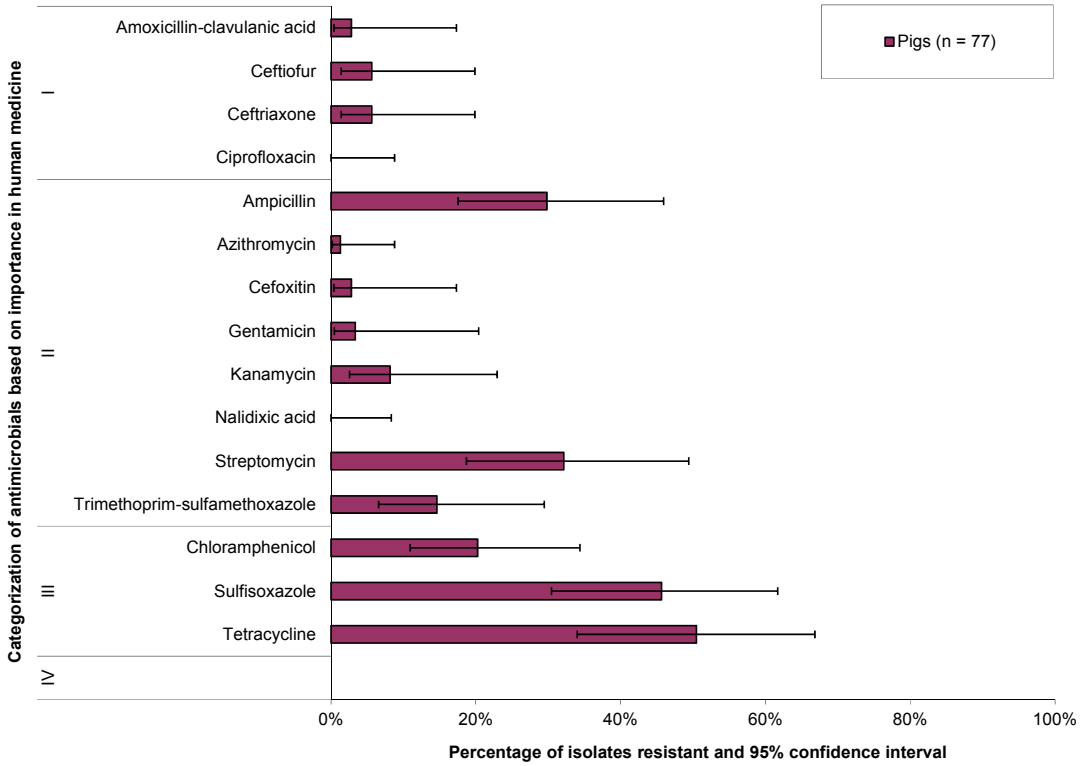
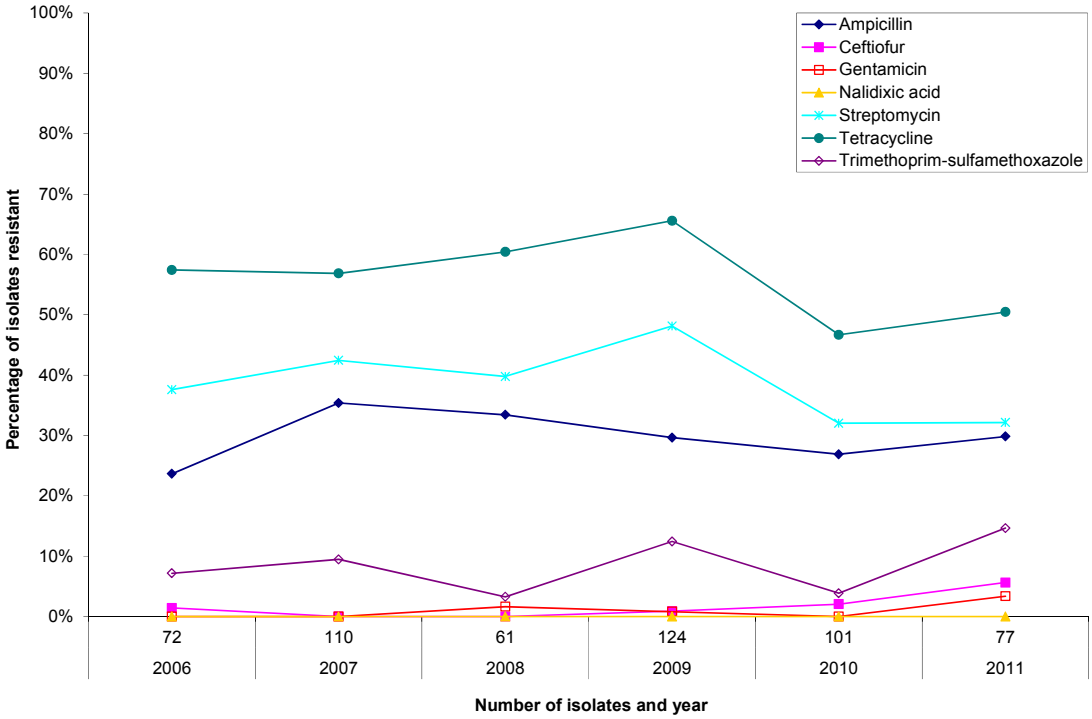


Table 21. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from pigs; *Farm Surveillance*, 2011.

Serovar	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial													
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Derby	12 (15.6)	3	3	5	1				6	1		1		1	6	1		1			8
Typhimurium var. 5-	12 (15.6)	1		4	7		1	4	10	7					11	2		7			8
Schwarzengrund	6 (7.8)				6				6	6					6						6
I 4,[5],12:i:-	5 (6.5)	2	2		1				1	1					1						3
Infantis	5 (6.5)	2	3							2											1
Livingstone	5 (6.5)			4	1				5	1	1	1	1	1	5	1		1			5
Typhimurium	5 (6.5)			2	3			3	3	5					5			3			5
Alachua	4 (5.2)	1		3											3						3
Mbandaka	3 (3.9)	2			1				1						1			1			1
Muenster	3 (3.9)	1	2												1	1					1
I 6,7:-:l,w	2 (2.6)				2				2	2	2	2	2	2	2	2		2			2
Mbandaka var.14+	2 (2.6)	2																			
Ouakam	2 (2.6)		1	1														1			2
Senftenberg	2 (2.6)	2																			
Less common serovars	9 (11.7)	6	2			1	1	1	1	1					2	2	1	1			2
Total	**77 (100)**	**22**	**13**	**19**	**22**	**1**	**2**	**8**	**35**	**26**	**3**	**4**	**3**	**4**	**43**	**9**	**1**	**17**			**47**

Antimicrobial abbreviations are defined in the Appendix.
Serovars represented by less than 2% of isolates were classified as "Less common serovars".
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.

