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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

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

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

OTHER PARTICIPANTS

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Health Canada, Veterinary Drugs Directorate
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Other Organizations
Canadian Meat Council
Canadian Pork Council
CIPARS Farm Swine Advisory Committee
John Ranson (independent contractor)

PREAMBLE

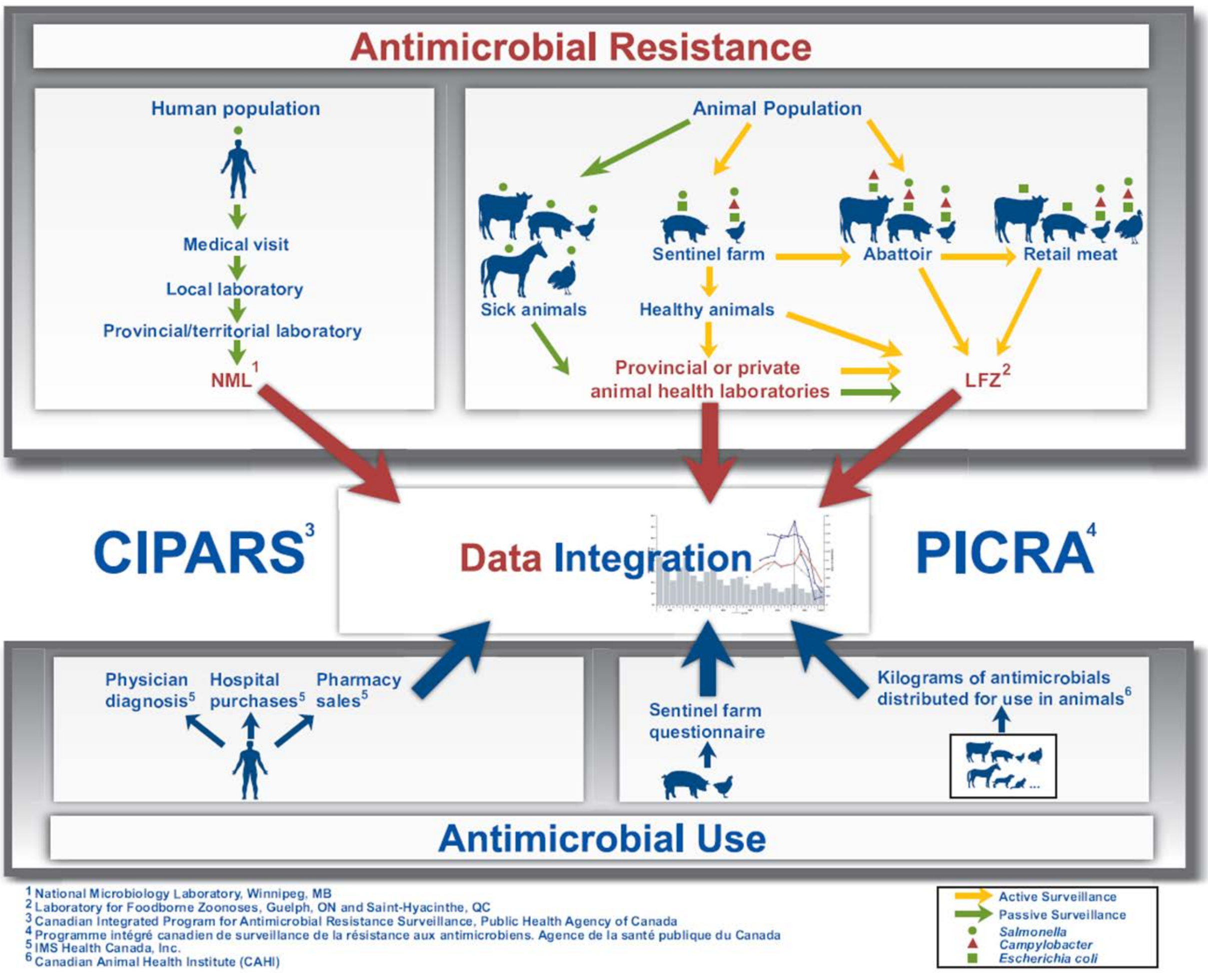
ABOUT CIPARS

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 alternative methods 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 be released in a Chapter format to improve the timeliness of the data release 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 2013



