Government of Canada Gouvernement du Canada

2012

CANADIAN INTEGRATED PROGRAM FOR ANTIMICROBIAL RESISTANCE SURVEILLANCE (CIPARS) ANNUAL REPORT

CHAPTER 2. ANTIMICROBIAL RESISTANCE

Canada

TO PROMOTE AND PROTECT THE HEALTH OF CANADIANS THROUGH LEADERSHIP, PARTNERSHIP, INNOVATION AND ACTION IN PUBLIC HEALTH.

—Public Health Agency of Canada

Également disponible en français sous le titre :

Rapport annuel du Programme intégré canadien de surveillance de la résistance aux antimicrobiens (PICRA) de 2012 - Chapitre 2. Résistance aux antimicrobiens

To obtain additional information, please contact:

Public Health Agency of Canada
Address Locator 0900C2
Ottawa, ON K1A 0K9
Tel.: 613-957-2991
Toll free: 1-866-225-0709
Fax: 613-941-5366
TTY: 1-800-465-7735
E-mail: publications@hc-sc.gc.ca

Publication date: September 2014

Cat.: HP2-4/2012-2E-PDF

ISSN: 1925-9859

Pub.: 140294

Suggested Citation

Government of Canada. Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) 2012 Annual Report – Chapter 2. Antimicrobial Resistance. Public Health Agency of Canada, Guelph, Ontario, 2014.

2

ANTIMICROBIAL RESISTANCE

TABLE OF CONTENTS

CONTRIBUTORS

PROGRAM COORDINATORS

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

SURVEILLANCE COMPONENT LEADS

Surveillance of Human Clinical Isolates
Rita Finley and Michael Mulvey
Retail Meat Surveillance
Brent Avery
Abattoir Surveillance
Anne Deckert
Farm Surveillance
Agnes Agunos, Anne Deckert, Sheryl Gow, and David Léger
Surveillance of Animal Clinical Isolates
Brent Avery and Jane Parmley

DATA MANAGEMENT, ANALYSIS, AND REPORTING LEADS

Brent Avery, Antoinette Ludwig, and Jane Parmley

LABORATORY COMPONENT LEADS

Laboratory for Foodborne Zoonoses, Guelph
Linda Cole (*Salmonella* Typing)
Andrea Desruisseau and Chad Gill (Antimicrobial Susceptibility Testing)
Laboratory for Foodborne Zoonoses, Saint-Hyacinthe
Danielle Daignault and Manon Caron (Antimicrobial Susceptibility Testing)
National Microbiology Laboratory, Winnipeg
Helen Tabor (*Salmonella* Serotyping)
Rafiq Ahmed (*Salmonella* Phage Typing)
Michael Mulvey (Antimicrobial Susceptibility Testing)

AUTHORS/ANALYSTS

Brent Avery, Anne Deckert, Rita Finley, Sheryl Gow, and Jane Parmley

REVIEWERS

Internal
Brent Avery, Carolee Carson, Danielle Daignault, Anne Deckert, Andrea Desruisseau, Rita Finley, Sheryl Gow, David Léger, Jane Parmley, Michelle Tessier, and Virginia Young

---

[1] Centre for Food-borne, Environmental and Zoonotic Infectious Diseases, Public Health Agency of Canada (PHAC)
[2] Laboratory for Foodborne Zoonoses, PHAC
[3] National Microbiology Laboratory, PHAC

External
Frank Pollari and Andrea Nesbitt[4]
Xian-Zhi Li[5]
Allison C. Brown[6]

REPORT PRODUCTION

Michelle Tessier and Virginia Young

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.
British Columbia Public Health Microbiology & Reference Laboratory, Provincial Health Services Authority, British Columbia (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)
Microbiology Laboratory, Queen Elizabeth II Health Sciences Centre, Nova Scotia (David Haldane)
Laboratory Services, Queen Elizabeth Hospital, Prince Edward Island (Greg German)
Newfoundland Public Health Laboratory (Sam Ratnam)

RETAIL MEAT SURVEILLANCE

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, Edwin MacDougall, Shaun Malakoe, Ron Popoff, Diane Pustina, Doug Quibell, Jennifer Reid, Peter Richter, Torsten Schulz, and Matthew Shumaker

[4] FoodNet Canada, Centre for Food-borne, Environmental and Zoonotic Infectious Diseases, Public Health Agency of Canada
[5] Veterinary Drugs Directorate, Health Canada
[6] National Antimicrobial Resistance Monitoring System for enteric bacteria (NARMS), United States Centers for Disease Control and Prevention

ABATTOIR SURVEILLANCE

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

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 générale des laboratoires d'expertise du ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (Marie Nadeau)
Laboratoire d'épidémiosurveillance animale du Québec (Olivia Labrecque)
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)

NATIONAL ANTIMICROBIAL RESISTANCE MONITORING SYSTEM FOR ENTERIC BACTERIA (NARMS)

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

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 would also like to thank the following individuals and organizations for their contribution to CIPARS 2012:

Public Health Agency of Canada
Ashleigh Andrysiak, Louise Bellai, Mark Blenkinsop, Gail Christie, Sindy Cleary, Ann-Marie Cochrane, Marie-Claude Deshaies, Claudia Dulgheru, George Golding, 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, Sophia Sheriff, Chris de Spiegelaere, Lien Mi Tien ,

Anatoliy Trokhymchuk, Rama Viswanathan, Victoria Weaver, Betty Wilkie, and Magdalena Zietarska

Canadian Food Inspection Agency
David Johnson, Daniel Leclair, and Marina Steele

Health Canada, Veterinary Drugs Directorate
Xian-Zhi Li and Manisha Mehrotra

Other Organizations
Canadian Meat Council
Canadian Pork Council
CIPARS Farm Swine Advisory Committee

SUMMARY – THE TOP KEY FINDINGS

Humans

- Pan-susceptibility among tested *Salmonella* isolates significantly increased from 2003 (59%) and 2011 (67%) to 2012 (70%).
- Resistance to Category I drugs remained stable, with 8% of *Salmonella* isolates observed in 2012 and 2011, respectively, and lower than the levels observed in 2003 (10%).
- Resistance to ciprofloxacin (Category I drug) continued to increase among *Salmonella* Typhi, with 3% and 10% observed in 2011 and 2012, respectively.

Abattoir

- In *Salmonella* from chicken, resistance to ceftiofur in 2012 was significantly higher than in 2006 but significantly lower than in 2011.
- Ten percent of *Campylobacter coli* isolates from pigs were resistant to ciprofloxacin in 2012.
- Resistance to ciprofloxacin was observed for the first time in an *Escherichia coli* isolate from chicken.

Integration of data across human, animal species and bacteria will be presented in Chapter 4. Integrated Findings and Discussion.

Retail Meat

- Ciprofloxacin resistance in *Campylobacter* from chicken continued to decline in British Columbia but has significantly increased in Ontario compared to the 2011.
- In Ontario, ceftiofur resistance among *Salmonella* from chicken was significantly lower in 2012 than 2004. In Québec, resistance to ceftiofur was significantly lower in 2012 than 2003 but was significantly higher in 2012 compared to 2006.
- In the first year of retail ground turkey collection, resistance to 6 of the 7 antimicrobial classes tested was observed in a single isolate of *S.* Indiana from Ontario. One *E. coli* isolate from Ontario was resistant to 7 (all) classes of antimicrobials tested.

On Farm

- In *E. coli* resistance to ceftiofur was significantly higher in 2012 (3%) than in 2006 (1%) or than in 2011 (1%).
- *E. coli* resistance to streptomcyin was also significantly higher in 2012 (44%) than in 2006 (37%) or 2011 (33%).
- Ampicillin resistance in *E. coli* was significantly lower in 2012 (31%), than in 2006 (35%).

PREAMBLE

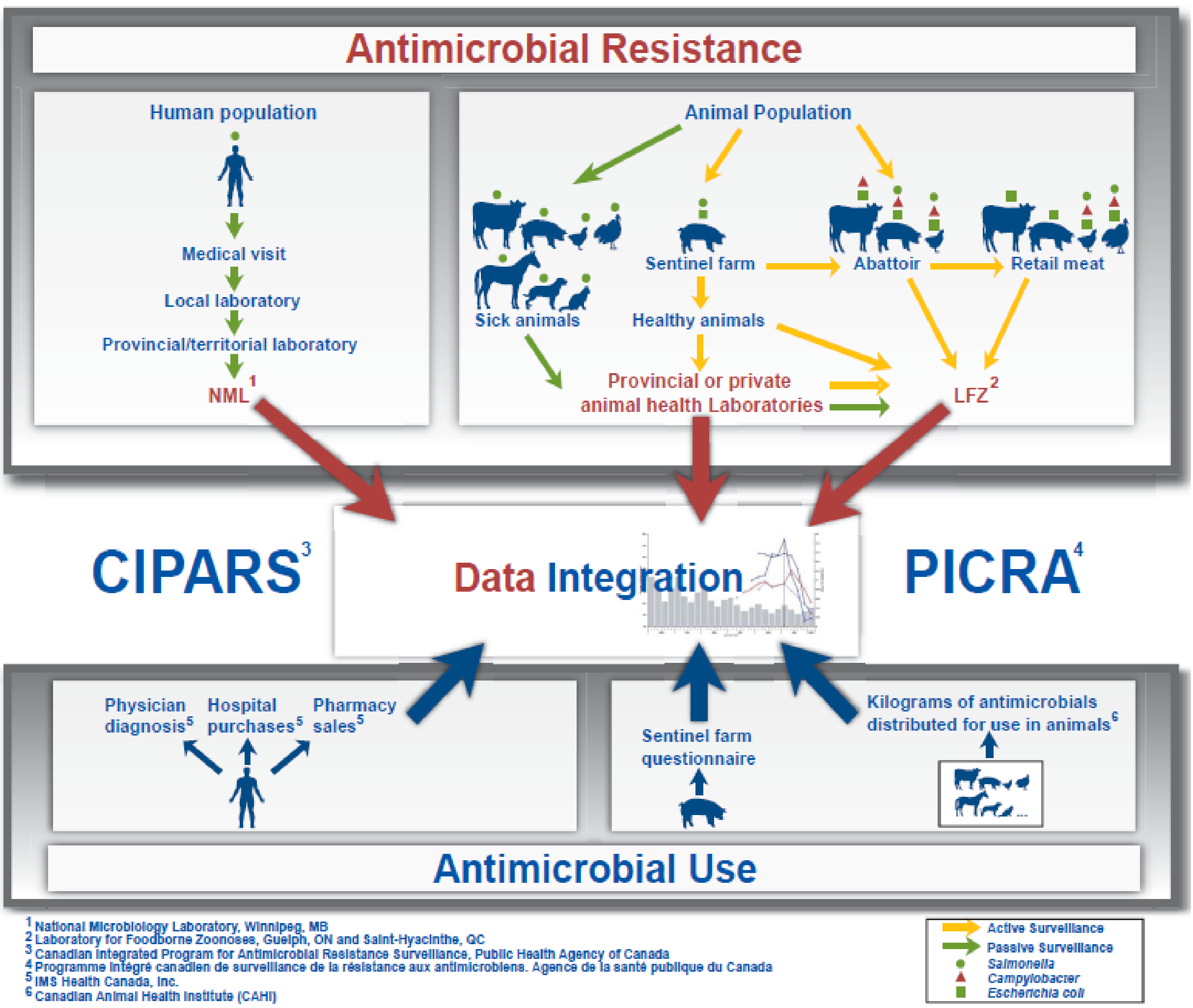
ABOUT CIPARS

The Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS), created in 2002, is a national program dedicated to the collection, integration, analysis, and communication of trends in antimicrobial use (AMU) and resistance (AMR) in selected bacteria from humans, animals, and animal-derived food sources across Canada. This information supports (i) the creation of evidence-based policies for AMU in hospitals, communities, and food-animal production with the aim of prolonging the effectiveness of these drugs and (ii) the identification of appropriate measures to contain the emergence and spread of resistant bacteria among animals, food, and people.

During 2012, CIPARS held discussions on new ways of analyzing and presenting the surveillance data, to adjust for different data closure dates and to maximize the integration of existing data. The Annual Report will now be released in a Chapter format to improve the timeliness of the data release where possible and consists of four chapters: Chapter 1 – Design and Methods, Chapter 2 – Antimicrobial Resistance, Chapter 3 – Antimicrobial Use, and Chapter 4 – Integrated Findings and Discussion. Chapter 1 includes detailed information on the Design and methods used by CIPARS to obtain and analyze the AMR and AMU data, including two summary tables describing changes that have been implemented since the beginning of the program. Chapter 2 and 3 present results for AMR and AMU, respectively, with each one including a section presenting the top key findings. Chapter 4 aims to bring together some of the results across surveillance components, over time and regions, and across host/bacterial species in an integrated manner and includes interpretation of this integration.

CIPARS SURVEILLANCE COMPONENTS

Figure 1. Diagram of CIPARS surveillance components in 2012



ABBREVIATIONS

ANTIMICROBIALS/ANTIMICROBIAL RESISTANCE PATTERNS

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

ANTIMICROBIAL RESISTANCE PATTERNS
A2C-AMP Amoxicillin-clavulanic acid, cefoxitin, ceftiofur, and ampicillin
ACSSuT Ampicillin, chloramphenicol, streptomycin, sulfisoxazole, and tetracycline
ACKSSuT Ampicillin, chloramphenicol, kanamycin, streptomycin, sulfisoxazole, and tetracycline
AKSSuT Ampicillin, kanamycin, streptomycin, sulfisoxazole, and tetracycline

CANADIAN PROVINCES, TERRITORIES, AND REGION

PROVINCES
BC British Columbia
AB Alberta
SK Saskatchewan
MB Manitoba
ON Ontario
QC Québec
NL Newfoundland and Labrador

TERRITORIES
YT Yukon
NT Northwest Territories
NU Nunavut

REGION OF THE MARITIMES
New Brunswick
Nova Scotia
Prince Edward Island

HUMAN SURVEILLANCE

KEY FINDINGS

The Provincial Public Health Laboratories forwarded a total of 4,129 *Salmonella* isolates (171 serovars) to the National Microbiology Laboratory, Public Health Agency of Canada, for phage typing and susceptibility testing.
Susceptibility testing was carried out on 8 serovars: Enteritidis, Heidelberg, Newport, Paratyphi A, Paratyphi B, Typhi, Typhimurium, and 4,[5],12:i:-. All other isolates have been stored for future susceptibility testing. Summary results are only provided for these serotypes based on analysis conducted on 2,565 isolates.
Human patients aged 50-69 years represented the most common age group for which *Salmonella* isolates were tested (15%, 564/2,565). Ontario was the province for which the largest proportion of isolates was received (41%, 1,547/2,565). Provincial incidence rates for specific *Salmonella* serovar infections can be found in Figure 2.

ENTERITIDIS (n = 1,179)

Most common phage types (PT) recovered: PT 8 (31%, 367/1,179), PT 13a (15%, 181/1,179) and atypical [7](11%, 134/1,179). Three percent of isolates were recovered from blood; significant increases in isolates from urine were observed in 2012 (3%, 40/1,179) compared to 2011 (2%, 18/951).
Significant increase in resistance to ciprofloxacin was observed compared to 2011, when no resistance was observed. Ten isolates had resistance in 2012 (1%, 10/1,179) compared to 1 isolate observed in 2009 (less than 1%, 1/1,092), the only other time when observed. Different PT were involved (22, 34a, 8, and atypical).
Overall a significant reduction in nalidixic acid resistance was observed between 2011 (15%, 146/951) and 2012 (12%, 145/1,179). Significant decrease was seen in Ontario from 21% (50/236) to 14% (53/374). A total of 9 isolates resistant to ciprofloxacin did not exhibit resistance to nalidixic acid. Less than 1% of the Enteritidis isolates (2/1,179) were resistant to both nalidixic acid and ceftriaxone.
The most common resistance pattern was nalidixic acid (11%, 124/1,179) mainly consisting of PT atypical (40%, 50/124) and PT 1 isolates (24%, 30/124). The pattern involving the greatest number of antimicrobials was AMP-AZM-FOX-TIO-CRO-CIP-GEN-KAN-NAL-SSS-TET-SXT (1 PT 8 isolate from Nova Scotia).

[7] Atypical isolates are those that reacted with the phages but did not conform to any recognized phage type (2012 Annual Report – Chapter 1. Design and Methods).

HEIDELBERG (n = 555)

Most common PT recovered included: PT 19 (54%, 298/555), PT 29 (21%, 114/555) and PT 18 (5%, 25/555) (Figure 3). Phage type 19 significantly increased compared to 2011 (45%, 171/377). Five percent (25/555) of isolates were recovered from urine and 10% (55/555) from blood.
Significant changes in resistance to specific antimicrobials and in specific provinces were observed:

Ceftiofur

- Decrease from 33% (125/377) in 2011 to 27% (150/555) in 2012
- Increase from 13% (57/430) in 2006 to 27% (150/555) in 2012
- Decrease from 33% (181/556) in 2004 to 27% (150/555) in 2012
- Increase in British Columbia from 12% (2/17) in 2011 to 64% (25/39) in 2012
- Decrease in Ontario from 35%, (49/140) in 2011 to 16% (35/222) in 2012

Amoxicillin-clavulanic acid

- Decrease from 33% (125/377) in 2011 to 25% (141/555) in 2012
- Increase in British Columbia from 12% (2/17) in 2011 to 49% (19/39) in 2012
- Decrease in Ontario from 35% (49/140) in 2011 to 16% (35/222) in 2012

Ceftriaxone

- Decrease from 33% (125/377) in 2011 to 26% (151/555) in 2012
- Increase in British Columbia from 12% (2/17) in 2011 to 67% (26/39) in 2012
- Decrease in Ontario from 35% (49/140) in 2011 to 16% (35/222) in 2012

Ampicillin

- Decrease from 41% (153/377) in 2011 to 34% (183/555) in 2012
- Decrease from 39% (168/430) in 2006 to 33% (183/555) in 2012
- Decrease from 45% (250/556) in 2004 to 33% (183/555) in 2012
- Increase in British Columbia from 24% (4/17) in 2011 to 74% (29/39) in 2012
- Decrease in Ontario from 44% (61/140) in 2011 to 22% (49/222) in 2012

Cefoxitin

- Decrease from 33% (125/377) in 2011 to 25% (140/555) in 2012
- Increase in British Columbia from 12% (2/17) in 2011 to 49% (19/39) in 2012
- Decrease in Ontario from 35% (49/140) in 2011 to 16% (35/222) in 2012

For all years combined, 81% (813/995) of resistance to ceftiofur is observed among PT 29, PT 41, PT 4, PT 32, and PT 19. Approximately 70% (2,353/3,405) of all ceftiofur-susceptible strains were among PT 19, 26, atypical, 11, and 5. Overall, resistance to ceftiofur was driven by the increases or decreases of PT 29 among Heidelberg isolates (Figure 3).

The most common resistance pattern was A2C-AMP-CRO (24%, 135/555), followed by the AMP pattern (4%, 24/555). The pattern involving the greatest number of antimicrobials was A2C-AMP-CRO-STR-SSS (1 PT 29 isolate from Manitoba).
Significant changes in age have occurred between 2011 and 2012: 18-29 age group has significantly increased from 9% (34/377) to 14% (79/555) of Heidelberg isolates, while those from patients 70 years and older has significantly decreased from 10% (39/377) to 3% (19/555) (Figure 5).

NEWPORT (n = 149)

The most common PT recovered included: PT 9 (17%, 26/149), atypical (15%, 23/149), and PT 2 (15%, 22/149). Three percent (4/149) of isolates were recovered from urine and 2% (3/149) from blood.
In 2011, decreases were observed in resistance to the A2C-AMP-CRO pattern (amoxicillin-clavulanic acid, ceftiofur, ceftriaxone, ampicillin, and cefoxitin) for British Columbia (21%, 3/14) and Alberta (15%, 3/20) when compared to 2012 (5%, 1/19 and 1/20, respectively). In 2012, nalidixic acid resistance was observed this year in 1 isolate each from Alberta, Saskatchewan, and Ontario only. There was no nalidixic acid resistance observed in 2011 and only in 1 isolate in 2010.
The most common resistance pattern was ACSSuT-A2C-CRO (5%, 8/149), followed by the NAL (1%, 2/149) and the CHL-KAN-STR-SSS-TET-SXT (1%, 2/149) patterns. The pattern involving the greatest number of antimicrobials was ACSSuT-A2C-CRO-SXT (1 PT 17a isolate from Québec).
Changes in patient age have occurred between 2011 and 2012: the proportion of Newport isolates belonging to the 18-29 age group represented 9% (9/149) of all cases, the lowest percentage observed since 2003 (Figure 6). The total number of isolates in the 30-49 and 50-69 age categories increased between 2011 (17%, 33/193; 17%, 32/193 respectively) and 2012 (20%, 29/149; 21%, 31/149 respectively).

PARATYPHI A (n = 38) and PARATYPHI B (n = 0)

There were no Paratyphi B isolates received by CIPARS for susceptibility testing in 2012. Sixty-three percent of Paratyphi A isolates (24/38) were recovered from blood samples.
Resistance to ciprofloxacin was observed in 1 Paratyphi A isolate from British Columbia (Table 1). This resistance was previously observed in 1 isolate from Nova Scotia in 2010. Resistance to nalidixic acid significantly increased from 42% (5/12) in 2011 to 95% (36/38) in 2012 (Figure 9).

TYPHI (n = 144)

The most common phage types recovered were PT UVS (I+IV) (23%, 33/144), PT E1 (21%, 30/144), PT E9 var. (15%, 21/144). Sixty-nine percent (99/144) of isolates were recovered from blood samples and 1% (1/144) from urine.
Overall, there was a significant increase in ciprofloxacin resistance from 3% (5/197) in 2011 to 10%, (14/144) observed in 2012. A significant increase in ciprofloxacin resistance from 4% (4/103) in 2011 to 17% (13/77) was also observed among isolates from Ontario in 2012.
The most common resistance pattern was resistance to the NAL pattern (58%, 83/144), followed by resistance to AMP-CHL-NAL-STR-SSS-SXT (15%, 22/144).
Significant increases in the proportion of Typhi cases between the ages of 5-12 years were observed from 10% (18/179) in 2010 to 19% (28/144) in 2012 (Figure 7). Smaller changes were also observed

among the age group of less than 5 years which increased from 2011 (6%, 13/197) to 2012 (10%, 15/144). A slight decrease among the age group of 50-69 years was observed between 2010 (9%, 17/179) and 2012 (5%, 7/144).

TYPHIMURIUM (n = 378)

The most common PT recovered was PT 108 (19%, 70/378), followed by atypical (16%, 60/378) and PT 104 (11%, 43/378). Significant decreases have been observed in PT 104 between 2003 (24%, 146/605) and 2012 (11%, 43/378).
Ciprofloxacin resistance was observed in 3 isolates in 2012 (2 from Ontario and 1 from Newfoundland and Labrador). No resistance was observed in 2011.
Azithromycin resistance was observed in 2 isolates from Ontario (PT 120 and atypical). No resistance to azithromycin was observed in 2011, the first year that susceptibility testing was undertaken for this antimicrobial. Azithromycin resistance was observed in the following resistance patterns: AZM-KAN-TET and AZM-CHL-GEN-KAN-STR-SSS-TET-SXT.
The most common resistance pattern was resistance to ACSSuT (14%, 52/378), followed by resistance to ACKSSuT (3%, 11/378). The pattern involving the greatest number of antimicrobials was ACSSuT-A2C-CRO-GEN-SXT (1 PT U310 isolate from Alberta).

4,[5],12:i:- (n = 122)

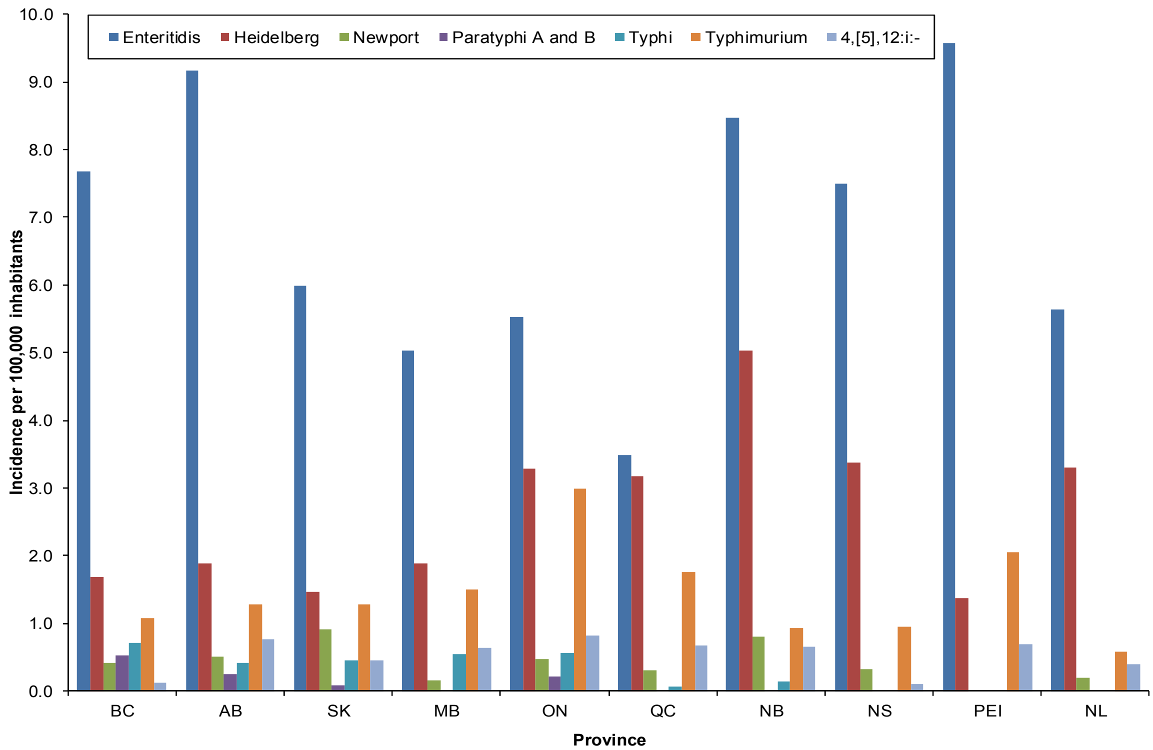
The most common PTs recovered were PT 193 (24%, 29/122), PT U291 (21%, 26/122) and atypical (17%, 21/122). Two percent (2/122) of isolates were recovered from urine samples and 1% (1/122) from blood.
Overall, significant decreases were observed among the following antimicrobials between 2011 and 2012:

- Amoxicillin resistance decreased from 12% (12/104) to 3% (3/122) (Figure 9).
- Ceftiofur resistance decreased from 12%, (12/104) to 2% (2/122). This decrease in Ontario was from 17% (4/23) to 2% (1/55) (Figure 9).
- Ceftriaxone resistance decreased from 12% (12/104) to 2% (2/122).
- Cefoxitin resistance decrease from 12% (12/104) to 2% (2/122).

Azithromycin resistance was observed in 3 isolates (1 PT 193 and 1 PT 35 from Ontario, and 1 PT 35 from Prince Edward Island). Resistance to azithromycin was observed in the following resistance patterns: AZM-KAN-TET (1 PT 35 from Ontario and 1 PT 35 from Prince Edward Island) and ACKSSuT-AZM-CIP-GEN-NAL-SXT (1 PT 193 isolate from Ontario).
The most common resistance pattern was AMP-STR-SSS-TET (25%, 31/122), followed by resistance to the TET pattern (9%, 11/122). The pattern involving the greatest number of antimicrobials was ACKSSUT-AZM-CIP-GEN-NAL-SXT (1 PT 193 isolate in Ontario).
Significant changes were observed among cases between the ages of 13-17 years which increased from 1% (1/104) in 2011 to 7% (9/122) of 4,[5],12:i:- isolates in 2012 (Figure 8). Smaller changes were also observed among the 50-69 age class which increased from 8%, (8/104) in 2011 to 16% (20/122) in 2012.

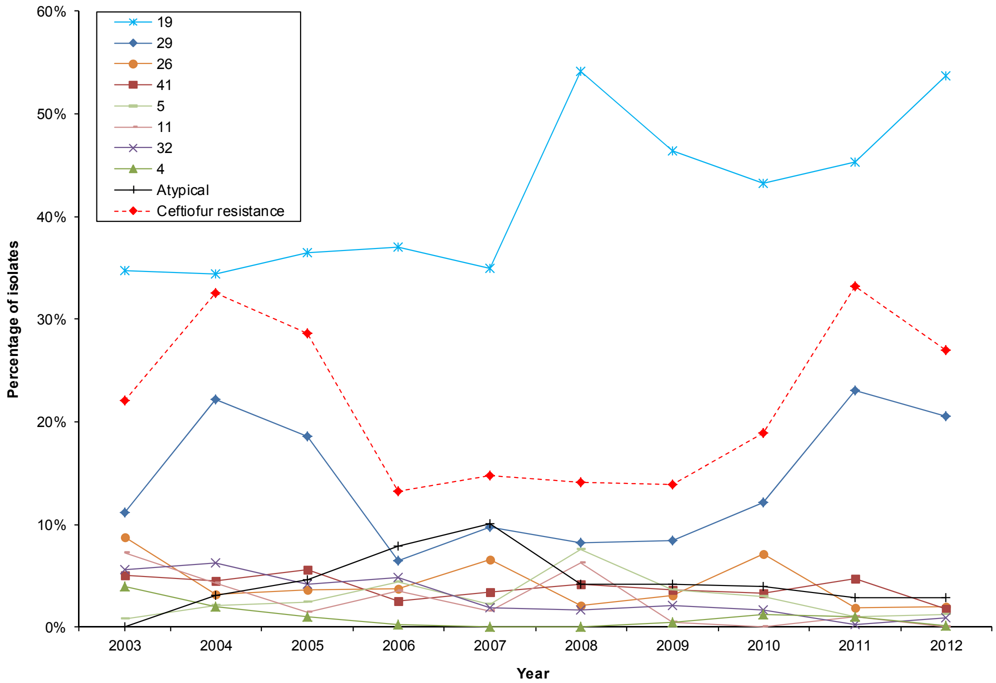
SEROVAR AND PHAGE TYPE DISTRIBUTION

Figure 2. Provincial incidence rates for specific *Salmonella* serovars in 2012



Provincial abbreviations are defined in the Preamble.
No *S.* Newport isolates were received from Prince Edward Island.
No *S.* Typhi isolates were received from Nova Scotia, Prince Edward Island, and Newfoundland and Labrador.
There were no Paratyphi B isolates received by CIPARS for susceptibility testing in 2012.

Figure 3. Temporal variations of the most common *Salmonella* Heidelberg phage types



For *Salmonella* Heidelberg, the majority of phage types were susceptible to ceftiofur, with the exception of PT 29 which contributed primarily to the observed ceftiofur resistance.