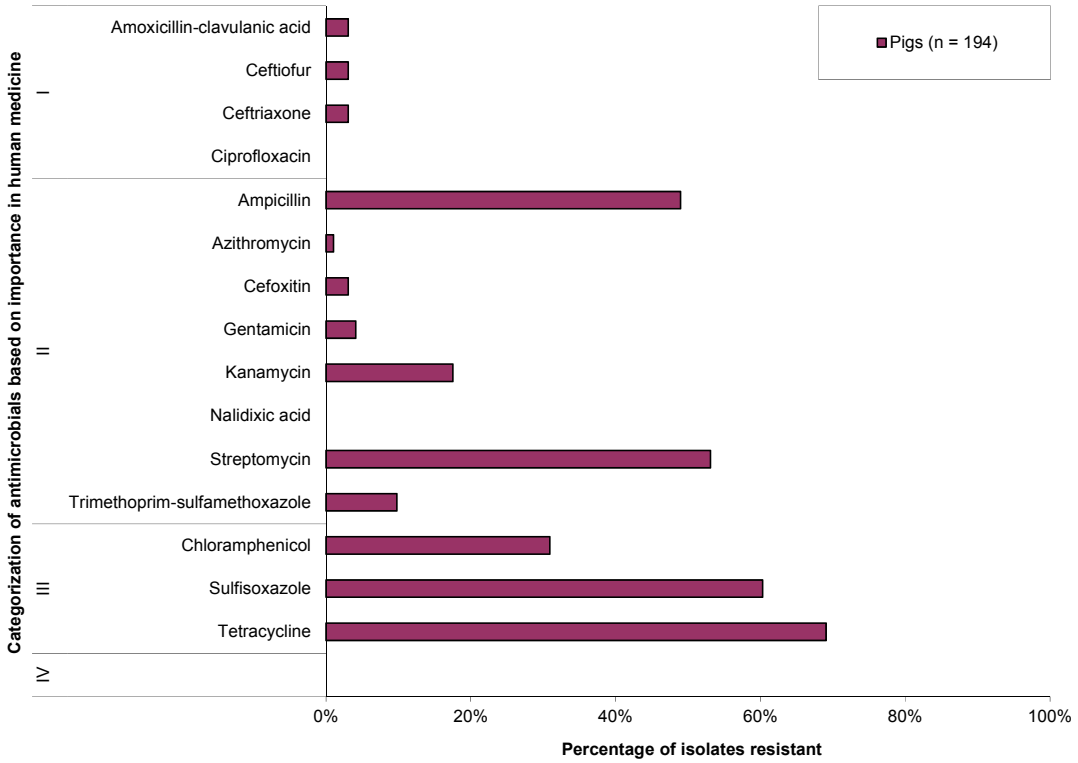
Figure 25. Temporal variation in resistance to selected antimicrobials in *Salmonella* isolates from pigs; *Farm Surveillance*, 2006–2011.



Surveillance of Animal Clinical Isolates

(n = 194)

Figure 26. Resistance to antimicrobials in *Salmonella* isolates from pigs; *Surveillance of Animal Clinical Isolates*, 2011.



Confidence intervals are not displayed for animal clinical data because samples were not obtained randomly and may not represent independent observations and true estimates of the prevalence.

Table 22. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from pigs; *Surveillance of Animal Clinical Isolates*, 2011.

Serovar	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial													
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Typhimurium	49 (25.4)	4	1	10	34			12	30	41	1	1	1	1	43	14		29			43
Typhimurium var. 5-	34 (17.6)	1	4		27	2	4	9	28	29					29	2	2	25			33
Derby	31 (16.1)	11	6	11	3		1	3	12	5	3	3	3	3	13	1		2			18
I 4,[5],12:i:-	15 (7.8)	2	1		12		1	1	12	12					12	1		2			13
Infantis	11 (5.7)	10		1				1	1	1	1	1	1	1							1
Brandenburg	8 (4.1)	7	1																		1
Worthington	7 (3.6)	3	1	2	1			3	1	1					3	1					4
I 4,[5],12:d:-	5 (2.6)			5					5						5						5
Mbandaka	4 (2.1)	2		2			1	1	2						2						2
Ohio	4 (2.1)	1	1	1	1			2	1	2	1	1	1	1	1			1			2
Less common serovars	25 (13.0)	13	1	7	4		1	2	11	4					9			1			12
Total	**193 (100)**	**54**	**16**	**39**	**82**	**2**	**8**	**34**	**103**	**95**	**6**	**6**	**6**	**6**	**117**	**19**	**2**	**60**			**134**

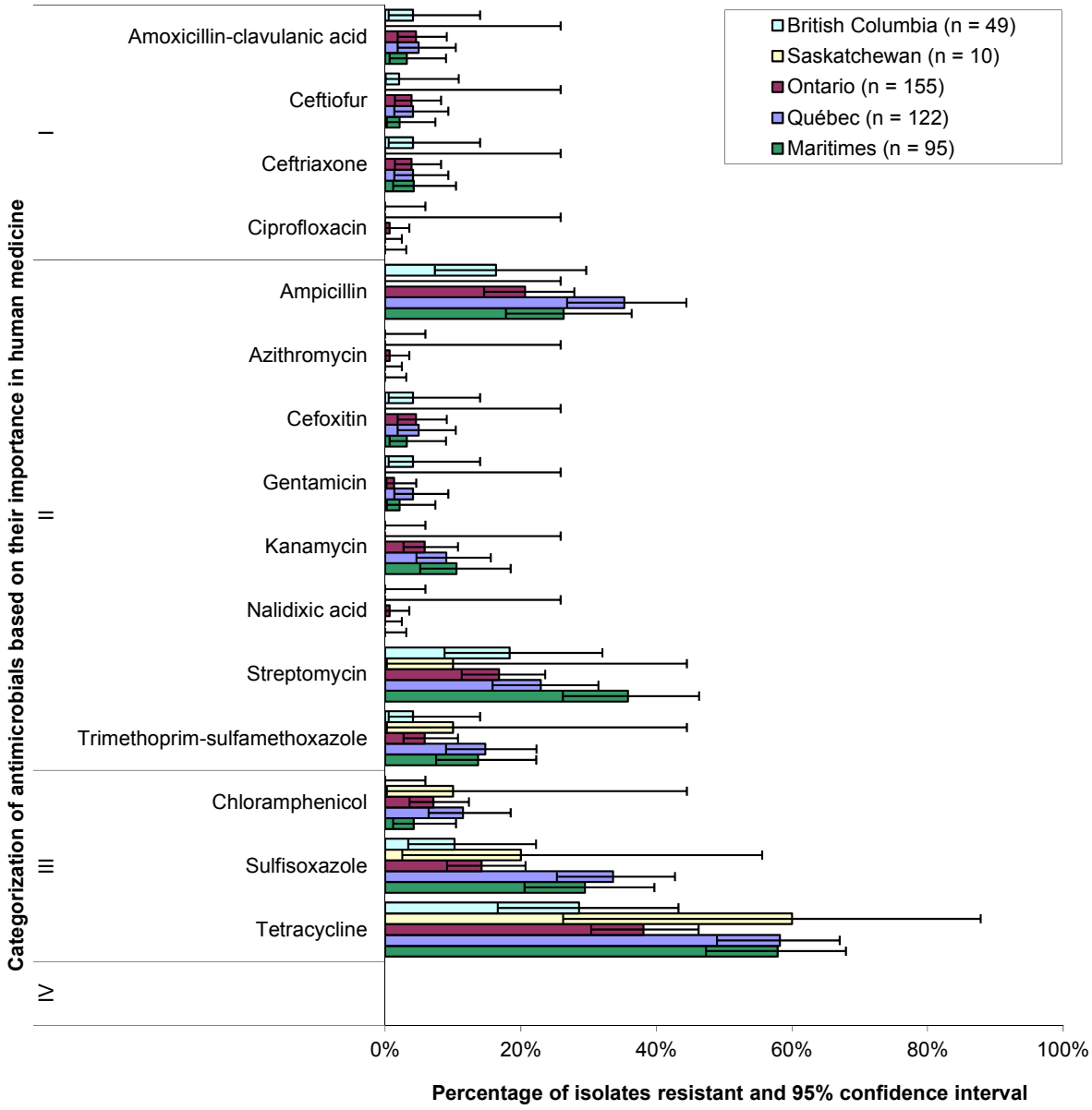
Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.
Serovars represented by less than 2% of isolates were classified as “Less common serovars”.
Results from one isolate were not presented because of missing serotype information.