HOW TO READ THIS CHAPTER

This chapter highlights the most notable antimicrobial resistance (AMR) findings across the different surveillance components of CIPARS for 2013. These findings are presented by component (human, farm, abattoir, retail, clinical animal, and feed and feed-ingredients) to facilitate comparison of resistance patterns across humans, different animal species, and bacterial species. The figures and tables have been grouped by component in separate subsections for the same purpose. Further integration of these findings across the AMR components is presented in the *2013 Annual Report – Chapter 4. Integrated Findings and Discussion.*

TEMPORAL FIGURES AND DATA TABLES FOR SIGNIFICANCE TESTING

All temporal figures and accompanying data tables presented in this chapter depict the variation in the percentage of isolates that are resistant to select antimicrobials since the beginning of CIPARS (2003) or the year surveillance was implemented in a new component, host species, bacteria or location. For consistency across the components, statistical analyses were limited to comparison of 2013 results for selected antimicrobials with: 1) 2012 results and 2) the first year of surveillance (2003 or later).

To facilitate the assessment of significant results at a glance, all significant differences found have been highlighted in blue (or underlined) in data tables underneath the temporal figures (see footnotes for more details, e.g. Figure 9). Finally, for all statistical analyses, a *P*-value ≤ 0.05 was used to indicate a significant difference between years. All statistically significant results are marked by the use of the word “significant” in the text. All other findings presented without this word should be considered as non-statistically significant and should be interpreted with caution.

For *S*. Heidelberg and *E. coli* isolates obtained from chicken (abattoir and retail) and human *S*. Heidelberg isolates, ceftiofur and ampicillin resistance for 2013 were compared with 2004 and 2006 results. These years were chosen because of changes in ceftiofur use which occurred in early 2005 and in 2007 across the chicken hatcheries in Québec. For retail chicken, comparisons using those reference years were limited to data for Ontario and Québec only.

For the F*arm surveillance*, multiple samples are collected from each herd or flock, therefore, where temporal comparisons are made, the AMR data have been adjusted for clustering within the herd.

Temporal variations in the data from *Surveillance of Animal Clinical Isolates* and *Feed and Feed Ingredients* were not investigated as provision of isolates from passive surveillance were unequal across years and regions. In addition, temporal figures were not presented if the total number of surveillance years was less than 3 years. In these situations, a bar chart figure was presented instead.

NATIONAL OR PROVINCIAL/REGIONAL PREVALENCE ESTIMATES

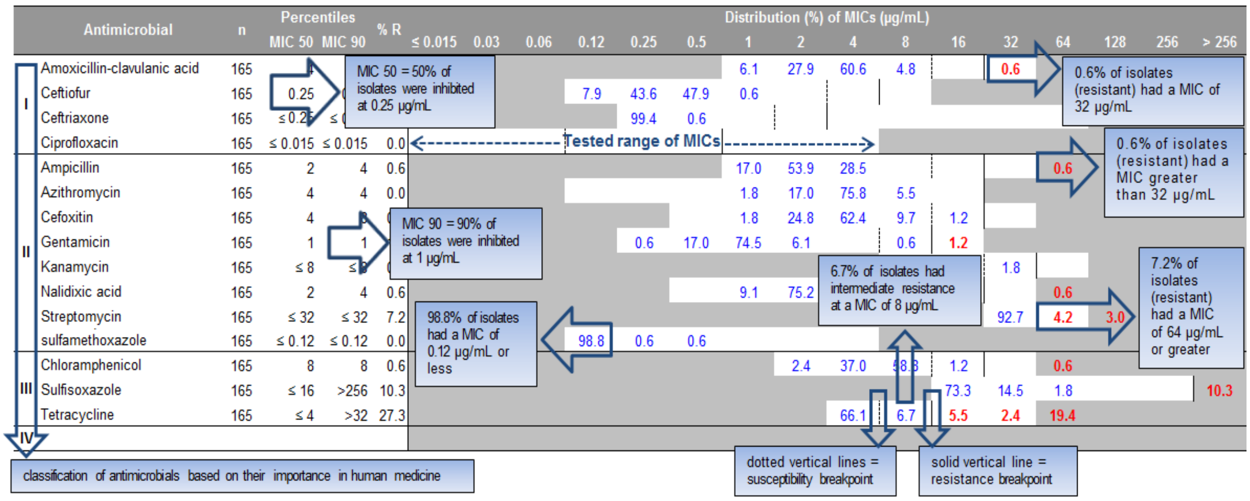
Data for humans, farm (broiler chickens) and retail surveillance components are presented at the provincial/regional level. Data for farm (swine), abattoir, animal clinical isolates, and feed and feed-ingredients are presented nationally with no provincial or regional breakdown.