Figure 4. Temporal variations of age groups represented within *Salmonella* Enteritidis isolates

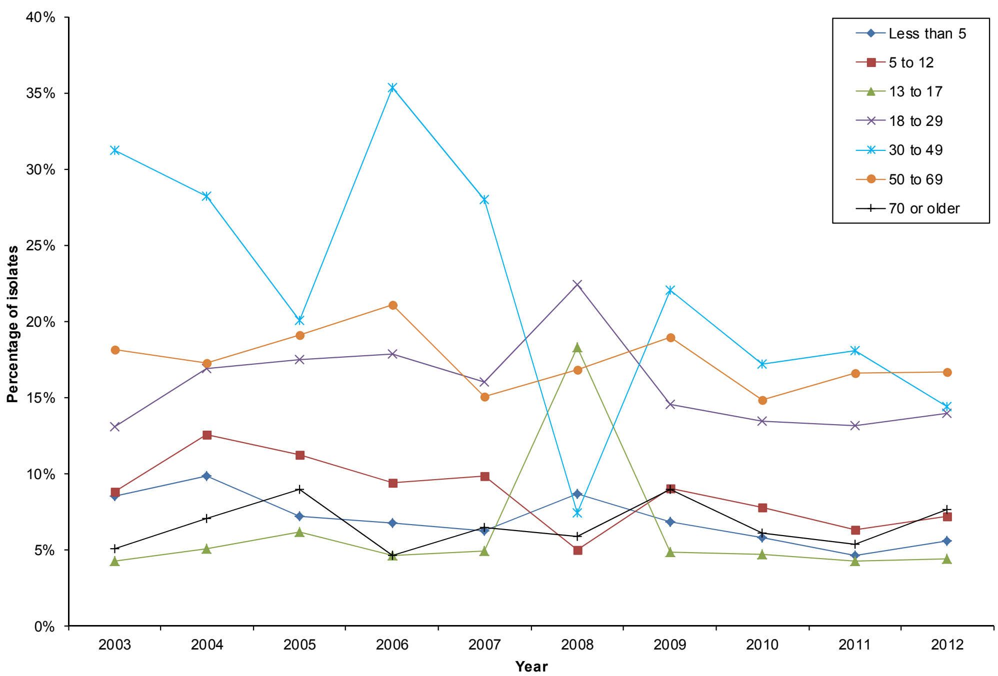


Figure 5. Temporal variations of age groups represented within *Salmonella* Heidelberg isolates

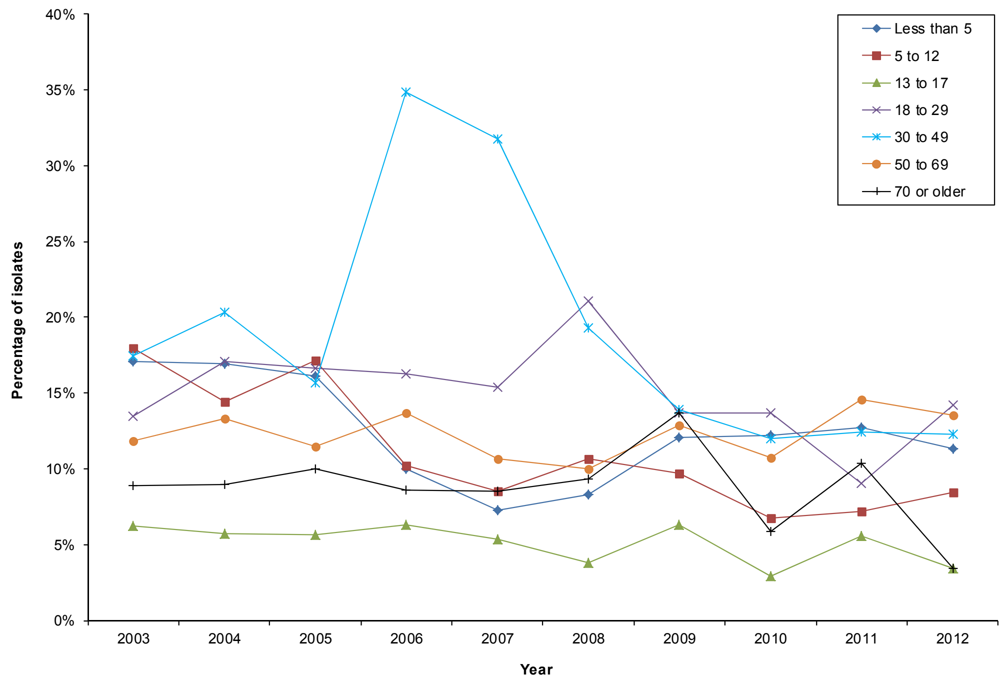


Figure 6. Temporal variations of age groups represented within *Salmonella* Newport isolates

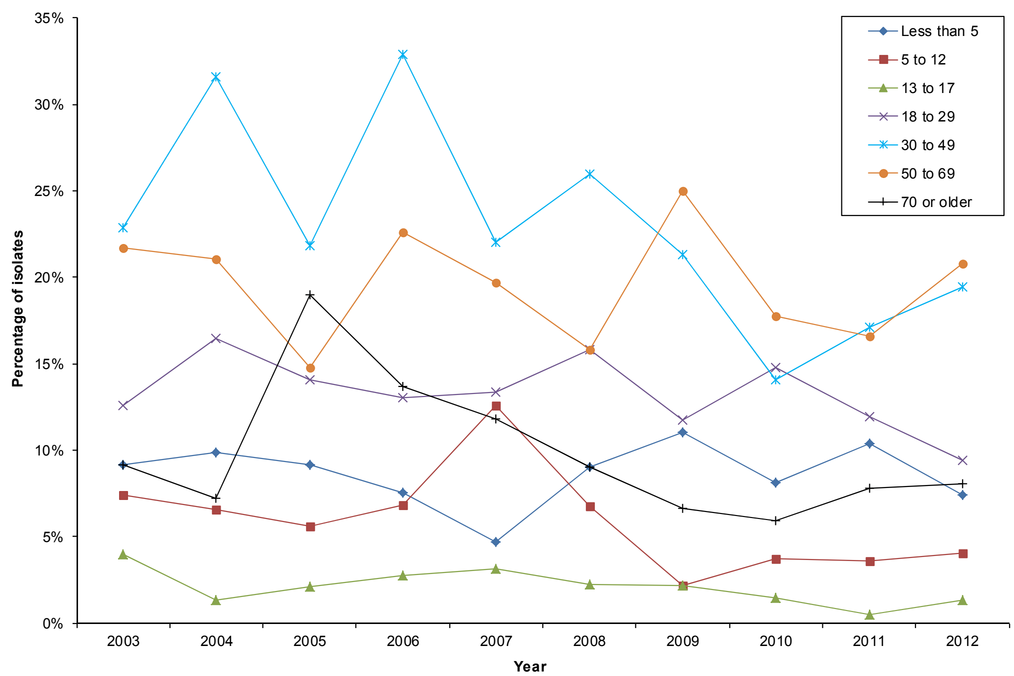


Figure 7. Temporal variations of age groups represented within *Salmonella* Typhi isolates

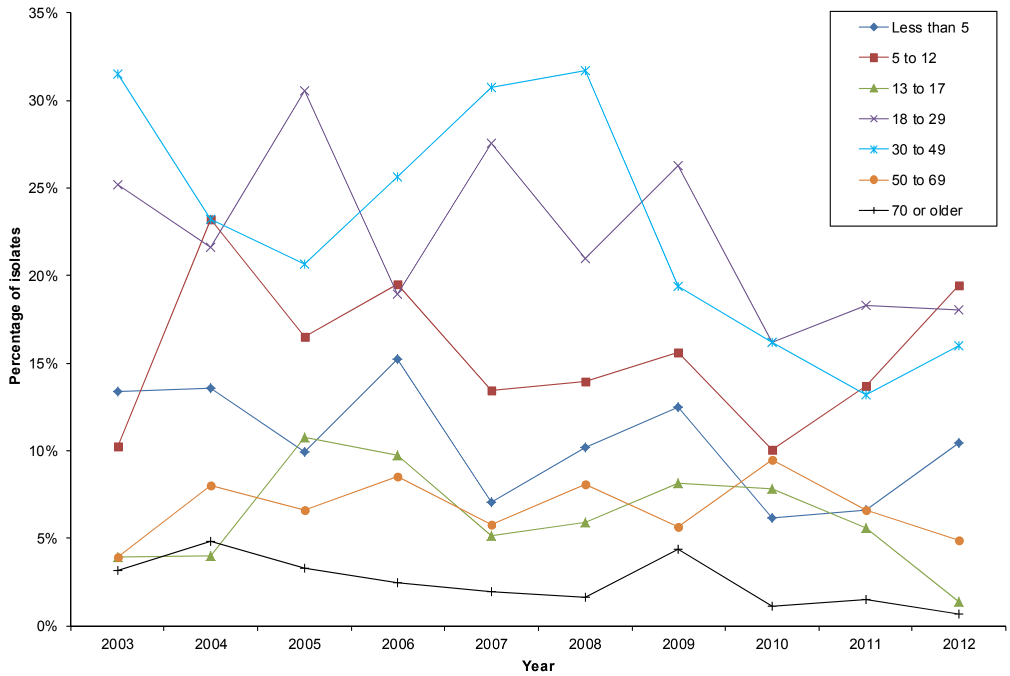
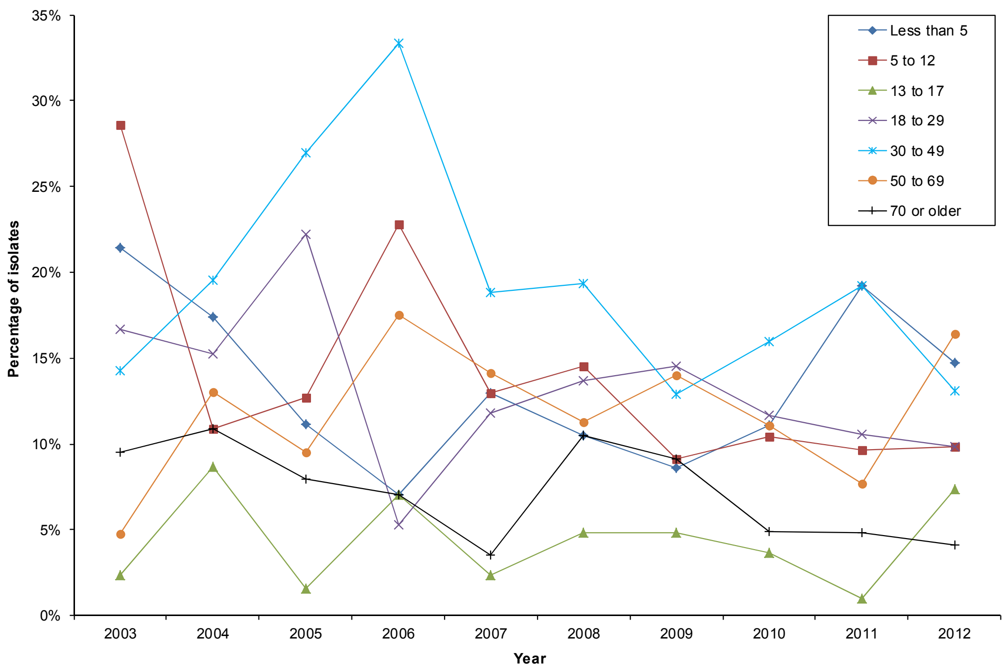


Figure 8. Temporal variations of age groups represented within *Salmonella* 4,[5],12:i:- isolates



MULTICLASS RESISTANCE

Table 1. Number of antimicrobial classes in resistance patterns of *Salmonella* serovars

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	178 (57.6)	151	22	1	4				4	4					5	1		2	2	22	6
Heidelberg	39 (12.6)	9	22	8				1		29	19	26	19	25							8
Typhi	33 (10.7)	5	27		1				1	1					1	1		1	1	28	
Typhimurium	25 (8.1)	15	2	1	7		1	1	7	8		1		1	8	1		6			9
Newport	19 (6.1)	16			3			2	3	1	1	1	1	1	3	2		3			3
Paratyphi A and B	12 (3.9)		12																1	12	
4,[5],12:i:-	3 (1.0)		2		1				1	1					1			1			3
Total	**309 (100)**	**196**	**87**	**10**	**16**		**1**	**4**	**16**	**44**	**20**	**28**	**20**	**27**	**18**	**5**		**13**	**4**	**62**	**29**
Alberta																					
Enteritidis	179 (60.3)	156	17	2	4		1		7	10	2	2	2	2	4			2		13	3
Heidelberg	37 (12.5)	18	15	4				1	3	16	15	15	15	15	1	1		1			3
Typhimurium	25 (8.4)	12		4	9		1	4	12	10	3	3	3	3	13	2		8			10
Newport	20 (6.7)	18	1		1				1	1	1	1	1	1	1			1		1	1
Typhi	16 (5.4)	2	8		6				6	6					7	6		6		13	
4,[5],12:i:-	15 (5.1)	5	5	1	4				5	4					4						10
Paratyphi A and B	5 (1.7)		5																	5	
Total	**297 (100)**	**211**	**51**	**11**	**24**		**2**	**5**	**34**	**47**	**21**	**21**	**21**	**21**	**30**	**9**		**18**		**32**	**27**
Saskatchewan																					
Enteritidis	65 (56.0)	59	6																	6	
Heidelberg	16 (13.8)	7	9							9	9	9	9	9							
Typhimurium	14 (12.1)	8	2	1	3		1		3	2	1	1	1	1	4	2		3		1	3
Newport	10 (8.6)	9			1			1	1						1	1				1	1
4,[5],12:i:-	5 (4.3)	1			4				4	4					4						4
Typhi	5 (4.3)		2	1	2				1	2					3	3		3		5	
Paratyphi A and B	1 (0.9)		1																	1	
Total	**116 (100)**	**84**	**20**	**2**	**10**		**1**	**1**	**9**	**17**	**10**	**10**	**10**	**10**	**12**	**6**		**6**		**14**	**8**
Manitoba																					
Enteritidis	64 (50.8)	53	9	2				1		1					1	1			1	9	1
Heidelberg	24 (19.0)	12	10	2					1	12	9	10	9	10	1						1
Typhimurium	19 (15.1)	8	2	1	8				9	10					9			6			8
4,[5],12:i:-	8 (6.3)	5	2		1				1	1					1						3
Typhi	7 (5.6)		7																	7	
Newport	2 (1.6)	2																			
Paratyphi A and B	2 (1.6)		2																	2	
Total	**126 (100)**	**80**	**32**	**5**	**9**			**1**	**11**	**24**	**9**	**10**	**9**	**10**	**12**	**1**		**6**	**1**	**18**	**13**
Ontario																					
Enteritidis	374 (37.1)	307	55	10	2				3	11					8	9		1	5	53	8
Heidelberg	222 (22.0)	163	51	8			1	1	7	49	35	35	35	35	8	6					5
Typhimurium	202 (20.0)	149	5	11	36	1	7	10	40	37	1	1	1	1	47	10	2	34	2	4	46
Typhi	77 (7.6)	7	54	2	14				15	15					16	16		15	13	68	
Newport	64 (6.6)	59	1	1	3				3	3	3	3	3	3	4	1		3		1	4
4,[5],12:i:-	55 (5.5)	37	5	2	10	1	1	2	13	13	2	1	1	1	12	2	2	1	1	1	15
Paratyphi A and B	15 (1.5)	2	13																	13	
Total	**1009 (100)**	**724**	**184**	**34**	**65**	**2**	**9**	**13**	**81**	**128**	**41**	**40**	**40**	**40**	**95**	**44**	**4**	**54**	**21**	**140**	**78**

Antimicrobial abbreviations are defined in the Preamble.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.
There were no Paratyphi B isolates received by CIPARS for susceptibility testing in 2012.

Table 1. Number of antimicrobial classes in resistance patterns of *Salmonella* serovars (cont'd)

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
Québec																					
Enteritidis	141 (35.4)	106	29	4	2		1	1	2	5		1	1		3	1			1	30	5
Heidelberg	128 (32.2)	90	35	3			1		3	35	31	31	31	31	2	1				1	
Typhimurium	71 (17.8)	39	5	4	22	1	1	4	24	23	2	3	2	3	27	10		20		3	28
4,[5],12:i:-	27 (6.8)	11	1	2	13				13	16	1	1	1	1	13	2		1			14
Newport	24 (6.0)	21			3				3	3	3	3	3	3	3	1		3			3
Typhi	5 (1.3)	5																			
Paratyphi A and B	2 (0.5)		2																	2	
Total	**398 (100)**	**272**	**72**	**13**	**40**	**1**	**3**	**5**	**45**	**82**	**37**	**39**	**38**	**38**	**48**	**15**		**24**	**1**	**36**	**50**
New Brunswick																					
Enteritidis	64 (52.9)	53	8		3				3	5					3					6	3
Heidelberg	38 (31.4)	20	11	7			1		3	17	10	12	10	12	3	4					2
Typhimurium	7 (5.8)	2		5			1		5						5						1
Newport	6 (5.0)	5			1				1	1	1	1	1	1	1			1			1
4,[5],12:i:-	5 (4.1)	3	1		1				1	1					2	1					1
Typhi	1 (0.8)	1																			
Total	**121 (100)**	**84**	**20**	**12**	**5**		**2**		**13**	**24**	**11**	**13**	**11**	**13**	**14**	**5**		**1**		**6**	**8**
Nova Scotia																					
Enteritidis	71 (61.2)	65	5			1	1	1		1		1	1	1	1	1	1		1	6	1
Heidelberg	32 (27.6)	24	7	1					1	8	8	8	8	8							
Typhimurium	9 (7.8)	6		1	2		1		2	2					3	1		2			3
Newport	3 (2.6)	3																			
4,[5],12:i:-	1 (0.9)	1																			
Total	**116 (100)**	**99**	**12**	**2**	**2**	**1**	**2**	**1**	**3**	**11**	**8**	**9**	**9**	**9**	**4**	**2**	**1**	**2**	**1**	**6**	**4**
Prince Edward Island																					
Enteritidis	14 (66.7)	11	2		1				1	3					1						1
Typhimurium	3 (14.3)	2			1				1	1					1			1			1
Heidelberg	2 (9.5)	2																			
4,[5],12:i:-	1 (4.8)			1				1									1				1
Paratyphi A and B	1 (4.8)		1																	1	
Total	**21 (100)**	**15**	**3**	**1**	**2**			**1**	**2**	**4**					**2**		**1**	**1**		**1**	**3**
Newfoundland and Labrador																					
Enteritidis	29 (55.8)	27	1		1				2	1					1						1
Heidelberg	17 (32.7)	8	9							8	5	5	4	5						1	
Typhimurium	3 (5.8)	2				1	1	1	1	1					1	1		1	1	1	1
4,[5],12:i:-	2 (3.8)	2																			
Newport	1 (1.9)		1																		1
Total	**52 (100)**	**39**	**11**		**1**	**1**	**1**	**1**	**3**	**10**	**5**	**5**	**4**	**5**	**2**	**1**		**1**	**1**	**2**	**3**

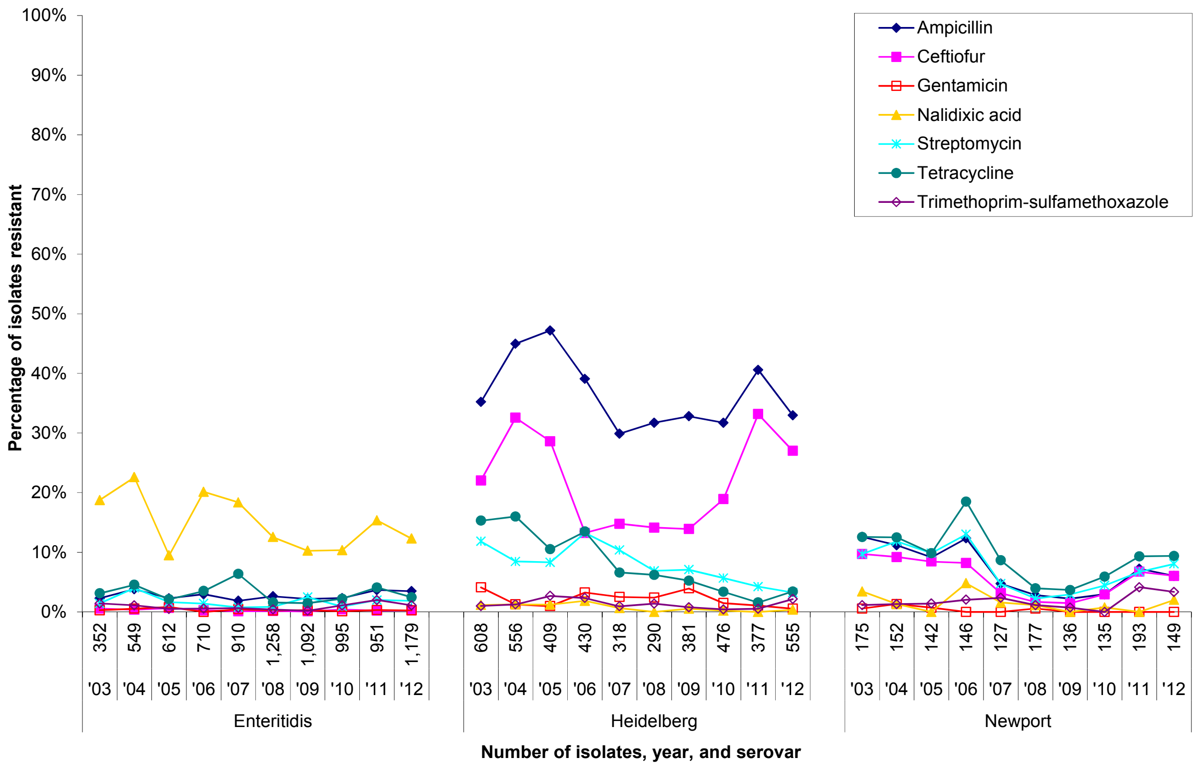
Antimicrobial abbreviations are defined in the Preamble.

Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

There were no Paratyphi B isolates received by CIPARS for susceptibility testing in 2012.

TEMPORAL ANTIMICROBIAL RESISTANCE SUMMARY

Figure 9. Temporal variations in resistance of *Salmonella* serovars from humans



Serovar	Enteritidis									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	352	549	612	710	910	1,258	1,092	995	951	1,179
Antimicrobial										
Ampicillin	2%	4%	2%	3%	2%	3%	2%	2%	4%	3%
Ceftiofur	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%
Gentamicin	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%
Nalidixic acid	19%	23%	9%	20%	18%	13%	10%	10%	15%	12%
Streptomycin	1%	4%	2%	1%	1%	1%	2%	1%	2%	2%
Tetracycline	3%	5%	2%	4%	6%	2%	1%	2%	4%	2%
Trimethoprim-sulfamethoxazole	1%	1%	0%	1%	1%	0%	0%	1%	2%	1%

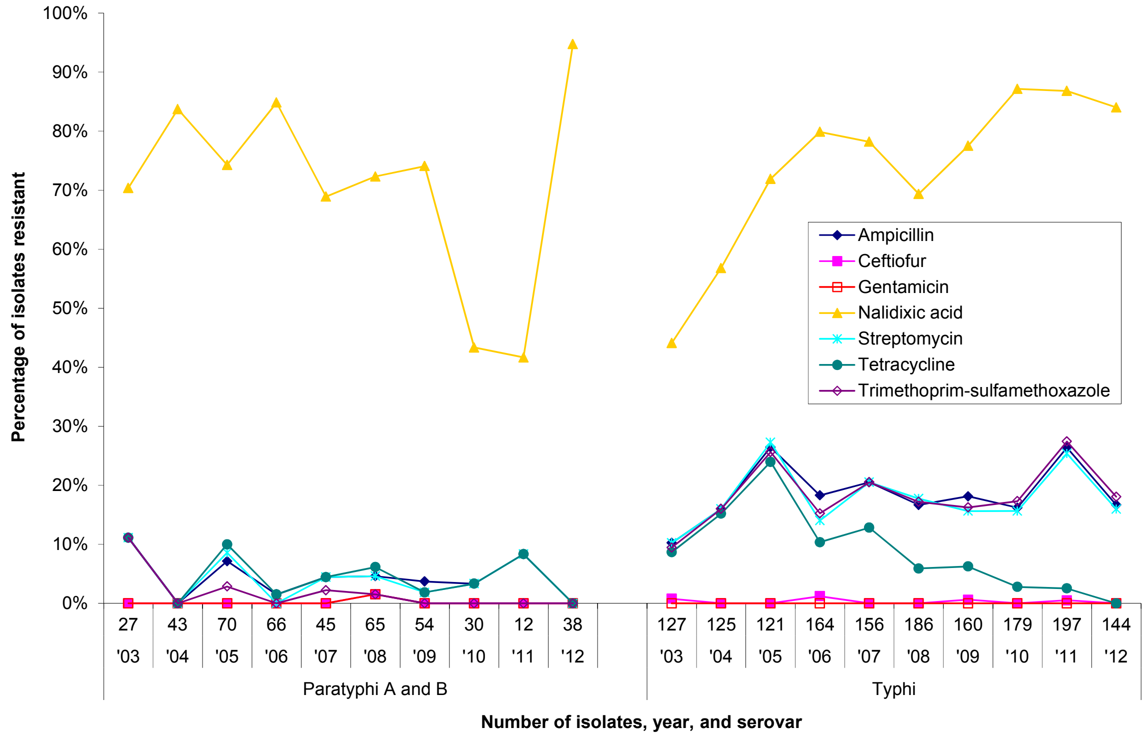
Serovar	Heidelberg									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	608	556	409	430	318	290	381	476	377	555
Antimicrobial										
Ampicillin	35%	45%	47%	39%	30%	32%	33%	32%	41%	33%
Ceftiofur	22%	33%	29%	13%	15%	14%	14%	19%	33%	27%
Gentamicin	4%	1%	1%	3%	3%	2%	4%	1%	1%	1%
Nalidixic acid	1%	1%	1%	2%	1%	0%	1%	0%	0%	0%
Streptomycin	12%	8%	8%	13%	10%	7%	7%	6%	4%	3%
Tetracycline	15%	16%	11%	13%	7%	6%	5%	3%	2%	3%
Trimethoprim-sulfamethoxazole	1%	1%	3%	2%	1%	1%	1%	0%	1%	2%

Serovar	Newport									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	175	152	142	146	127	177	136	135	193	149
Antimicrobial										
Ampicillin	13%	11%	9%	12%	5%	3%	2%	3%	7%	6%
Ceftiofur	10%	9%	8%	8%	3%	2%	1%	3%	7%	6%
Gentamicin	1%	1%	1%	0%	0%	1%	0%	0%	0%	0%
Nalidixic acid	3%	1%	0%	5%	2%	1%	0%	1%	0%	2%
Streptomycin	10%	12%	10%	13%	5%	2%	3%	4%	7%	8%
Tetracycline	13%	13%	10%	18%	9%	4%	4%	6%	9%	9%
Trimethoprim-sulfamethoxazole	1%	1%	1%	2%	2%	1%	1%	0%	4%	3%

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

Additional temporal analyses for ampicillin and ceftiofur were conducted for *Salmonella* Heidelberg. These two antimicrobials and years (2004 and 2006) were selected due to a change in ceftiofur use practices by Québec chicken hatcheries in early 2005 and in 2007 (start and end of the voluntary period of withdrawal). Significant differences ($P \leq 0.05$) observed between the current year results and additional reference year results are indicated by underlined numbers.

Figure 9. Temporal variations in resistance of *Salmonella* serovars from humans (cont'd)

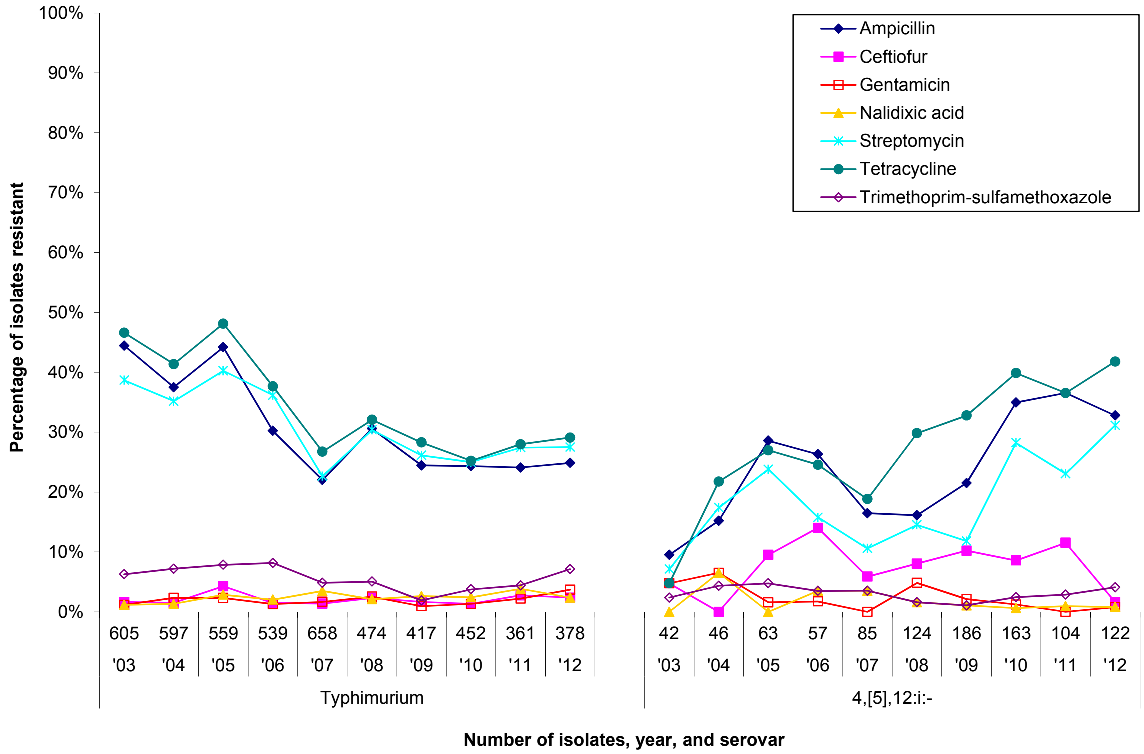


Serovar	Paratyphi A and B										Typhi									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	27	43	70	66	45	65	54	30	12	38	127	125	121	164	156	186	160	179	197	144
Antimicrobial																				
Ampicillin	**11%**	0%	7%	2%	4%	5%	4%	3%	**8%**	**0%**	**10%**	16%	26%	18%	21%	17%	18%	16%	**26%**	**17%**
Ceftiofur	**0%**	0%	0%	0%	0%	2%	0%	0%	**0%**	**0%**	**1%**	0%	0%	1%	0%	0%	1%	0%	**1%**	**0%**
Gentamicin	**0%**	0%	0%	0%	0%	2%	0%	0%	**0%**	**0%**	**0%**	0%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Nalidixic acid	**70%**	84%	74%	85%	69%	72%	74%	43%	**42%**	**95%**	**44%**	57%	72%	80%	78%	69%	78%	87%	**87%**	**84%**
Streptomycin	**11%**	0%	9%	0%	4%	5%	2%	3%	**8%**	**0%**	**10%**	16%	27%	14%	21%	18%	16%	16%	**25%**	**16%**
Tetracycline	**11%**	0%	10%	2%	4%	6%	2%	3%	**8%**	**0%**	**9%**	15%	24%	10%	13%	6%	6%	3%	**3%**	**0%**
Trimethoprim-sulfamethoxazole	**11%**	0%	3%	0%	2%	2%	0%	0%	**0%**	**0%**	**9%**	16%	26%	15%	21%	17%	16%	17%	**27%**	**18%**

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

There were no Paratyphi B isolates received by CIPARS for susceptibility testing in 2012.

Figure 9. Temporal variations in resistance of *Salmonella* serovars from humans (cont'd)



Serovar	Typhimurium										4,[5],12:i:-									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	605	597	559	539	658	474	417	452	361	378	42	46	63	57	85	124	186	163	104	122
Antimicrobial																				
Ampicillin	**44%**	38%	44%	30%	22%	31%	24%	24%	**24%**	**25%**	**10%**	15%	29%	26%	16%	16%	22%	35%	**37%**	**33%**
Ceftiofur	**2%**	2%	4%	1%	1%	2%	2%	1%	**3%**	**2%**	**5%**	0%	10%	14%	6%	8%	10%	9%	**12%**	**2%**
Gentamicin	**1%**	2%	2%	1%	2%	3%	1%	1%	**2%**	**4%**	**5%**	7%	2%	2%	0%	5%	2%	1%	**0%**	**1%**
Nalidixic acid	**1%**	1%	3%	2%	3%	2%	3%	2%	**4%**	**2%**	**0%**	7%	0%	4%	4%	2%	1%	1%	**1%**	**1%**
Streptomycin	**39%**	35%	40%	36%	23%	30%	26%	25%	**27%**	**28%**	**7%**	17%	24%	16%	11%	15%	12%	28%	**23%**	**31%**
Tetracycline	**47%**	41%	48%	38%	27%	32%	28%	25%	**28%**	**29%**	**5%**	22%	27%	25%	19%	30%	33%	40%	**37%**	**42%**
Trimethoprim-sulfamethoxazole	**6%**	7%	8%	8%	5%	5%	2%	4%	**4%**	**7%**	**2%**	4%	5%	4%	4%	2%	1%	2%	**3%**	**4%**

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

.

MINIMUM INHIBITORY CONCENTRATIONS

More details on how to interpret the minimum inhibitory concentrations (MICs) tables are provided in the CIPARS Annual Report 2012 – Chapter 1. Design and Methods.

Table 2. Distribution of minimum inhibitory concentrations among *Salmonella* Enteritidis

	Antimicrobial	n	Percentiles		% R	Distribution (%) of MICs (µg/mL)															
			MIC 50	MIC 90		≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	1,179	≤ 1	≤ 1	0.2							91.6	4.8	0.2	3.1	0.2		0.2			
I	Ceftiofur	1,179	1	1	0.3						2.0	93.4	4.3			0.3					
I	Ceftriaxone	1,179	≤ 0.25	≤ 0.25	0.3					99.4	0.2		0.1		0.1	0.2			0.1		
I	Ciprofloxacin	1,179	≤ 0.015	0.12	0.8	51.2	34.5	0.9	4.2	5.6	2.6	0.4	0.3		0.1						
II	Ampicillin	1,179	≤ 1	2	3.5							70.9	25.1	0.3	0.2			3.5			
II	Azithromycin	1,179	4	4	0.1							0.1	5.2	89.8	4.7	0.2	0.1				
II	Cefoxitin	1,179	2	4	0.3							4.2	84.1	10.6	0.6	0.1	0.3	0.1			
II	Gentamicin	1,179	0.50	0.50	0.3					31.5	66.3	1.9			0.1		0.3				
II	Kanamycin	1,179	≤ 8	≤ 8	0.3										99.7	0.1		0.1	0.2		
II	Nalidixic acid	1,179	4	> 32	12.3							0.1	7.3	74.9	3.5	2.0	0.6	11.7			
II	Streptomycin	1,179	≤ 32	≤ 32	1.9												98.1	0.5	1.4		
II	Trimethoprim-sulfamethoxazole	1,179	≤ 0.12	≤ 0.12	1.1				97.6	1.1		0.1	0.1		1.1						
III	Chloramphenicol	1,179	8	8	0.4								0.2	37.9	61.0	0.5		0.4			
III	Sulfisoxazole	1,179	64	128	2.3											2.8	26.4	59.8	8.7	0.1	2.3
III	Tetracycline	1,179	≤ 4	≤ 4	2.5									97.5	0.1		0.1	2.4			
IV																					

Table 3. Distribution of minimum inhibitory concentrations among *Salmonella* Heidelberg

	Antimicrobial	n	Percentiles		% R	Distribution (%) of MICs (µg/mL)															
			MIC 50	MIC 90		≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	555	≤ 1	> 32	25.4							66.7	0.4	0.7	5.0	1.8	7.4	18.0			
I	Ceftiofur	555	1	> 8	27.0						21.8	50.3	0.7	0.2	1.3	25.8					
I	Ceftriaxone	555	≤ 0.25	16	27.2					72.8				1.3	0.9	18.9	5.6	0.5			
I	Ciprofloxacin	555	≤ 0.015	≤ 0.015	0.0	97.8	1.6	0.2	0.2	0.2											
II	Ampicillin	555	≤ 1	> 32	33.0							65.2	1.6	0.2				33.0			
II	Azithromycin	555	4	4	0.0								1.1	91.2	7.7						
II	Cefoxitin	555	1	32	25.2							53.3	18.6	2.7		0.2	19.1	6.1			
II	Gentamicin	555	0.50	1	0.5					1.3	76.0	21.4	0.5		0.2		0.5				
II	Kanamycin	555	≤ 8	≤ 8	0.5										99.3	0.2			0.5		
II	Nalidixic acid	555	4	4	0.4								29.7	69.2	0.5	0.2		0.4			
II	Streptomycin	555	≤ 32	≤ 32	3.2												96.8	1.4	1.8		
II	Trimethoprim-sulfamethoxazole	555	≤ 0.12	≤ 0.12	2.2				97.7	0.2				0.2	2.0						
III	Chloramphenicol	555	8	8	0.2								0.2	26.7	72.4	0.5		0.2			
III	Sulfisoxazole	555	32	64	2.7											9.9	67.7	18.7	0.9		2.7
III	Tetracycline	555	≤ 4	≤ 4	3.4									96.6				3.4			
IV																					

Table 4. Distribution of minimum inhibitory concentrations among *Salmonella* Newport

	Antimicrobial	n	Percentiles		% R	Distribution (%) of MICs (µg/mL)															
			MIC 50	MIC 90		≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	149	≤ 1	≤ 1	6.0							92.6	0.7	0.7			2.7	3.4			
I	Ceftiofur	149	1	1	6.0						26.2	67.8				6.0					
I	Ceftriaxone	149	≤ 0.25	≤ 0.25	6.0					93.3	0.7						4.7	1.3			
I	Ciprofloxacin	149	≤ 0.015	≤ 0.015	0.0	93.3	2.0		2.7	0.7	1.3										
II	Ampicillin	149	≤ 1	≤ 1	6.0							92.6	1.3					6.0			
II	Azithromycin	149	4	4	0.0								13.4	83.9	2.7						
II	Cefoxitin	149	2	2	6.0							31.5	59.1	3.4				6.0			
II	Gentamicin	149	0.50	0.50	0.0					2.7	88.6	8.7									
II	Kanamycin	149	≤ 8	≤ 8	2.0										98.0				2.0		
II	Nalidixic acid	149	4	4	2.0								45.0	51.0	0.7	1.3		2.0			
II	Streptomycin	149	≤ 32	≤ 32	8.1												91.9		8.1		
II	Trimethoprim-sulfamethoxazole	149	≤ 0.12	≤ 0.12	3.4				96.6						3.4						
III	Chloramphenicol	149	4	8	7.4									71.1	21.5			7.4			
III	Sulfisoxazole	149	64	128	8.7											3.4	27.5	54.4	5.4	0.7	8.7
III	Tetracycline	149	≤ 4	≤ 4	9.4									90.6				9.4			
IV																					

Table 5. Distribution of minimum inhibitory concentrations among Salmonella Paratyphi A