Escherichia coli

Retail Meat Surveillance[1]

(n = 431)

Figure 27. Resistance to antimicrobials in *Escherichia coli* isolates from pork; *Retail Meat Surveillance*, 2011.



The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

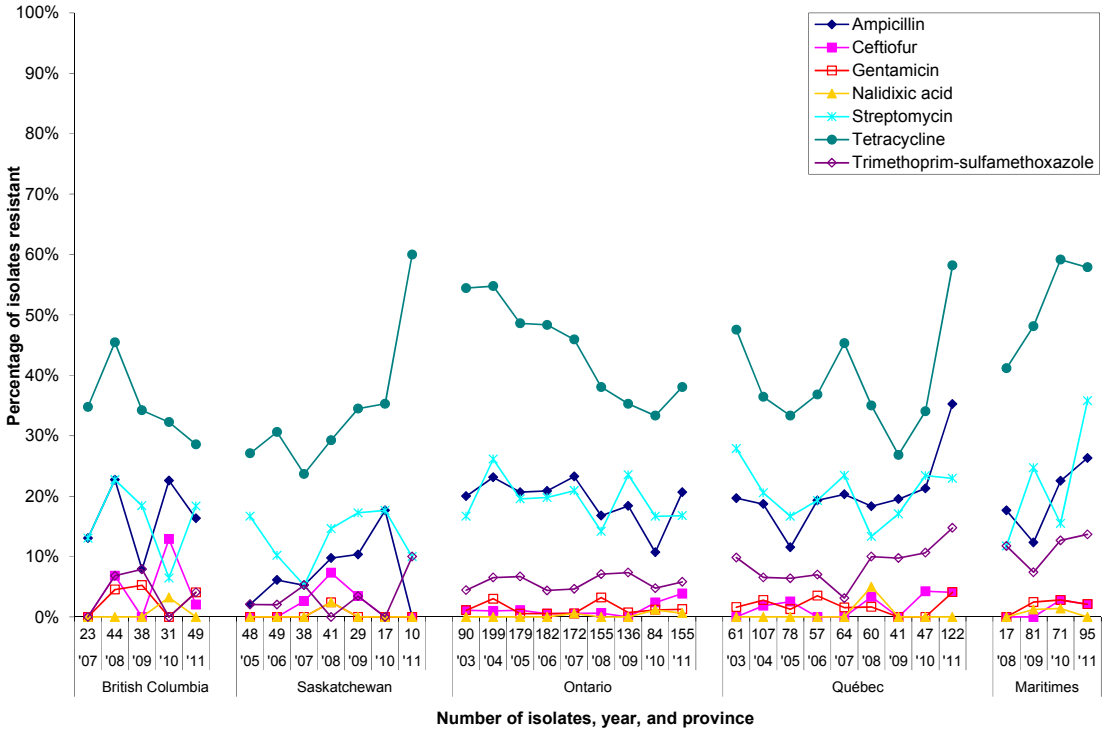
[1] In 2011, due to an unforeseeable pause in retail sampling in Saskatchewan of approximately 3 months, the expected number of samples was not met and thus, results for this province should be interpreted with caution.

Table 23. Number of antimicrobial classes in resistance patterns of *Escherichia coli* isolates from pork; *Retail Meat Surveillance*, 2011.

Province or region	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial												
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia	49 (11.4)	32	5	9	3		2		9	8	2	2	2	1	5	2					14
Saskatchewan	10 (2.3)	4	4	2					1						2	1		1			6
Ontario	155 (36.0)	86	25	34	9	1	2	9	26	32	7	6	7	6	22	9	1	11	1	1	59
Québec	122 (28.3)	41	20	39	22		5	11	28	43	6	5	6	5	41	18		14			71
Maritimes	95 (22.0)	37	10	38	10		2	10	34	25	3	4	3	2	28	13		4			55

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.
The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

Figure 28. Temporal variation in resistance to selected antimicrobials in *Escherichia coli* isolates from pork; *Retail Meat Surveillance*, 2003–2011.



The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

Abattoir Surveillance

(n = 190)

Figure 29. Resistance to antimicrobials in *Escherichia coli* isolates from pigs; *Abattoir Surveillance*, 2011.

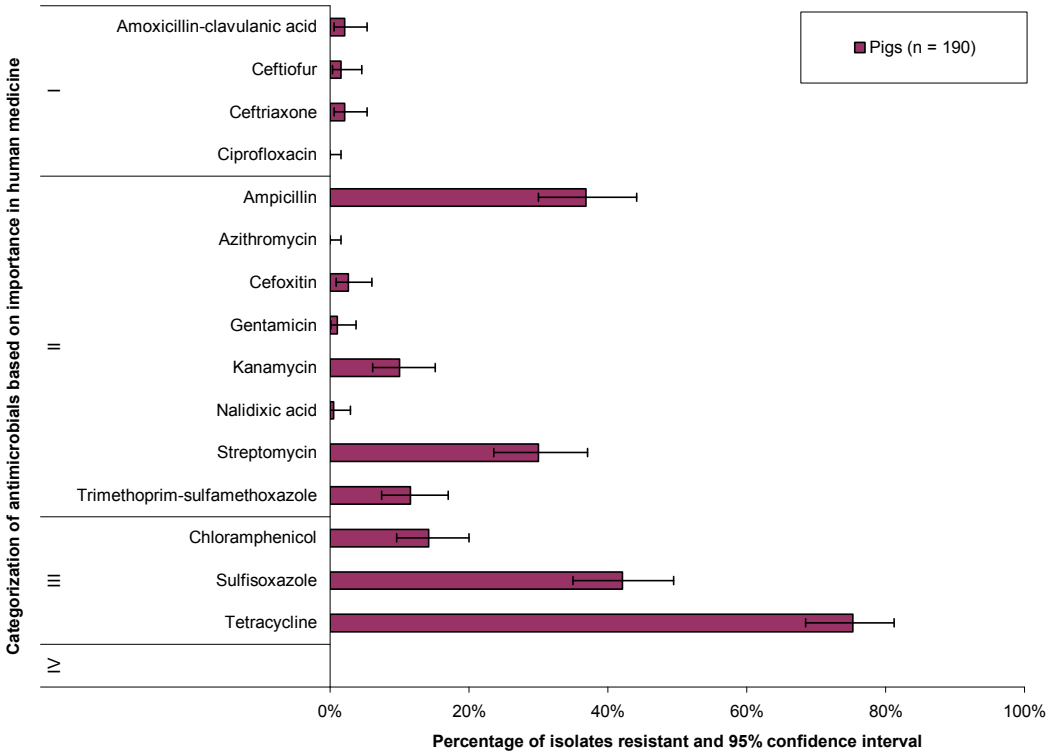
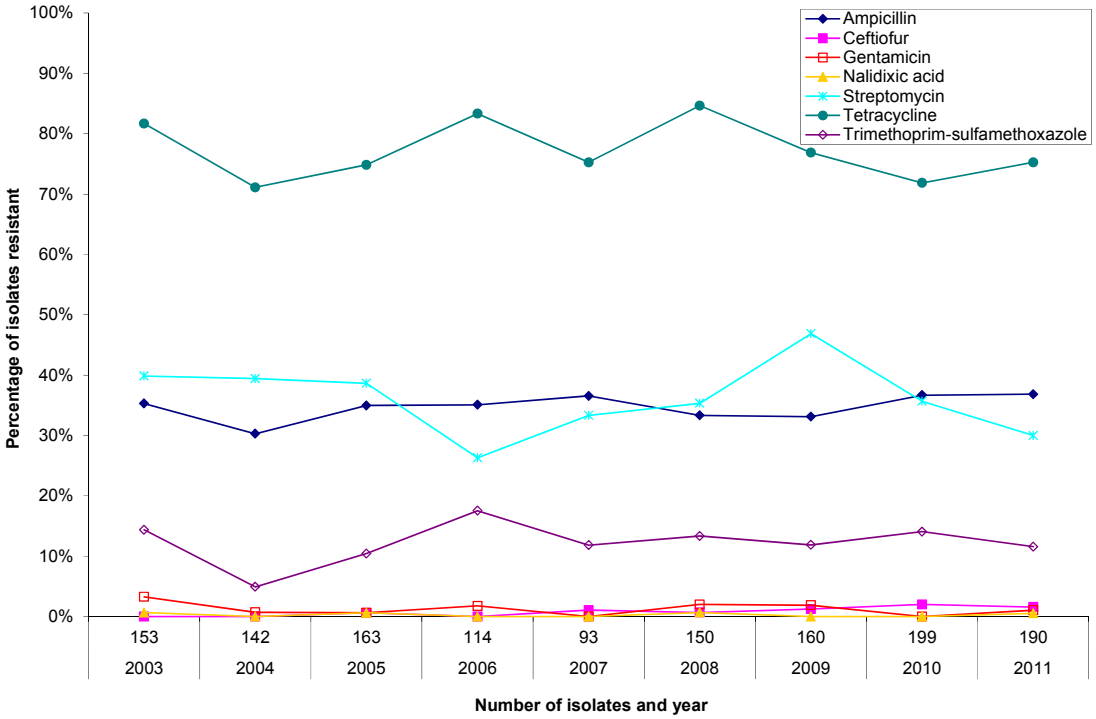