HOW TO READ MINIMUM INHIBITORY CONCENTRATION TABLES

The following information is important for the interpretation of tables presenting results on the distribution of MICs. See how to interpret MIC results (on the next page).

- Roman numerals I to IV indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Health Canada's Veterinary Drugs Directorate
- The unshaded fields indicate the range of concentrations tested for each antimicrobial in the test plate configuration
- Blue-coloured numbers indicate the percentage of isolates that were susceptible to the antimicrobial according to the predefined susceptibility breakpoint
- Red-coloured numbers indicate the percentage of isolates that were resistant to the antimicrobial according to the predefined resistance breakpoint
- Numbers to the right of the highest concentration in the tested range (i.e. red numbers in shaded fields) represent the percentage of isolates with growth in all wells of the test plate within the tested range, indicating that the actual MICs were greater than the tested range of concentrations
- Numbers at the lowest concentration in the tested range (i.e. blue numbers at the far left in unshaded fields) represent the percentage of isolates susceptible to the antimicrobial at the indicated or lower concentrations
- Solid vertical lines represent resistance breakpoints
- Dotted vertical lines represent susceptibility breakpoints.
- MIC 50 = MIC at which growth of 50% of isolates was inhibited by a specific antimicrobial
- MIC 90 = MIC at which growth of 90% of isolates was inhibited by a specific antimicrobial
- %R = Percentage of isolates that were resistant to a specific antimicrobial.

HOW TO READ MINIMUM INHIBITORY CONCENTRATION TABLES (cont'd)



ABBREVIATIONS

ANTIMICROBIALS AND SOME IMPORTANT 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

ABBREVIATIONS (cont'd)

CANADIAN PROVINCES, TERRITORIES, AND REGION

PROVINCES
BC British Columbia
AB Alberta
SK Saskatchewan
MB Manitoba
ON Ontario
QC Québec
NB New Brunswick[9]
NS Nova Scotia[9]
PEI Prince Edward Island[9]
NL Newfoundland and Labrador

TERRITORIES
YT Yukon
NT Northwest Territories
NU Nunavut

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

SUMMARY – THE TOP KEY FINDINGS

Humans

- The proportion of non-typhoidal *Salmonella* infections susceptible to all antimicrobials remained stable with 74% of isolates in 2013 compared to 76% in 2012.
- Resistance to gentamicin is increasing among *S*. Heidelberg (3% in 2013 compared to < 1% in 2012) and *S*. Newport (3% in 2013 compared to 0 in 2012).
- Resistance to ciprofloxacin among *S*. Typhi human infections continues to increase with 18% in 2013 compared to 10% observed in 2012.

Abattoir

- Resistance to ciprofloxacin in *Campylobacter* from abattoir chicken significantly increased from 4% in 2010 to 14% in 2013.
- All *S*. Enteritidis isolates from abattoir chicken were susceptible to all antimicrobials tested.
- The percentage of *E. coli* isolates from abattoir cattle with resistance to 4 or 5 classes of antimicrobials has risen from 1% in 2012 to 8% in 2013 and resistance to 1 class of antimicrobials has dropped from 19% in 2012 to 9% in 2013.