	Antimicrobial	n	Percentiles		% R	Distribution (%) of MICs (µg/mL)															
			MIC 50	MIC 90		≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	38	2	2	0.0							31.6	68.4								
I	Ceftiofur	38	1	1	0.0							100.0									
I	Ceftriaxone	38	≤ 0.25	≤ 0.25	0.0					97.4	2.6										
I	Ciprofloxacin	38	0.50	0.50	2.6	2.6	2.6				92.1	2.6									
II	Ampicillin	38	2	2	0.0							5.3	94.7								
II	Azithromycin	38	4	8	0.0									57.9	42.1						
II	Cefoxitin	38	4	8	0.0								2.6	76.3	21.1						
II	Gentamicin	38	≤ 0.25	≤ 0.25	0.0					97.4	2.6										
II	Kanamycin	38	≤ 8	≤ 8	0.0										100.0						
II	Nalidixic acid	38	> 32	> 32	94.7									2.6	2.6		10.5	84.2			
II	Streptomycin	38	≤ 32	≤ 32	0.0												100.0				
II	Trimethoprim-sulfamethoxazole	38	≤ 0.12	≤ 0.12	0.0				94.7	5.3											
III	Chloramphenicol	38	8	8	0.0										94.7	5.3					
III	Sulfisoxazole	38	64	64	0.0											2.6	44.7	52.6			
III	Tetracycline	38	≤ 4	≤ 4	0.0									100.0							
IV																					

Table 6. Distribution of minimum inhibitory concentrations among *Salmonella* Typhi

	Antimicrobial	n	Percentiles		% R	Distribution (%) of MICs (µg/mL)															
			MIC 50	MIC 90		≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	144	≤ 1	8	0.0							83.3		1.4	15.3						
I	Ceftiofur	144	0.50	1	0.0						61.8	38.2									
I	Ceftriaxone	144	≤ 0.25	≤ 0.25	0.0					100.0											
I	Ciprofloxacin	144	0.25	0.50	9.7	15.3			6.9	40.3	27.8	2.8	0.7		6.3						
II	Ampicillin	144	≤ 1	> 32	16.7							83.3						16.7			
II	Azithromycin	144	4	4	0.0							0.7	35.4	61.8	2.1						
II	Cefoxitin	144	4	8	0.0							29.9	7.6	43.1	18.8	0.7					
II	Gentamicin	144	0.50	0.50	0.0					49.3	50.7										
II	Kanamycin	144	≤ 8	≤ 8	0.0										100.0						
II	Nalidixic acid	144	> 32	> 32	84.0							2.1	11.8	1.4		0.7	0.7	83.3			
II	Streptomycin	144	≤ 32	> 64	16.0												84.0		16.0		
II	Trimethoprim-sulfamethoxazole	144	≤ 0.12	> 4	18.1				81.3	0.7					18.1						
III	Chloramphenicol	144	8	> 32	17.4								0.7	47.2	34.7			17.4			
III	Sulfisoxazole	144	64	> 256	18.8											8.3	37.5	31.3	3.5	0.7	18.8
III	Tetracycline	144	≤ 4	≤ 4	0.0									100.0							
IV																					

Table 7. Distribution of minimum inhibitory concentrations among *Salmonella* Typhimurium

	Antimicrobial	n	Percentiles MIC 50	Percentiles MIC 90	% R	Distribution (%) of MICs (µg/mL) ≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	378	≤ 1	16	1.9							70.1	4.5	1.1	4.8	17.7		1.9			
	Ceftiofur	378	1	1	2.4						11.6	81.7	4.2			2.4					
	Ceftriaxone	378	≤ 0.25	≤ 0.25	2.4					97.1			0.5			1.1	1.1		0.3		
	Ciprofloxacin	378	≤ 0.015	0.03	0.8	87.8	7.4	0.8	0.5	1.3	1.3	0.8									
II	Ampicillin	378	≤ 1	> 32	24.9							67.5	4.5	2.4		0.8	0.3	24.6			
	Azithromycin	378	4	4	0.5								4.2	88.4	6.9		0.5				
	Cefoxitin	378	2	4	1.9							24.6	62.4	8.5	2.6		1.3	0.5			
	Gentamicin	378	0.50	1	3.7					2.4	75.9	17.5	0.3	0.3		1.9	1.9				
	Kanamycin	378	≤ 8	≤ 8	5.3										93.9	0.5	0.3		5.3		
	Nalidixic acid	378	4	4	2.4							0.3	26.5	66.9	3.7	0.3	0.5	1.9			
	Streptomycin	378	≤ 32	> 64	27.5												72.5	5.3	22.2		
	Trimethoprim-sulfamethoxazole	378	≤ 0.12	0.25	7.1				86.5	6.3				0.3	6.9						
III	Chloramphenicol	378	8	> 32	21.4								0.3	17.5	57.9	2.9		21.4			
	Sulfisoxazole	378	64	> 256	31.2											4.8	31.2	31.5	1.3		31.2
	Tetracycline	378	≤ 4	> 32	29.1									70.9		0.5	13.8	14.8			
IV																					

Table 8. Distribution of minimum inhibitory concentrations in *Salmonella* 4,[5],12:i:-

	Antimicrobial	n	Percentiles MIC 50	Percentiles MIC 90	% R	Distribution (%) of MICs (µg/mL) ≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	122	≤ 1	8	2.5							65.6	1.6	12.3	16.4	1.6	0.8	1.6			
	Ceftiofur	122	1	1	1.6						23.0	73.8	1.6			1.6					
	Ceftriaxone	122	≤ 0.25	≤ 0.25	1.6					98.4						0.8		0.8			
	Ciprofloxacin	122	≤ 0.015	≤ 0.015	0.8	95.9	3.3						0.8								
II	Ampicillin	122	≤ 1	> 32	32.8							64.8	2.5					32.8			
	Azithromycin	122	4	4	2.5								4.9	91.0	1.6		2.5				
	Cefoxitin	122	2	2	1.6							36.9	56.6	3.3	1.6			1.6			
	Gentamicin	122	0.50	1	0.8					1.6	81.1	16.4					0.8				
	Kanamycin	122	≤ 8	≤ 8	2.5										96.7	0.8			2.5		
	Nalidixic acid	122	4	4	0.8								35.2	62.3	1.6		0.8				
	Streptomycin	122	≤ 32	> 64	31.1												68.9	0.8	30.3		
	Trimethoprim-sulfamethoxazole	122	≤ 0.12	≤ 0.12	4.1				95.1	0.8					4.1						
III	Chloramphenicol	122	8	8	2.5									41.0	55.7	0.8	0.8	1.6			
	Sulfisoxazole	122	64	> 256	30.3											1.6	18.9	45.9	2.5	0.8	30.3
	Tetracycline	122	≤ 4	> 32	41.8									58.2				41.8			
IV																					

RETAIL MEAT SURVEILLANCE

KEY FINDINGS

BEEF

ESCHERICHIA COLI (n = 362)

As in previous years, resistance levels (≤ 1%) of category I β-lactam amoxicillin-clavulanic acid, ceftriaxone, and ceftiofur remained low in beef *E. coli* isolates in 2012 (Table 9). No ciprofloxacin resistance was observed in 2012 (Table 9). One isolate (1%, 1/107) from Ontario was resistant to azithromycin (Table 9).

CHICKEN

SALMONELLA (n = 307)

Across all provinces[8] sampled, the top 3 chicken *Salmonella* serovars were *S.* Heidelberg, *S*. Kentucky, and *S*. Enteritidis. Regional differences in serovar distribution were observed in 2012 with *S*. Enteritidis being the most common serovar in both British Columbia (34%, 18/53) and Saskatchewan (30%, 14/46) unlike Ontario and Québec where the most common serovar was *S*. Heidelberg (41%, 42/102 and 40%, 40/106 respectively) (Table 10). No *S*. Enteritidis was recovered in Québec.

All *S.* Enteritidis isolates were susceptible to all antimicrobials tested in 2012. No ciprofloxacin resistance was observed in any serotype in 2012 (Table 10). Nalidixic acid resistance was observed in 2 *S*. Kentucky isolates (4%, 2/53) from British Columbia (Table 10); previously nalidixic acid resistance has only been observed in 2 isolates (*S.* Hadar and *S*. 4,[5],12:i-) from Saskatchewan in 2005.

Category I β-lactam (amoxicillin-clavulanic acid, ceftriaxone, ceftiofur) resistance levels (26%, 80/307) remained similar to levels in 2011 (30%, 108/361). Resistance to ceftiofur (23%, 23/102) was significantly lower in 2012 than 2004 (46%, 25/54) in Ontario (Figure 11). Although resistance to ceftiofur (28%, 30/106) was significantly lower in 2012 than 2003 (50%, 14/28) in Québec, ceftiofur resistance in Québec was significantly higher in 2012 compared to 2006 (9%, 3/33) (Figure 11).

[8] Due to unforeseen and lengthy delays in retail sampling in the Maritimes in 2012, data are not presented for this year in the interest of precision. Data for this region will be presented again in the 2013 Annual Report.

ESCHERICHIA COLI (n = 373)

No ciprofloxacin resistance was observed in chicken *E. coli* isolates in 2012 (Table 11). Resistance levels of category I β-lactam amoxicillin-clavulanic acid, ceftriaxone, and ceftiofur remain similar to those in 2011. Resistance to ceftiofur was significantly higher in 2012 (22%, 14/64) than 2005 (4%, 3/82) in Saskatchewan (Figure 12). Resistance to ceftiofur was significantly higher in 2012 (25%, 32/128) than 2006 (6%, 8/135) in Québec (Figure 12). One isolate (1%, 1/128) from Québec was resistant to azithromycin (Table 11).

CAMPYLOBACTER (n = 280)

Low-level (3%, 3/88) of telithromycin resistance was observed in *Campylobacter* isolates from Ontario in 2012 (Table 12); this is similar to levels in recent previous years.
In 2012, ciprofloxacin resistance continues to decline in British Columbia (8%, 6/73) and remains at a similar level in Saskatchewan (5%, 2/40) compared to 2011 (4%, 1/25) (Figure 13). In isolates from Ontario, ciprofloxacin resistance has significantly increased in 2012 (16%, 14/88) compared to 2011 (6%, 4/71) and 2003 (4%, 3/78) (Figure 13). Resistance to azithromycin was significantly lower in 2012 (8%, 6/79) than 2003 (22%, 21/94) in Québec (Figure 13).

PORK

ESCHERICHIA COLI (n = 193)

Recovery of *E. coli* from retail pork continues to decline overall and remains relatively low (Table 25).
No key findings were found with respect to antimicrobial resistance.

TURKEY

In 2012, no statistical temporal analyses were performed for retail ground turkey samples. Additionally, no temporal variation figures were presented as 2012 was the first year for retail ground turkey sampling.

SALMONELLA (n = 140)

The distribution of *Salmonella* serovars varies by province in the first full year of retail surveillance of ground turkey (Table 14).
No ciprofloxacin or nalidixic acid resistance was observed (Table 14). One (2%, 1/44) *S*. Indiana isolate from Ontario was resistant to 6 antimicrobial classes (Table 14) and presented the ACKSSuT-A2C-AZM-CRO-GEN-SXT resistance pattern.

ESCHERICHIA COLI (n = 504)

One (1%, 1/152) retail turkey isolate of *E. coli* from Ontario was resistant to 7 classes of antimicrobials tested (Table 15) and had the following resistance pattern: ACKSSuT-A2C-AZM-CRO-CIP-GEN-NAL-SXT.

CAMPYLOBACTER (n = 74)

Two isolates (10%, 2/20) from Ontario were resistant to telithromycin in 2012 (Table 16). Ciprofloxacin resistance was observed in 21% (7/33) of isolates from British Columbia and 1 (1/6) isolate from Saskatchewan (Table 16).

MULTICLASS RESISTANCE

Table 9. Number of antimicrobial classes in resistance patterns of *Escherichia coli* from beef

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 (19.3)	46	7	15	2			1	14	3	1	1	1	1	15	1		2			24
Saskatchewan	78 (21.5)	62	6	10					7	2	1	1	1	1	8						14
Ontario	110 (30.4)	73	13	18	5	1	2	4	21	9	1		1		18	8	1	3		2	33
Québec	104 (28.7)	86	7	10	1			2	6	3					8	2		1		3	16
Total	**362 (100)**	**267**	**33**	**53**	**8**	**1**	**2**	**7**	**48**	**17**	**3**	**2**	**3**	**2**	**49**	**11**	**1**	**6**		**5**	**87**

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

Table 10. Number of antimicrobial classes in resistance patterns of *Salmonella* from chicken

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	18 (34.0)	18																			
Kentucky	15 (28.3)		1	12	2				13	13	13	13	11	13						2	14
Heidelberg	7 (13.2)	1	6							6	6	6	6	6							
Hadar	5 (9.4)	4		1					1												1
Infantis	2 (3.8)	2																			
Mbandaka	2 (3.8)	1	1																		1
Less common serovars	4 (7.5)	2	2							2	2	2	2	2							
Total	**53 (100)**	**28**	**10**	**13**	**2**				**14**	**21**	**21**	**21**	**19**	**21**						**2**	**16**
Saskatchewan																					
Enteritidis	14 (30.4)	14																			
Kentucky	10 (21.7)	2	3	5					5	5	5	5	4	5							5
Heidelberg	5 (10.9)	5																			
Infantis	4 (8.7)	3	1							1	1	1	1	1							
Thompson	4 (8.7)	4																			
Hadar	2 (4.3)	1		1					1												1
Schwarzengrund	2 (4.3)	2																			
Typhimurium	2 (4.3)				2				2	2					2			2			2
Livingstone var. 14+	1 (2.2)	1																			
Mbandaka	1 (2.2)		1																		1
Senftenberg	1 (2.2)	1																			
Total	**46 (100)**	**33**	**5**	**6**	**2**				**8**	**8**	**6**	**6**	**5**	**6**	**2**			**2**			**9**
Ontario																					
Heidelberg	42 (41.2)	26	16							15	12	12	12	12							1
Kentucky	34 (33.3)	11	3	20					20	9	9	9	7	9							21
Enteritidis	3 (2.9)	3																			
Kiambu	3 (2.9)			3						3											3
Less common serovars	20 (19.6)	12	3	3	2				4	5	2	2	2	2	3			1			5
Total	**102 (100)**	**52**	**22**	**26**	**2**				**24**	**32**	**23**	**23**	**21**	**23**	**3**			**1**			**30**
Québec																					
Heidelberg	40 (37.7)	27	13							13	12	12	11	12							
Kentucky	32 (30.2)	5		27					27	11	11	11	11	11							27
Thompson	13 (12.3)	12	1							1	1	1	1	1							
4,[5],12:r:-	3 (2.8)		3							3	3	3	3	3							
Less common serovars	18 (17.0)	9	2	6	1		3	1	5	3	3	3	3	3	6			1			6
Total	**106 (100)**	**53**	**19**	**33**	**1**		**3**	**1**	**32**	**31**	**30**	**30**	**29**	**30**	**6**			**1**			**33**
TOTAL	**307 (100)**	**166**	**56**	**78**	**7**		**3**	**1**	**78**	**92**	**80**	**80**	**74**	**80**	**11**			**4**		**2**	**88**

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

Table 11. Number of antimicrobial classes in resistance patterns of *Escherichia coli* from chicken

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	74 (19.8)	19	15	23	17		9	2	27	44	32	30	30	29	26	7		8		3	31
Saskatchewan	64 (17.2)	23	17	18	6		6	7	23	18	15	14	15	14	13	1				5	23
Ontario	107 (28.7)	32	19	47	9		13	15	30	47	21	20	21	20	29	8		1		2	52
Québec	128 (34.3)	29	19	52	28		31	24	58	56	34	34	34	32	63	20	1	5		2	76
Total	**373 (100)**	**103**	**70**	**140**	**60**		**59**	**48**	**138**	**165**	**102**	**98**	**100**	**95**	**131**	**36**	**1**	**14**		**12**	**182**

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

Table 12. Number of antimicrobial classes in resistance patterns of *Campylobacter* from chicken

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	66 (90.4)	48	16	2									3	3	17
Campylobacter coli	7 (9.6)	3	3	1									3	3	2
Total	**73 (100)**	**51**	**19**	**3**									**6**	**6**	**19**
Saskatchewan															
Campylobacter jejuni	36 (90.0)	17	16	3						1	1		2	2	19
Campylobacter coli	3 (7.5)	2	1												1
Campylobacter spp.	1 (2.5)	1													
Total	**40 (100)**	**20**	**17**	**3**						**1**	**1**		**2**	**2**	**20**
Ontario															
Campylobacter jejuni	75 (85.2)	34	29	12				2	1	4	4		10	10	38
Campylobacter coli	10 (11.4)	5	2	2	1			1	3	2	2		1	1	4
Campylobacter spp.	3 (3.4)		3										3	3	
Total	**88 (100)**	**39**	**34**	**14**	**1**			**3**	**4**	**6**	**6**		**14**	**14**	**42**
Québec															
Campylobacter jejuni	76 (96.2)	25	45	6					1	6	6		1	1	49
Campylobacter coli	3 (3.8)	2		1					1				1	1	1
Total	**79 (100)**	**27**	**45**	**7**					**2**	**6**	**6**		**2**	**2**	**50**
TOTAL	**280 (100)**	**137**	**115**	**27**	**1**			**3**	**6**	**13**	**13**		**24**	**24**	**131**

Antimicrobial abbreviations are defined in the Preamble.

Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

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

Table 13. Number of antimicrobial classes in resistance patterns of *Escherichia coli* from pork

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	37 (19.2)	26	4	5	2		1		5	7	4	4	4	4	4	1		1		1	9
Saskatchewan	26 (13.5)	16	2	7	1				5	5	1	1	1	1	5	2		2			9
Ontario	86 (44.6)	33	13	32	8			9	26	25	2	2	2	1	20	4		7			50
Québec	44 (22.8)	21	4	13	6		2	8	16	8	1		1		17	4		3		1	21
Total	**193 (100)**	**96**	**23**	**57**	**17**		**3**	**17**	**52**	**45**	**8**	**7**	**8**	**6**	**46**	**11**		**13**		**2**	**89**

Antimicrobial abbreviations are defined in the Preamble.

Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

Table 14. Number of antimicrobial classes in resistance patterns of *Salmonella* from turkey

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	7 (25.9)	7																			
Kentucky	7 (25.9)			7					7	6	6	6	4	6							7
Hadar	5 (18.5)			5					5												5
Heidelberg	3 (11.1)	1	2							2	2	2	2	2							
Agona	2 (7.4)			1	1				1	2		2		1	2						2
Johannesburg	1 (3.7)	1																			
Newport	1 (3.7)	1																			
Schwarzengrund	1 (3.7)	1																			
Total	**27 (100)**	**11**	**2**	**13**	**1**				**13**	**10**	**8**	**10**	**6**	**9**	**2**						**14**
Saskatchewan																					
Derby	3 (16.7)			3					3						3						3
Agona	2 (11.1)			1	1		1		1	1	1	1	1	1	2						2
Hadar	2 (11.1)			2			2		2						2						2
Heidelberg	2 (11.1)	1	1																		1
Meleagridis	2 (11.1)	2																			
Alachua	1 (5.6)	1																			
Kentucky	1 (5.6)			1					1												1
Mbandaka var. 14+	1 (5.6)		1																		1
Reading	1 (5.6)	1																			
Schwarzengrund	1 (5.6)			1					1						1						1
Typhimurium var. 5-	1 (5.6)				1				1	1					1			1			1
Uganda	1 (5.6)	1																			
Total	**18 (100)**	**6**	**2**	**8**	**2**		**3**		**9**	**2**	**1**	**1**	**1**	**1**	**9**			**1**			**12**
Ontario																					
Heidelberg	14 (31.8)	11	2	1					1	3	3	3	3	3							
Enteritidis	5 (11.4)	5																			
Saintpaul	5 (11.4)	5																			
Infantis	3 (6.8)	1	1		1		1		1	2	2	2	2	2	1			1			1
Schwarzengrund	3 (6.8)	3																			
Hadar	2 (4.5)			2					2												2
Indiana	2 (4.5)				1	1	1	1	2	2	2	2	2	2	2	1	1	2			2
Typhimurium	2 (4.5)	1			1			1	1	1					1			1			1
Worthington	2 (4.5)	1	1							1	1	1	1	1							
Albany	1 (2.3)			1			1			1	1	1	1	1							
4,[5],12:i:-	1 (2.3)	1																			
6,7:-:1,5	1 (2.3)	1																			
Johannesburg	1 (2.3)	1																			
Kentucky	1 (2.3)			1					1												1
Typhimurium var. 5-	1 (2.3)				1				1	1					1			1			1
Total	**44 (100)**	**30**	**4**	**5**	**4**	**1**	**3**	**2**	**9**	**11**	**9**	**9**	**9**	**9**	**5**	**1**	**1**	**5**			**8**
Québec																					
Heidelberg	9 (17.6)		4	3	2				4	7	6	6	6	6	2						6
Saintpaul	9 (17.6)	9																			
Agona	6 (11.8)	1	5							5	5	5	5	5							
Muenster	5 (9.8)	3		2					2	2											
Schwarzengrund	5 (9.8)	2		3			1		3						3						2
Worthington	3 (5.9)	2	1							1	1	1	1	1							
Kentucky	2 (3.9)			2					2	1	1	1	1	1							2
Kiambu	2 (3.9)			2					1	2					2	2					
Liverpool	2 (3.9)	2																			
Thompson	2 (3.9)	2																			
Less common serovars	6 (11.8)	2	1	3					3	2	2	2	2	2	1						2
Total	**51 (100)**	**23**	**11**	**15**	**2**		**1**		**15**	**20**	**15**	**15**	**15**	**15**	**8**	**2**					**12**
TOTAL	**140 (100)**	**70**	**19**	**41**	**9**	**1**	**7**	**2**	**46**	**43**	**33**	**35**	**31**	**34**	**24**	**3**	**1**	**6**			**46**

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

Table 15. Number of antimicrobial classes in resistance patterns of *Escherichia coli* from turkey

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	101 (20.0)	35	17	41	8		7	10	46	31	16	14	15	13	26	3		2		2	47
Saskatchewan	81 (16.1)	30	12	31	8		11	10	36	20	4	3	3	3	20	1		1		2	42
Ontario	152 (30.2)	49	34	49	19	1	24	16	53	47	17	14	16	13	42	13	2	8	1	3	90
Québec	170 (33.7)	55	27	67	21		16	14	62	64	21	19	20	19	49	20		10			99
Total	**504 (100)**	**169**	**90**	**188**	**56**	**1**	**58**	**50**	**197**	**162**	**58**	**50**	**54**	**48**	**137**	**37**	**2**	**21**	**1**	**7**	**278**

Antimicrobial abbreviations are defined in the Preamble.

Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

Table 16. Number of antimicrobial classes in resistance patterns of *Campylobacter* from turkey

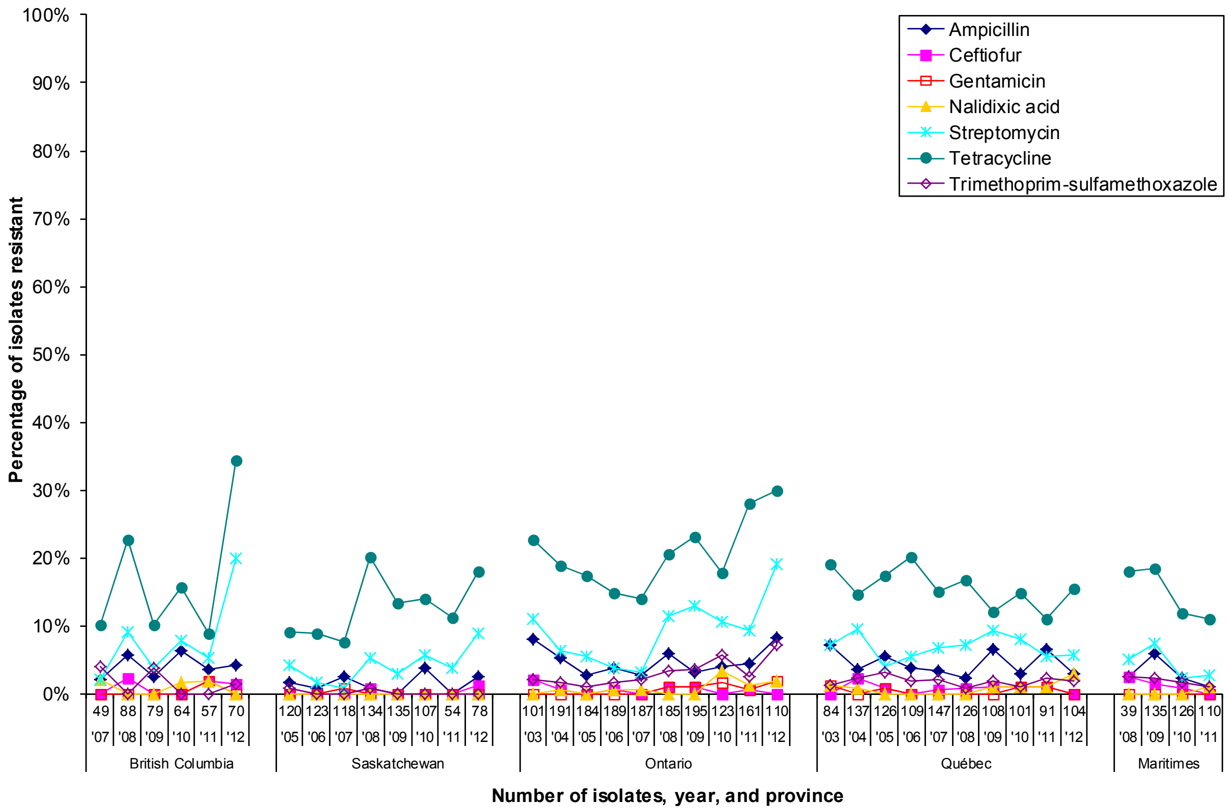
Province or region / species	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial: Aminoglycosides	Ketolides	Lincosamides	Macrolides		Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	TEL	CLI	AZM	ERY	FLR	CIP	NAL	TET
British Columbia															
Campylobacter jejuni	26 (78.8)	20	3	3									3	3	6
Campylobacter coli	7 (21.2)		4	3									4	4	6
Total	**33 (100)**	**20**	**7**	**6**									**7**	**7**	**12**
Saskatchewan															
Campylobacter jejuni	6 (100.0)	2	3	1									1	1	4
Total	**6 (100)**	**2**	**3**	**1**									**1**	**1**	**4**
Ontario															
Campylobacter jejuni	12 (60.0)	1	10	1				1		1	1				10
Campylobacter coli	8 (40.0)	2	5	1				1	1	1	1				5
Total	**20 (100)**	**3**	**15**	**2**				**2**	**1**	**2**	**2**				**15**
Québec															
Campylobacter jejuni	14 (93.3)	3	11												11
Campylobacter coli	1 (6.7)	1													
Total	**15 (100)**	**4**	**11**												**11**
TOTAL	**74 (100)**	**29**	**36**	**9**				**2**	**1**	**2**	**2**		**8**	**8**	**42**

Antimicrobial abbreviations are defined in the Preamble.

Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

TEMPORAL ANTIMICROBIAL RESISTANCE SUMMARY

Figure 10. Temporal variations in resistance of *Escherichia coli* isolates from beef



Province	British Columbia					
Year	'07	'08	'09	'10	'11	'12
Number of isolates	49	88	79	64	57	70
Antimicrobial						
Ampicillin	**2%**	6%	3%	6%	**4%**	**4%**
Ceftiofur	**0%**	2%	0%	0%	**2%**	**1%**
Gentamicin	**0%**	0%	0%	0%	**2%**	**0%**
Nalidixic acid	**2%**	0%	0%	2%	**2%**	**0%**
Streptomycin	**2%**	9%	4%	8%	**5%**	**20%**
Tetracycline	**10%**	23%	10%	16%	**9%**	**34%**
Trimethoprim-sulfamethoxazole	**4%**	0%	4%	0%	**0%**	**1%**

Province	Saskatchewan							
Year	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	120	123	118	134	135	107	54	78
Antimicrobial								
Ampicillin	**2%**	1%	3%	1%	0%	4%	**0%**	**3%**
Ceftiofur	**0%**	0%	0%	1%	0%	0%	**0%**	**1%**
Gentamicin	**0%**	0%	1%	0%	0%	0%	**0%**	**0%**
Nalidixic acid	**0%**	0%	0%	0%	0%	0%	**0%**	**0%**
Streptomycin	**4%**	2%	1%	5%	3%	6%	**4%**	**9%**
Tetracycline	**9%**	9%	8%	20%	13%	14%	**11%**	**18%**
Trimethoprim-sulfamethoxazole	**1%**	0%	0%	1%	0%	0%	**0%**	**0%**

Province	Ontario									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	101	191	184	189	187	185	195	123	161	110
Antimicrobial										
Ampicillin	**8%**	5%	3%	4%	3%	6%	3%	4%	**4%**	**8%**
Ceftiofur	**2%**	1%	0%	1%	0%	1%	1%	0%	**1%**	**0%**
Gentamicin	**0%**	0%	0%	0%	0%	1%	1%	2%	**1%**	**2%**
Nalidixic acid	**0%**	1%	0%	1%	1%	0%	0%	3%	**1%**	**2%**
Streptomycin	**11%**	6%	5%	4%	3%	11%	13%	11%	**9%**	**19%**
Tetracycline	**23%**	19%	17%	15%	14%	21%	23%	18%	**28%**	**30%**
Trimethoprim-sulfamethoxazole	**2%**	2%	1%	2%	2%	3%	4%	6%	**2%**	**7%**

Province	Québec									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	84	137	126	109	147	126	108	101	91	104
Antimicrobial										
Ampicillin	**7%**	4%	6%	4%	3%	2%	6%	3%	**7%**	**3%**
Ceftiofur	**0%**	2%	1%	0%	1%	1%	1%	1%	**1%**	**0%**
Gentamicin	**1%**	0%	1%	0%	0%	0%	0%	1%	**1%**	**0%**
Nalidixic acid	**1%**	1%	0%	0%	0%	0%	1%	1%	**1%**	**3%**
Streptomycin	**7%**	9%	4%	6%	7%	7%	9%	8%	**5%**	**6%**
Tetracycline	**19%**	15%	17%	20%	15%	17%	12%	15%	**11%**	**15%**
Trimethoprim-sulfamethoxazole	**1%**	2%	3%	2%	2%	1%	2%	1%	**2%**	**2%**

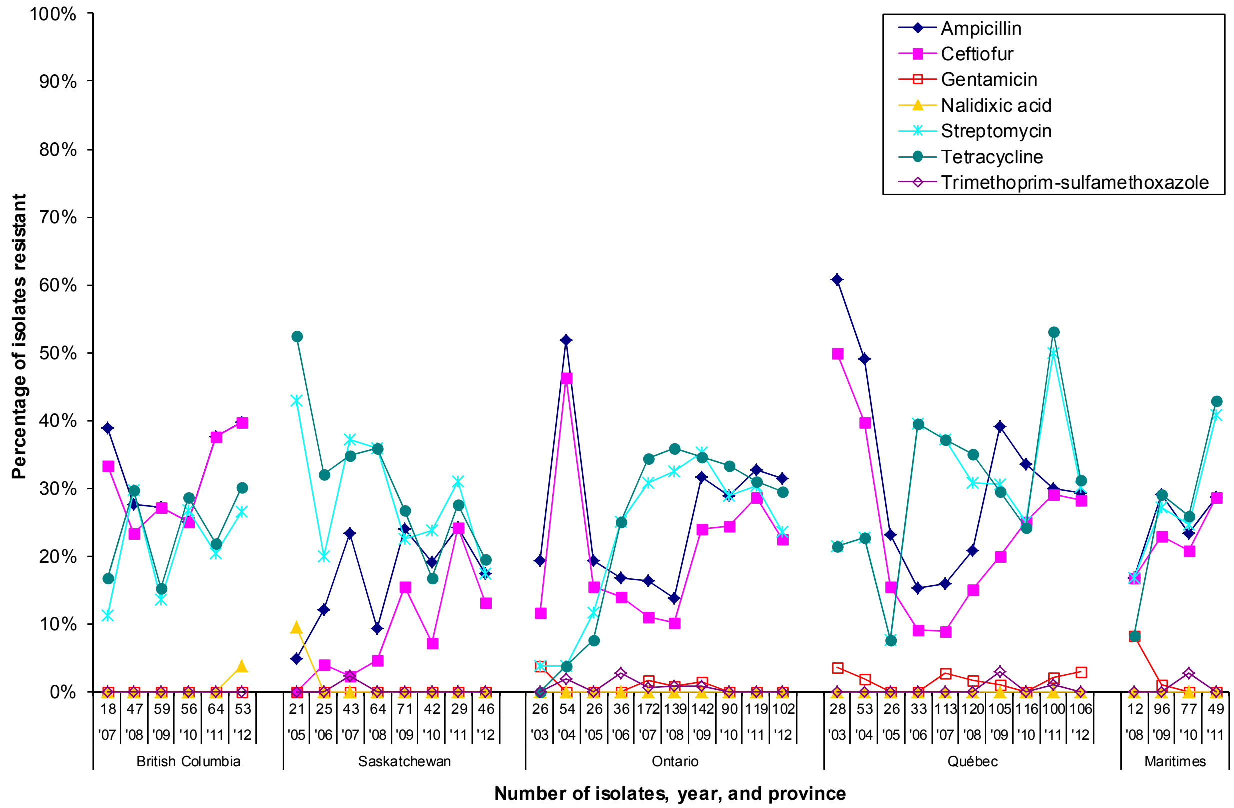
Province	Maritimes			
Year	'08	'09	'10	'11
Number of isolates	39	135	126	110
Antimicrobial				
Ampicillin	3%	6%	2%	1%
Ceftiofur	3%	1%	1%	0%
Gentamicin	0%	0%	0%	0%
Nalidixic acid	0%	0%	0%	1%
Streptomycin	5%	7%	2%	3%
Tetracycline	18%	19%	12%	11%
Trimethoprim-sulfamethoxazole	3%	2%	2%	1%

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

Due to unforeseen and lengthy delays in retail sampling in the Maritimes in 2012, data are not presented for this year in the interest of precision. Data for this region will be presented again in 2013.