Table 24. Number of antimicrobial classes in resistance patterns of *Escherichia coli* isolates from pigs; *Abattoir Surveillance*, 2011.

Species	Number of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial													
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Pigs	190	29	48	84	29		2	19	57	70	4	4	5	3	80	22		27		1	143

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.

Figure 30. Temporal variation in resistance to selected antimicrobials in *Escherichia coli* isolates from pigs; *Abattoir Surveillance*, 2003–2011.



Farm Surveillance

(n = 1,667)[1]

Figure 31. Resistance to antimicrobials in *Escherichia coli* isolates from pigs; *Farm Surveillance*, 2011.

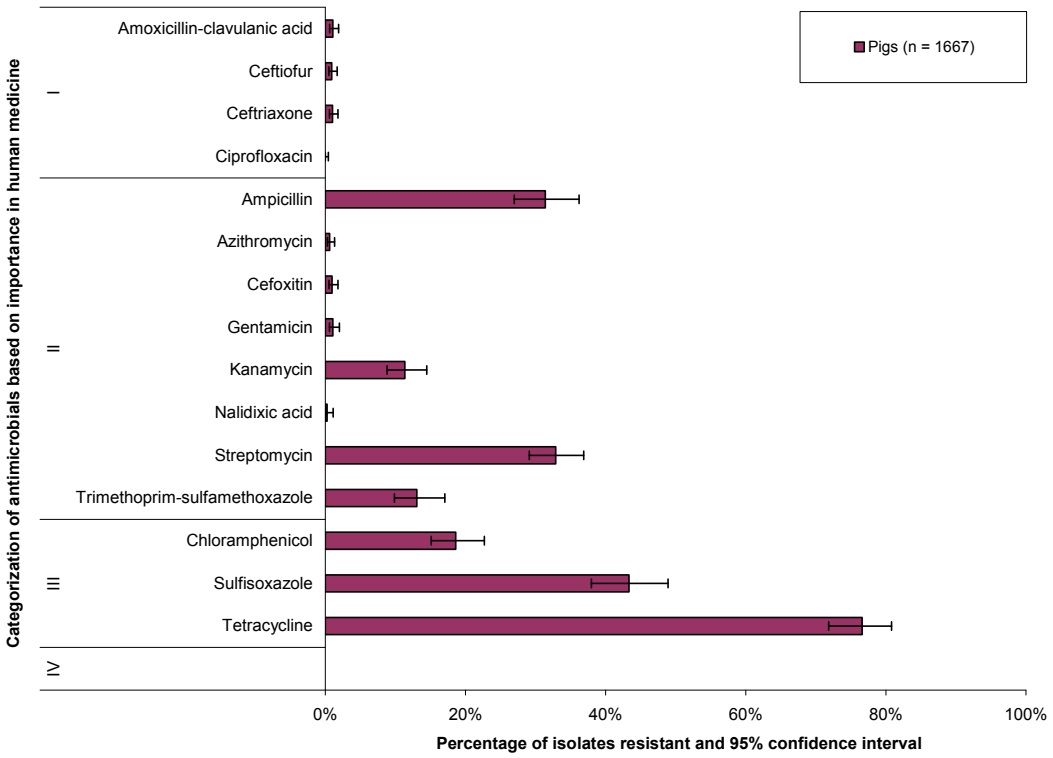


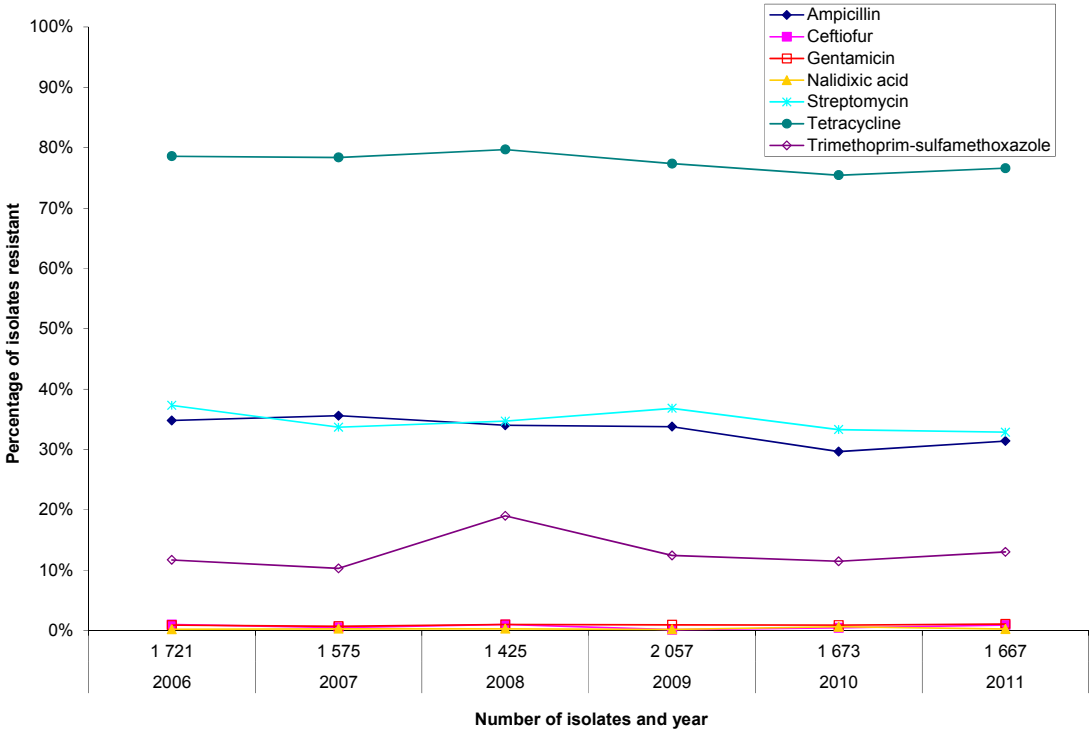
Table 25. Number of antimicrobial classes in resistance patterns of *Escherichia coli* isolates from pigs; *Farm Surveillance*, 2011.