Retail Meat

- Ciprofloxacin resistance in *Campylobacter* from chicken significantly increased to 26% in 2013 in British Columbia compared to 2012 (8%).
- In Ontario, ceftiofur resistance among *Salmonella* from chicken was significantly lower in 2013 (22%) than 2004 (45%). In Québec, resistance to ceftiofur was significantly higher in 2013 among both *Salmonella* (30%) and *E. coli* (24%) compared to 2006 (5% and 6%, respectively).
- In Québec, a single *E. coli* isolate from beef was resistant to 7 (all) classes of antimicrobials tested with the following pattern: ACSSuT-AZM-TIO-CRO-CIP-NAL-SXT.

On Farm:

Grower-Finisher Pigs

- Although not statistically significant, there was an increase in ampicillin resistance in *Salmonella* isolates from 25% to 40% between 2012 and 2013. Historically, over the last 7 years, ampicillin resistance has been ≤ 35%.
- In *Salmonella,* the patterns containing the highest number of antimicrobials were ACKSSuT-A2C-CRO and ACSSuT-A2C-CRO-SXT
- In *E. coli*, resistance to ceftiofur was significantly lower in 2013 (1%) than in 2012 (2%)
- *E. coli* resistance to streptomycin was also significantly lower in 2013 (34%) than in 2006 (37%) or 2012 (44%).
- Similar to 2012, ampicillin resistance in *E. coli* was significantly lower in 2013 (31%) than in 2006 (35%).

On Farm:

Broiler Chickens

- In *Salmonella,* the pattern containing the highest number of antimicrobials was A2C-AMP-CRO-STR-TET detected at both chick placement and pre-harvest.
- In *E. coli,* the pattern containing the highest number of antimicrobial was A2C-ACSSUT-CRO-GEN-SXT and A2C-AMP detected at both sampling period.
- In *Campylobacter*, overall resistance to ciprofloxacin was 16% and the pattern containing the highest number of antimicrobials was CIP-NAL-TET.

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

HUMAN SURVEILLANCE

KEY FINDINGS

The Provincial Public Health Laboratories forwarded a total of 3,612 *Salmonella* isolates (185 serovars) to the National Microbiology Laboratory, Public Health Agency of Canada. Of these isolates antimicrobial susceptibility testing was performed for 3,159 isolates. The remaining isolates are stored for future susceptibility testing.

SALMONELLA (n = 3,159)

Susceptibility testing was routinely carried out on 8 serovars: Enteritidis, Heidelberg, 4,[5],12:i:-, Newport, Paratyphi A, Paratyphi B, Typhi and Typhimurium (2,062 isolates). Summary results only are presented for other serovars (1,097 isolates).

The most commonly isolated serovars in 2013 were Enteritidis (24%, 746/3,159), Heidelberg (13%, 418/3,159), and Typhimurium (12%, 384/3,159). Although the proportion of Enteritidis isolates has decreased significantly since 2011 (38%, 361/2,510), the overall proportion of Enteritidis isolates has increased significantly since 2003 (12%, 352/3,041) (Figure 2).

The proportion of Heidelberg isolates has declined slightly between 2010 and 2013 following an increase from 2008 to 2010 (Figure 2). Similarly, the proportion Typhimurium isolates has decreased to 24% from a high of 38% in 2011 (Figure 2). No dramatic increases in the other top serovars were observed over this time; therefore, increases in the proportion of less common serovars have occurred from 2011 and 2013.

Ten percent (311/3,159) of isolates were recovered from blood. Typhoidal isolates (*S*. Typhi, *S*. Paratyphi A, and *S*.Paratyphi B) accounted for a large proportion of these isolates from blood (41%, 129/311). Recovery from urine occurred for 180/3,159 (6%) of isolates. In contrast to isolation from blood, typhoidal isolates accounted for a very small proportion of isolates from urine (2%, 3/180). The proportion of isolates recovered from blood, urine, and other sample types varied by serovar, as seen in Figure 3.

Age information was available for 63% (1,997/3,159) of all isolates in 2013. Patients aged 30 to 49 years were the most commonly represented age group in the dataset (22%, 449/1,997). The age group with the fewest isolates in the dataset was patients 13 to 17 years (4%, 83/1,997).