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

Figure 11. Temporal variations in resistance of *Salmonella* isolates from chicken



Province	British Columbia					
Year	'07	'08	'09	'10	'11	'12
Number of isolates	18	47	59	56	64	53
Antimicrobial						
Ampicillin	**39%**	28%	27%	25%	**38%**	**40%**
Ceftiofur	**33%**	23%	27%	25%	**38%**	**40%**
Gentamicin	**0%**	0%	0%	0%	**0%**	**0%**
Nalidixic acid	**0%**	0%	0%	0%	**0%**	**4%**
Streptomycin	**11%**	30%	14%	27%	**20%**	**26%**
Tetracycline	**17%**	30%	15%	29%	**22%**	**30%**
Trimethoprim-sulfamethoxazole	**0%**	0%	0%	0%	**0%**	**0%**

Province	Saskatchewan							
Year	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	21	25	43	64	71	42	29	46
Antimicrobial								
Ampicillin	**5%**	12%	23%	9%	24%	19%	**24%**	**17%**
Ceftiofur	**0%**	4%	2%	5%	15%	7%	**24%**	**13%**
Gentamicin	**0%**	0%	0%	0%	0%	0%	**0%**	**0%**
Nalidixic acid	**10%**	0%	0%	0%	0%	0%	**0%**	**0%**
Streptomycin	**43%**	20%	37%	36%	23%	24%	**31%**	**17%**
Tetracycline	**52%**	32%	35%	36%	27%	17%	**28%**	**20%**
Trimethoprim-sulfamethoxazole	**0%**	0%	2%	0%	0%	0%	**0%**	**0%**

Province	Ontario									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	26	54	26	36	172	139	142	90	119	102
Antimicrobial										
Ampicillin	**19%**	**52%**	19%	**17%**	16%	14%	32%	29%	**33%**	**31%**
Ceftiofur	**12%**	**<u>46%</u>**	15%	**14%**	11%	10%	24%	24%	**29%**	**<u>23%</u>**
Gentamicin	**4%**	0%	0%	0%	2%	1%	1%	0%	**0%**	**0%**
Nalidixic acid	**0%**	0%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Streptomycin	**4%**	4%	12%	25%	31%	32%	35%	29%	**30%**	**24%**
Tetracycline	**0%**	4%	8%	25%	34%	36%	35%	33%	**31%**	**29%**
Trimethoprim-sulfamethoxazole	**0%**	2%	0%	3%	1%	1%	1%	0%	**0%**	**0%**

Province	Québec									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	28	53	26	33	113	120	105	116	100	106
Antimicrobial										
Ampicillin	**61%**	**49%**	23%	**15%**	16%	21%	39%	34%	**30%**	**29%**
Ceftiofur	**50%**	**40%**	15%	**<u>9%</u>**	9%	15%	20%	25%	**29%**	**<u>28%</u>**
Gentamicin	**4%**	2%	0%	0%	3%	2%	1%	0%	**2%**	**3%**
Nalidixic acid	**0%**	0%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Streptomycin	**21%**	23%	8%	39%	37%	31%	30%	25%	**50%**	**30%**
Tetracycline	**21%**	23%	8%	39%	37%	35%	30%	24%	**53%**	**31%**
Trimethoprim-sulfamethoxazole	**0%**	0%	0%	0%	0%	0%	3%	0%	**1%**	**0%**

Province	Maritimes			
Year	'08	'09	'10	'11
Number of isolates	12	96	77	49
Antimicrobial				
Ampicillin	17%	29%	23%	29%
Ceftiofur	17%	23%	21%	29%
Gentamicin	8%	1%	0%	0%
Nalidixic acid	0%	0%	0%	0%
Streptomycin	17%	27%	25%	41%
Tetracycline	8%	29%	26%	43%
Trimethoprim-sulfamethoxazole	0%	0%	3%	0%

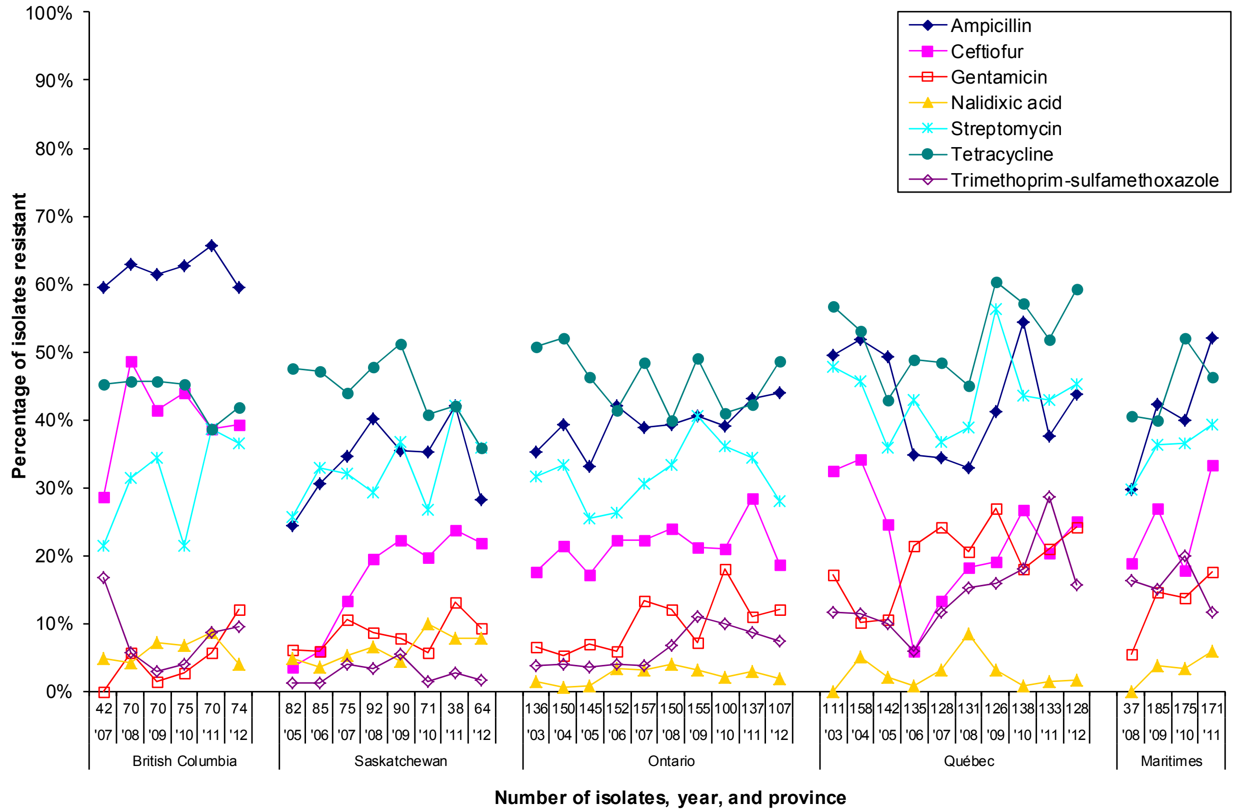
For the temporal analyses by province/region, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

Additional temporal analyses for ampicillin and ceftiofur were conducted for *Salmonella* isolates from Ontario and Québec. These two antimicrobials, provinces, and years (2004 and 2006) were selected due to a change in ceftiofur use practices by Québec chicken hatcheries in early 2005 and in 2007 (start and end of the voluntary period of withdrawal). Significant differences ($P \leq 0.05$) observed between the current year results and additional reference year results are indicated by underlined numbers.

Due to unforeseen and lengthy delays in retail sampling in the Maritimes in 2012, data are not presented for this year in the interest of precision. Data for this region will be presented again in 2013.

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

Figure 12. Temporal variations in resistance of *Escherichia coli* isolates from chicken



Province	British Columbia					
Year	'07	'08	'09	'10	'11	'12
Number of isolates	42	70	70	75	70	74
Antimicrobial						
Ampicillin	**60%**	63%	61%	63%	**66%**	**59%**
Ceftiofur	**29%**	49%	41%	44%	**39%**	**39%**
Gentamicin	**0%**	6%	1%	3%	**6%**	**12%**
Nalidixic acid	**5%**	4%	7%	7%	**9%**	**4%**
Streptomycin	**21%**	31%	34%	21%	**39%**	**36%**
Tetracycline	**45%**	46%	46%	45%	**39%**	**42%**
Trimethoprim-sulfamethoxazole	**17%**	6%	3%	4%	**9%**	**9%**

Province	Saskatchewan							
Year	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	82	85	75	92	90	71	38	64
Antimicrobial								
Ampicillin	**24%**	31%	35%	40%	36%	35%	**42%**	**28%**
Ceftiofur	**4%**	6%	13%	20%	22%	20%	**24%**	**22%**
Gentamicin	**6%**	6%	11%	9%	8%	6%	**13%**	**9%**
Nalidixic acid	**5%**	4%	5%	7%	4%	10%	**8%**	**8%**
Streptomycin	**26%**	33%	32%	29%	37%	27%	**42%**	**36%**
Tetracycline	**48%**	47%	44%	48%	51%	41%	**42%**	**36%**
Trimethoprim-sulfamethoxazole	**1%**	1%	4%	3%	6%	1%	**3%**	**2%**

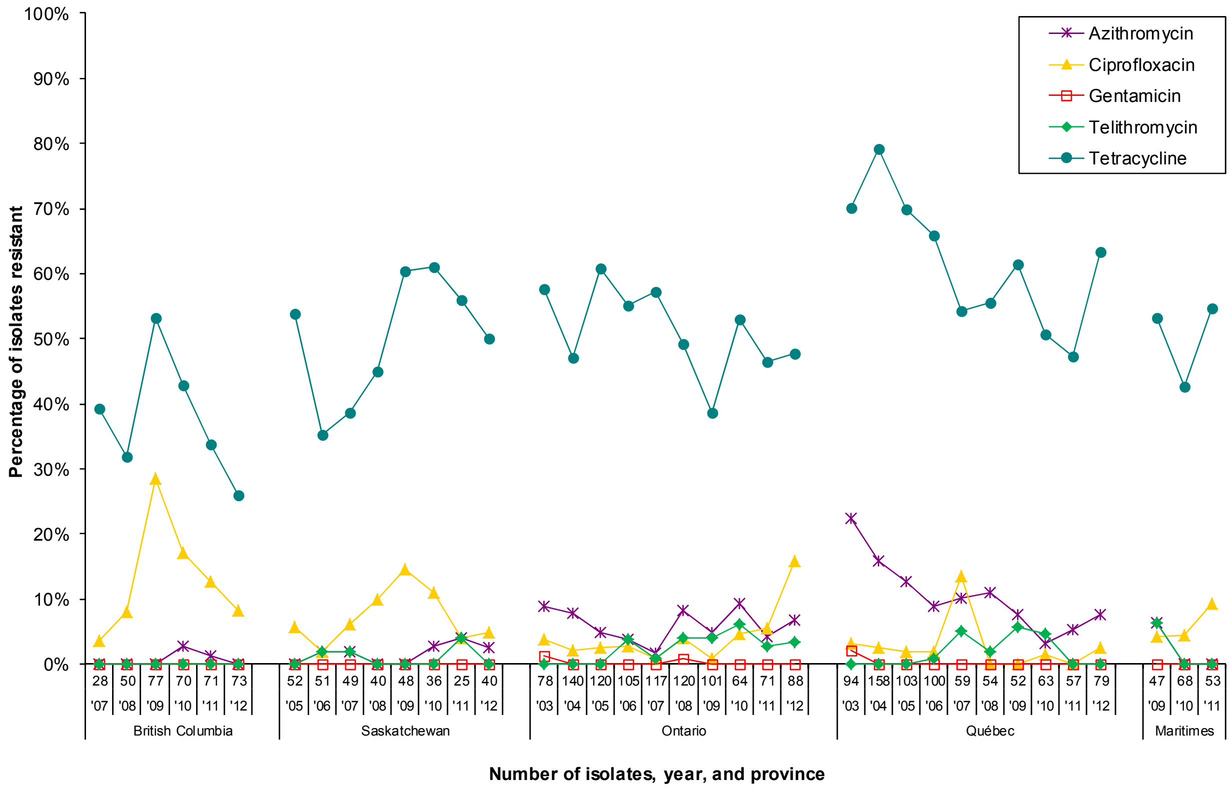
Province	Ontario									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	136	150	145	152	157	150	155	100	137	107
Antimicrobial										
Ampicillin	**35%**	**39%**	33%	**42%**	39%	39%	41%	39%	**43%**	**44%**
Ceftiofur	**18%**	**21%**	17%	**22%**	22%	24%	21%	21%	**28%**	**19%**
Gentamicin	**7%**	5%	7%	6%	13%	12%	7%	18%	**11%**	**12%**
Nalidixic acid	**1%**	1%	1%	3%	3%	4%	3%	2%	**3%**	**2%**
Streptomycin	**32%**	33%	26%	26%	31%	33%	41%	36%	**34%**	**28%**
Tetracycline	**51%**	52%	46%	41%	48%	40%	49%	41%	**42%**	**49%**
Trimethoprim-sulfamethoxazole	**4%**	4%	3%	4%	4%	7%	11%	10%	**9%**	**7%**

Province	Québec									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	111	158	142	135	128	131	126	138	133	128
Antimicrobial										
Ampicillin	**50%**	**52%**	49%	**35%**	34%	33%	41%	54%	**38%**	**44%**
Ceftiofur	**32%**	**34%**	25%	**6%**	13%	18%	19%	27%	**20%**	**25%**
Gentamicin	**17%**	10%	11%	21%	24%	21%	27%	18%	**21%**	**24%**
Nalidixic acid	**0%**	5%	2%	1%	3%	8%	3%	1%	**2%**	**2%**
Streptomycin	**48%**	46%	36%	43%	37%	39%	56%	43%	**43%**	**45%**
Tetracycline	**57%**	53%	43%	49%	48%	45%	60%	57%	**52%**	**59%**
Trimethoprim-sulfamethoxazole	**12%**	11%	10%	6%	12%	15%	16%	18%	**29%**	**16%**

Province	Maritimes			
Year	'08	'09	'10	'11
Number of isolates	37	185	175	171
Antimicrobial				
Ampicillin	30%	42%	40%	52%
Ceftiofur	19%	27%	18%	33%
Gentamicin	5%	15%	14%	18%
Nalidixic acid	0%	4%	3%	6%
Streptomycin	30%	36%	37%	39%
Tetracycline	41%	40%	52%	46%
Trimethoprim-sulfamethoxazole	16%	15%	20%	12%

For the temporal analyses by province/region, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.
Additional temporal analyses for ampicillin and ceftiofur were conducted for *E. coli* isolates from Ontario and Québec. These two antimicrobials, provinces, and years (2004 and 2006) were selected due to a change in ceftiofur use practices by Québec chicken hatcheries in early 2005 and in 2007 (start and end of the voluntary period of withdrawal). Significant differences ($P \leq 0.05$) observed between the current year results and additional reference year results are indicated by underlined numbers.
Due to unforeseen and lengthy delays in retail sampling in the Maritimes in 2012, data are not presented for this year in the interest of precision. Data for this region will be presented again in 2013.
The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

Figure 13. Temporal variations in resistance of *Campylobacter* isolates from chicken



Province	British Columbia					
Year	'07	'08	'09	'10	'11	'12
Number of isolates	28	50	77	70	71	73
Antimicrobial						
Azithromycin	**0%**	0%	0%	3%	**1%**	**0%**
Ciprofloxacin	**4%**	8%	29%	17%	**13%**	**8%**
Gentamicin	**0%**	0%	0%	0%	**0%**	**0%**
Telithromycin	**0%**	0%	0%	0%	**0%**	**0%**
Tetracycline	**39%**	32%	53%	43%	**34%**	**26%**

Province	Saskatchewan							
Year	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	52	51	49	40	48	36	25	40
Antimicrobial								
Azithromycin	**0%**	2%	2%	0%	0%	3%	**4%**	**3%**
Ciprofloxacin	**6%**	2%	6%	10%	15%	11%	**4%**	**5%**
Gentamicin	**0%**	0%	0%	0%	0%	0%	**0%**	**0%**
Telithromycin	**0%**	2%	2%	0%	0%	0%	**4%**	**0%**
Tetracycline	**54%**	35%	39%	45%	60%	61%	**56%**	**50%**

Province	Ontario									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	78	140	120	105	117	120	101	64	71	88
Antimicrobial										
Azithromycin	**9%**	8%	5%	4%	2%	8%	5%	9%	**4%**	**7%**
Ciprofloxacin	**4%**	2%	3%	3%	1%	4%	1%	5%	**6%**	**16%**
Gentamicin	**1%**	0%	0%	0%	0%	1%	0%	0%	**0%**	**0%**
Telithromycin	**0%**	0%	0%	4%	1%	4%	4%	6%	**3%**	**3%**
Tetracycline	**58%**	47%	61%	55%	57%	49%	39%	53%	**46%**	**48%**

Province	Québec									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	94	158	103	100	59	54	52	63	57	79
Antimicrobial										
Azithromycin	**22%**	16%	13%	9%	10%	11%	8%	3%	**5%**	**8%**
Ciprofloxacin	**3%**	3%	2%	2%	14%	0%	0%	2%	**0%**	**3%**
Gentamicin	**2%**	0%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Telithromycin	**0%**	0%	0%	1%	5%	2%	6%	5%	**0%**	**0%**
Tetracycline	**70%**	79%	70%	66%	54%	56%	62%	51%	**47%**	**63%**

Province	Maritimes		
Year	'09	'10	'11
Number of isolates	47	68	53
Antimicrobial			
Azithromycin	6%	0%	0%
Ciprofloxacin	4%	4%	9%
Gentamicin	0%	0%	0%
Telithromycin	6%	0%	0%
Tetracycline	53%	43%	55%

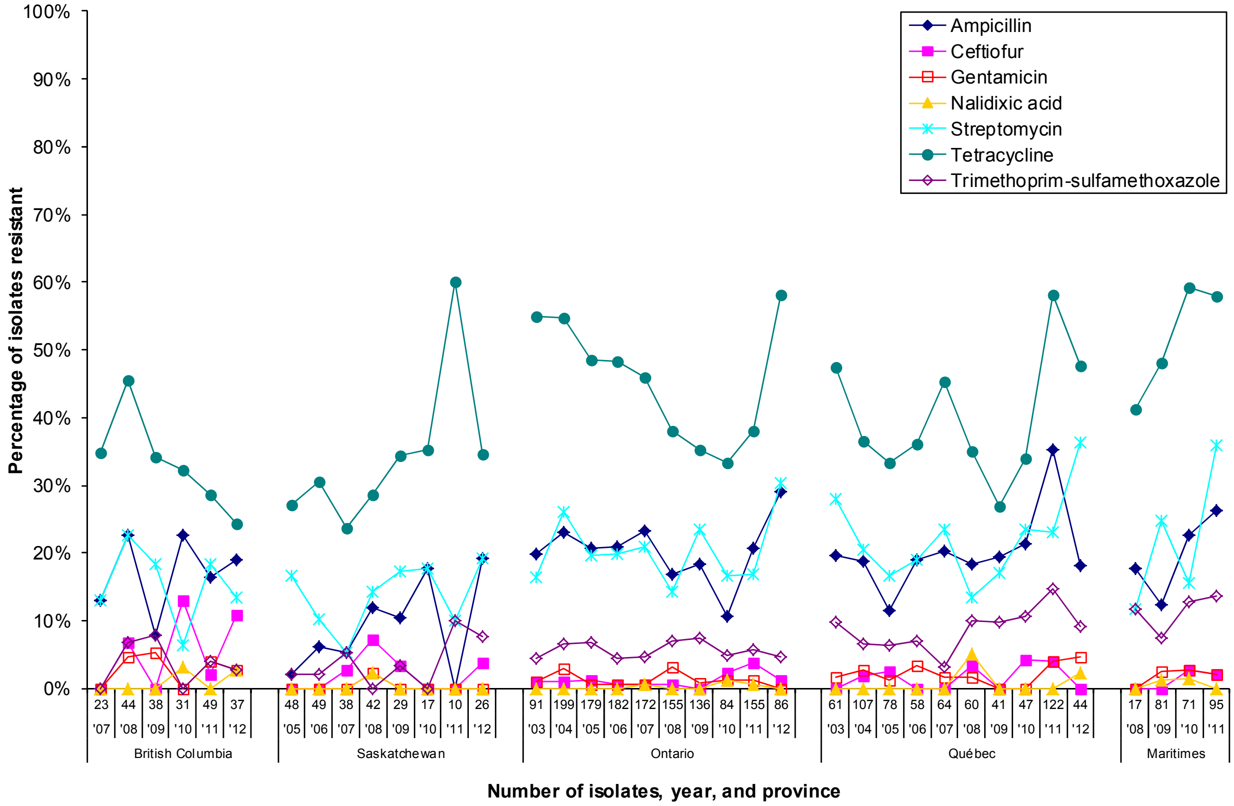
For the temporal analyses by province/region, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

Due to unforeseen and lengthy delays in retail sampling in the Maritimes in 2012, data are not presented for this year in the interest of precision. Data for this region will be presented again in 2013.

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.

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

Figure 14. Temporal variations in resistance of *Escherichia coli* isolates from pork



Province	British Columbia					
Year	'07	'08	'09	'10	'11	'12
Number of isolates	23	44	38	31	49	37
Antimicrobial						
Ampicillin	**13%**	23%	8%	23%	**16%**	**19%**
Ceftiofur	**0%**	7%	0%	13%	**2%**	**11%**
Gentamicin	**0%**	5%	5%	0%	**4%**	**3%**
Nalidixic acid	**0%**	0%	0%	3%	**0%**	**3%**
Streptomycin	**13%**	23%	18%	6%	**18%**	**14%**
Tetracycline	**35%**	45%	34%	32%	**29%**	**24%**
Trimethoprim-sulfamethoxazole	**0%**	7%	8%	0%	**4%**	**3%**

Province	Saskatchewan							
Year	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	48	49	38	42	29	17	10	26
Antimicrobial								
Ampicillin	**2%**	6%	5%	12%	10%	18%	**0%**	**19%**
Ceftiofur	**0%**	0%	3%	7%	3%	0%	**0%**	**4%**
Gentamicin	**0%**	0%	0%	2%	0%	0%	**0%**	**0%**
Nalidixic acid	**0%**	0%	0%	2%	0%	0%	**0%**	**0%**
Streptomycin	**17%**	10%	5%	14%	17%	18%	**10%**	**19%**
Tetracycline	**27%**	31%	24%	29%	34%	35%	**60%**	**35%**
Trimethoprim-sulfamethoxazole	**2%**	2%	5%	0%	3%	0%	**10%**	**8%**

Province	Ontario									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	91	199	179	182	172	155	136	84	155	86
Antimicrobial										
Ampicillin	**20%**	23%	21%	21%	23%	17%	18%	11%	**21%**	**29%**
Ceftiofur	**1%**	1%	1%	1%	1%	1%	0%	2%	**4%**	**1%**
Gentamicin	**1%**	3%	1%	1%	1%	3%	1%	1%	**1%**	**0%**
Nalidixic acid	**0%**	0%	0%	0%	1%	0%	0%	1%	**1%**	**0%**
Streptomycin	**16%**	26%	20%	20%	21%	14%	24%	17%	**17%**	**30%**
Tetracycline	**55%**	55%	49%	48%	46%	38%	35%	33%	**38%**	**58%**
Trimethoprim-sulfamethoxazole	**4%**	7%	7%	4%	5%	7%	7%	5%	**6%**	**5%**

Province	Québec									
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Number of isolates	61	107	78	58	64	60	41	47	122	44
Antimicrobial										
Ampicillin	**20%**	19%	12%	19%	20%	18%	20%	21%	**35%**	**18%**
Ceftiofur	**0%**	2%	3%	0%	0%	3%	0%	4%	**4%**	**0%**
Gentamicin	**2%**	3%	1%	3%	2%	2%	0%	0%	**4%**	**5%**
Nalidixic acid	**0%**	0%	0%	0%	0%	5%	0%	0%	**0%**	**2%**
Streptomycin	**28%**	21%	17%	19%	23%	13%	17%	23%	**23%**	**36%**
Tetracycline	**48%**	36%	33%	36%	45%	35%	27%	34%	**58%**	**48%**
Trimethoprim-sulfamethoxazole	**10%**	7%	6%	7%	3%	10%	10%	11%	**15%**	**9%**

Province	Maritimes			
Year	'08	'09	'10	'11
Number of isolates	17	81	71	95
Antimicrobial				
Ampicillin	18%	12%	23%	26%
Ceftiofur	0%	0%	3%	2%
Gentamicin	0%	2%	3%	2%
Nalidixic acid	0%	1%	1%	0%
Streptomycin	12%	25%	15%	36%
Tetracycline	41%	48%	59%	58%
Trimethoprim-sulfamethoxazole	12%	7%	13%	14%

For the temporal analyses by province/region, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.
Due to unforeseen and lengthy delays in retail sampling in the Maritimes in 2012, data are not presented for this year in the interest of precision. Data for this region will be presented again in 2013.
The Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

MINIMUM INHIBITORY CONCENTRATIONS

More details on how to interpret the minimum inhibitory concentrations (MICs) tables are provided in the CIPARS Annual Report 2012 – Chapter 1. Design and Methods.

Table 17. Distribution of minimum inhibitory concentrations among *Escherichia coli* from beef

	Antimicrobial	Province/region	n	Percentiles MIC 50	MIC 90	% R	Distribution (%) of MICs (µg/mL) ≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
	Amoxicillin-clavulanic acid	British Columbia	70	4	4	1.4							5.7	40.0	47.1	5.7			1.4			
		Saskatchewan	78	4	4	1.3							5.1	21.8	64.1	7.7			1.3			
		Ontario	110	4	8	0.9							3.6	29.1	48.2	18.2		0.9				
		Québec	104	4	4	0.0							2.9	27.9	63.5	5.8						
	Ceftiofur	British Columbia	70	0.25	0.50	1.4				10.0	54.3	34.3					1.4					
		Saskatchewan	78	0.25	0.50	1.3				2.6	50.0	46.2					1.3					
		Ontario	110	0.25	0.50	0.0				7.3	48.2	42.7	0.9	0.9								
I		Québec	104	0.25	0.50	0.0				2.9	59.6	37.5										
	Ceftriaxone	British Columbia	70	≤ 0.25	≤ 0.25	1.4					98.6						1.4					
		Saskatchewan	78	≤ 0.25	≤ 0.25	1.3					98.7						1.3					
		Ontario	110	≤ 0.25	≤ 0.25	0.0					98.2	0.9	0.9									
		Québec	104	≤ 0.25	≤ 0.25	0.0					100.0											
	Ciprofloxacin	British Columbia	70	≤ 0.015	≤ 0.015	0.0	100.0															
		Saskatchewan	78	≤ 0.015	≤ 0.015	0.0	100.0															
		Ontario	110	≤ 0.015	≤ 0.015	0.0	98.2			0.9	0.9											
		Québec	104	≤ 0.015	≤ 0.015	0.0	94.2	2.9		1.9		1.0										
	Ampicillin	British Columbia	70	2	4	4.3							21.4	52.9	21.4				4.3			
		Saskatchewan	78	2	4	2.6							14.1	53.8	29.5				2.6			
		Ontario	110	2	4	8.2							11.8	53.6	26.4				8.2			
		Québec	104	2	4	2.9							5.8	64.4	26.0		1.0		2.9			
	Azithromycin	British Columbia	70	4	4	0.0						1.4	7.1	11.4	71.4	7.1	1.4					
		Saskatchewan	78	4	4	0.0								16.7	78.2	5.1						
		Ontario	110	4	4	0.9							2.7	21.8	69.1	5.5		0.9				
		Québec	104	4	4	0.0							1.0	21.2	71.2	6.7						
	Cefoxitin	British Columbia	70	4	4	1.4							5.7	40.0	45.7	7.1			1.4			
		Saskatchewan	78	4	4	1.3							3.8	33.3	56.4	5.1			1.3			
		Ontario	110	4	8	0.9							1.8	38.2	49.1	9.1	0.9		0.9			
		Québec	104	4	4	0.0							1.0	36.5	56.7	4.8	1.0					
	Gentamicin	British Columbia	70	1	1	0.0						18.6	75.7	5.7								
		Saskatchewan	78	1	1	0.0					1.3	21.8	73.1	3.8								
		Ontario	110	1	2	1.8						20.0	70.0	8.2			0.9	0.9				
		Québec	104	1	1	0.0						28.8	65.4	5.8								
II	Kanamycin	British Columbia	70	≤ 8	≤ 8	1.4										98.6				1.4		
		Saskatchewan	78	≤ 8	≤ 8	0.0										100.0						
		Ontario	110	≤ 8	≤ 8	3.6										96.4				3.6		
		Québec	104	≤ 8	≤ 8	1.9										98.1				1.9		
	Nalidixic acid	British Columbia	70	2	2	0.0							17.1	74.3	8.6							
		Saskatchewan	78	2	4	0.0						1.3	6.4	82.1	10.3							
		Ontario	110	2	4	1.8							12.7	73.6	11.8				1.8			
		Québec	104	2	4	2.9							18.3	69.2	9.6				2.9			
	Streptomycin	British Columbia	70	≤ 32	64	20.0												80.0	14.3	5.7		
		Saskatchewan	78	≤ 32	≤ 32	9.0												91.0	6.4	2.6		
		Ontario	110	≤ 32	> 64	19.1												80.9	8.2	10.9		
		Québec	104	≤ 32	≤ 32	5.8												94.2	3.8	1.9		
	Trimethoprim-sulfamethoxazole	British Columbia	70	≤ 0.12	≤ 0.12	1.4				97.1	1.4					1.4						
		Saskatchewan	78	≤ 0.12	≤ 0.12	0.0				97.4	2.6											
		Ontario	110	≤ 0.12	≤ 0.12	7.3				91.8	0.9					7.3						
		Québec	104	≤ 0.12	≤ 0.12	1.9				95.2	1.0	1.9				1.9						
	Chloramphenicol	British Columbia	70	8	8	2.9								1.4	48.6	45.7	1.4	1.4	1.4			
		Saskatchewan	78	8	8	0.0								5.1	42.3	51.3	1.3					
		Ontario	110	8	8	2.7								1.8	38.2	56.4	0.9		2.7			
		Québec	104	8	8	1.0								2.9	42.3	50.0	3.8		1.0			
	Sulfisoxazole	British Columbia	70	≤ 16	> 256	21.4											60.0	18.6				21.4
		Saskatchewan	78	≤ 16	> 256	10.3											78.2	11.5				10.3
III		Ontario	110	≤ 16	> 256	16.4											71.8	9.1	2.7			16.4
		Québec	104	≤ 16	32	7.7											76.0	16.3				7.7
	Tetracycline	British Columbia	70	≤ 4	> 32	34.3									64.3	1.4	7.1	1.4	25.7			
		Saskatchewan	78	≤ 4	> 32	17.9									80.8	1.3			17.9			
		Ontario	110	≤ 4	> 32	30.0									66.4	3.6	0.9	0.9	28.2			
		Québec	104	≤ 4	> 32	15.4									83.7	1.0	1.0	1.9	12.5			
IV																						

Table 18. Distribution of minimum inhibitory concentrations among *Salmonella* from chicken

	Antimicrobial	Province/region	n	Percentiles MIC 50	Percentiles MIC 90	% R	Distribution (%) of MICs (µg/mL) ≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	British Columbia	53	≤ 1	> 32	39.6							58.5	1.9				5.7	34.0			
		Saskatchewan	46	≤ 1	> 32	13.0							82.6				4.3		13.0			
		Ontario	102	≤ 1	> 32	22.5							68.6		1.0	3.9	3.9	1.0	21.6			
		Québec	106	≤ 1	> 32	28.3							69.8	0.9		0.9		2.8	25.5			
	Ceftiofur	British Columbia	53	1	> 8	39.6						11.3	47.2	1.9		1.9	37.7					
		Saskatchewan	46	1	> 8	13.0						21.7	65.2			2.2	10.9					
		Ontario	102	1	> 8	22.5						36.3	40.2	1.0		1.0	21.6					
		Québec	106	1	> 8	28.3						37.7	34.0				28.3					
	Ceftriaxone	British Columbia	53	≤ 0.25	32	39.6					60.4					5.7	18.9	11.3	3.8			
		Saskatchewan	46	≤ 0.25	8	13.0					87.0				2.2	2.2	4.3	2.2	2.2			
		Ontario	102	≤ 0.25	16	22.5					77.5					2.0	11.8	8.8				
		Québec	106	≤ 0.25	16	28.3					71.7					1.9	17.0	6.6	2.8			
	Ciprofloxacin	British Columbia	53	≤ 0.015	0.03	0.0	81.1	15.1			3.8											
		Saskatchewan	46	≤ 0.015	0.03	0.0	73.9	26.1														
		Ontario	102	≤ 0.015	≤ 0.015	0.0	90.2	9.8														
		Québec	106	≤ 0.015	0.03	0.0	85.8	14.2														
II	Ampicillin	British Columbia	53	≤ 1	> 32	39.6							58.5	1.9					39.6			
		Saskatchewan	46	≤ 1	> 32	17.4							82.6						17.4			
		Ontario	102	≤ 1	> 32	31.4							64.7	3.9					31.4			
		Québec	106	≤ 1	> 32	29.2							68.9	1.9					29.2			
	Azithromycin	British Columbia	53	4	4	0.0								9.4	83.0	7.5						
		Saskatchewan	46	4	4	0.0							4.3	10.9	78.3	6.5						
		Ontario	102	4	8	0.0							2.0	8.8	65.7	23.5						
		Québec	106	4	8	0.0							0.9	9.4	76.4	13.2						
	Cefoxitin	British Columbia	53	2	> 32	35.8							9.4	45.3	5.7		3.8	24.5	11.3			
		Saskatchewan	46	2	32	10.9							21.7	52.2	10.9	2.2	2.2	6.5	4.3			
		Ontario	102	2	32	20.6							29.4	42.2	5.9		2.0	15.7	4.9			
		Québec	106	2	32	27.4							33.0	31.1	7.5		0.9	21.7	5.7			
	Gentamicin	British Columbia	53	0.50	1	0.0					20.8	60.4	18.9									
		Saskatchewan	46	0.50	1	0.0					13.0	73.9	10.9	2.2								
		Ontario	102	0.50	1	0.0					8.8	76.5	14.7									
		Québec	106	0.50	1	2.8					8.5	72.6	16.0					2.8				
	Kanamycin	British Columbia	53	≤ 8	≤ 8	0.0										100.0						
		Saskatchewan	46	≤ 8	≤ 8	0.0										100.0						
		Ontario	102	≤ 8	≤ 8	0.0										100.0						
		Québec	106	≤ 8	≤ 8	0.9										99.1				0.9		
	Nalidixic acid	British Columbia	53	4	4	3.8								30.2	64.2	1.9			3.8			
		Saskatchewan	46	4	4	0.0								23.9	71.7	4.3						
		Ontario	102	4	4	0.0							1.0	24.5	70.6	3.9						
		Québec	106	4	4	0.0							1.9	30.2	67.9							
	Streptomycin	British Columbia	53	≤ 32	> 64	26.4												73.6	7.5	18.9		
		Saskatchewan	46	≤ 32	> 64	17.4												82.6	4.3	13.0		
		Ontario	102	≤ 32	> 64	23.5												76.5	7.8	15.7		
		Québec	106	≤ 32	> 64	30.2												69.8	13.2	17.0		
	Trimethoprim-sulfamethoxazole	British Columbia	53	≤ 0.12	≤ 0.12	0.0				100.0												
		Saskatchewan	46	≤ 0.12	≤ 0.12	0.0				97.8		2.2										
		Ontario	102	≤ 0.12	≤ 0.12	0.0				97.1	2.0	1.0										
		Québec	106	≤ 0.12	≤ 0.12	0.0				99.1		0.9										
III	Chloramphenicol	British Columbia	53	4	8	0.0									50.9	47.2	1.9					
		Saskatchewan	46	8	8	4.3								4.3	39.1	52.2			4.3			
		Ontario	102	8	8	1.0								3.9	30.4	63.7	1.0		1.0			
		Québec	106	8	8	0.9								0.9	40.6	57.5			0.9			
	Sulfisoxazole	British Columbia	53	32	64	0.0											5.7	66.0	28.3			
		Saskatchewan	46	32	64	4.3											19.6	47.8	26.1	2.2		4.3
		Ontario	102	32	64	2.9											16.7	60.8	18.6	1.0		2.9
		Québec	106	32	64	5.7											19.8	55.7	18.9			5.7
	Tetracycline	British Columbia	53	≤ 4	> 32	30.2									67.9	1.9			30.2			
		Saskatchewan	46	≤ 4	> 32	19.6									80.4		2.2	2.2	15.2			
		Ontario	102	≤ 4	> 32	29.4									70.6			1.0	28.4			
		Québec	106	≤ 4	> 32	31.1									68.9				31.1			
IV																						