Serovar	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial												
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Pigs	1,667	278	363	715	309	2	18	189	548	524	18	17	16	15	723	218	10	310		4	1,279

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.

[1] Up to 3 generic *E. coli* isolates per positive sample were kept for analysis. The expected number of total isolates was 1,680 (560 x 3) but only 1,667 isolates were collected for antimicrobials susceptibility testing leaving a difference of 13 isolates. The difference resulted from 3 samples with only 1 isolate cultured (6 isolates not cultured) and 7 samples with only 2 isolates cultured (7 isolates not cultured). The number of isolates recovered through *Farm Surveillance* was much higher than through other surveillance components. The reason for collecting a larger number of isolates in *Farm Surveillance* is to ensure adequate power to investigate the association between antimicrobial resistance and antimicrobial use.

Figure 32. Temporal variation in resistance to selected antimicrobials in *Escherichia coli* isolates from pigs; *Farm Surveillance*, 2006–2011.



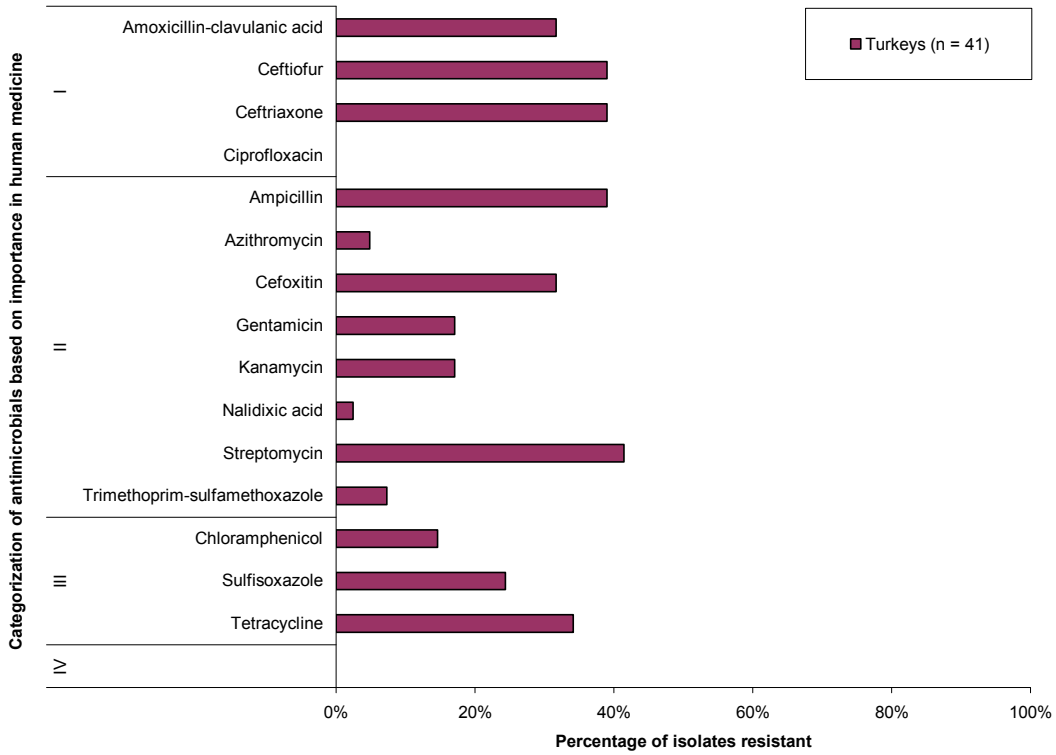
Turkeys

Salmonella

Surveillance of Animal Clinical Isolates

(n = 41)

Figure 33. Resistance to antimicrobials in *Salmonella* isolates from turkeys; *Surveillance of Animal Clinical* Isolates, 2011.



Confidence intervals are not displayed for animal clinical data because samples were not obtained randomly and may not represent independent observations and true estimates of the prevalence.

Table 26. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from turkeys; *Surveillance of Animal Clinical Isolates*, 2011.

Serovar	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial													
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Hadar	6 (14.6)	1	1	4					4												5
Cubana	4 (9.8)	4																			
Heidelberg	4 (9.8)		2	2					2	2	2	2	2	2							2
Senftenberg	4 (9.8)	1		3			2	1	2	1		1		1	1			1		1	
Indiana	3 (7.3)				1	2	2	1	3	3	3	3	3	3	3	2	2	3			3
Bredeney	2 (4.9)			2			2	2	2	2	1	2	1	2	2						
Kiambu	2 (4.9)		2							2	2	2	2	2							
Mbandaka	2 (4.9)	1		1				1	1						1						1
Schwarzengrund	2 (4.9)	2																			
Typhimurium	2 (4.9)	1	1							1	1	1	1	1							
Agona	1 (2.4)				1				1	1	1	1	1	1	1	1		1			1
Anatum	1 (2.4)	1																			
Derby	1 (2.4)				1			1	1	1	1	1	1	1	1						1
Enteritidis	1 (2.4)	1																			
I 4,[5],12:-:-	1 (2.4)		1							1	1	1	1	1							
Johannesburg	1 (2.4)			1											1			1			1
Newport	1 (2.4)		1							1	1	1	1	1							
Orion var.15+34+	1 (2.4)	1																			
Ouakam	1 (2.4)			1			1	1	1	1		1		1							
Rissen	1 (2.4)	1																			
Total	**41 (100)**	**14**	**8**	**14**	**3**	**2**	**7**	**7**	**17**	**16**	**13**	**16**	**13**	**16**	**10**	**3**	**2**	**6**		**1**	**14**

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.