Although the focus of this report is resistance (or lack of resistance) among *Salmonella* isolated from humans, as a reference, provincial incidence rates for all *Salmonella* infections (regardless of resistance pattern), broken down by specific serovars, can be found in Figure 4. More details on the incidence of *Salmonella* and other enteric pathogens in Canada are available through the National Enteric Surveillance Program (NESP)[10].

In 2013, 74% of all non-typhoidal *Salmonella* isolates were susceptible to all antimicrobials tested, compared to 76% in 2012. Resistance to the antimicrobials streptomycin, sulfisoxazole and tetracycline significantly increased in 2013 (12%, 12%, and 14%, respectively) compared to 2012 (9%, 9% and 11%, respectively). Although no significant changes were observed, there were more isolates with azithromycin resistance in 2013 (24 isolates) compared to 2012 (16), with higher numbers observed in British Columbia, Alberta, Québec, New Brunswick, and Newfoundland and Labrador.

ENTERITIDIS (n = 746)

The most common phage types (PTs) recovered in 2013 were: PT 8 (38%, 281/746), PT 13a (15%, 111/746) and PT 13 (9%, 65/746). The proportion of PT 8 and 13a isolates have increased dramatically since 2007, when they represented 19% (177/909) and 1% (9/909) of Enteritidis isolates, respectively. Conversely, the proportion of PT 13 isolates over this same time frame has declined from a high of 31% (285/909) in 2007.

In 2013, 4% of Enteritidis isolates were recovered from blood (32/746), which was an increase from 3% in 2012 (37/1,184). Two percent of isolates in 2013 were recovered from urine (16/746), which was a decrease from 3% (40/1,184) in 2012. In 2013, the proportion of isolates recovered from blood and urine have slowly increased (2%, 7/352) since 2003 (1%, 3/352).

No significant increases in resistance to any of the tested antimicrobials were seen between 2012 and 2013 at the National level. Only a single change in resistance was seen at the provincial level:

Ceftiofur

- Increase in British Columbia from 0% (0/178) in 2012 to 3% (3/88) in 2013

The majority of Enteritidis isolates in 2013 were pan-susceptible (84%, 625/746). Where resistance was present, the most common pattern was NAL (resistance to nalidixic acid alone resistance) (10%, 74/746), attributable to PT ATEN-16 (39%, 29/74) and PT 1 (32%, 24/74). The pattern involving the greatest number of antimicrobials was A2C-AMP-CHL-FOX-TIO-CRO-KAN-NAL-STR-TET (1 PT 33 isolate from British Columbia).

HEIDELBERG (n = 418)

The most common PTs recovered were: PT 19 (44%, 186/418), PT 29 (26%, 109/418) and PT 26 (4%, 18/418). PTs 29 and 26 increased slightly compared to 2012, while PT 19 decreased compared to a peak seen in 2012 (54%, 298/555). An overall increase in PT 29 has occurred over the 2009 to 2013 time frame.

[10] Public Health Agency of Canada. 2014.National Enteric Surveillance Program. Available at: www.nml-lnm.gc.ca/NESP-PNSME/index-eng.htm. Accessed December 2014.

A large increase in the proportion of isolates recovered from blood occurred between 2012 and 2013 (10% to 15%, 55/554 to 63/418). Historically (since 2003), the proportion of isolations from blood has fluctuated between 8 and 12%. The proportion of isolates recovered from urine increased significantly from 5% (25/554) in 2012 to 8% (33/418) in 2013. Since 2003, the overall proportion of Heidelberg isolates recovered from urine has increased slightly to the high observed in 2013.
Comparisons were made between the proportion of resistant isolates seen in 2013 to the proportion seen in 2012. Comparisons were also made between 2013 and 2006, due to the voluntary withdrawl of ceftiofur use at chicken hatcheries in Québec during this year. All analyses were performed at the national and provincial levels for each antimicrobial tested. The significant results observed were:

Amoxicillin-clavulanic acid

- Increase in Ontario from 16% (35/222) in 2012 to 30% (44/147) in 2013

Ceftiofur

- Increase from 13% (57/430) in 2006 to 31% (129/418) in 2013
- Decrease in British Columbia from 64% (25/39) in 2012 to 30% (9/30) in 2013
- Increase in Ontario from 16% (35/222) in 2012 to 30% (44/147) in 2013
- Increase in Nova Scotia from 24% (8/32) in 2012 to 58% (15/26) in 2013
- For all surveillance years combined, resistance to ceftiofur was high among PT 4, PT 29, and PT 41 isolates, with 94% (51/54), 89% (670/749), and 61% (113/184) resistance, respectively. These three phage types account for > 74% of ceftiofur resistance seen among Heidelberg isolates. In contrast, susceptibility to ceftiofur was observed in 99% of PT 26 (208/211) isolates and 98% of PT 19 isolates (1,969/2,015). Therefore, ceftiofur resistance among Heidelberg isolates is driven by the proportion of these phage types in the population.

Ceftriaxone (common resistance mechanism as ceftiofur resistance)

- Decrease in British Columbia from 67% (26/39) in 2012 to 30% (9/30) in 2013
- Increase in Ontario from 16% (35/222) in 2012 to 30% (44/147) in 2013
- Increase in Nova Scotia from 25% (8/32) in 2012 to 58% (15/26) in 2013

Ampicillin

- Decrease from 45% (250/556) in 2004 to 33% (139/418) in 2013
- Decrease in British Columbia from 74% (29/39) in 2012 to 50% (15/30) in 2013
- Increase in Nova Scotia from 25% (8/32) in 2012 to 65% (17/26) in 2013

Cefoxitin

- Increase in Ontario from 16% (35/222) in 2012 to 30% (44/147) in 2013

- Increase in Nova Scotia from 25% (8/32) in 2012 to 58% (15/26) in 2013

Kanamycin

- Increase from < 1% (3/555) in 2012 to 2% (9/414) in 2013

Gentamicin

- Increase from < 1% (3/555) in 2012 to 3% (11/414) in 2013
- Increase in Ontario from < 1% (1/222) in 2012 to 3% (5/147) in 2013

In 2013, 59% (248/418) of Heidelberg isolates and 91% (169/186) of PT 19 isolates were pan-susceptible. Among isolates displaying some resistance, the most common pattern was A2C-AMP-CRO (31%, 128/418). The pattern involving the greatest number of antimicrobials was A2C-AMP-CRO-STR-TET (1 PT 29 isolate from Nova Scotia). While in previous years the top two resistance patterns have been A2C-AMP-CRO and AMP (resistance to ampicillin alone), in 2013 the GEN-STR-SSS pattern was observed as the second most common resistance pattern, representing 2% of Heidelberg isolates.

The proportion of Heidelberg isolates from patients aged 70 or older increased significantly between 2012 and 2013, from 19/555 (3%) to 33/418 (8%) (Figure 5). However, 8% falls within the historical levels seen within this age group (3% to 14% of isolates).

NEWPORT (n = 174)

The most common PTs recovered were: PT 9 (18%, 31/174), PT 14b (13%, 23/174), and PT 13 (9%, 16/174). The proportion of PT 9 isolates out of all Newport isolates has remained relatively stable since 2007. In contrast, the proportion of PT 14b isolates has increased overall from 2009 to 2013, and a large increase in PT 13 isolates was seen from 2012 to 2013 (3% to 9%, 4/149 to 16/174).

Three percent (6/174) of Newport isolates were recovered from blood in 2013; a slight increase from 2% (3/149) in 2012, but not statistically significant. Seven percent (12/174) of isolates were recovered from urine, which is an increase from the low of 2% (4/149) seen in 2012, but again, not statistically significant.