Table 19. Distribution of minimum inhibitory concentrations among *Escherichia coli* from chicken

	Antimicrobial	Province / region	n	Percentiles MIC 50	Percentiles MIC 90	% R	Distribution (%) of MICs (µg/mL) ≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
	Amoxicillin-clavulanic acid	British Columbia	74	8	> 32	43.2								17.6	25.7	13.5		29.7	13.5			
		Saskatchewan	64	4	32	23.4								28.1	43.8	4.7		14.1	9.4			
		Ontario	107	4	32	19.6							2.8	19.6	30.8	25.2	1.9	12.1	7.5			
		Québec	128	4	32	26.6							0.8	20.3	31.3	17.2	3.9	18.8	7.8			
	Ceftiofur	British Columbia	74	0.50	> 8	39.2					23.0	28.4	2.7	5.4	1.4	21.6	17.6					
		Saskatchewan	64	0.50	8	21.9				1.6	37.5	34.4	3.1	1.6		14.1	7.8					
		Ontario	107	0.50	8	18.7					37.4	43.9				9.3	9.3					
I		Québec	128	0.50	8	25.0					32.8	39.8	0.8		1.6	17.2	7.8					
	Ceftriaxone	British Columbia	74	≤ 0.25	16	40.5					51.4	1.4	2.7	4.1		21.6	12.2	6.8				
		Saskatchewan	64	≤ 0.25	16	21.9					73.4	1.6	1.6	1.6		6.3	9.4	6.3				
		Ontario	107	≤ 0.25	16	18.7					81.3					5.6	10.3	2.8				
		Québec	128	≤ 0.25	16	26.6					71.9	1.6				9.4	14.1	3.1				
	Ciprofloxacin	British Columbia	74	≤ 0.015	≤ 0.015	0.0	93.2	2.7		4.1												
		Saskatchewan	64	≤ 0.015	0.03	0.0	89.1	3.1		3.1	4.7											
		Ontario	107	≤ 0.015	≤ 0.015	0.0	94.4	2.8		0.9	1.9											
		Québec	128	≤ 0.015	≤ 0.015	0.0	96.1	2.3	0.8	0.8												
	Ampicillin	British Columbia	74	> 32	> 32	59.5							8.1	20.3	12.2				59.5			
		Saskatchewan	64	4	> 32	28.1							7.8	35.9	28.1				28.1			
		Ontario	107	4	> 32	43.9							7.5	23.4	23.4	1.9		0.9	43.0			
		Québec	128	4	> 32	43.8							7.8	33.6	14.8				43.8			
	Azithromycin	British Columbia	74	4	8	0.0							2.7	16.2	66.2	14.9						
		Saskatchewan	64	4	4	0.0								21.9	76.6	1.6						
		Ontario	107	4	4	0.0							0.9	25.2	70.1	3.7						
		Québec	128	4	8	0.8							0.8	18.0	67.2	13.3		0.8				
	Cefoxitin	British Columbia	74	4	> 32	40.5								18.9	35.1	4.1	1.4	9.5	31.1			
		Saskatchewan	64	4	> 32	23.4								21.9	46.9	7.8		3.1	20.3			
		Ontario	107	4	> 32	19.6								16.8	57.0	6.5		5.6	14.0			
		Québec	128	4	> 32	26.6							0.8	14.8	51.6	6.3		12.5	14.1			
	Gentamicin	British Columbia	74	1	16	12.2						13.5	64.9	4.1		5.4	5.4	6.8				
		Saskatchewan	64	1	8	9.4						12.5	70.3	6.3		1.6	1.6	7.8				
		Ontario	107	1	16	12.1						14.0	70.1	3.7			3.7	8.4				
		Québec	128	1	> 16	24.2						14.8	57.0	2.3		1.6	3.1	21.1				
II	Kanamycin	British Columbia	74	≤ 8	≤ 8	2.7										93.2	4.1			2.7		
		Saskatchewan	64	≤ 8	> 64	10.9										87.5	1.6			10.9		
		Ontario	107	≤ 8	> 64	14.0										83.2	2.8			14.0		
		Québec	128	≤ 8	> 64	18.8										77.3	3.9		0.8	18.0		
	Nalidixic acid	British Columbia	74	2	4	4.1							14.9	64.9	16.2			1.4	2.7			
		Saskatchewan	64	2	4	7.8							7.8	79.7	4.7			3.1	4.7			
		Ontario	107	2	4	1.9							13.1	73.8	10.3		0.9		1.9			
		Québec	128	2	4	1.6						0.8	7.8	75.0	14.8			0.8	0.8			
	Streptomycin	British Columbia	74	≤ 32	> 64	36.5												63.5	10.8	25.7		
		Saskatchewan	64	≤ 32	> 64	35.9												64.1	4.7	31.3		
		Ontario	107	≤ 32	> 64	28.0												72.0	5.6	22.4		
		Québec	128	≤ 32	> 64	45.3												54.7	17.2	28.1		
	Trimethoprim-sulfamethoxazole	British Columbia	74	≤ 0.12	0.50	9.5				78.4	10.8	1.4				9.5						
		Saskatchewan	64	≤ 0.12	0.25	1.6				89.1	6.3	3.1				1.6						
		Ontario	107	≤ 0.12	0.25	7.5				86.9	5.6					7.5						
		Québec	128	≤ 0.12	> 4	15.6				71.1	10.9	1.6	0.8			15.6						
	Chloramphenicol	British Columbia	74	8	> 32	10.8								1.4	39.2	47.3	1.4		10.8			
		Saskatchewan	64	8	8	0.0								1.6	35.9	62.5						
		Ontario	107	8	8	0.9									44.9	53.3	0.9		0.9			
		Québec	128	8	8	3.9								2.3	43.0	48.4	2.3		3.9			
	Sulfisoxazole	British Columbia	74	32	> 256	35.1											43.2	18.9	2.7			35.1
		Saskatchewan	64	≤ 16	> 256	20.3											59.4	18.8	1.6			20.3
III		Ontario	107	32	> 256	27.1											47.7	25.2				27.1
		Québec	128	32	> 256	49.2											43.0	7.8				49.2
	Tetracycline	British Columbia	74	≤ 4	> 32	41.9									58.1			2.7	39.2			
		Saskatchewan	64	≤ 4	> 32	35.9									64.1		1.6		34.4			
		Ontario	107	≤ 4	> 32	48.6									51.4			0.9	47.7			
		Québec	128	> 32	> 32	59.4									39.8	0.8	0.8	0.8	57.8			
IV																						

Table 20. Distribution of minimum inhibitory concentrations among *Campylobacter* from chicken

	Antimicrobial	Species	Province / region	n	Percentiles		% R	Distribution (%) of MICs (µg/mL)													
					MIC 50	MIC 90		≤ 0.016	0.032	0.064	0.125	0.25	0.5	1	2	4	8	16	32	64	> 64
	Ciprofloxacin	*Campylobacter coli*	British Columbia	7	0.125	16	42.9			28.6	28.6						14.3	28.6			
	Ciprofloxacin	*Campylobacter coli*	Saskatchewan	3	0.125	0.125	0.0			33.3	66.7										
	Ciprofloxacin	*Campylobacter coli*	Ontario	10	0.064	16	10.0			60.0	10.0	20.0						10.0			
	Ciprofloxacin	*Campylobacter coli*	Québec	3	0.25	16	33.3				33.3	33.3						33.3			
	Ciprofloxacin	*Campylobacter jejuni*	British Columbia	66	0.125	0.125	4.5			37.9	53.0	4.5						4.5			
	Ciprofloxacin	*Campylobacter jejuni*	Saskatchewan	36	0.125	0.125	5.6			44.4	47.2	2.8					5.6				
	Ciprofloxacin	*Campylobacter jejuni*	Ontario	75	0.125	8	13.3			29.3	44.0	13.3					4.0	9.3			
	Ciprofloxacin	*Campylobacter jejuni*	Québec	76	0.125	0.25	1.3			28.9	47.4	22.4					1.3				
	Ciprofloxacin	*Campylobacter* spp.	British Columbia	0	0	0	0.0														
	Ciprofloxacin	*Campylobacter* spp.	Saskatchewan	1	0.125	0.125	0.0				100.0										
	Ciprofloxacin	*Campylobacter* spp.	Ontario	3	4	4	100.0									100.0					
	Ciprofloxacin	*Campylobacter* spp.	Québec	0	0	0	0.0														
I	Telithromycin	*Campylobacter coli*	British Columbia	7	0.25	2	0.0					57.1		14.3	28.6						
	Telithromycin	*Campylobacter coli*	Saskatchewan	3	2	2	0.0							33.3	66.7						
	Telithromycin	*Campylobacter coli*	Ontario	10	2	16	10.0					40.0	10.0		30.0	10.0		10.0			
	Telithromycin	*Campylobacter coli*	Québec	3	2	4	0.0								66.7	33.3					
	Telithromycin	*Campylobacter jejuni*	British Columbia	66	0.5	1	0.0					10.6	68.2	21.2							
	Telithromycin	*Campylobacter jejuni*	Saskatchewan	36	0.5	1	0.0					22.2	44.4	25.0	5.6		2.8				
	Telithromycin	*Campylobacter jejuni*	Ontario	75	0.5	2	2.7					13.3	45.3	25.3	9.3	2.7	1.3	2.7			
	Telithromycin	*Campylobacter jejuni*	Québec	76	1	2	0.0					10.5	38.2	28.9	13.2	5.3	3.9				
	Telithromycin	*Campylobacter* spp.	British Columbia	0	0	0	0.0														
	Telithromycin	*Campylobacter* spp.	Saskatchewan	1	0.25	0.25	0.0					100.0									
	Telithromycin	*Campylobacter* spp.	Ontario	3	1	1	0.0							100.0							
	Telithromycin	*Campylobacter* spp.	Québec	0	0	0	0.0														
	Azithromycin	*Campylobacter coli*	British Columbia	7	0.032	0.125	0.0	28.6	28.6	28.6	14.3										
	Azithromycin	*Campylobacter coli*	Saskatchewan	3	0.125	0.125	0.0			33.3	66.7										
	Azithromycin	*Campylobacter coli*	Ontario	10	0.064	> 64	20.0			60.0	20.0										20.0
	Azithromycin	*Campylobacter coli*	Québec	3	0.125	0.125	0.0				100.0										
	Azithromycin	*Campylobacter jejuni*	British Columbia	66	0.064	0.064	0.0		39.4	59.1	1.5										
	Azithromycin	*Campylobacter jejuni*	Saskatchewan	36	0.064	0.064	2.8	2.8	33.3	55.6	5.6										2.8
	Azithromycin	*Campylobacter jejuni*	Ontario	75	0.064	0.064	5.3	2.7	45.3	42.7	2.7		1.3								5.3
	Azithromycin	*Campylobacter jejuni*	Québec	76	0.064	0.125	7.9	2.6	36.8	44.7	7.9										7.9
	Azithromycin	*Campylobacter* spp.	British Columbia	0	0	0	0.0														
	Azithromycin	*Campylobacter* spp.	Saskatchewan	1	0.032	0.032	0.0		100.0												
	Azithromycin	*Campylobacter* spp.	Ontario	3	0.125	0.125	0.0				100.0										
	Azithromycin	*Campylobacter* spp.	Québec	0	0	0	0.0														
	Clindamycin	*Campylobacter coli*	British Columbia	7	0.25	1	0.0				28.6	28.6	28.6	14.3							
	Clindamycin	*Campylobacter coli*	Saskatchewan	3	0.25	0.5	0.0					66.7	33.3								
	Clindamycin	*Campylobacter coli*	Ontario	10	0.25	16	30.0				20.0	40.0	10.0				20.0	10.0			
	Clindamycin	*Campylobacter jejuni*	Québec	3	1	8	33.3						33.3	33.3			33.3				
	Clindamycin	*Campylobacter jejuni*	British Columbia	66	0.125	0.25	0.0			7.6	56.1	34.8	1.5								
II	Clindamycin	*Campylobacter jejuni*	Saskatchewan	36	0.125	0.25	0.0			2.8	63.9	27.8	2.8			2.8					
	Clindamycin	*Campylobacter jejuni*	Ontario	75	0.125	0.25	1.3			13.3	44.0	34.7	2.7			4.0	1.3				
	Clindamycin	*Campylobacter jejuni*	Québec	76	0.125	0.5	1.3			6.6	57.9	21.1	6.6		1.3	5.3	1.3				
	Clindamycin	*Campylobacter* spp.	British Columbia	0	0	0	0.0														
	Clindamycin	*Campylobacter* spp.	Saskatchewan	1	0.25	0.25	0.0					100.0									
	Clindamycin	*Campylobacter* spp.	Ontario	3	0.125	0.25	0.0				66.7	33.3									
	Clindamycin	*Campylobacter* spp.	Québec	0	0	0	0.0														
	Erythromycin	*Campylobacter coli*	British Columbia	7	0.25	2	0.0				14.3	42.9	14.3	14.3	14.3						
	Erythromycin	*Campylobacter coli*	Saskatchewan	3	1	2	0.0					33.3		33.3	33.3						
	Erythromycin	*Campylobacter coli*	Ontario	10	1	> 64	20.0					40.0	10.0	10.0	20.0						20.0
	Erythromycin	*Campylobacter coli*	Québec	3	2	2	0.0							33.3	66.7						
	Erythromycin	*Campylobacter jejuni*	British Columbia	66	0.25	0.5	0.0					80.3	19.7								
	Erythromycin	*Campylobacter jejuni*	Saskatchewan	36	0.25	0.5	2.8				2.8	75.0	16.7	2.8						2.8	
	Erythromycin	*Campylobacter jejuni*	Ontario	75	0.25	0.5	5.3				6.7	53.3	30.7	4.0						1.3	4.0
	Erythromycin	*Campylobacter jejuni*	Québec	76	0.5	2	7.9				1.3	43.4	35.5	9.2	2.6						7.9
	Erythromycin	*Campylobacter* spp.	British Columbia	0	0	0	0.0														
	Erythromycin	*Campylobacter* spp.	Saskatchewan	1	0.125	0.125	0.0				100.0										
	Erythromycin	*Campylobacter* spp.	Ontario	3	1	1	0.0						33.3	66.7							
	Erythromycin	*Campylobacter* spp.	Québec	0	0	0	0.0														

Table 20. Distribution of minimum inhibitory concentrations among *Campylobacter* from chicken (cont'd)

	Antimicrobial	Species	Province / region	n	Percentiles		% R	Distribution (%) of MICs (µg/mL)													
					MIC 50	MIC 90		≤ 0.016	0.032	0.064	0.125	0.25	0.5	1	2	4	8	16	32	64	> 64
	Gentamicin	*Campylobacter coli*	British Columbia	7	0.5	1	0.0						85.7	14.3							
	Gentamicin	*Campylobacter coli*	Saskatchewan	3	1	1	0.0							100.0							
	Gentamicin	*Campylobacter coli*	Ontario	10	0.5	1	0.0						60.0	40.0							
	Gentamicin	*Campylobacter coli*	Québec	3	1	2	0.0							66.7	33.3						
	Gentamicin	*Campylobacter jejuni*	British Columbia	66	1	1	0.0						47.0	53.0							
	Gentamicin	*Campylobacter jejuni*	Saskatchewan	36	1	1	0.0						27.8	72.2							
	Gentamicin	*Campylobacter jejuni*	Ontario	75	0.5	1	0.0						50.7	49.3							
	Gentamicin	*Campylobacter jejuni*	Québec	76	0.5	1	0.0					1.3	55.3	43.4							
	Gentamicin	*Campylobacter* spp.	British Columbia	0	0	0	0.0														
	Gentamicin	*Campylobacter* spp.	Saskatchewan	1	1	1	0.0							100.0							
	Gentamicin	*Campylobacter* spp.	Ontario	3	1	2	0.0							66.7	33.3						
	Gentamicin	*Campylobacter* spp.	Québec	0	0	0	0.0														
II	Nalidixic acid	*Campylobacter coli*	British Columbia	7	16	> 64	42.9									14.3	28.6	14.3		14.3	28.6
	Nalidixic acid	*Campylobacter coli*	Saskatchewan	3	8	16	0.0									33.3	33.3	33.3			
	Nalidixic acid	*Campylobacter coli*	Ontario	10	8	> 64	10.0									50.0	20.0	20.0			10.0
	Nalidixic acid	*Campylobacter coli*	Québec	3	8	> 64	33.3									33.3	33.3				33.3
	Nalidixic acid	*Campylobacter jejuni*	British Columbia	66	≤ 4	8	4.5									63.6	31.8				4.5
	Nalidixic acid	*Campylobacter jejuni*	Saskatchewan	36	≤ 4	8	5.6									77.8	16.7				5.6
	Nalidixic acid	*Campylobacter jejuni*	Ontario	75	≤ 4	> 64	13.3									62.7	24.0				13.3
	Nalidixic acid	*Campylobacter jejuni*	Québec	76	≤ 4	8	1.3									56.6	42.1				1.3
	Nalidixic acid	*Campylobacter* spp.	British Columbia	0	0	0	0.0														
	Nalidixic acid	*Campylobacter* spp.	Saskatchewan	1	8	8	0.0										100.0				
	Nalidixic acid	*Campylobacter* spp.	Ontario	3	> 64	> 64	100.0													33.3	66.7
	Nalidixic acid	*Campylobacter* spp.	Québec	0	0	0	0.0														
	Florfenicol	*Campylobacter coli*	British Columbia	7	1	2	0.0							57.1	42.9						
	Florfenicol	*Campylobacter coli*	Saskatchewan	3	1	1	0.0							100.0							
	Florfenicol	*Campylobacter coli*	Ontario	10	1	2	0.0						10.0	70.0	20.0						
	Florfenicol	*Campylobacter coli*	Québec	3	1	2	0.0						33.3	33.3	33.3						
	Florfenicol	*Campylobacter jejuni*	British Columbia	66	1	1	0.0					1.5	7.6	90.9							
	Florfenicol	*Campylobacter jejuni*	Saskatchewan	36	1	1	0.0						16.7	80.6	2.8						
	Florfenicol	*Campylobacter jejuni*	Ontario	75	1	1	0.0						8.0	89.3	2.7						
	Florfenicol	*Campylobacter jejuni*	Québec	76	1	2	0.0						10.5	75.0	14.5						
	Florfenicol	*Campylobacter* spp.	British Columbia	0	0	0	0.0														
	Florfenicol	*Campylobacter* spp.	Saskatchewan	1	1	1	0.0							100.0							
	Florfenicol	*Campylobacter* spp.	Ontario	3	1	1	0.0							100.0							
	Florfenicol	*Campylobacter* spp.	Québec	0	0	0	0.0														
III	Tetracycline	*Campylobacter coli*	British Columbia	7	1	64	28.6					14.3	14.3	42.9					14.3	14.3	
	Tetracycline	*Campylobacter coli*	Saskatchewan	3	0.5	> 64	33.3				33.3		33.3								33.3
	Tetracycline	*Campylobacter coli*	Ontario	10	0.5	> 64	40.0				10.0	40.0	10.0							10.0	30.0
	Tetracycline	*Campylobacter coli*	Québec	3	8	> 64	33.3							33.3			33.3				33.3
	Tetracycline	*Campylobacter jejuni*	British Columbia	66	0.25	64	25.8				19.7	48.5	4.5	1.5					1.5	16.7	7.6
	Tetracycline	*Campylobacter jejuni*	Saskatchewan	36	32	> 64	52.8				25.0	22.2							5.6	22.2	25.0
	Tetracycline	*Campylobacter jejuni*	Ontario	75	32	> 64	50.7				17.3	20.0	9.3	2.7					6.7	16.0	28.0
	Tetracycline	*Campylobacter jejuni*	Québec	76	64	> 64	64.5				10.5	14.5	5.3	3.9		1.3				25.0	39.5
	Tetracycline	*Campylobacter* spp.	British Columbia	0	0	0	0.0														
	Tetracycline	*Campylobacter* spp.	Saskatchewan	1	0.5	0.5	0.0						100.0								
	Tetracycline	*Campylobacter* spp.	Ontario	3	0.25	0.25	0.0				33.3	66.7									
	Tetracycline	*Campylobacter* spp.	Québec	0	0	0	0.0														
IV																					

Table 21. Distribution of minimum inhibitory concentrations among *Escherichia coli* from pork

	Antimicrobial	Province / region	n	Percentiles MIC 50	Percentiles MIC 90	% R	Distribution (%) of MICs (µg/mL) ≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	British Columbia	37	4	32	10.8								21.6	54.1	13.5		2.7	8.1			
		Saskatchewan	26	4	8	3.8							7.7	19.2	53.8	15.4			3.8			
		Ontario	86	4	8	2.3							2.3	19.8	44.2	30.2	1.2	2.3				
		Québec	44	4	8	2.3								25.0	45.5	27.3			2.3			
	Ceftiofur	British Columbia	37	0.50	8	10.8					48.6	37.8	2.7			5.4	5.4					
		Saskatchewan	26	0.50	0.50	3.8				3.8	38.5	53.8					3.8					
		Ontario	86	0.25	0.50	1.2				2.3	57.0	37.2	1.2		1.2	1.2						
		Québec	44	0.50	0.50	0.0				9.1	40.9	47.7		2.3								
	Ceftriaxone	British Columbia	37	≤ 0.25	16	10.8					86.5		2.7				8.1	2.7				
		Saskatchewan	26	≤ 0.25	≤ 0.25	3.8					96.2						3.8					
		Ontario	86	≤ 0.25	≤ 0.25	2.3					97.7					2.3						
		Québec	44	≤ 0.25	≤ 0.25	0.0					95.5	2.3	2.3									
	Ciprofloxacin	British Columbia	37	≤ 0.015	≤ 0.015	0.0	91.9	5.4			2.7											
		Saskatchewan	26	≤ 0.015	≤ 0.015	0.0	96.2		3.8													
		Ontario	86	≤ 0.015	≤ 0.015	0.0	97.7	2.3														
		Québec	44	≤ 0.015	≤ 0.015	0.0	95.5	2.3			2.3											
II	Ampicillin	British Columbia	37	2	> 32	18.9							8.1	43.2	27.0	2.7			18.9			
		Saskatchewan	26	2	> 32	19.2							11.5	50.0	19.2				19.2			
		Ontario	86	4	> 32	29.1							7.0	39.5	23.3	1.2			29.1			
		Québec	44	2	> 32	18.2							6.8	45.5	27.3		2.3		18.2			
	Azithromycin	British Columbia	37	4	8	0.0								16.2	70.3	10.8	2.7					
		Saskatchewan	26	4	4	0.0							3.8	15.4	76.9	3.8						
		Ontario	86	4	4	0.0							1.2	22.1	73.3	3.5						
		Québec	44	4	4	0.0								20.5	70.5	9.1						
	Cefoxitin	British Columbia	37	4	> 32	10.8								29.7	48.6	10.8			10.8			
		Saskatchewan	26	4	4	3.8								23.1	73.1				3.8			
		Ontario	86	4	4	2.3							1.2	36.0	54.7	5.8		2.3				
		Québec	44	4	8	2.3							2.3	31.8	54.5	9.1		2.3				
	Gentamicin	British Columbia	37	1	1	2.7						18.9	73.0	5.4				2.7				
		Saskatchewan	26	1	1	0.0						34.6	61.5	3.8								
		Ontario	86	1	1	0.0						5.8	87.2	7.0								
		Québec	44	1	2	4.5					2.3	15.9	63.6	13.6			2.3	2.3				
	Kanamycin	British Columbia	37	≤ 8	≤ 8	0.0										100.0						
		Saskatchewan	26	≤ 8	≤ 8	0.0										100.0						
		Ontario	86	≤ 8	> 64	10.5										89.5				10.5		
		Québec	44	≤ 8	> 64	18.2										81.8				18.2		
	Nalidixic acid	British Columbia	37	2	4	2.7							13.5	67.6	16.2				2.7			
		Saskatchewan	26	2	2	0.0							7.7	84.6	7.7							
		Ontario	86	2	4	0.0							15.1	72.1	12.8							
		Québec	44	2	4	2.3							11.4	75.0	11.4				2.3			
	Streptomycin	British Columbia	37	≤ 32	> 64	13.5												86.5	2.7	10.8		
		Saskatchewan	26	≤ 32	> 64	19.2												80.8	7.7	11.5		
		Ontario	86	≤ 32	> 64	30.2												69.8	15.1	15.1		
		Québec	44	≤ 32	> 64	36.4												63.6	13.6	22.7		
	Trimethoprim-sulfamethoxazole	British Columbia	37	≤ 0.12	≤ 0.12	2.7				91.9	5.4					2.7						
		Saskatchewan	26	≤ 0.12	0.25	7.7				88.5	3.8					7.7						
		Ontario	86	≤ 0.12	0.25	4.7				84.9	9.3		1.2			4.7						
		Québec	44	≤ 0.12	0.25	9.1				81.8	9.1					9.1						
III	Chloramphenicol	British Columbia	37	8	8	2.7								2.7	40.5	54.1			2.7			
		Saskatchewan	26	8	8	7.7								11.5	26.9	53.8		3.8	3.8			
		Ontario	86	8	8	8.1								2.3	39.5	50.0		4.7	3.5			
		Québec	44	8	8	6.8									43.2	50.0		2.3	4.5			
	Sulfisoxazole	British Columbia	37	≤ 16	> 256	10.8											70.3	16.2	2.7			10.8
		Saskatchewan	26	≤ 16	> 256	19.2											73.1	7.7				19.2
		Ontario	86	≤ 16	> 256	23.3											68.6	8.1				23.3
		Québec	44	≤ 16	> 256	38.6											59.1	2.3				38.6
	Tetracycline	British Columbia	37	≤ 4	> 32	24.3									75.7				24.3			
		Saskatchewan	26	≤ 4	> 32	34.6									65.4				34.6			
		Ontario	86	> 32	> 32	58.1									40.7	1.2			58.1			
		Québec	44	≤ 4	> 32	47.7									52.3				47.7			
IV																						

Table 22. Distribution of minimum inhibitory concentrations in *Salmonella* from turkey

	Antimicrobial	Province/region	n	Percentiles MIC 50	MIC 90	% R	Distribution (%) of MICs (µg/mL) ≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
	Amoxicillin-clavulanic acid	British Columbia	27	≤ 1	> 32	29.6							63.0		7.4			3.7	25.9			
		Saskatchewan	18	≤ 1	16	5.6							77.8	11.1			5.6		5.6			
		Ontario	44	≤ 1	> 32	20.5							72.7	2.3		2.3	2.3		20.5			
		Québec	51	≤ 1	> 32	29.4							56.9	3.9		7.8	2.0		29.4			
	Ceftiofur	British Columbia	27	1	> 8	33.3						11.1	51.9		3.7	7.4	25.9					
		Saskatchewan	18	1	1	5.6						16.7	77.8				5.6					
		Ontario	44	1	> 8	20.5						15.9	61.4	2.3			20.5					
I		Québec	51	1	> 8	29.4						9.8	60.8				29.4					
	Ceftriaxone	British Columbia	27	≤ 0.25	16	37.0					63.0				7.4	11.1	18.5					
		Saskatchewan	18	≤ 0.25	≤ 0.25	5.6					94.4								5.6			
		Ontario	44	≤ 0.25	32	20.5					79.5						9.1	6.8	2.3	2.3		
		Québec	51	≤ 0.25	32	29.4					70.6					2.0	5.9	15.7	5.9			
	Ciprofloxacin	British Columbia	27	≤ 0.015	0.03	0.0	85.2	14.8														
		Saskatchewan	18	≤ 0.015	0.03	0.0	83.3	16.7														
		Ontario	44	≤ 0.015	0.03	0.0	77.3	20.5	2.3													
		Québec	51	≤ 0.015	0.03	0.0	82.4	17.6														
	Ampicillin	British Columbia	27	≤ 1	> 32	37.0							55.6	7.4					37.0			
		Saskatchewan	18	≤ 1	> 32	11.1							77.8	11.1					11.1			
		Ontario	44	≤ 1	> 32	25.0							75.0						25.0			
		Québec	51	≤ 1	> 32	39.2							56.9	3.9					39.2			
	Azithromycin	British Columbia	27	4	4	0.0								7.4	88.9	3.7						
		Saskatchewan	18	4	8	0.0							5.6		72.2	22.2						
		Ontario	44	4	8	2.3									75.0	20.5	2.3	2.3				
		Québec	51	4	8	0.0							2.0	13.7	68.6	15.7						
	Cefoxitin	British Columbia	27	2	32	22.2							3.7	55.6	11.1		7.4	22.2				
		Saskatchewan	18	4	4	5.6							11.1	33.3	50.0				5.6			
		Ontario	44	2	> 32	20.5							13.6	52.3	13.6			4.5	15.9			
		Québec	51	4	> 32	29.4							9.8	35.3	25.5			5.9	23.5			
	Gentamicin	British Columbia	27	0.50	1	0.0					14.8	59.3	18.5			7.4						
		Saskatchewan	18	0.50	> 16	16.7					11.1	55.6	16.7					16.7				
		Ontario	44	0.50	1	6.8					6.8	63.6	20.5	2.3				6.8				
		Québec	51	0.50	1	2.0						78.4	19.6					2.0				
II	Kanamycin	British Columbia	27	≤ 8	≤ 8	0.0										100.0						
		Saskatchewan	18	≤ 8	≤ 8	0.0										94.4	5.6					
		Ontario	44	≤ 8	≤ 8	4.5										95.5				4.5		
		Québec	51	≤ 8	≤ 8	0.0										100.0						
	Nalidixic acid	British Columbia	27	4	4	0.0								33.3	59.3	7.4						
		Saskatchewan	18	4	4	0.0								22.2	77.8							
		Ontario	44	4	4	0.0								9.1	86.4	4.5						
		Québec	51	4	4	0.0								13.7	80.4	5.9						
	Streptomycin	British Columbia	27	≤ 32	> 64	48.1												51.9	7.4	40.7		
		Saskatchewan	18	> 64	> 64	50.0												50.0		50.0		
		Ontario	44	≤ 32	> 64	20.5												79.5	6.8	13.6		
		Québec	51	≤ 32	> 64	29.4												70.6	7.8	21.6		
	Trimethoprim-sulfamethoxazole	British Columbia	27	≤ 0.12	≤ 0.12	0.0				100.0												
		Saskatchewan	18	≤ 0.12	0.25	0.0				72.2	22.2	5.6										
		Ontario	44	≤ 0.12	≤ 0.12	2.3				90.9	4.5	2.3				2.3						
		Québec	51	≤ 0.12	0.25	3.9				86.3	7.8	2.0				3.9						
	Chloramphenicol	British Columbia	27	8	8	0.0								3.7	37.0	59.3						
		Saskatchewan	18	8	8	5.6									27.8	66.7			5.6			
		Ontario	44	8	> 32	11.4									18.2	70.5			11.4			
		Québec	51	8	8	0.0									15.7	82.4	2.0					
	Sulfisoxazole	British Columbia	27	32	128	7.4											14.8	51.9	22.2	3.7		7.4
III		Saskatchewan	18	> 256	> 256	50.0											5.6	27.8	16.7			50.0
		Ontario	44	32	> 256	11.4											18.2	50.0	20.5			11.4
		Québec	51	32	> 256	15.7											11.8	54.9	17.6			15.7
	Tetracycline	British Columbia	27	> 32	> 32	51.9									48.1				51.9			
		Saskatchewan	18	> 32	> 32	66.7									33.3			5.6	61.1			
		Ontario	44	≤ 4	> 32	18.2									81.8			4.5	13.6			
		Québec	51	≤ 4	> 32	23.5									76.5			2.0	21.6			
IV																						

Table 23. Distribution of minimum inhibitory concentrations in *Escherichia coli* from turkey