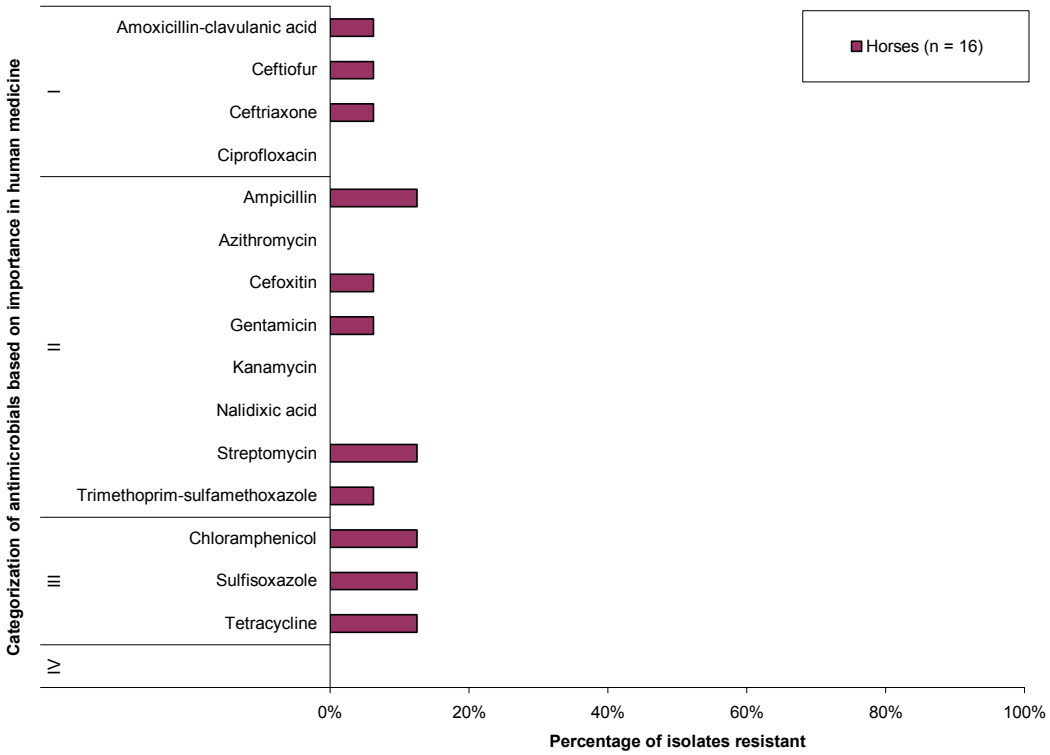
Horses

Salmonella

Surveillance of Animal Clinical Isolates

(n = 16)

Figure 34. Resistance to antimicrobials in *Salmonella* isolates from horses; *Surveillance of Animal Clinical Isolates*, 2011.



Confidence intervals are not displayed for animal clinical data because samples were not obtained randomly and may not represent independent observations and true estimates of the prevalence.

Table 27. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from horses; *Surveillance of Animal Clinical Isolates*, 2011.

Serovar	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial												
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Typhimurium	3 (18.8)	2			1				1	1					1			1			1
Heidelberg	2 (12.5)	1			1		1		1	1	1	1	1	1	1	1		1			1
Oranienburg	2 (12.5)	2																			
Typhimurium var. 5-	2 (12.5)	2																			
Berta	1 (6.3)	1																			
Enteritidis	1 (6.3)	1																			
I 4,[5],12:i:-	1 (6.3)	1																			
Senftenberg	1 (6.3)	1																			
Stanley	1 (6.3)	1																			
Thompson	1 (6.3)	1																			
Uganda	1 (6.3)	1																			
Total	**16 (100)**	**14**			**2**		**1**		**2**	**2**	**1**	**1**	**1**	**1**	**2**	**1**		**2**			**2**

Antimicrobial abbreviations are defined in the Appendix.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.

Feed and Feed Ingredients

Salmonella

(n = 14)

Table 28. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from feed and feed ingredients; *Feed and Feed Ingredients*, 2011.

Serovar	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial												
							Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Senftenberg	3 (21.4)	3																			
Mbandaka	2 (14.3)	2																			
Agona	1 (7.1)	1																			
Anatum var.15+	1 (7.1)	1																			
Bareilly	1 (7.1)	1																			
Braenderup	1 (7.1)	1																			
I 10:-:1,5	1 (7.1)	1																			
I 42:z4,z23:-	1 (7.1)	1																			
Orion var.15+34+	1 (7.1)	1																			
Ouakam	1 (7.1)	1																			
Rissen	25 (13.0)	1																			
Total	**14 (100)**	**14**																			

Antimicrobial abbreviations are defined in the Appendix.

Appendix

Antimicrobial Susceptibility Breakpoints

Table A.1. Breakpoints in antimicrobial susceptibility of *Salmonella* and *Escherichia coli* isolates; CMV2AGNF plate,[1] 2011.

	Antimicrobial	Range tested (μg/mL)	Breakpoints[a] (μg/mL)		
			S	I	R
I	Amoxicillin-clavulanic acid	1.0/0.5 – 32/16	≤ 8/4	16/8	≥ 32/16
	Ceftiofur[b]	0.12 – 8	≤ 2	4	≥ 8
	Ceftriaxone	0.25 – 64	≤ 1	2	≥ 4
	Ciprofloxacin	0.015 – 4	≤ 1	2	≥ 4
II	Ampicillin	1 – 32	≤ 8	16	≥ 32
	Azithromycin[c]	0.12 – 16	≤ 16	N/A	≥ 32
	Cefoxitin	0.5 – 32	≤ 8	16	≥ 32
	Gentamicin	0.25 – 16	≤ 4	8	≥ 16
	Kanamycin	8 – 64	≤ 16	32	≥ 64
	Nalidixic acid	0.5 – 32	≤ 16	N/A	≥ 32
	Streptomycin[c]	32 – 64	≤ 32	N/A	≥ 64
	Trimethoprim-sulfamethoxazole	0.12/2.38 – 4/76	≤ 2/38	N/A	≥ 4/76
III	Chloramphenicol	2 – 32	≤ 8	16	≥ 32
	Sulfisoxazole	16 – 512	≤ 256	N/A	≥ 512
	Tetracycline	4 – 32	≤ 4	8	≥ 16
IV					

Roman numerals I to IV indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.
S = Susceptible. I = Intermediate susceptibility. R = Resistant. N/A = Not applicable.
[a] Unless otherwise specified, CLSI M100-S21 was the reference used for all antimicrobials in the panel.
[b] CLSI M31-A2.
[c] No Clinical and Laboratory Standards Institute interpretive criteria for Enterobacteriaceae were available for this antimicrobial. Breakpoints were based on the distribution of minimal inhibitory concentrations and were harmonized with those of the National Antimicrobial Resistance Monitoring System.

[1] http://www.trekds.com/products/sensititre/vet_pltformats.asp

Table A.2. Breakpoints in antimicrobial susceptibility of *Campylobacter* isolates; CAMPY plate,[1] 2011.

	Antimicrobial	Range tested (μg/mL)	Breakpoints[a] (μg/mL)		
			S	I	R
I	Ciprofloxacin	0.015 – 64	≤ 1	2	≥ 4
	Telithromycin[b]	0.015 – 8	≤ 4	8	≥ 16
II	Azithromycin[b]	0.015 – 64	≤ 2	4	≥ 8
	Clindamycin[b]	0.03 – 16	≤ 2	4	≥ 8
	Erythromycin	0.03 – 64	≤ 8	16	≥ 32
	Gentamicin[b]	0.12 – 32	≤ 2	4	≥ 8
	Nalidixic acid[b]	4 – 64	≤ 16	32	≥ 64
III	Florfenicol[c]	0.03 – 64	≤ 4	N/A	N/A
	Tetracycline	0.06 – 64	≤ 4	8	≥ 16
IV					

Roman numerals I to IV indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.
S = Susceptible. I = Intermediate susceptibility. R = Resistant. N/A = Not applicable.
[a] CLSI M45-A2.
[b] No Clinical and Laboratory Standards Institute interpretive criteria for *Campylobacter* were available for this antimicrobial. Breakpoints were based on the distribution of minimal inhibitory concentrations and were harmonized with those of the National Antimicrobial Resistance Monitoring System.
[c] For florfenicol, only a susceptible breakpoint has been established. In this report, we therefore only report the proportion of isolates non-susceptible.