	Antimicrobial	Province/region	n	Percentiles MIC 50	Percentiles MIC 90	% R	Distribution (%) of MICs (µg/mL) ≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
	Amoxicillin-clavulanic acid	British Columbia	101	4	32	15.8							5.0	27.7	31.7	18.8	1.0	9.9	5.9			
		Saskatchewan	81	4	8	4.9							4.9	28.4	40.7	21.0		4.9				
		Ontario	152	4	32	11.2							2.6	25.0	42.1	16.4	2.6	9.2	2.0			
		Québec	170	4	32	12.4							3.5	21.2	34.1	27.1	1.8	8.8	3.5			
	Ceftiofur	British Columbia	101	0.50	8	12.9				4.0	41.6	37.6	1.0	2.0	1.0	8.9	4.0					
		Saskatchewan	81	0.25	0.50	3.7				4.9	45.7	44.4	1.2			2.5	1.2					
		Ontario	152	0.50	1	8.6				5.3	42.1	42.1	1.3		0.7	8.6						
I		Québec	170	0.50	8	11.2				2.4	42.4	42.4	1.8			4.7	6.5					
	Ceftriaxone	British Columbia	101	≤ 0.25	8	13.9					83.2		3.0			5.0	6.9	2.0				
		Saskatchewan	81	≤ 0.25	≤ 0.25	3.7					96.3					1.2	2.5					
		Ontario	152	≤ 0.25	0.50	9.2					88.8	1.3	0.7			3.3	5.3		0.7			
		Québec	170	≤ 0.25	8	11.2					88.2		0.6			3.5	5.9	1.8				
	Ciprofloxacin	British Columbia	101	≤ 0.015	≤ 0.015	0.0	96.0	2.0			1.0	1.0										
		Saskatchewan	81	≤ 0.015	≤ 0.015	0.0	96.3	1.2			2.5											
		Ontario	152	≤ 0.015	≤ 0.015	0.7	95.4	2.0		0.7	1.3					0.7						
		Québec	170	≤ 0.015	≤ 0.015	0.0	97.1	1.2	0.6			1.2										
	Ampicillin	British Columbia	101	2	> 32	30.7							10.9	41.6	16.8			1.0	29.7			
		Saskatchewan	81	2	> 32	24.7							21.0	40.7	13.6				24.7			
		Ontario	152	2	> 32	30.9							15.1	42.1	11.8				30.9			
		Québec	170	4	> 32	37.6							10.6	37.1	13.5	1.2			37.6			
	Azithromycin	British Columbia	101	4	4	0.0							5.0	20.8	68.3	5.9						
		Saskatchewan	81	4	4	0.0							4.9	32.1	55.6	7.4						
		Ontario	152	4	8	1.3						1.3	4.6	28.9	53.3	9.9	0.7	1.3				
		Québec	170	4	4	0.0							5.9	30.6	56.5	6.5	0.6					
	Cefoxitin	British Columbia	101	4	> 32	14.9								25.7	51.5	5.9	2.0	4.0	10.9			
		Saskatchewan	81	4	8	3.7							1.2	25.9	60.5	7.4	1.2	1.2	2.5			
		Ontario	152	4	32	10.5							1.3	26.3	48.7	12.5	0.7	4.6	5.9			
		Québec	170	4	32	11.8							0.6	28.8	47.1	10.6	1.2	4.1	7.6			
	Gentamicin	British Columbia	101	1	2	6.9						15.8	68.3	5.9		3.0	3.0	4.0				
		Saskatchewan	81	1	16	13.6						16.0	59.3	4.9	1.2	4.9	3.7	9.9				
		Ontario	152	1	> 16	15.8						11.2	66.4	5.3	0.7	0.7	2.0	13.8				
		Québec	170	1	2	9.4						15.3	67.1	8.2			2.4	7.1				
II	Kanamycin	British Columbia	101	≤ 8	16	9.9										89.1	1.0			9.9		
		Saskatchewan	81	≤ 8	> 64	12.3										81.5	6.2			12.3		
		Ontario	152	≤ 8	> 64	10.5										85.5	3.9			10.5		
		Québec	170	≤ 8	≤ 8	8.2										90.6	1.2			8.2		
	Nalidixic acid	British Columbia	101	2	4	2.0							21.8	63.4	12.9				2.0			
		Saskatchewan	81	2	2	2.5						2.5	21.0	67.9	6.2				2.5			
		Ontario	152	2	4	2.0						0.7	21.7	65.1	9.9	0.7			2.0			
		Québec	170	2	4	0.0						0.6	18.2	66.5	12.9	0.6	1.2					
	Streptomycin	British Columbia	101	≤ 32	> 64	45.5												54.5	7.9	37.6		
		Saskatchewan	81	≤ 32	> 64	44.4												55.6	18.5	25.9		
		Ontario	152	≤ 32	> 64	34.9												65.1	7.2	27.6		
		Québec	170	≤ 32	> 64	36.5												63.5	9.4	27.1		
	Trimethoprim-sulfamethoxazole	British Columbia	101	≤ 0.12	≤ 0.12	3.0				91.1	4.0	2.0				3.0						
		Saskatchewan	81	≤ 0.12	≤ 0.12	1.2				93.8	4.9					1.2						
		Ontario	152	≤ 0.12	0.25	8.6				84.2	6.6	0.7				8.6						
		Québec	170	≤ 0.12	> 4	11.8				77.1	8.8	1.8	0.6			11.8						
	Chloramphenicol	British Columbia	101	8	8	2.0								4.0	41.6	52.5			2.0			
		Saskatchewan	81	4	8	1.2								6.2	45.7	46.9			1.2			
		Ontario	152	8	8	5.3								4.6	44.1	44.1	2.0	0.7	4.6			
		Québec	170	4	8	5.9								2.4	50.6	39.4	1.8	0.6	5.3			
	Sulfisoxazole	British Columbia	101	≤ 16	> 256	25.7											59.4	13.9	1.0			25.7
		Saskatchewan	81	≤ 16	> 256	24.7											56.8	17.3	1.2			24.7
III		Ontario	152	32	> 256	27.6											48.7	20.4	3.3			27.6
		Québec	170	32	> 256	28.8											48.8	20.0	1.8	0.6		28.8
	Tetracycline	British Columbia	101	≤ 4	> 32	46.5									53.5			2.0	44.6			
		Saskatchewan	81	> 32	> 32	51.9									48.1			1.2	50.6			
		Ontario	152	> 32	> 32	59.2									40.8			0.7	58.6			
		Québec	170	> 32	> 32	58.2									41.8			2.9	55.3			
IV																						

Table 24. Distribution of minimum inhibitory concentrations in *Campylobacter* from turkey

	Antimicrobial	Species	Province / region	n	Percentiles		% R	Distribution (%) of MICs (µg/mL)													
					MIC 50	MIC 90		≤ 0.016	0.032	0.064	0.125	0.25	0.5	1	2	4	8	16	32	64	> 64
	Ciprofloxacin	*Campylobacter coli*	British Columbia	7	16	16	57.1			42.9								57.1			
	Ciprofloxacin	*Campylobacter coli*	Saskatchewan	0	0	0	0.0														
	Ciprofloxacin	*Campylobacter coli*	Ontario	8	0.25	0.25	0.0			12.5	25.0	62.5									
	Ciprofloxacin	*Campylobacter coli*	Québec	1	0.25	0.25	0.0					100.0									
	Ciprofloxacin	*Campylobacter jejuni*	British Columbia	26	0.125	16	11.5			23.1	53.8	11.5						11.5			
	Ciprofloxacin	*Campylobacter jejuni*	Saskatchewan	6	0.064	16	16.7			66.7	16.7							16.7			
	Ciprofloxacin	*Campylobacter jejuni*	Ontario	12	0.125	0.25	0.0			16.7	66.7	16.7									
I	Ciprofloxacin	*Campylobacter jejuni*	Québec	14	0.125	0.25	0.0			42.9	35.7	21.4									
	Telithromycin	*Campylobacter coli*	British Columbia	7	0.25	0.25	0.0					100.0									
	Telithromycin	*Campylobacter coli*	Saskatchewan	0	0	0	0.0														
	Telithromycin	*Campylobacter coli*	Ontario	8	2	16	12.5					25.0			62.5			12.5			
	Telithromycin	*Campylobacter coli*	Québec	1	2	2	0.0								100.0						
	Telithromycin	*Campylobacter jejuni*	British Columbia	26	0.5	1	0.0					3.8	57.7	38.5							
	Telithromycin	*Campylobacter jejuni*	Saskatchewan	6	0.5	1	0.0					33.3	50.0	16.7							
	Telithromycin	*Campylobacter jejuni*	Ontario	12	0.5	1	8.3					33.3	33.3	25.0				8.3			
	Telithromycin	*Campylobacter jejuni*	Québec	14	1	2	0.0					14.3	35.7	35.7	14.3						
	Azithromycin	*Campylobacter coli*	British Columbia	7	0.064	0.064	0.0		42.9	57.1											
	Azithromycin	*Campylobacter coli*	Saskatchewan	0	0	0	0.0														
	Azithromycin	*Campylobacter coli*	Ontario	8	0.064	> 64	12.5		12.5	75.0											12.5
	Azithromycin	*Campylobacter coli*	Québec	1	0.064	0.064	0.0			100.0											
	Azithromycin	*Campylobacter jejuni*	British Columbia	26	0.064	0.064	0.0	3.8	23.1	65.4	7.7										
	Azithromycin	*Campylobacter jejuni*	Saskatchewan	6	0.064	0.064	0.0	16.7	33.3	50.0											
	Azithromycin	*Campylobacter jejuni*	Ontario	12	0.032	0.125	8.3		58.3	25.0	8.3										8.3
	Azithromycin	*Campylobacter jejuni*	Québec	14	0.064	0.064	0.0		21.4	71.4	7.1										
	Clindamycin	*Campylobacter coli*	Saskatchewan	7	0.25	0.25	0.0				14.3	85.7									
	Clindamycin	*Campylobacter coli*	Ontario	0	0	0	0.0														
	Clindamycin	*Campylobacter coli*	Québec	8	0.25	8	12.5				12.5	62.5	12.5				12.5				
	Clindamycin	*Campylobacter jejuni*	British Columbia	1	0.25	0.25	0.0					100.0									
II	Clindamycin	*Campylobacter jejuni*	Saskatchewan	26	0.125	0.25	0.0			11.5	50.0	38.5									
	Clindamycin	*Campylobacter jejuni*	Ontario	6	0.125	0.125	0.0			16.7	83.3										
	Clindamycin	*Campylobacter jejuni*	Québec	12	0.125	0.125	0.0			33.3	58.3					8.3					
	Clindamycin	*Campylobacter jejuni*	Maritimes	14	0.125	0.25	0.0			14.3	64.3	21.4									
	Erythromycin	*Campylobacter coli*	British Columbia	7	0.25	0.25	0.0					100.0									
	Erythromycin	*Campylobacter coli*	Saskatchewan	0	0	0	0.0														
	Erythromycin	*Campylobacter coli*	Ontario	8	1	> 64	12.5					25.0	25.0	37.5							12.5
	Erythromycin	*Campylobacter coli*	Québec	1	1	1	0.0							100.0							
	Erythromycin	*Campylobacter jejuni*	British Columbia	26	0.25	1	0.0					57.7	26.9	15.4							
	Erythromycin	*Campylobacter jejuni*	Saskatchewan	6	0.25	0.5	0.0					83.3	16.7								
	Erythromycin	*Campylobacter jejuni*	Ontario	12	0.25	0.5	8.3				16.7	50.0	25.0								8.3
	Erythromycin	*Campylobacter jejuni*	Québec	14	0.5	1	0.0					50.0	35.7	14.3							
	Gentamicin	*Campylobacter coli*	British Columbia	7	1	1	0.0						42.9	57.1							
	Gentamicin	*Campylobacter coli*	Saskatchewan	0	0	0	0.0														
	Gentamicin	*Campylobacter coli*	Ontario	8	1	1	0.0						25.0	75.0							
	Gentamicin	*Campylobacter coli*	Québec	1	1	1	0.0							100.0							
	Gentamicin	*Campylobacter jejuni*	British Columbia	26	1	1	0.0					3.8	42.3	53.8							
	Gentamicin	*Campylobacter jejuni*	Saskatchewan	6	1	1	0.0						33.3	66.7							
	Gentamicin	*Campylobacter jejuni*	Ontario	12	1	1	0.0					8.3	41.7	50.0							
	Gentamicin	*Campylobacter jejuni*	Québec	14	0.5	1	0.0						57.1	42.9							
II	Nalidixic acid	*Campylobacter coli*	British Columbia	7	> 64	> 64	57.1									42.9					57.1
	Nalidixic acid	*Campylobacter coli*	Saskatchewan	0	0	0	0.0														
	Nalidixic acid	*Campylobacter coli*	Ontario	8	8	8	0.0									37.5	62.5				
	Nalidixic acid	*Campylobacter coli*	Québec	1	8	8	0.0										100.0				
	Nalidixic acid	*Campylobacter jejuni*	British Columbia	26	8	> 64	11.5									50.0	30.8	7.7			11.5
	Nalidixic acid	*Campylobacter jejuni*	Saskatchewan	6	8	> 64	16.7									33.3	50.0				16.7
	Nalidixic acid	*Campylobacter jejuni*	Ontario	12	≤ 4	8	0.0									75.0	25.0				
	Nalidixic acid	*Campylobacter jejuni*	Québec	14	≤ 4	8	0.0									85.7	14.3				
	Florfenicol	*Campylobacter coli*	British Columbia	7	1	2	0.0							71.4	28.6						
	Florfenicol	*Campylobacter coli*	Saskatchewan	0	0	0	0.0														
	Florfenicol	*Campylobacter coli*	Ontario	8	1	1	0.0							100.0							
	Florfenicol	*Campylobacter coli*	Québec	1	1	1	0.0							100.0							
	Florfenicol	*Campylobacter jejuni*	British Columbia	26	1	2	0.0						3.8	84.6	7.7	3.8					
	Florfenicol	*Campylobacter jejuni*	Saskatchewan	6	1	1	0.0						33.3	66.7							
	Florfenicol	*Campylobacter jejuni*	Ontario	12	1	1	0.0							100.0							
	Florfenicol	*Campylobacter jejuni*	Québec	14	1	2	0.0						7.1	78.6	14.3						
III	Tetracycline	*Campylobacter coli*	British Columbia	7	> 64	> 64	85.7							14.3						14.3	71.4
	Tetracycline	*Campylobacter coli*	Saskatchewan	0	0	0	0.0														
	Tetracycline	*Campylobacter coli*	Ontario	8	> 64	> 64	62.5					25.0	12.5								62.5
	Tetracycline	*Campylobacter coli*	Québec	1	0.5	0.5	0.0						100.0								
	Tetracycline	*Campylobacter jejuni*	British Columbia	26	0.25	64	23.1				11.5	42.3	11.5	7.7	3.8					19.2	3.8
	Tetracycline	*Campylobacter jejuni*	Saskatchewan	6	32	64	66.7					16.7	16.7						33.3	33.3	
	Tetracycline	*Campylobacter jejuni*	Ontario	12	64	> 64	83.3					8.3	8.3						8.3	50.0	25.0
	Tetracycline	*Campylobacter jejuni*	Québec	14	64	> 64	78.6					14.3				7.1				35.7	42.9
IV																					

RECOVERY RESULTS

Table 25. Retail surveillance recovery rates, 2003-2012

CIPARS Component/ Animal species	Province	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted							
			Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*	
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						
		2012	**60%**	76/126						
	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						
		2012	**75%**	80/107						
	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						
		2012	**63%**	110/176						
	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						
		2012	**51%**	107/219						
	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						
		2012[d]	**50%**	24/48						

Grey-shaded areas indicate either: a) isolates recovered from sampling activities outside the scope of CIPARS routine (or "core") surveillance in the specified year (i.e. grey-shaded areas with data) or b) discontinuation or no surveillance activity (i.e. grey-shaded areas with no data).

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 for this year should be interpreted with caution.

[d] Due to an unforeseeable pause in retail sampling in the Maritimes from April through December in 2012, the expected number of samples was not achieved and thus, results for this region in 2012 are not representative and potentially lack the precision necessary to be included as regular surveillance data. For this reason, these data are not presented anywhere else in this chapter.

Table 25. Retail surveillance recovery rates, 2003-2012 (cont'd)

Component/ Animal species	Province	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted							
			Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*	
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		
		2012	**99%**	82/83	**32%**	53/166	**44%**	73/166		
	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		
		2012	**94%**	67/71	**33%**	46/140	**29%**	40/140		
	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		
		2012	**92%**	107/116	**44%**	102/232	**39%**	87/226		
	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		
		2012	**95%**	133/140	**38%**	106/280	**28%**	78/274		
	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		
		2012[d]	**96%**	46/48	**23%**	11/48	**21%**	10/48		

Grey-shaded areas indicate either: a) isolates recovered from sampling activities outside the scope of CIPARS routine (or "core") surveillance in the specified year (i.e. grey-shaded areas with data) or b) discontinuation or no surveillance activity (i.e. grey-shaded areas with no data).

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 for this year 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] For the Maritimes, 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.

[d] Due to an unforeseeable pause in retail sampling in the Maritimes from April through December in 2012, the expected number of samples was not achieved and thus, results for this region in 2012 are not representative and potentially lack the precision necessary to be included as regular surveillance data. For this reason, these data are not presented anywhere else in this chapter.

Table 25. Retail surveillance recovery rates, 2003-2012 (cont'd)

Component/ Animal species	Province	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted							
			Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*	
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				
		2012	**25%**	41/167	**0%**	0/167				
	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				
		2012	**19%**	26/140	**1%**	2/141				
	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				
		2012	**37%**	86/231	**2%**	5/231				
	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				
		2012	**16%**	46/279	**3%**	8/279				
	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				
		2012[d]	**25%**	12/48	**0%**	0/48				
Turkey	British Columbia	2011	**97%**	59/61	**11%**	8/71	**24%**	17/71		
		2012	**97%**	101/104	**18%**	27/153	**22%**	33/153		
	Saskatchewan	2011[a]	**100%**	10/10	**20%**	2/10	**10%**	1/10		
		2012	**91%**	81/89	**14%**	18/128	**5%**	6/128		
	Ontario	2011	**95%**	162/171	**14%**	27/191	**9%**	18/191		
		2012	**97%**	152/156	**20%**	44/223	**9%**	20/223		
	Québec	2011	**91%**	138/152	**17%**	27/163	**10%**	16/163		
		2012	**96%**	170/178	**21%**	51/246	**6%**	15/246		

Grey-shaded areas indicate either: a) isolates recovered from sampling activities outside the scope of CIPARS routine (or "core") surveillance in the specified year (i.e. grey-shaded areas with data) or b) discontinuation or no surveillance activity (i.e. grey-shaded areas with no data).

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 for this year should be interpreted with caution.

[d] Due to an unforeseeable pause in retail sampling in the Maritimes from April through December in 2012, the expected number of samples was not achieved and thus, results for this region in 2012 are not representative and potentially lack the precision necessary to be included as regular surveillance data. For this reason, these data are not presented anywhere else in this chapter.

ABATTOIR SURVEILLANCE

KEY FINDINGS

BEEF CATTLE

ESCHERICHIA COLI (n = 165)

One percent (1/165) of *E. coli* isolates were resistant to nalidixic acid (Table 26). The previous occurrence of this resistance in CIPARS *Abattoir surveillance* was 1 isolate (less than 1%, 1/167) in 2004 (Figure 15).

CAMPYLOBACTER (n = 152)

Recovery of *Campylobacter* isolates in beef continues to rise from 77% (108/141) in 2011 to 92% (152/166) in 2012 (Table 42).
Slight increase in resistance to ciprofloxacin was observed from 2011 (1%, 1/108) to 2012 (5%, 8/152) (Figure 16).
Resistance to tetracycline was significantly higher in 2012 (63%, 95/152) than in 2006 (45%, 37/82) (Figure 16).

CHICKENS

SALMONELLA (n = 126)

Recovery of *Salmonella* in chickens continued to decline to 18% (126/684) from a peak of 28% (234/851) in 2008 (Table 42). This is similar to levels from the first 3 years of the program (2003-2005).
The proportion of S. Enteritidis isolates decreased from 20% (28/140) in 2011 to 7% (7/104), although 22 isolates do not have serovar information in the 2012 data.
In 2012, resistance to ceftiofur (20%, 25/126) and ampicillin (24%, 30/126) was significantly lower than in 2011 (31%, 44/140; 36%, 51/140, respectively) (Figure 17). This difference was primarily driven by a decrease in ceftiofur (2012: 26%, 11/43; 2011: 57%, 33/58) and ampicillin resistance (2012: 28%, 12/43; 2011: 57% 33/58) in Kentucky isolates.
Resistance to ceftiofur was significantly higher (20%, 25/126) in 2012 than in 2006 (10%, 18/187) (Figure 17).
Resistance to streptomycin and tetracycline was significantly higher in 2012 (39%, 49/126, 40%, 51/126, respectively) than in 2003 (24%, 30/126, 19%, 24/126, respectively) (Figure 17).

ESCHERICHIA COLI (n = 173)

Two percent of *E. coli* isolates (3/173) were resistant to 6 to 7 classes of antimicrobials (Table 29). The previous occurrence of this multi-class resistance in CIPARS *Abattoir Surveillance* was 2 isolates (2/171) in 2009.
The apparent slow increase in resistance to nalidixic acid in 2011 (5%, 9/164) continued in 2012 (8%, 14/173) (Figure 18). One percent (1/173) of isolates were resistant to ciprofloxacin (Table 29 and Table 37). This is the first time resistance to ciprofloxacin has been observed in *E. coli* isolates from abattoir chicken.

Other key findings were:

- One percent (1/173) of isolates were resistant to azithromycin (Table 29 and Table 37).
- The decrease in resistance to ceftiofur seen in 2011 (20%, 32/164) was maintained in 2012 (17%, 30/173) (Figure 18).
- Resistance to tetracycline was significantly lower in 2012 (51%, 88/173) than in 2003 (69%, 106/153) (Figure 18).
- Resistance to trimethoprim-sulfamethoxazole was significantly higher (15%, 26/173) in 2012 than in 2003 (8%, 12/153) (Figure 18).

CAMPYLOBACTER (n = 155)

One percent (2/145) of *C. jejuni* isolates was resistant to 4 to 5 classes of antimicrobials (Table 30). Although this has been previously seen in *C. coli* from CIPARS *Abattoir Surveillance*, this is the first occurrence in *C. jejuni*. The number of *C. coli* isolates susceptible to all of the classes of antimicrobials tested decreased from 11 (out of 13) in 2011 to 3 (out of 10) in 2012.

PIGS

SALMONELLA (n = 157)

Resistance to trimethoprim-sulfamethoxazole was significantly higher in 2012 (6%, 9/157) than in 2003 (2%, 9/391) (Figure 20).

ESCHERICHIA COLI (n = 184)

Resistance to streptomycin and tetracycline was significantly higher in 2012 (40%, 73/184; 84%, 154/184, respectively) than in 2011 (30%, 57/190; 75%, 143/190, respectively) (Figure 21).

CAMPYLOBACTER (n = 287)

No temporal analysis and temporal figure were presented in this report as 2012 is the first year where surveillance began. Recovery of *Campylobacter* in the first year of porcine sampling was 78% (289/370) (Table 42). Ninety-nine percent (286/287) of isolates were *C. coli*, less than 1% (1/287) were *Campylobacter* spp., and no *C. jejuni* were isolated. Other key findings were:

- Approximately 45% of isolates were resistant to telithromycin (128/287) and clindamycin (126/287) (Table 33 and Table 41).
- Fifty-three percent (151/287) of isolates were resistant to azithromycin and erythromycin (Table 33 and Table 41).
- Ten percent of isolates were resistant to ciprofloxacin (28/287) and nalidixic acid (29/287) (Table 33 and Table 41).

The high proportion (99%) of *C. coli* plays a role in the percentage of isolates resistant to these antimicrobials.

MULTICLASS RESISTANCE

Table 26. Number of antimicrobial classes in resistance patterns of *Escherichia coli* from beef cattle

Animal 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	165	113	32	19	1		2		12	1	1				17			1		1	45

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

Table 27. Number of antimicrobial classes in resistance patterns of *Campylobacter* from beef cattle

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	111 (73.0)	47	58	6									6	6	64
Campylobacter coli	39 (25.7)	7	30	2									2	2	32
Campylobacter spp.	2 (1.3)		2											2	
Total	**152 (100)**	**54**	**90**	**8**									**8**	**10**	**96**

Antimicrobial abbreviations are defined in the Preamble.
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.

Table 28. Number of antimicrobial classes in resistance patterns of *Salmonella* from chickens

Serovar	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					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	43 (41.3)	9	3	31				1	31	12	11	11	11	11							31
Heidelberg	26 (25.0)	18	7	1						7	7	7	7	7	1	1		1			1
Hadar	8 (7.7)	4		4					4	1											4
Enteritidis	7 (6.7)	7																			
Schwarzengrund	4 (3.8)	4																			
Thompson	4 (3.8)	3		1					1	1					1						
Less common serovars	12 (11.5)	7	2	2	1				2	3	1	1	1	1	3	1		1			4
Total	**104 (100)**	**52**	**12**	**39**	**1**			**1**	**38**	**24**	**19**	**19**	**19**	**19**	**5**	**2**		**2**			**40**

Antimicrobial abbreviations are defined in the Preamble.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.
Serovars represented by less than 2% of isolates were classified as ''Less common serovars''.
The total number of isolates was 126 but 22 isolates did not have serovar information.

Table 29. Number of antimicrobial classes in resistance patterns of *Escherichia coli* from chickens

Animal species	Number of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					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	173	48	24	70	28	3	23	30	87	68	33	32	33	30	70	26	1	9	1	14	88

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

Table 30. Number of antimicrobial classes in resistance patterns of *Campylobacter* from chickens

Species	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					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	145 (93.5)	71	58	14	2			6	5	8	8		9	8	70
Campylobacter coli	10 (6.5)	3	6		1			1	1	1	1		2	2	6
Total	**155 (100)**	**74**	**64**	**14**	**3**			**7**	**6**	**9**	**9**		**11**	**10**	**76**

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

Table 31. Number of antimicrobial classes in resistance patterns of *Salmonella* from pigs

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	36 (24.2)	5	9	22			2	3	21						22	3		3			26
Typhimurium var. 5-	18 (12.1)	1		6	11			4	13	14					17	4		10			13
Infantis	16 (10.7)	15	1							1	1	1	1	1							
Brandenburg	10 (6.7)	5	3	2				2	1	2											3
London	10 (6.7)	9			1				1	1					1						1
Agona	8 (5.4)	5	2		1				1	1	1	1	1	1	1			1			3
Typhimurium	8 (5.4)	3		1	4			3	4	5					4	2	1	3			5
Bovismorbificans	6 (4.0)	3			3				3	3					3						3
Give	4 (2.7)	4																			
4,[5],12:i:-	4 (2.7)	1	1		2				2	2					2						3
Muenchen	4 (2.7)	4																			
Ohio	4 (2.7)	3	1																		1
Worthington	4 (2.7)	4																			
Putten	3 (2.0)	3																			
Less common serovars	14 (9.4)	7	3	4				2	4	2	1	1	1	1	2						7
Total	**149 (100)**	**72**	**20**	**35**	**22**		**2**	**14**	**50**	**31**	**3**	**3**	**3**	**3**	**52**	**9**	**1**	**17**			**65**

Antimicrobial abbreviations are defined in the Preamble.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.
Serovars represented by less than 2% of isolates were classified as ''Less common serovars''.
The total number of isolates was 157 but 8 isolates did not have serovar information.

Table 32. Number of antimicrobial classes in resistance patterns of *Escherichia coli* from pigs

Animal 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	184	20	40	89	35		2	25	73	66	3	3	3	3	72	25	1	34			154

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

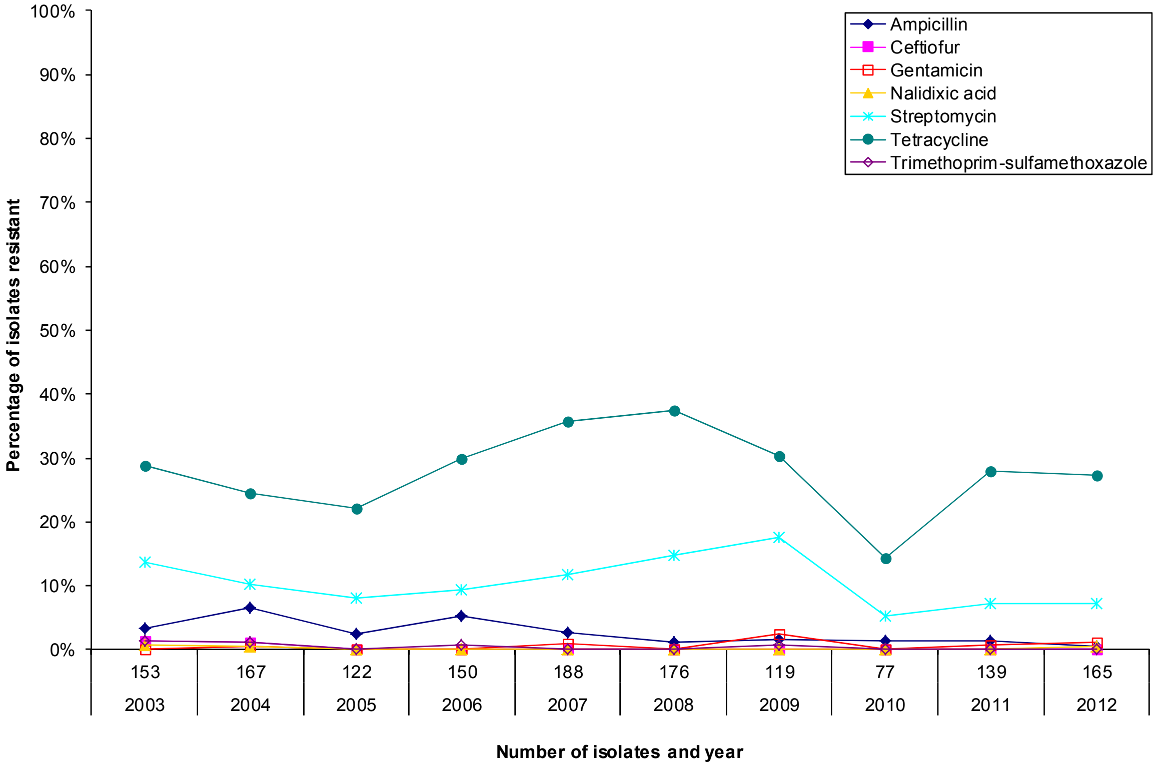
Table 33. Number of antimicrobial classes in resistance patterns of *Campylobacter* from pigs

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 coli	286 (99.7)	44	69	81	92			128	126	151	151		28	28	216
Campylobacter spp.	1 (0.3)			1										1	1
Total	**287 (100)**	**44**	**69**	**82**	**92**			**128**	**126**	**151**	**151**		**28**	**29**	**217**

Antimicrobial abbreviations are defined in the Preamble.
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.

TEMPORAL ANTIMICROBIAL RESISTANCE SUMMARY

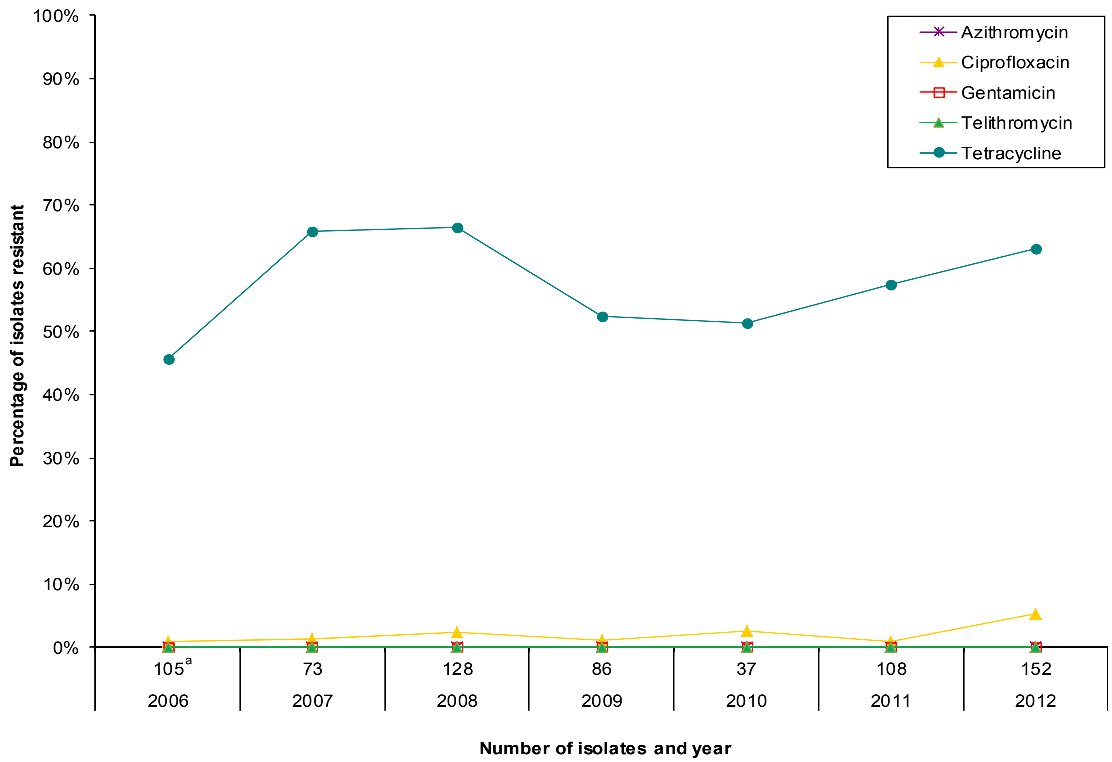
Figure 15. Temporal variations in resistance of *Escherichia coli* isolates from beef cattle



Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of isolates	153	167	122	150	188	176	119	77	139	165
Antimicrobial										
Ampicillin	**3%**	7%	2%	5%	3%	1%	2%	1%	**1%**	**1%**
Ceftiofur	**1%**	1%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Gentamicin	**0%**	1%	0%	0%	1%	0%	3%	0%	**1%**	**1%**
Nalidixic acid	**1%**	1%	0%	0%	0%	0%	0%	0%	**0%**	**1%**
Streptomycin	**14%**	10%	8%	9%	12%	15%	18%	5%	**7%**	**7%**
Tetracycline	**29%**	25%	22%	30%	36%	38%	30%	14%	**28%**	**27%**
Trimethoprim-sulfamethoxazole	**1%**	1%	0%	1%	0%	0%	1%	0%	**0%**	**0%**

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

Figure 16. Temporal variations in resistance of *Campylobacter* isolates from beef cattle

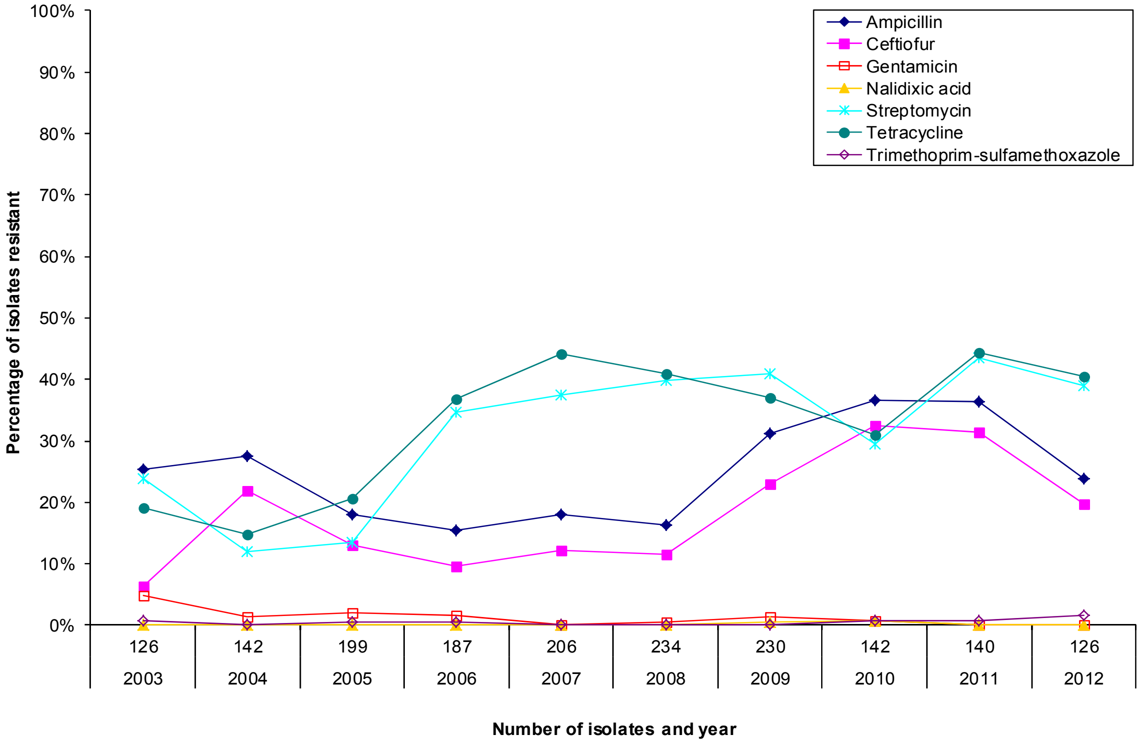


Year	2006	2007	2008	2009	2010	2011	2012
Number of isolates	105[a]	73	128	86	37	108	152
Antimicrobial							
Azithromycin	**0%**	0%	0%	0%	0%	**0%**	**0%**
Ciprofloxacin	**1%**	1%	2%	1%	3%	**1%**	**5%**
Gentamicin	**0%**	0%	0%	0%	0%	**0%**	**0%**
Telithromycin	**0%**	0%	0%	0%	0%	**0%**	**0%**
Tetracycline	**46%**	66%	66%	52%	51%	**57%**	**63%**

[a] This number of isolates includes isolates from the end of year 2005 (n = 23).

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

Figure 17. Temporal variations in resistance of *Salmonella* isolates from chickens

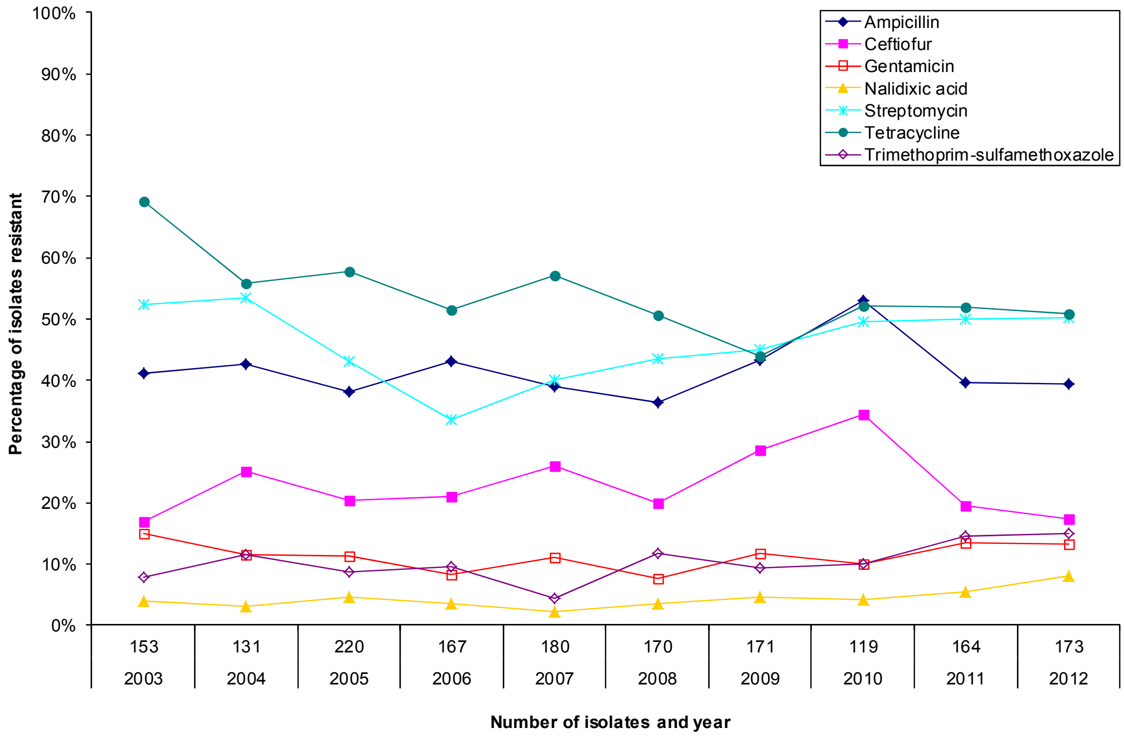


Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of isolates	126	142	199	187	206	234	230	142	140	126
Antimicrobial										
Ampicillin	**25%**	**27%**	18%	**16%**	18%	16%	31%	37%	**36%**	**24%**
Ceftiofur	**6%**	**22%**	13%	**10%**	12%	12%	23%	32%	**31%**	**20%**
Gentamicin	**5%**	1%	2%	2%	0%	0%	1%	1%	**0%**	**0%**
Nalidixic acid	**0%**	0%	0%	0%	0%	0%	0%	1%	**0%**	**0%**
Streptomycin	**24%**	12%	14%	35%	37%	40%	41%	30%	**44%**	**39%**
Tetracycline	**19%**	15%	21%	37%	44%	41%	37%	31%	**44%**	**40%**
Trimethoprim-sulfamethoxazole	**1%**	0%	1%	1%	0%	0%	0%	1%	**1%**	**2%**

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given and antimicrobial.

Additional temporal analyses for ampicillin and ceftiofur were conducted for *Salmonella* isolates from Ontario and Québec. These two antimicrobials and years (2004 and 2006) were selected due to a change in ceftiofur use practices by Québec chicken hatcheries in early 2005 and in 2007 (start and end of the voluntary period of withdrawal). Significant differences ($P \leq 0.05$) observed between the current year results and additional reference year results are indicated by underlined numbers.

Figure 18. Temporal variations in resistance of *Escherichia coli* isolates from chickens

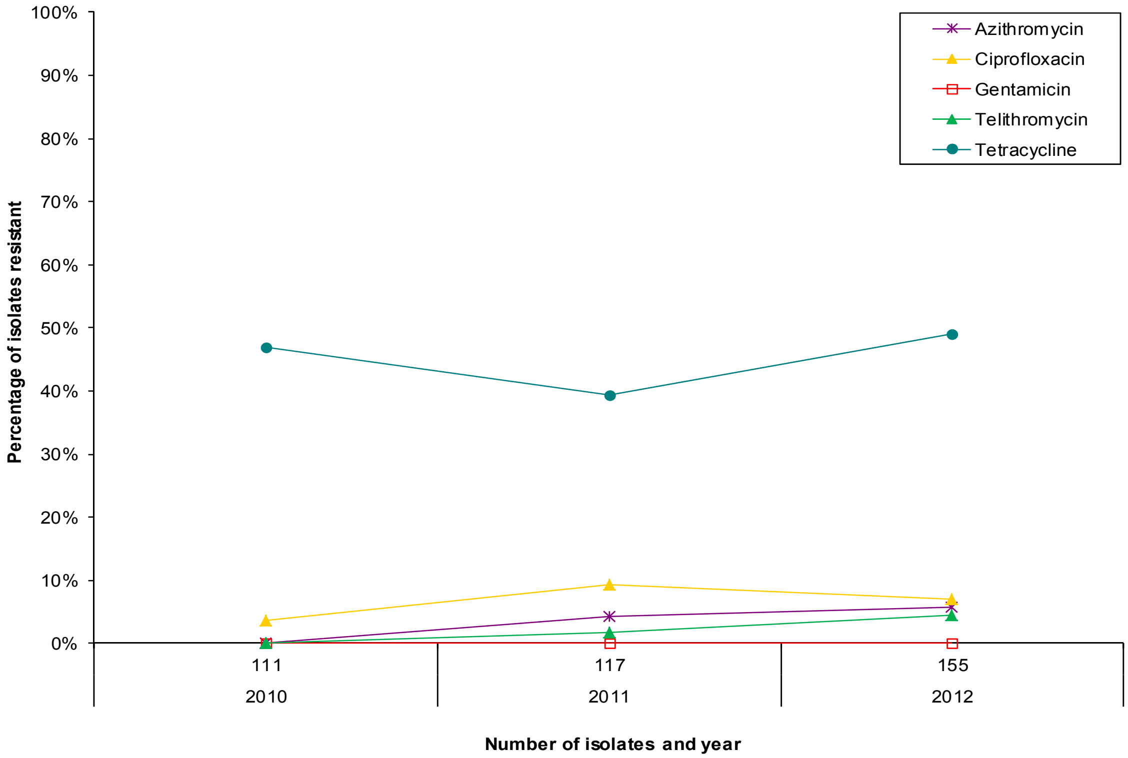


Year Number of isolates	2003 153	2004 131	2005 220	2006 167	2007 180	2008 170	2009 171	2010 119	2011 164	2012 173
Antimicrobial										
Ampicillin	**41%**	**43%**	38%	**43%**	39%	36%	43%	53%	**40%**	**39%**
Ceftiofur	**17%**	**25%**	20%	**21%**	26%	20%	29%	34%	**20%**	**17%**
Gentamicin	**15%**	11%	11%	8%	11%	8%	12%	10%	**13%**	**13%**
Nalidixic acid	**4%**	3%	5%	4%	2%	4%	5%	4%	**5%**	**8%**
Streptomycin	**52%**	53%	43%	34%	40%	44%	45%	50%	**50%**	**50%**
Tetracycline	**69%**	56%	58%	51%	57%	51%	44%	52%	**52%**	**51%**
Trimethoprim-sulfamethoxazole	**8%**	11%	9%	10%	4%	12%	9%	10%	**15%**	**15%**

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given and antimicrobial.

Additional temporal analyses for ampicillin and ceftiofur were conducted for *E. coli* isolates from Ontario and Québec. These two antimicrobials and years (2004 and 2006) were selected due to a change in ceftiofur use practices by Québec chicken hatcheries in early 2005 and in 2007 (start and end of the voluntary period of withdrawal). Significant differences ($P \leq 0.05$) observed between the current year results and additional reference year results are indicated by underlined numbers.

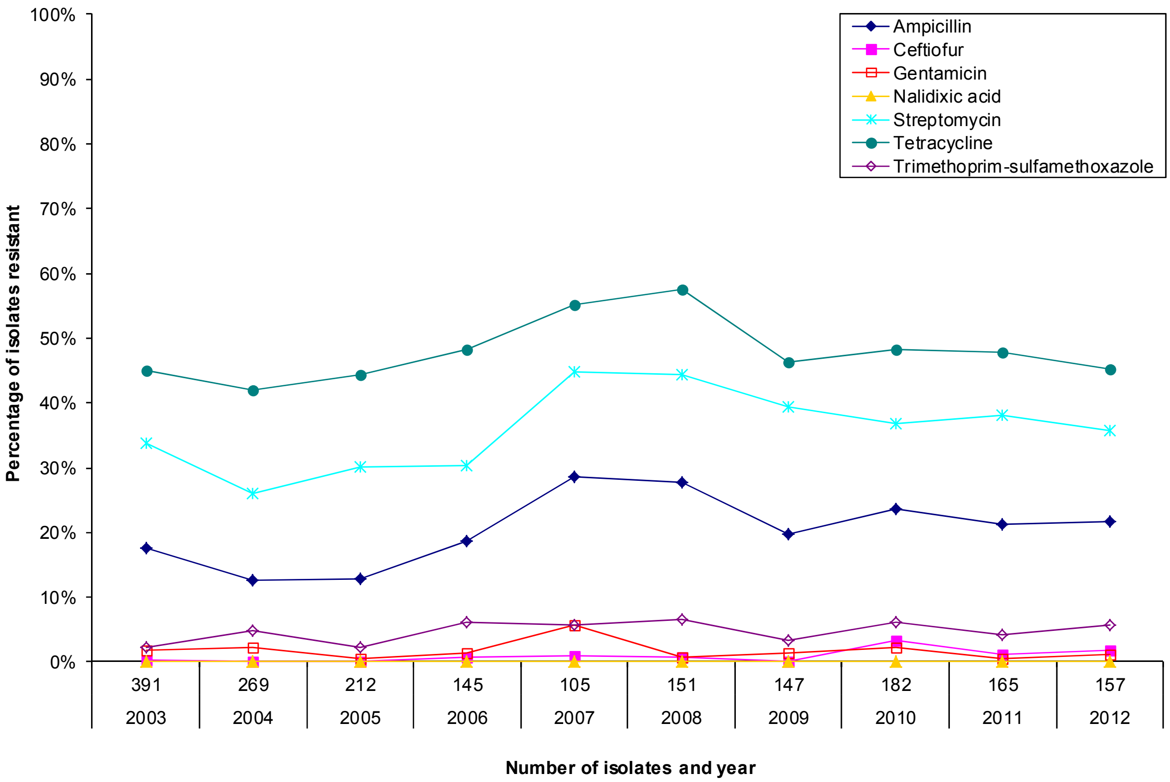
Figure 19. Temporal variations in resistance of *Campylobacter* isolates from chickens



Year	2010	2011	2012
Number of isolates	111	117	155
Antimicrobial			
Azithromycin	**6%**	**4%**	**6%**
Ciprofloxacin	**4%**	**9%**	**7%**
Gentamicin	**0%**	**0%**	**0%**
Telithromycin	**4%**	**2%**	**5%**
Tetracycline	**47%**	**39%**	**49%**

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

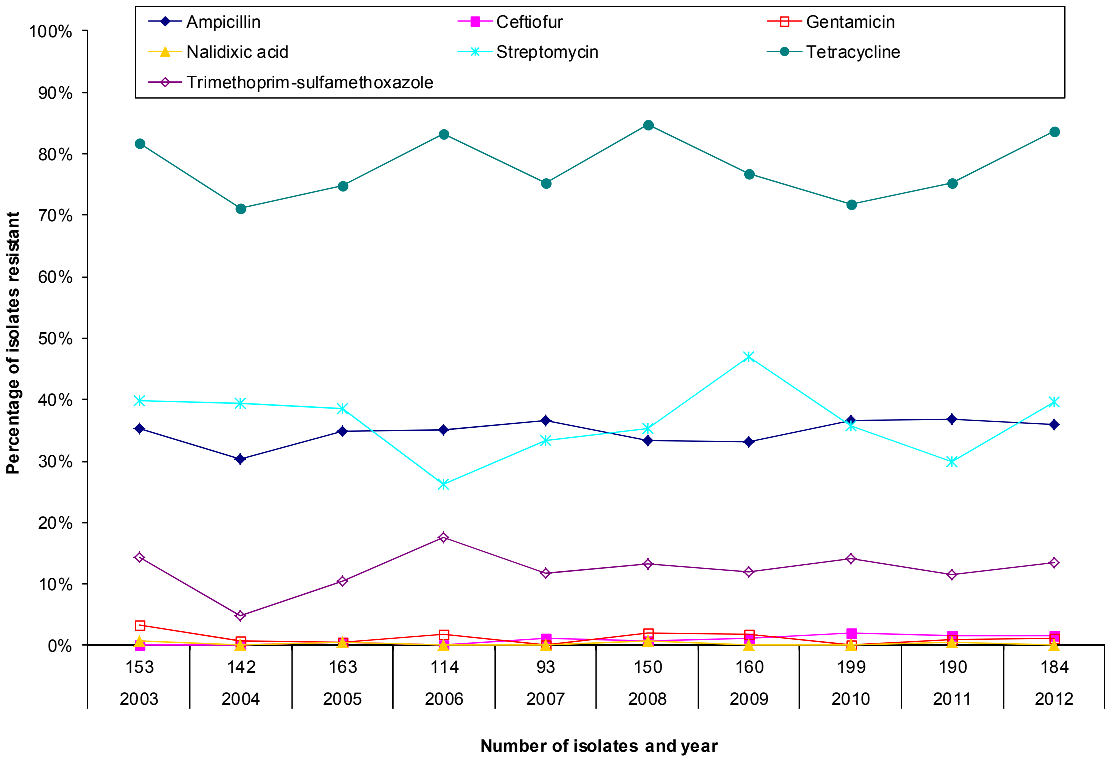
Figure 20. Temporal variations in resistance of *Salmonella* isolates from pigs



Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of isolates	391	269	212	145	105	151	147	182	165	157
Antimicrobial										
Ampicillin	**18%**	13%	13%	19%	29%	28%	20%	24%	**21%**	**22%**
Ceftiofur	**0%**	0%	0%	1%	1%	1%	0%	3%	**1%**	**2%**
Gentamicin	**2%**	2%	0%	1%	6%	1%	1%	2%	**1%**	**1%**
Nalidixic acid	**0%**	0%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Streptomycin	**34%**	26%	30%	30%	45%	44%	39%	37%	**38%**	**36%**
Tetracycline	**45%**	42%	44%	48%	55%	58%	46%	48%	**48%**	**45%**
Trimethoprim-sulfamethoxazole	**2%**	5%	2%	6%	6%	7%	3%	6%	**4%**	**6%**

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given and antimicrobial.

Figure 21. Temporal variations in resistance of *Escherichia coli* isolates from pigs



Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of isolates	153	142	163	114	93	150	160	199	190	184
Antimicrobial										
Ampicillin	**35%**	30%	35%	35%	37%	33%	33%	37%	**37%**	**36%**
Ceftiofur	**0%**	0%	1%	0%	1%	1%	1%	2%	**2%**	**2%**
Gentamicin	**3%**	1%	1%	2%	0%	2%	2%	0%	**1%**	**1%**
Nalidixic acid	**1%**	0%	1%	0%	0%	1%	0%	0%	**1%**	**0%**
Streptomycin	**40%**	39%	39%	26%	33%	35%	47%	36%	**30%**	**40%**
Tetracycline	**82%**	71%	75%	83%	75%	85%	77%	72%	**75%**	**84%**
Trimethoprim-sulfamethoxazole	**14%**	5%	10%	18%	12%	13%	12%	14%	**12%**	**14%**

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given and antimicrobial.

MINIMUM INHIBITORY CONCENTRATIONS

More details on how to interpret the minimum inhibitory concentrations (MICs) tables are provided in the CIPARS Annual Report 2012 – Chapter 1. Design and Methods.

Table 34. Distribution of minimum inhibitory concentrations among *Escherichia coli* isolates from beef cattle

	Antimicrobial	n	Percentiles MIC 50	Percentiles MIC 90	% R	Distribution (%) of MICs (µg/mL) ≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	165	4	4	0.6							6.1	27.9	60.6	4.8		0.6				
I	Ceftiofur	165	0.25	0.50	0.0				7.9	43.6	47.9	0.6									
I	Ceftriaxone	165	≤ 0.25	≤ 0.25	0.0					99.4	0.6										
I	Ciprofloxacin	165	≤ 0.015	≤ 0.015	0.0	98.8	0.6			0.6											
II	Ampicillin	165	2	4	0.6							17.0	53.9	28.5				0.6			
II	Azithromycin	165	4	4	0.0							1.8	17.0	75.8	5.5						
II	Cefoxitin	165	4	8	0.0							1.8	24.8	62.4	9.7	1.2					
II	Gentamicin	165	1	1	1.2					0.6	17.0	74.5	6.1		0.6	1.2					
II	Kanamycin	165	≤ 8	≤ 8	0.0										97.6	0.6	1.8				
II	Nalidixic acid	165	2	4	0.6							9.1	75.2	15.2				0.6			
II	Streptomycin	165	≤ 32	≤ 32	7.3												92.7	4.2	3.0		
II	Trimethoprim-sulfamethoxazole	165	≤ 0.12	≤ 0.12	0.0				98.8	0.6	0.6										
III	Chloramphenicol	165	8	8	0.6								2.4	37.0	58.8	1.2		0.6			
III	Sulfisoxazole	165	≤ 16	> 256	10.3											73.3	14.5	1.8			10.3
III	Tetracycline	165	≤ 4	> 32	27.3									66.1	6.7	5.5	2.4	19.4			
IV																					

Table 35. Distribution of minimum inhibitory concentrations among *Campylobacter* isolates from beef cattle

	Antimicrobial	Species	n	Percentiles MIC 50	Percentiles MIC 90	% R	Distribution (%) of MICs (µg/mL) ≤ 0.016	0.032	0.064	0.125	0.25	0.5	1	2	4	8	16	32	64	> 64
I	Ciprofloxacin	*Campylobacter coli*	39	0.125	0.25	5.1				66.7	28.2					2.6	2.6			
I	Ciprofloxacin	*Campylobacter jejuni*	111	0.125	0.25	5.4			31.5	47.7	12.6	2.7				2.7	0.9	1.8		
I	Ciprofloxacin	*Campylobacter* spp.	2	0.25	0.25	0.0					100.0									
I	Telithromycin	*Campylobacter coli*	39	4	4	0.0							2.6	35.9	61.5					
I	Telithromycin	*Campylobacter jejuni*	111	1	2	0.0					0.9	34.2	43.2	21.6						
I	Telithromycin	*Campylobacter* spp.	2	1	1	0.0						50.0	50.0							
II	Azithromycin	*Campylobacter coli*	39	0.125	0.25	0.0				69.2	30.8									
II	Azithromycin	*Campylobacter jejuni*	111	0.064	0.064	0.0		41.4	51.4	7.2										
II	Azithromycin	*Campylobacter* spp.	2	0.25	0.25	0.0			50.0		50.0									
II	Clindamycin	*Campylobacter coli*	39	0.5	1	0.0					2.6	51.3	43.6		2.6					
II	Clindamycin	*Campylobacter jejuni*	111	0.25	0.25	0.0		0.9	3.6	32.4	59.5	3.6								
II	Clindamycin	*Campylobacter* spp.	2	0.25	0.25	0.0			50.0		50.0									
II	Erythromycin	*Campylobacter coli*	39	2	2	0.0							12.8	79.5	7.7					
II	Erythromycin	*Campylobacter jejuni*	111	0.5	0.5	0.0				0.9	34.2	55.9	9.0							
II	Erythromycin	*Campylobacter* spp.	2	0.5	0.5	0.0						100.0								
II	Gentamicin	*Campylobacter coli*	39	1	1	0.0						12.8	84.6	2.6						
II	Gentamicin	*Campylobacter jejuni*	111	1	2	0.0						11.7	76.6	11.7						
II	Gentamicin	*Campylobacter* spp.	2	0.25	0.25	0.0					100.0									
II	Nalidixic acid	*Campylobacter coli*	39	16	16	5.1										38.5	56.4			5.1
II	Nalidixic acid	*Campylobacter jejuni*	111	≤ 4	8	5.4									50.5	41.4	2.7			5.4
II	Nalidixic acid	*Campylobacter* spp.	2	64	64	100.0													100.0	
III	Florfenicol	*Campylobacter coli*	39	2	2	0.0							28.2	71.8						
III	Florfenicol	*Campylobacter jejuni*	111	1	1	0.0						5.4	84.7	9.9						
III	Florfenicol	*Campylobacter* spp.	2	0.5	0.5	0.0					50.0	50.0								
III	Tetracycline	*Campylobacter coli*	39	> 64	> 64	82.1							17.9							82.1
III	Tetracycline	*Campylobacter jejuni*	111	32	> 64	57.7				8.1	22.5	8.1	3.6				0.9	7.2	18.9	30.6
III	Tetracycline	*Campylobacter* spp.	2	0.25	0.25	0.0					100.0									
IV																				

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

Table 36. Distribution of minimum inhibitory concentrations among *Salmonella* isolates from chickens

Class	Antimicrobial	n	MIC 50	MIC 90	% R	≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
			Percentiles			Distribution (%) of MICs (µg/mL)															
I	Amoxicillin-clavulanic acid	126	≤ 1	> 32	19.8							75.4	0.8		2.4	1.6	2.4	17.5			
I	Ceftiofur	126	1	> 8	19.8						31.7	46.8	1.6		0.8	19.0					
I	Ceftriaxone	126	≤ 0.25	16	19.8					80.2						15.9	4.0				
I	Ciprofloxacin	126	≤ 0.015	0.03	0.0	85.7	14.3														
II	Ampicillin	126	≤ 1	> 32	23.8							72.2	4.0					23.8			
II	Azithromycin	126	4	8	0.0								14.3	66.7	18.3	0.8					
II	Cefoxitin	126	2	32	19.0							26.2	42.9	9.5	1.6	0.8	17.5	1.6			
II	Gentamicin	126	0.50	1	0.0					8.7	79.4	11.1	0.8								
II	Kanamycin	126	≤ 8	≤ 8	0.8										99.2				0.8		
II	Nalidixic acid	126	4	4	0.0							3.2	34.9	61.9							
II	Streptomycin	126	≤ 32	> 64	38.9												61.1	16.7	22.2		
II	Trimethoprim-sulfamethoxazole	126	≤ 0.12	≤ 0.12	1.6				96.0	2.4					1.6						
III	Chloramphenicol	126	8	8	1.6								4.0	42.9	50.8	0.8		1.6			
III	Sulfisoxazole	126	32	64	6.3											8.7	65.9	19.0			6.3
III	Tetracycline	126	≤ 4	> 32	40.5									57.9	1.6		1.6	38.9			
IV																					

Table 37. Distribution of minimum inhibitory concentrations among *Escherichia coli* isolates from chickens

Class	Antimicrobial	n	MIC 50	MIC 90	% R	≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
			Percentiles			Distribution (%) of MICs (µg/mL)															
I	Amoxicillin-clavulanic acid	173	4	32	19.1							1.7	20.2	37.0	21.4	0.6	15.0	4.0			
I	Ceftiofur	173	0.50	8	17.3				1.7	31.2	45.1	2.3	1.2	1.2	12.7	4.6					
I	Ceftriaxone	173	≤ 0.25	16	18.5					78.6		1.7	1.2		6.4	9.8	2.3				
I	Ciprofloxacin	173	≤ 0.015	0.03	0.6	88.4	2.3		3.5	3.5	1.7	0.6									
II	Ampicillin	173	4	> 32	39.3							5.8	34.1	19.7	1.2			39.3			
II	Azithromycin	173	4	8	0.6							1.7	13.9	71.7	11.0	1.2	0.6				
II	Cefoxitin	173	4	> 32	19.1								9.2	49.1	20.2	2.3	6.9	12.1			
II	Gentamicin	173	1	> 16	13.3						15.6	61.3	8.1		1.7	2.3	11.0				
II	Kanamycin	173	≤ 8	> 64	17.3										80.3	1.7	0.6	1.2	16.2		
II	Nalidixic acid	173	2	4	8.1							14.5	62.4	13.9	0.6	0.6	0.6	7.5			
II	Streptomycin	173	64	> 64	50.3												49.7	11.6	38.7		
II	Trimethoprim-sulfamethoxazole	173	≤ 0.12	> 4	15.0				74.6	8.7	1.2	0.6			15.0						
III	Chloramphenicol	173	8	8	5.2								1.2	37.6	53.2	2.9		5.2			
III	Sulfisoxazole	173	32	> 256	40.5											45.1	13.3	1.2			40.5
III	Tetracycline	173	> 32	> 32	50.9									49.1			0.6	50.3			
IV																					

Table 38. Distribution of minimum inhibitory concentrations among *Campylobacter* isolates from chickens

Class	Antimicrobial	Species	n	MIC 50	MIC 90	% R	≤ 0.016	0.032	0.064	0.125	0.25	0.5	1	2	4	8	16	32	64	> 64
				Percentiles			Distribution (%) of MICs (µg/mL)													
I	Ciprofloxacin	*Campylobacter coli*	10	0.125	16	20.0			20.0	40.0	20.0					10.0	10.0			
I	Ciprofloxacin	*Campylobacter jejuni*	145	0.125	0.25	6.2			29.0	51.0	13.1	0.7				2.8	3.4			
I	Telithromycin	*Campylobacter coli*	10	0.5	16	10.0					50.0	10.0		30.0			10.0			
I	Telithromycin	*Campylobacter jejuni*	145	1	2	4.1				0.7	11.0	37.9	37.9	6.9	0.7	0.7	4.1			
II	Azithromycin	*Campylobacter coli*	10	0.064	> 64	10.0	10.0	20.0	40.0	20.0										10.0
II	Azithromycin	*Campylobacter jejuni*	145	0.064	0.125	5.5	1.4	31.7	52.4	9.0										5.5
II	Clindamycin	*Campylobacter coli*	10	0.25	8	10.0				20.0	60.0	10.0				10.0				
II	Clindamycin	*Campylobacter jejuni*	145	0.125	0.25	3.4			6.2	49.7	36.6	2.1	0.7		1.4	2.8		0.7		
II	Erythromycin	*Campylobacter coli*	10	0.5	> 64	10.0					40.0	30.0	20.0							10.0
II	Erythromycin	*Campylobacter jejuni*	145	0.5	1	5.5				2.8	43.4	40.0	8.3						0.7	4.8
II	Gentamicin	*Campylobacter coli*	10	1	2	0.0						30.0	60.0	10.0						
II	Gentamicin	*Campylobacter jejuni*	145	1	1	0.0						24.8	74.5	0.7						
II	Nalidixic acid	*Campylobacter coli*	10	8	> 64	20.0									30.0	50.0				20.0
II	Nalidixic acid	*Campylobacter jejuni*	145	≤ 4	8	5.5									55.9	38.6				5.5
III	Florfenicol	*Campylobacter coli*	10	1	2	0.0						10.0	80.0	10.0						
III	Florfenicol	*Campylobacter jejuni*	145	1	1	0.0						2.8	92.4	4.8						
III	Tetracycline	*Campylobacter coli*	10	> 64	> 64	60.0				10.0	10.0	10.0	10.0							60.0
III	Tetracycline	*Campylobacter jejuni*	145	2	> 64	48.3				17.2	25.5	6.2	0.7	2.1			1.4	2.8	19.3	24.8
IV																				

Table 39. Distribution of minimum inhibitory concentrations among *Salmonella* isolates from pigs

	Antimicrobial	n	Percentiles MIC 50	Percentiles MIC 90	% R	≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	157	≤ 1	16	1.9							75.8	4.5	2.5	6.4	8.9	0.6	1.3			
I	Ceftiofur	157	1	1	1.9						12.1	79.0	7.0			1.9					
I	Ceftriaxone	157	≤ 0.25	≤ 0.25	1.9					98.1					0.6		0.6	0.6			
I	Ciprofloxacin	157	≤ 0.015	0.03	0.0	80.3	17.2	2.5													
II	Ampicillin	157	≤ 1	> 32	21.7							67.5	8.9	1.3		0.6	1.9	19.7			
II	Azithromycin	157	4	8	0.6								10.8	56.7	29.3	2.5	0.6				
II	Cefoxitin	157	4	4	1.9							8.3	39.5	44.6	5.1	0.6		1.9			
II	Gentamicin	157	0.50	1	1.3					3.8	72.0	21.7	0.6	0.6			1.3				
II	Kanamycin	157	≤ 8	≤ 8	8.9										91.1			0.6	8.3		
II	Nalidixic acid	157	4	4	0.0								25.5	68.8	5.1	0.6					
II	Streptomycin	157	≤ 32	> 64	35.7												64.3	4.5	31.2		
II	Trimethoprim-sulfamethoxazole	157	≤ 0.12	0.25	5.7				74.5	17.8	1.9				5.7						
III	Chloramphenicol	157	8	> 32	12.7								1.9	14.0	63.1	8.3		12.7			
III	Sulfisoxazole	157	64	> 256	36.9											2.5	29.3	30.6	0.6		36.9
III	Tetracycline	157	≤ 4	> 32	45.2									54.8		0.6	4.5	40.1			
IV																					

Table 40. Distribution of minimum inhibitory concentrations among *Escherichia coli* isolates from pigs

	Antimicrobial	n	Percentiles MIC 50	Percentiles MIC 90	% R	≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	184	4	8	1.6							2.2	16.8	45.1	29.9	4.3	1.6				
I	Ceftiofur	184	0.25	0.50	1.6				1.1	51.6	45.7				1.6						
I	Ceftriaxone	184	≤ 0.25	≤ 0.25	1.6					97.8	0.5				0.5	1.1					
I	Ciprofloxacin	184	≤ 0.015	≤ 0.015	0.0	97.8	2.2														
II	Ampicillin	184	4	> 32	35.9							6.0	39.1	17.4	1.1	0.5		35.9			
II	Azithromycin	184	4	8	0.5					0.5		1.1	20.7	65.8	11.4		0.5				
II	Cefoxitin	184	4	8	1.6								29.3	59.8	9.2		0.5	1.1			
II	Gentamicin	184	1	2	1.1						25.0	63.6	10.3				1.1				
II	Kanamycin	184	≤ 8	> 64	13.6										85.9	0.5			13.6		
II	Nalidixic acid	184	2	4	0.0							8.7	78.3	13.0							
II	Streptomycin	184	≤ 32	> 64	39.7												60.3	16.8	22.8		
II	Trimethoprim-sulfamethoxazole	184	≤ 0.12	> 4	13.6				75.5	6.5	2.7	1.1	0.5		13.6						
III	Chloramphenicol	184	8	32	18.5								4.9	27.7	47.3	1.6	10.3	8.2			
III	Sulfisoxazole	184	32	> 256	39.1											47.3	12.5	1.1			39.1
III	Tetracycline	184	> 32	> 32	83.7									15.8	0.5	1.1	1.1	81.5			
IV																					

Table 41. Distribution of minimum inhibitory concentrations among *Campylobacter* from pigs

	Antimicrobial	Species	n	Percentiles MIC 50	Percentiles MIC 90	% R	≤ 0.016	0.032	0.064	0.125	0.25	0.5	1	2	4	8	16	32	64	> 64
I	Ciprofloxacin	*Campylobacter coli*	286	0.125	0.5	9.8			15.0	42.0	30.4	2.8				1.0	8.0	0.7		
I	Ciprofloxacin	*Campylobacter* spp.	1	0.25	0.25	0.0					100.0									
I	Telithromycin	*Campylobacter coli*	286	4	16	44.8				0.7	4.5	3.1	13.3	19.9	9.1	4.5	44.8			
I	Telithromycin	*Campylobacter* spp.	1	1	1	0.0							100.0							
II	Azithromycin	*Campylobacter coli*	286	> 64	> 64	52.8		1.7	16.1	24.1	5.2									52.8
II	Azithromycin	*Campylobacter* spp.	1	0.125	0.125	0.0				100.0										
II	Clindamycin	*Campylobacter coli*	286	4	16	44.1			0.3	2.1	9.1	12.9	5.6	7.0	18.9	22.4	15.4	6.3		
II	Clindamycin	*Campylobacter* spp.	1	0.5	0.5	0.0						100.0								
II	Erythromycin	*Campylobacter coli*	286	64	> 64	52.8				0.3	4.5	10.1	21.0	10.1	1.0			1.4	1.7	49.7
II	Erythromycin	*Campylobacter* spp.	1	1	1	0.0							100.0							
II	Gentamicin	*Campylobacter coli*	286	1	2	0.0						3.1	76.6	20.3						
II	Gentamicin	*Campylobacter* spp.	1	0.5	0.5	0.0						100.0								
II	Nalidixic acid	*Campylobacter coli*	286	8	32	9.8									10.8	70.6	8.0	0.7	0.3	9.4
II	Nalidixic acid	*Campylobacter* spp.	1	> 64	> 64	100.0														100.0
III	Florfenicol	*Campylobacter coli*	286	1	2	0.0					0.7	15.0	67.5	16.4	0.3					
III	Florfenicol	*Campylobacter* spp.	1	0.5	0.5	0.0						100.0								
III	Tetracycline	*Campylobacter coli*	286	64	> 64	75.5				0.7	5.9	6.6	5.9	2.4	0.7	2.1	7.7	6.3	12.2	49.3
III	Tetracycline	*Campylobacter* spp.	1	32	32	100.0												100.0		
IV																				

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

RECOVERY RESULTS

Table 42. Abattoir surveillance recovery rates, 2003-2012

CIPARS Component/ Animal species	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted							
		Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*	
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%[a]**	129/182		
	2009	**94%**	119/126			**68%**	86/126		
	2010	**97%[b]**	77/79			**53%[b]**	37/70		
	2011	**99%**	139/141			**77%**	108/141		
	2012	**99%**	165/166			**92%**	152/166		
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		
	2012	**100%**	173/173	**18%[c]**	126/684	**23%**	155/685		
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				
	2012	**100%**	184/184	**42%**	157/370	**78%**	289/370		

Grey-shaded areas indicate either: a) isolates recovered from sampling activities outside the scope of CIPARS routine (or "core") surveillance in the specified year (i.e. grey-shaded areas with data) or b) discontinuation or no surveillance activity (i.e. grey-shaded areas with no data).