[1] http://www.trekds.com/products/sensititre/vet_pltformats.asp

Recovery Rates

Table A.3. Bacterial recovery rates of samples collected through the CIPARS agri-food components, 2002-2011.

CIPARS Component/ Animal species	Province or region	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted							
			Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*	
Retail Meat Surveillance										
Beef	British Columbia	2005	**93%**	27/29						
		2007	**79%**	49/62						
		2008	**77%**	88/115						
		2009	**71%**	79/112						
		2010	**51%**	64/125						
		2011	**53%**	57/107						
	Saskatchewan	2005	**79%**	120/151						
		2006	**76%**	123/161						
		2007	**78%**	118/151						
		2008	**76%**	134/177						
		2009	**83%**	135/163						
		2010	**80%**	107/134						
		2011[a]	**75%**	54/72						
	Ontario	2003	**66%**	101/154	**2%**	2/84	**3%**	2/76	**91%**	69/76
		2004	**80%**	190/237						
		2005	**81%**	184/227						
		2006	**81%**	189/235						
		2007	**71%**	184/227						
		2008	**78%**	185/236						
		2009	**79%**	195/248						
		2010	**69%**	123/177						
		2011	**73%**	161/222						
	Québec	2003	**57%**	84/147	**0%**	0/33	**0%**	0/33	**80%**	28/35
		2004	**56%**	137/245						
		2005	**56%**	126/225						
		2006	**50%**	109/215						
		2007	**68%**	147/216						
		2008	**59%**	126/214						
		2009	**54%**	108/201						
		2010	**46%**	102/223						
		2011	**45%**	91/204						
	Maritimes	2004	**67%**	16/24						
		2007	**52%**	16/31						
		2008	**70%**	39/56						
		2009	**69%**	137/200						
		2010	**69%**	126/183						
		2011	**58%**	110/191						

Grey-shaded areas with results represent isolates recovered from CIPARS non-core surveillance (pilot surveillance) and those without results indicate absence or discontinuation of surveillance activity.
Human and animal clinical *Salmonella* data were not presented as the information on the number of samples cultured and isolates recovered was unavailable to CIPARS.
The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.
[a] In 2011, due to an unforeseeable pause in retail sampling in Saskatchewan of approximately 3 months, the expected number of samples was not met and thus, results for this province should be interpreted with caution.

Table A.3. (continued). Bacterial recovery rates of samples collected through the CIPARS agri-food components, 2002-2011.

CIPARS Component/ Animal species	Province or region	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted							
			Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*	
Retail Meat Surveillance										
Chicken	British Columbia	2005	**95%**	19/20	**13%**	5/39	**69%**	27/39	**100%**	20/20
		2007	**98%**	42/43	**22%**[b]	18/81	**35%**	28/80	**100%**	34/34
		2008	**90%**	70/78	**32%**	47/145	**34%**	50/145	**100%**	78/78
		2009	**95%**	70/74	**40%**	59/146	**53%**	78/146	**97%**	72/74
		2010	**89%**	75/84	**34%**	56/166	**42%**	70/166		
		2011	**96%**	70/73	**45%**	64/143	**50%**	71/143		
	Saskatchewan	2005	**98%**	81/83	**14%**	21/153	**37%**	53/145	**98%**	83/85
		2006	**98%**	85/86	**16%**	25/153	**33%**	51/155	**98%**	85/87
		2007	**97%**	75/77	**31%**[b]	43/141	**35%**	49/141	**100%**	77/77
		2008	**99%**	91/92	**40%**	64/161	**25%**	41/161	**100%**	92/92
		2009	**98%**	90/92	**47%**	71/150	**32%**	48/150	**100%**	92/92
		2010	**90%**	71/79	**32%**	42/132	**28%**	37/132		
		2011[a]	**97%**	38/39	**40%**	29/73	**34%**	25/73		
	Ontario	2003	**95%**	137/144	**16%**	27/167	**47%**	78/166	**99%**	143/144
		2004	**95%**	150/158	**17%**	54/315	**45%**	143/315	**100%**	158/158
		2005	**95%**	145/153	**9%**	26/303	**40%**	120/303	**99%**	150/152
		2006	**97%**	152/156	**12%**	36/311	**34%**	104/311	**98%**	154/156
		2007	**98%**	157/161	**54%**[b]	172/320	**37%**	117/320	**100%**	161/161
		2008	**96%**	150/156	**45%**	139/311	**39%**	121/311	**99%**	154/156
		2009	**95%**	155/164	**43%**	142/328	**31%**	101/328	**100%**	164/164
		2010	**86%**	100/116	**39%**	90/232	**28%**	64/232		
		2011	**93%**	137/147	**40%**	119/294	**24%**	71/293		
	Québec	2003	**89%**	112/126	**16%**	29/171	**55%**	94/170	**100%**	125/125
		2004	**96%**	157/161	**17%**	53/320	**50%**	161/322	**100%**	161/161
		2005	**95%**	142/149	**9%**	26/300	**34%**	103/299	**100%**	150/150
		2006	**94%**	135/144	**12%**	33/288	**35%**	100/288	**100%**	144/144
		2007	**90%**	129/144	**40%**[b]	113/287	**21%**	59/287	**99%**	143/144
		2008	**91%**	131/144	**42%**	120/287	**19%**	54/287	**100%**	144/144
		2009	**94%**	126/134	**39%**	105/267	**20%**	52/266	**99%**	132/134
		2010	**93%**	138/148	**39%**	116/296	**21%**	63/296		
		2011	**99%**	134/136	**37%**	100/272	**21%**	57/272		
	Maritimes	2004	**100%**	13/13	**4%**	1/25	**40%**	10/25	**100%**	13/13
		2007[c]	**91%**	29/32	**22%**[b]	7/32				
		2008[c]	**68%**	38/56	**22%**	12/56				
		2009[c]	**94%**	187/199	**49%**	97/199	**29%**	57/199		
		2010	**93%**	176/190	**41%**	77/190	**37%**	70/190		
		2011	**89%**	171/192	**28%**	53/192	**30%**	57/192		

Grey-shaded areas with results represent isolates recovered from CIPARS non-core surveillance (pilot surveillance) and those without results indicate absence or discontinuation of surveillance activity.
Human and animal clinical *Salmonella* data were not presented as the information on the number of samples cultured and isolates recovered was unavailable to CIPARS.
The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

[a] In 2011, due to an unforeseeable pause in retail sampling in Saskatchewan of approximately 3 months, the expected number of samples was not met and thus, results for this province should be interpreted with caution.
[b] Enhancement to the *Salmonella* recovery method yielded higher recovery rates from retail chicken in 2007 than in prior years.
[c] Recovery results are not presented for *Campylobacter* in 2007 and 2008 as well as for *Enterococcus* in 2007, 2008, and 2009 due to concerns regarding harmonization of laboratory methods.