[a] Implementation of a new *Campylobacter* recovery method in 2008 in abattoir beef cattle isolates.

[b] 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.

[c] Decreased prevalence in chickens and one non-compliant plant (lack of sampling) resulted in a shortfall of *Salmonella* isolates from chickens.

FARM SURVEILLANCE

KEY FINDINGS

PIGS

SALMONELLA (n = 93)

In 2012, the category I β-lactams ceftriaxone (3%, 3/93) and ceftiofur (3%, 3/93) had resistance levels that were slightly lower than in 2011 [ceftriaxone (5%, 4/77) and ceftiofur (5%, 4/77)]. None of the isolates were resistant to amoxicillin-clavulanic acid, cefoxitin, azithromycin, ciprofloxacin, or nalidixic acid (Table 43 and Table 45). Overall, there was a decrease in resistance to 4 or more antimicrobial classes (14%, 13/93) in 2012 compared to 2011 (29%, 22/77).

No significant temporal variations were detected in the percentages of *Salmonella* isolates with resistance to the selected antimicrobials between 2012 and 2011 or between 2012 and 2006 (Figure 22).

ESCHERICHIA COLI (n= 1,553)[9]

In 2012, the category 1 β-lactams amoxicillin-clavulanic acid (3%, 40/1,553), ceftriaxone (3%, 39/1,553), and ceftiofur (3%, 39/1,553) had resistance levels that were higher than in 2011 amoxicillin-clavulanic acid (1%, 18/1,667), ceftriaxone (1%, 17/1,667), and ceftiofur (1%, 15/1,667). When examined temporally, ceftiofur resistance was significantly higher in 2012 as compared to either 2006 (1%, 17/1,721), or 2011 (1%, 15/1,667) (Figure 23). Similarly, resistance to streptomycin was significantly higher in 2012 (44%, 679/1,553) than in 2006 (37%, 619/1,721), or in 2011 (33%, 548/1,667) (Figure 23). However, resistance to ampicillin was significantly lower in 2012 (31%, 480/1,553) than in 2006 (35%, 564/1,721) (Figure 23). None of the isolates were resistant to ciprofloxacin but reduced susceptibility to ciprofloxacin was detected in less than 1% (6/1,553) of isolates (Table 46).

[9] Up to 3 generic *E. coli* isolates per positive sample were kept for analysis. The expected number of total isolates was 1,560 (520 x 3) but only 1,553 isolates were collected for antimicrobials susceptibility testing leaving a difference of 7 isolates. 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.

MULTICLASS RESISTANCE

Table 43. Number of antimicrobial classes in resistance patterns of *Salmonella* from pigs

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	23 (24.7)		10	12	1				13	1					13			1			22
Infantis	13 (14.0)	12	1						1												
Typhimurium var. 5-	12 (12.9)		8	2	2			2	4	8					2			2			6
London	6 (6.5)	6																			
Typhimurium var. Copenhagen	6 (6.5)			2	4			3	4	4					4			4			6
California	5 (5.4)			3	2		1	4	4	2		2		2	5	3		1			4
Livingstone	5 (5.4)			5					5						5						5
4,[5],12:i:-	4 (4.3)		1	1	2			3	3	2					3			2			3
Typhimurium	3 (3.3)		1	1	1				2	1					3			1			2
Alachua	2 (2.2)	1		1											1						1
Bovismorbificans	2 (2.2)		2							2											
4,12:i:-	2 (2.2)		2																		2
Less common serovars	10 (10.8)	5	1	3	1				3	2		1		1	4	1		1			4
Total	**93 (100)**	**24**	**26**	**30**	**13**		**1**	**12**	**39**	**22**		**3**		**3**	**40**	**4**		**12**			**55**

Antimicrobial abbreviations are defined in the Preamble.

Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

Serovars represented by less than 2% of isolates were classified as ''Less common serovars''.

Table 44. Number of antimicrobial classes in resistance patterns of *Escherichia coli* from pigs

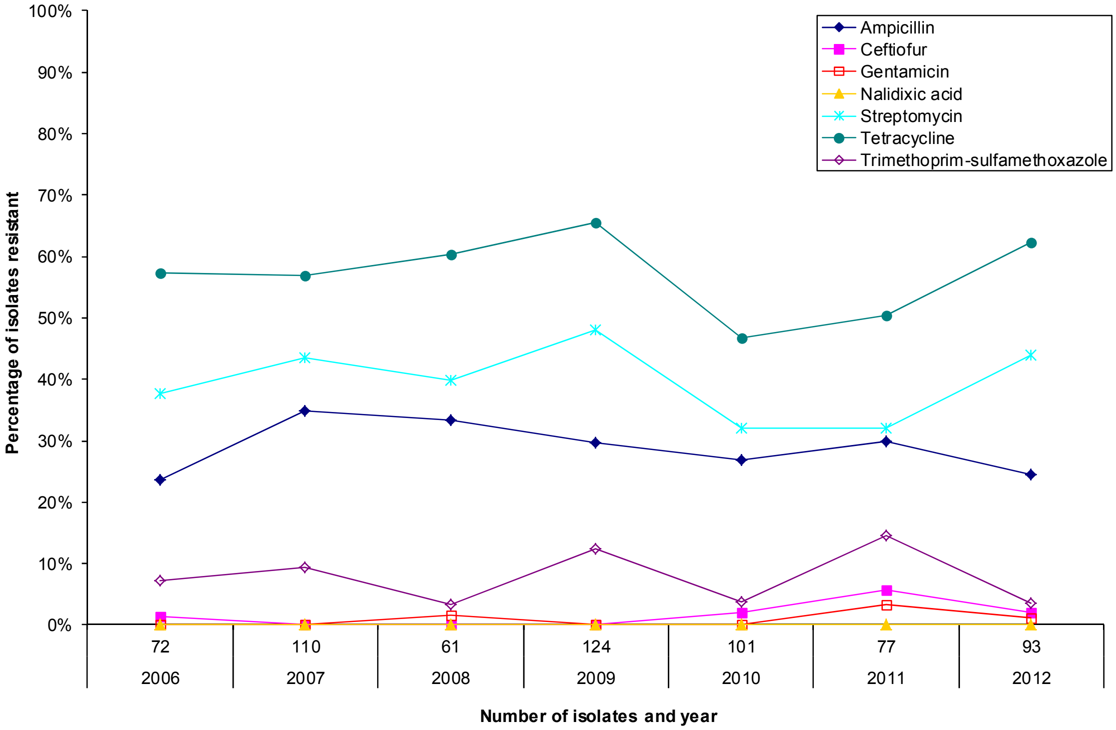
Animal species	Number (%) of isolates	Number of isolates by number of antimicrobial classes in the resistance pattern					Number of isolates resistant by antimicrobial class and antimicrobial: Aminoglycosides			β-lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Pigs	1,553	220	344	732	253	4	12	165	679	480	40	39	40	39	630	180	5	254		4	1,192

Antimicrobial abbreviations are defined in the Preamble.

Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

TEMPORAL ANTIMICROBIAL RESISTANCE SUMMARY

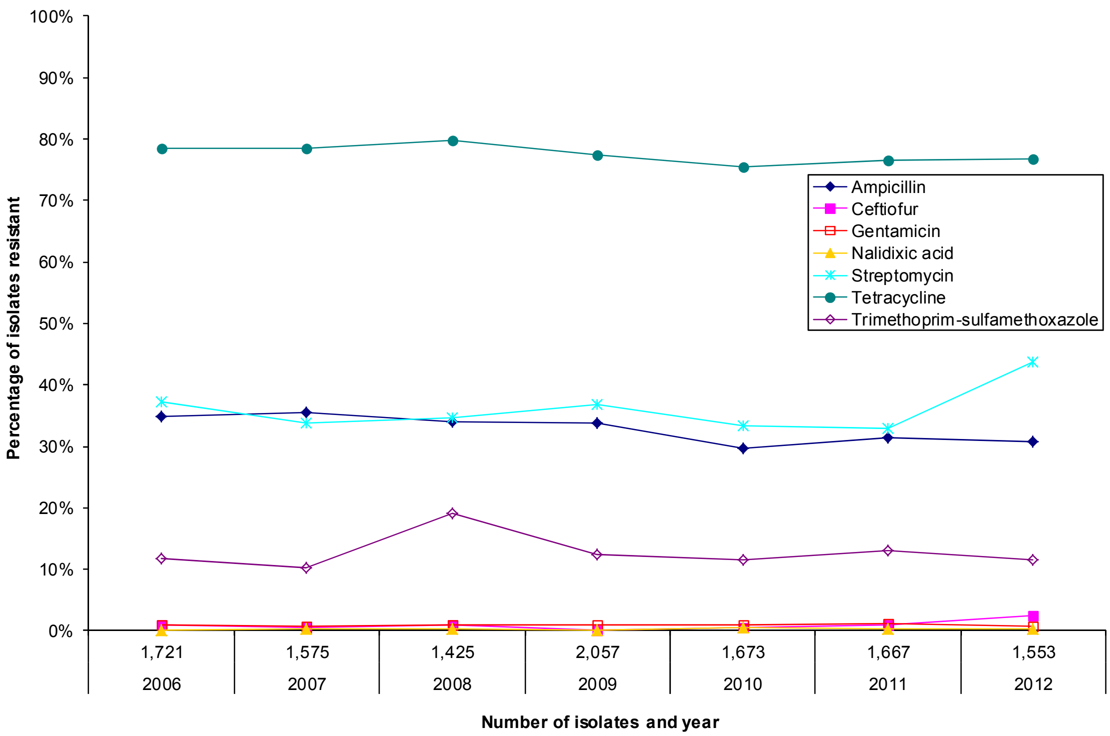
Figure 22. Temporal variations in resistance of *Salmonella* isolates from pigs



Year Number of isolates	2006 72	2007 110	2008 61	2009 124	2010 101	2011 77	2012 93
Antimicrobial							
Ampicillin	**24%**	35%	33%	30%	27%	**30%**	**24%**
Ceftiofur	**1%**	0%	0%	0%	2%	**6%**	**2%**
Gentamicin	**0%**	0%	2%	0%	0%	**3%**	**1%**
Nalidixic acid	**0%**	0%	0%	0%	0%	**0%**	**0%**
Streptomycin	**38%**	44%	40%	48%	32%	**32%**	**44%**
Tetracycline	**57%**	57%	60%	66%	47%	**50%**	**62%**
Trimethoprim-sulfamethoxazole	**7%**	9%	3%	12%	4%	**15%**	**3%**

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

Figure 23. Temporal variations in resistance of *Escherichia coli* isolates from pigs



Year	2006	2007	2008	2009	2010	2011	2012
Number of isolates	1,721	1,575	1,425	2,057	1,673	1,667	1,553
Antimicrobial							
Ampicillin	**35%**	36%	34%	34%	30%	**31%**	**31%**
Ceftiofur	**1%**	1%	1%	0%	0%	**1%**	**2%**
Gentamicin	**1%**	1%	1%	1%	1%	**1%**	**1%**
Nalidixic acid	**0%**	0%	0%	0%	1%	**0%**	**0%**
Streptomycin	**37%**	34%	35%	37%	33%	**33%**	**44%**
Tetracycline	**79%**	78%	80%	77%	75%	**77%**	**77%**
Trimethoprim-sulfamethoxazole	**12%**	10%	19%	12%	11%	**13%**	**12%**

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

MINIMUM INHIBITORY CONCENTRATIONS

More details on how to interpret the minimum inhibitory concentrations (MICs) tables are provided in the CIPARS Annual Report 2012 – Chapter 1. Design and Methods.

Table 45. Distribution of minimum inhibitory concentrations among *Salmonella* from pigs

	Antimicrobial	n	Percentiles		% R	Distribution (%) of MICs (µg/mL)															
			MIC 50	MIC 90		≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	93	1	8	0.0							69.9	6.5	4.3	9.7	9.7					
	Ceftiofur	93	1	1	3.2						4.3	87.1	4.3	1.1	3.2						
	Ceftriaxone	93	≤ 0.25	≤ 0.25	3.2					96.8				2.2	1.1						
	Ciprofloxacin	93	≤ 0.015	0.03	0.0	75.3	23.7	1.1													
II	Ampicillin	93	1	> 32	23.7							64.5	10.8	1.1				23.7			
	Azithromycin	93	4	8	0.0								9.7	68.8	20.4	1.1					
	Cefoxitin	93	2	4	0.0							5.4	46.2	37.6	10.8						
	Gentamicin	93	0.5	1	1.1					5.4	66.7	23.7	1.1	2.2		1.1					
	Kanamycin	93	≤ 8	> 64	12.9										86.0	1.1			12.9		
	Nalidixic acid	93	4	4	0.0								24.7	72.0	3.2						
	Streptomycin	93	≤ 32	> 64	41.9												58.1	5.4	36.6		
	Trimethoprim-sulfamethoxazole	93	≤ 0.12	0.5	4.3				68.8	17.2	8.6	1.1			4.3						
III	Chloramphenicol	93	8	> 32	12.9									11.8	74.2	1.1	2.2	10.8			
	Sulfisoxazole	93	64	> 256	43.0											4.3	19.4	30.1	3.2		43.0
	Tetracycline	93	> 32	> 32	59.1									40.9		1.1	4.3	53.8			
IV																					

Table 46. Distribution of minimum inhibitory concentrations among *Escherichia coli* from pigs

	Antimicrobial	n	Percentiles		% R	Distribution (%) of MICs (µg/mL)															
			MIC 50	MIC 90		≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	1,553	4	8	2.6							2.4	26.1	41.2	26.5	1.2	1.7	0.9			
	Ceftiofur	1,553	0.25	0.5	2.5				3.9	53.1	39.8	0.8			1.2	1.4					
	Ceftriaxone	1,553	≤ 0.25	≤ 0.25	2.5					97.2	0.3			0.1	0.7	1.3	0.3	0.2			
	Ciprofloxacin	1,553	≤ 0.015	≤ 0.015	0.0	97.4	2.1	0.2	0.1	0.2	0.1										
II	Ampicillin	1,553	2	> 32	30.9							10.4	39.7	17.2	0.8	1.0	0.1	30.8			
	Azithromycin	1,553	4	8	0.3						0.4	1.6	16.2	68.4	12.6	0.5	0.3				
	Cefoxitin	1,553	4	8	2.6						0.1	1.2	33.4	54.7	7.5	0.6	0.6	1.9			
	Gentamicin	1,553	1	1	0.8					0.6	29.9	62.0	6.2	0.2	0.3	0.3	0.5				
	Kanamycin	1,553	≤ 8	> 64	10.6										89.1	0.3		0.3	10.4		
	Nalidixic acid	1,553	2	4	0.3						0.1	12.4	73.8	13.0	0.3	0.1	0.1	0.1			
	Streptomycin	1,553	≤ 32	> 64	43.7												56.3	18.4	25.3		
	Trimethoprim-sulfamethoxazole	1,553	≤ 0.12	> 4	11.6				75.7	10.7	1.7	0.3	0.1		11.6						
III	Chloramphenicol	1,553	8	32	16.4								2.0	29.3	48.4	4.0	9.1	7.3			
	Sulfisoxazole	1,553	16	> 256	40.6											51.8	7.5	0.1			40.6
	Tetracycline	1,553	> 32	> 32	76.8									23.2	0.1	0.3	1.5	75.0			
IV																					

RECOVERY RESULTS

Table 47. *Farm surveillance* recovery rates, 2003-2012

CIPARS Component/ Animal species	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted							
		Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*	
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				
	2012	**99%**	519/520	**18%**	93/520				

Grey-shaded areas indicate either: a) isolates recovered from sampling activities outside the scope of CIPARS routine (or "core") surveillance in the specified year (i.e. grey-shaded areas with data) or b) discontinuation or no surveillance activity (i.e. grey-shaded areas with no data).

SURVEILLANCE OF ANIMAL CLINICAL ISOLATES

KEY FINDINGS

CATTLE

SALMONELLA (n = 177)

Salmonella Dublin was the most common serovar recovered from cattle (25%, 45/177); 7 isolates were resistant to 6 antimicrobial classes (all except macrolides), 44 isolates were resistant to ≥ 4 classes, and 8 isolates were resistant to nalidixic acid (Table 48 and Table 53).

CHICKENS

SALMONELLA (n = 161)

Salmonella Heidelberg was the most common serovar from chickens (34%, 55/161) and 6 isolates were resistant to ≥ 1 antimicrobial class (Table 49 and Table 54). One *S*. Enteritidis isolate was resistant to gentamicin and sulfisoxazole (Table 49 and Table 54).
Seventy percent (113/161) of all *Salmonella* isolates from chickens were non-resistant (Table 49 and Table 54).

PIGS

SALMONELLA (n = 255)

Resistance to nalidixic acid was observed in 1 *S*. Cubana isolate and 1 *S*. Typhimurium isolate (Table 50 and Table 55).

TURKEYS

SALMONELLA (n = 58)

Two *Salmonella* Indiana isolates were resistant to all antimicrobial classes except the quinolones (Table 51). Resistance to nalidixic acid was observed in 1 *S*. Senftenberg isolate (Table 51 and Table 56).

HORSES

SALMONELLA (n = 14)

Four *S*. Heidelberg isolates were resistant to 4 antimicrobial classes (Table 52).

MULTICLASS RESISTANCE

Table 48. Number of antimicrobial classes in resistance patterns of *Salmonella* from cattle

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
Dublin	45 (25.4)	1			37	7	3	4	41	33	33	33	31	33	44			44		8	44
Typhimurium	33 (18.6)	16	1	2	14			7	14	12	5	5	5	5	16	5	1	13			17
Typhimurium var. 5-	32 (18.1)	1	2		29			28	18	31	1	1	1	1	29			4			29
4,[5],12:i:-	12 (6.8)	6	1	1	4			2	4	6	1	1	1	1	5	1					4
Cerro	9 (5.1)	9																			
Heidelberg	7 (4.0)	6			1				1	1	1	1	1	1	1	1		1			1
Thompson	6 (3.4)	6																			
Enteritidis	5 (2.8)	1			4		4	4		4	4	4	4	4	4			4			4
Less common serovars	28 (15.8)	21	1	4	2			1	5	2	2	2	2	2	4			2			7
Total	**177 (100)**	**67**	**5**	**7**	**91**	**7**	**7**	**46**	**83**	**89**	**47**	**47**	**45**	**47**	**103**	**7**	**1**	**68**		**8**	**106**

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

Table 49. Number of antimicrobial classes in resistance patterns of *Salmonella* from chickens

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
Heidelberg	55 (34.2)	49	4	2				2		4	4	4	4	4							2
Enteritidis	26 (16.1)	25		1			1								1						
Kentucky	20 (12.4)	3	3	14					14	9	9	9	9	9							14
4,[5],12:i:-	8 (5.0)	6	2							2	2	2	2	2							
Senftenberg	7 (4.3)	5	2							2	2	2	2	2							
Agona	6 (3.7)	5			1				1	1	1	1	1	1	1			1			1
Anatum	5 (3.1)			5					5	5											
Mbandaka	5 (3.1)	3		2					2						2						2
Alachua	4 (2.5)	4																			
Less common serovars	25 (15.5)	13	5	6	1			1	6	8	6	6	6	6	3	1		1			7
Total	**161 (100)**	**113**	**16**	**30**	**2**		**1**	**3**	**28**	**31**	**24**	**24**	**24**	**24**	**7**	**1**		**2**			**26**

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

Table 50. Number of antimicrobial classes in resistance patterns of *Salmonella* from pigs

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	74 (29.0)	7	10	15	42		1	15	43	53	2	2	2	2	50	10	1	33			63
Typhimurium var. 5-	36 (14.1)	1	4	4	27			6	27	32	1				28	3		25			32
4,[5],12:i:-	25 (9.8)	3			22		2	3	22	22	1	1	1	1	22	1		2			22
Derby	23 (9.0)	4	3	14	2		3	3	12	1	1	1	2	1	15	4		2			18
Infantis	19 (7.5)	17		1	1			2	2	2					1						2
Worthington	11 (4.3)		9	2			1		1	1		1		1	2	1					11
Mbandaka	7 (2.7)	6		1					1						1						1
Schwarzengrund	7 (2.7)	1		4	2				6	2					6						6
Less common serovars	53 (20.8)	22	5	16	10		1	6	17	14	1	1	1	1	23	5		8		1	30
Total	**255 (100)**	**61**	**31**	**57**	**106**		**8**	**35**	**131**	**127**	**6**	**6**	**6**	**6**	**148**	**24**	**1**	**70**		**1**	**185**

Antimicrobial abbreviations are defined in the Preamble.

Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

Serovars represented by less than 2% of isolates were classified as ''Less common serovars''.

Table 51. Number of antimicrobial classes in resistance patterns of *Salmonella* from turkeys

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
Heidelberg	14 (24.1)	11	1	1	1		1	1	3	1	1	1	1	1	2						2
Agona	12 (20.7)	1		5	6		1		8	11	8	9	8	9	8	1		4			11
Worthington	5 (8.6)			5			1	3	5						5						4
Hadar	3 (5.2)			3					3	1											3
Mbandaka	3 (5.2)	1		2				1	2						2						2
Senftenberg	3 (5.2)		1	2			2	2	2	2					1					1	
Albany	2 (3.4)	1	1							1	1	1	1	1							
Indiana	2 (3.4)					2	2	2	2	2	2	2	1	2	2	2	2	2			2
Muenchen	2 (3.4)			2			2		2						2						2
Schwarzengrund	2 (3.4)			2					1						2						2
Less common serovars	10 (17.2)	4	4	2			1	1	1	6	5	6	5	6	1						1
Total	**58 (100)**	**18**	**7**	**24**	**7**	**2**	**10**	**10**	**29**	**24**	**17**	**19**	**16**	**19**	**25**	**3**	**2**	**6**		**1**	**29**

Antimicrobial abbreviations are defined in the Preamble.

Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

Serovars represented by less than 2% of isolates were classified as ''Less common serovars''.

Table 52. Number of antimicrobial classes in resistance patterns of *Salmonella* from horses

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
Heidelberg	5 (35.7)		1		4		4	4	3	5	1	1	1	1	4	4		4			
Infantis	2 (14.3)	2																			
Enteritidis	1 (7.1)	1																			
Give	1 (7.1)	1																			
Hartford	1 (7.1)	1																			
Indiana	1 (7.1)	1																			
Newport	1 (7.1)	1																			
Senftenberg	1 (7.1)	1																			
Typhimurium	1 (7.1)				1				1	1	1	1	1	1	1			1			1
Total	**14 (100)**	**8**	**1**		**5**		**4**	**4**	**4**	**6**	**2**	**2**	**2**	**2**	**5**	**4**		**5**			**1**

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

MINIMUM INHIBITORY CONCENTRATIONS

More details on how to interpret the minimum inhibitory concentrations (MICs) tables are provided in the CIPARS Annual Report 2012 – Chapter 1. Design and Methods.

Table 53. Distribution of minimum inhibitory concentrations among *Salmonella* from cattle

	Antimicrobial	n	Percentiles		% R	Distribution (%) of MICs (µg/mL)															
			MIC 50	MIC 90		≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	177	4	> 32	26.6							43.5	6.2	0.6	15.3	7.9		26.6			
I	Ceftiofur	177	1	> 8	26.6						20.9	52.0	0.6		1.1	25.4					
I	Ceftriaxone	177	≤ 0.25	32	26.6					73.4				0.6	0.6	7.3	14.1	3.4	0.6		
I	Ciprofloxacin	177	≤ 0.015	0.03	0.0	78.0	17.5		2.3	1.1	1.1										
II	Ampicillin	177	> 32	> 32	50.3							41.8	7.9					50.3			
II	Azithromycin	177	4	8	0.6								2.3	78.0	18.1	1.1	0.6				
II	Cefoxitin	177	2	> 32	25.4							14.7	42.9	13.0	2.8	1.1	3.4	22.0			
II	Gentamicin	177	0.50	1	4.0					1.1	55.4	38.4	1.1				4.0				
II	Kanamycin	177	≤ 8	> 64	26.0										74.0			0.6	25.4		
II	Nalidixic acid	177	4	4	4.5							0.6	27.1	67.2	0.6			4.5			
II	Streptomycin	177	≤ 32	> 64	46.9												53.1	5.1	41.8		
II	Trimethoprim-sulfamethoxazole	177	≤ 0.12	0.25	4.0				57.1	34.5	4.5				4.0						
III	Chloramphenicol	177	8	> 32	38.4								0.6	14.1	46.3	0.6		38.4			
III	Sulfisoxazole	177	> 256	> 256	58.2											2.3	26.0	13.6			58.2
III	Tetracycline	177	> 32	> 32	59.9									40.1			1.7	58.2			
IV																					

Table 54. Distribution of minimum inhibitory concentrations among *Salmonella* from chickens

	Antimicrobial	n	Percentiles		% R	Distribution (%) of MICs (µg/mL)															
			MIC 50	MIC 90		≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	161	≤ 1	> 32	14.9							78.9	1.9		4.3			14.9			
I	Ceftiofur	161	1	> 8	14.9				2.5		19.9	62.1	0.6			14.9					
I	Ceftriaxone	161	≤ 0.25	16	14.9					84.5		0.6				8.7	5.0	1.2			
I	Ciprofloxacin	161	≤ 0.015	≤ 0.015	0.0	91.3	8.7														
II	Ampicillin	161	≤ 1	> 32	19.3							75.8	5.0					19.3			
II	Azithromycin	161	4	8	0.0						0.6	1.9	0.6	65.8	29.8	1.2					
II	Cefoxitin	161	2	32	14.9							24.2	43.5	16.1	1.2		9.3	5.6			
II	Gentamicin	161	0.50	1	0.6					8.1	72.7	18.6				0.6					
II	Kanamycin	161	≤ 8	≤ 8	1.9										98.1				1.9		
II	Nalidixic acid	161	4	4	0.0							0.6	32.9	63.4	0.6	2.5					
II	Streptomycin	161	≤ 32	> 64	17.4												82.6	3.1	14.3		
II	Trimethoprim-sulfamethoxazole	161	≤ 0.12	≤ 0.12	0.6				98.1	1.2					0.6						
III	Chloramphenicol	161	8	8	1.2								2.5	18.0	76.4	1.9		1.2			
III	Sulfisoxazole	161	32	64	4.3											2.5	60.2	32.9			4.3
III	Tetracycline	161	≤ 4	> 32	16.1									83.9				16.1			
IV																					

Table 55. Distribution of minimum inhibitory concentrations among *Salmonella* from pigs

	Antimicrobial	n	Percentiles MIC 50	MIC 90	% R	Distribution (%) of MICs (µg/mL) ≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	255	2	16	2.4							45.1	5.5	5.1	17.3	24.7	0.4	2.0			
I	Ceftiofur	255	1	1	2.4						10.2	81.2	6.3			2.4					
I	Ceftriaxone	255	≤ 0.25	≤ 0.25	2.4					97.3	0.4					0.8	1.2		0.4		
I	Ciprofloxacin	255	≤ 0.015	≤ 0.015	0.0	91.8	6.7	1.2		0.4											
II	Ampicillin	255	4	> 32	49.8							42.4	5.5	2.4			0.4	49.4			
II	Azithromycin	255	4	8	0.4								1.6	66.3	27.8	3.9	0.4				
II	Cefoxitin	255	2	4	2.4							7.5	52.2	34.5	2.4	1.2	1.2	1.2			
II	Gentamicin	255	0.50	1	3.1						64.7	29.0	3.1			1.6	1.6				
II	Kanamycin	255	≤ 8	> 64	13.7										85.9	0.4			13.7		
II	Nalidixic acid	255	4	4	0.4								38.8	57.3	3.5			0.4			
II	Streptomycin	255	64	> 64	51.4												48.6	7.1	44.3		
II	Trimethoprim-sulfamethoxazole	255	≤ 0.12	2	9.4				68.2	18.0	1.2	2.0	1.2		9.4						
III	Chloramphenicol	255	8	> 32	27.5									7.5	59.6	5.5	0.8	26.7			
III	Sulfisoxazole	255	> 256	> 256	58.0											0.8	18.8	20.4	1.6	0.4	58.0
III	Tetracycline	255	> 32	> 32	72.5									27.5			11.0	61.6			
IV																					

Table 56. Distribution of minimum inhibitory concentrations among *Salmonella* from turkeys

	Antimicrobial	n	Percentiles MIC 50	MIC 90	% R	Distribution (%) of MICs (µg/mL) ≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	58	≤ 1	> 32	29.3							55.2	3.4	1.7	5.2	5.2	3.4	25.9			
I	Ceftiofur	58	1	> 8	32.8						6.9	58.6	1.7		1.7	31.0					
I	Ceftriaxone	58	≤ 0.25	32	32.8					67.2				1.7	1.7	10.3	13.8	3.4	1.7		
I	Ciprofloxacin	58	≤ 0.015	≤ 0.015	0.0	94.8	3.4			1.7											
II	Ampicillin	58	≤ 1	> 32	41.4							55.2	1.7	1.7				41.4			
II	Azithromycin	58	4	8	3.4								5.2	60.3	31.0		3.4				
II	Cefoxitin	58	4	> 32	27.6							8.6	31.0	24.1	5.2	3.4	3.4	24.1			
II	Gentamicin	58	1	> 16	17.2					1.7	46.6	32.8			1.7	1.7	15.5				
II	Kanamycin	58	≤ 8	> 64	17.2										81.0	1.7		1.7	15.5		
II	Nalidixic acid	58	4	4	1.7								27.6	69.0	1.7			1.7			
II	Streptomycin	58	64	> 64	50.0												50.0	19.0	31.0		
II	Trimethoprim-sulfamethoxazole	58	≤ 0.12	0.25	5.2				87.9	5.2		1.7			5.2						
III	Chloramphenicol	58	8	> 32	10.3									8.6	75.9	5.2		10.3			
III	Sulfisoxazole	58	64	> 256	43.1											3.4	46.6	6.9			43.1
III	Tetracycline	58	> 32	> 32	50.0									50.0				50.0			
IV																					

Table 57. Distribution of minimum inhibitory concentrations among *Salmonella* from horses

	Antimicrobial	n	Percentiles MIC 50	MIC 90	% R	Distribution (%) of MICs (µg/mL) ≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	14	≤ 1	32	14.3							57.1			28.6		7.1	7.1			
I	Ceftiofur	14	1	> 8	14.3						14.3	71.4				14.3					
I	Ceftriaxone	14	≤ 0.25	16	14.3					85.7						14.3					
I	Ciprofloxacin	14	≤ 0.015	0.25	0.0	64.3	7.1			28.6											
II	Ampicillin	14	2	> 32	42.9							42.9	14.3					42.9			
II	Azithromycin	14	4	8	0.0								7.1	50.0	42.9						
II	Cefoxitin	14	2	32	14.3							42.9	21.4	21.4			7.1	7.1			
II	Gentamicin	14	0.50	> 16	28.6						64.3	7.1					28.6				
II	Kanamycin	14	≤ 8	> 64	28.6										71.4				28.6		
II	Nalidixic acid	14	4	8	0.0								21.4	50.0	28.6						
II	Streptomycin	14	≤ 32	> 64	28.6												71.4	14.3	14.3		
II	Trimethoprim-sulfamethoxazole	14	≤ 0.12	> 4	28.6				64.3	7.1					28.6						
III	Chloramphenicol	14	8	> 32	35.7									7.1	57.1			35.7			
III	Sulfisoxazole	14	64	> 256	35.7												21.4	42.9			35.7
III	Tetracycline	14	≤ 4	≤ 4	7.1									92.9				7.1			
IV																					

SURVEILLANCE OF FEED AND FEED INGREDIENTS

KEY FINDINGS

SALMONELLA (n = 35)

One *Salmonella* Mishmarhaemek isolate was resistant to 3 antimicrobial classes. None of these antimicrobials were from Category I resistance. No information about source or intended use of feed product was available.

MULTICLASS RESISTANCE

FEED AND FEED INGREDIENTS

Table 58. Number of antimicrobial classes in resistance patterns of *Salmonella* from feed and feed ingredients

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
Oranienburg	4 (12.5)	4																			
Schwarzengrund	4 (12.5)	4																			
Infantis	3 (9.4)	3																			
Amsterdam var. 15+ 34+	2 (6.3)	2																			
Agona	1 (3.1)	1																			
Anatum	1 (3.1)	1																			
Hartford	1 (3.1)	1																			
Havana	1 (3.1)	1																			
Heidelberg	1 (3.1)	1																			
8,20:z10:-	1 (3.1)	1																			
Livingstone	1 (3.1)	1																			
Llandoff	1 (3.1)	1																			
Mbandaka	1 (3.1)	1																			
Mbandaka var. 14+	1 (3.1)	1																			
Minnesota	1 (3.1)	1																			
Mishmarhaemek	1 (3.1)			1						1					1					1	
Montevideo	1 (3.1)	1																			
Muenster	1 (3.1)	1																			
Putten	1 (3.1)	1																			
Rissen	1 (3.1)	1																			
Senftenberg	1 (3.1)	1																			
Tennessee	1 (3.1)	1																			
Worthington	1 (3.1)	1																			
Total	**32 (100)**	**31**		**1**						**1**					**1**					**1**	

Antimicrobial abbreviations are defined in the Preamble.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.
The total number of isolates was 35 but 3 isolates did not have serovar information.

MINIMUM INHIBITORY CONCENTRATIONS

More details on how to interpret the minimum inhibitory concentrations (MICs) tables are provided in the CIPARS Annual Report 2012 – Chapter 1. Design and Methods.

Table 59. Distribution of minimum inhibitory concentrations among *Salmonella* from feed and feed ingredients

	Antimicrobial	n	Percentiles		% R	Distribution (%) of MICs (µg/mL)															
			MIC 50	MIC 90		≤ 0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256
I	Amoxicillin-clavulanic acid	35	≤ 1	≤ 1	0.0							97.1			2.9						
I	Ceftiofur	35	1	1	0.0						20.0	80.0									
I	Ceftriaxone	35	≤ 0.25	≤ 0.25	0.0					100.0											
I	Ciprofloxacin	35	≤ 0.015	≤ 0.015	0.0	91.4	5.7	2.9													
II	Ampicillin	35	≤ 1	≤ 1	2.9							94.3	2.9					2.9			
II	Azithromycin	35	4	8	0.0								2.9	62.9	34.3						
II	Cefoxitin	35	4	4	0.0							2.9	34.3	62.9							
II	Gentamicin	35	0.50	1	0.0					5.7	82.9	11.4									
II	Kanamycin	35	≤ 8	≤ 8	0.0										100.0						
II	Nalidixic acid	35	4	4	2.9								37.1	60.0				2.9			
II	Streptomycin	35	≤ 32	≤ 32	0.0												100.0				
II	Trimethoprim-sulfamethoxazole	35	≤ 0.12	≤ 0.12	0.0				100.0												
III	Chloramphenicol	35	8	8	0.0									8.6	85.7	5.7					
III	Sulfisoxazole	35	64	64	2.9											5.7	34.3	54.3	2.9		2.9
III	Tetracycline	35	≤ 4	≤ 4	0.0									100.0							
IV																					