Table A.3. (continued). Bacterial recovery rates of samples collected through the CIPARS agri-food components, 2002-2011.

CIPARS Component/ Animal species	Province or region	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted							
			Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*	
Retail Meat Surveillance										
Pork	British Columbia	2005	**31%**	10/32						
		2007	**29%**	23/79	**1%**	1/79				
		2008	**30%**	44/148	**2%**	3/148				
		2009	**26%**	38/145	**1%**	2/145				
		2010	**19%**	31/166	**1%**	2/167				
		2011	**27%**	49/180	**2%**	3/180				
	Saskatchewan	2005	**30%**	48/162						
		2006	**30%**	49/165	**2%**	3/134				
		2007	**25%**	38/154	**2%**	3/154				
		2008	**23%**	41/176	**1%**	1/176				
		2009	**18%**	29/164	**0%**	0/164				
		2010	**12%**	17/142	**1%**	1/142				
		2011[a]	**11%**	10/90	**1%**	1/90				
	Ontario	2003	**58%**	90/154	**1%**	1/93	**0%**	0/76	**87%**	66/76
		2004	**71%**	198/279						
		2005	**59%**	179/303						
		2006	**59%**	182/311	**< 1%**	1/255				
		2007	**54%**	172/320	**2%**	6/319				
		2008	**50%**	155/312	**2%**	7/310				
		2009	**41%**	136/328	**2%**	8/327				
		2010	**38%**	84/224	**0%**	0/224				
		2011	**42%**	155/371	**2%**	6/370				
	Québec	2003	**42%**	61/147	**3%**	1/32	**9%**	3/32	**82%**	28/34
		2004	**38%**	109/290						
		2005	**26%**	79/300						
		2006	**20%**	57/287	**0%**	0/232				
		2007	**22%**	64/287	**1%**	3/288				
		2008	**21%**	60/287	**2%**	5/286				
		2009	**15%**	41/268	**1%**	3/268				
		2010	**16%**	47/296	**1%**	4/296				
		2011	**32%**	122/387	**4%**	17/387				
	Maritimes	2004	**58%**	14/24						
		2007	**39%**	13/31	**3%**	1/30				
		2008	**30%**	17/56	**2%**	1/56				
		2009	**41%**	82/200	**3%**	5/199				
		2010	**39%**	74/190	**4%**	8/190				
		2011	**43%**	95/223	**3%**	7/221				
Turkey	British Columbia	2011	**97%**	59/61	**11%**	8/71	**24%**	17/71		
	Saskatchewan	2011[a]	**100%**	10/10	**20%**	2/10	**10%**	1/10		
	Ontario	2011	**95%**	162/171	**14%**	27/191	**9%**	18/191		
	Québec	2011	**91%**	138/152	**17%**	27/163	**10%**	16/163		

Grey-shaded areas with results represent isolates recovered from CIPARS non-core surveillance (pilot surveillance) and those without results indicate absence or discontinuation of surveillance activity.
Human and animal clinical *Salmonella* data were not presented as the information on the number of samples cultured and isolates recovered was unavailable to CIPARS.
The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

[a] In 2011, due to an unforeseeable pause in retail sampling in Saskatchewan of approximately 3 months, the expected number of samples was not met and thus, results for this province should be interpreted with caution.

Table A.3. (continued). Bacterial recovery rates of samples collected through the CIPARS agri-food components, 2002-2011.

CIPARS Component/ Animal species	Province or region	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted							
			Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*	
Abattoir Surveillance										
Beef cattle		2002	**97%**	76/78	**1%**	3/78				
		2003	**97%**	155/159	**< 1 %**	1/114				
		2004	**98%**	167/170						
		2005	**97%**	122/126			**66%**	23/35		
		2006	**100%**	150/150			**36%**	31/87		
		2007	**99%**	188/190			**39%**	75/190		
		2008	**97%**	176/182			**71%**[d]	129/182		
		2009	**94%**	119/126			**68%**	86/126		
		2010	**97%**[e]	77/79			**53%**[e]	37/70		
		2011	**99%**	139/141			**77%**	108/141		
Chickens		2002	**100%**	40/40	**13%**	25/195				
		2003	**97%**	150/153	**16%**	126/803				
		2004	**99%**	130/131	**16%**	142/893				
		2005	**99%**	218/220	**18%**	200/1,103				
		2006	**100%**	166/166	**23%**	187/824				
		2007	**99%**	180/181	**25%**	204/808				
		2008	**99%**	170/171	**28%**	234/851				
		2009	**100%**	171/171	**27%**	230/851				
		2010	**99%**	119/120	**24%**	142/599	**19%**	111/599		
		2011	**99%**	164/166	**20%**	140/701	**17%**	117/696		
Pigs		2002	**97%**	38/39	**27%**	103/385				
		2003	**98%**	153/155	**28%**	395/1,393				
		2004	**99%**	142/143	**38%**	270/703				
		2005	**99%**	163/164	**42%**	212/486				
		2006	**98%**	115/117	**40%**	145/359				
		2007	**98%**	93/95	**36%**	105/296				
		2008	**100%**	150/150	**44%**	151/340				
		2009	**98%**	160/163	**45%**	147/327				
		2010	**98%**	199/203	**44%**	182/410				
		2011	**99%**	190/191	**43%**	165/382				
Farm Surveillance										
Pigs		2006	**99%**	459/462	**20%**	94/462			**81%**	374/462
		2007	**100%**	612/612	**21%**	136/612			**81%**	495/612
		2008	**99%**	481/486	**13%**	61/486			**92%**	448/486
		2009	**99%**	695/698	**18%**	124/698			**97%**	680/698
		2010	**99%**	566/569	**18%**	101/569			**96%**	545/569
		2011	**100%**	560/560	**14%**	77/560				

Grey-shaded areas with results represent isolates recovered from CIPARS non-core surveillance (pilot surveillance) and those without results indicate absence or discontinuation of surveillance activity.
Human and animal clinical *Salmonella* data were not presented as the information on the number of samples cultured and isolates recovered was unavailable to CIPARS.
The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.
[d] Implementation of a new *Campylobacter* recovery method in 2008 in abattoir beef cattle isolates.
[e] In 2010, the number of samples received from abattoir beef cattle was much lower than anticipated due to a 55% drop in submissions related to unavoidable operational issues at 2 major participating abattoirs.

Abbreviations

Antimicrobials

AMC	Amoxicillin-clavulanic acid
AMK	Amikacin
AMP	Ampicillin
AZM	Azithromycin
CHL	Chloramphenicol
CIP	Ciprofloxacin
CLI	Clindamycin
CRO	Ceftriaxone
ERY	Erythromycin
FLR	Florfenicol
FOX	Cefoxitin
GEN	Gentamicin
KAN	Kanamycin
NAL	Nalidixic acid
SSS	Sulfisoxazole
STR	Streptomycin
SXT	Trimethoprim-sulfamethoxazole
TEL	Telithromycin
TET	Tetracycline
TIO	Ceftiofur

Canadian Provinces, Territories, and Region

BC	British Columbia
AB	Alberta
SK	Saskatchewan
MB	Manitoba
ON	Ontario
QC	Québec
NB	New Brunswick
NS	Nova Scotia
PEI	Prince Edward Island
NL	Newfoundland and Labrador

Territories

YT	Yukon
NT	Northwest Territories
NU	Nunavut

The Maritimes

New Brunswick
Nova Scotia
Prince Edward Island