Ciprofloxacin resistance was observed for the first time in this serovar: 1 isolate in Alberta (PT 13, ACKSSuT-A2C-AZM-CRO-CIP-GEN-NAL-SXT) and 1 isolate in Prince Edward Island (PT 15, CIP-KAN). Resistance to azithromycin was also observed for the first time in Newport isolates. Two isolates were from patients in Québec with resistance to AZM (resistance to azithromycin only), while 2 isolates were recovered in Alberta with the following resistance patterns: ACSSuT-A2C-AXM-CRO-SXT and ACKSSuT-A2C-AZM-CRO-CIP-GEN-NAL-SXT.

Gentamicin resistance was observed in 5 isolates when only 1 isolate had been previously observed in each of the years 2003, 2005, and 2008. Four of these isolates were identified in Alberta.

The majority of Newport isolates in 2013 were pan-susceptible (87%, 152/174). The most common resistance pattern observed was ACSSuT-A2C-CRO (5%, 8/174), which was also the most common pattern observed in 2012 (5%, 8/149). The pattern involving the greatest number of antimicrobials was ACKSSuT-A2C-AZM-CRO-CIP-GEN-NAL-SXT (1 PT 13 isolate from Alberta).

PARATYPHI A (n = 34) AND PARATYPHI B[11] (n = 9)

Eighty-five percent (29/34) of the Paratyphi A isolates were recovered from blood samples, while 11% (1/9) of the Paratyphi B isolates were recovered from blood (11%).
Resistance to nalidixic acid decreased significantly from 2012 (93%, 27/29) to 2013 (72%, 31/43). The most common resistance pattern was CIP-NAL, present in 7 Paratyphi A isolates. One Paratyphi A isolate from Manitoba displayed the FOX-CHL-CIP-NAL pattern, and 1 Paratyphi B isolate from Québec had the ACSSuT pattern. Ciprofloxacin resistance was identified in 8 Paratyphi A isolates when previously only 1 isolate had been identified in 2010. The proportion of Paratyphi A and B isolates from patients aged 5 to 12 increased significantly between 2012 and 2013, from 2/29 (7%) to 11/43 (26%), which is well above the historical range (0% to 16%) (Figure 6).

TYPHI (n = 131)

The most common phage types recovered were PT E1 (28%, 37/131), PT UVS (I+IV) (21%, 27/131), and PT E9 var. (11%, 15/131). Seventy-five percent (99/131) of isolates were recovered from blood samples; a proportion that has increased dramatically since surveillance initiation in 2003, when this proportion was 40% (51/127). Recovery of *S.* Typhi from urine remained low in 2013 (2%, 3/131).
A significant increase in ciprofloxacin resistance occurred in British Columbia from 2012 to 2013 (3%, 1/33 to 26%, 7/27).
The most common resistance pattern was resistance to NAL (resistance to nalidixic acid alone) (50%, 65/131), followed by resistance to CIP-NAL (19/131). Interestingly, the AMP-CHL-NAL-STR-SSS-SXT pattern which was found in 15% (22/144) of isolates in 2012 was less prevalent in 2013, representing 7/131 (5%) isolates. Two isolates in 2013 from Ontario were resistant to ACSSuT-NAL-SXT.
The proportion of cases aged less than 5 years declined significantly between 2012 and 2013 (10%, 15/144 to 4%, 5/131).

TYPHIMURIUM (n = 384)

The most common PTs recovered were PT 10 (12%, 46/384), PT 104 (12%, 46/384) and PT 108 (10%, 37/384). The proportion of PT 10 isolates in 2013 was greater than in any previous surveillance year, and has increased significantly from the 2% of Typhimurium isolates seen in 2003 (13/605). The proportion of PT 104 isolates has followed the opposite trajectory from PT

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[11] *Salmonella* Paratyphi B does not include *S*. Paratyphi B var. L (+) tartrate (+), formerly called *S*. Paratyphi var. Java. The biotype of *S*. Paratyphi B included here is tartrate (-) and associated with severe typhoid-like fever. *Salmonella* Paratyphi B var. L (+) tartrate (+) is commonly associated with gastrointestinal illness. However, there were no Paratyphi B isolates received for susceptibility testing in 2012.

10, with a significant overall decrease from 2003 to 2013 (24%, 146/605 in 2003). The proportion of PT 108 isolates has ranged from 15% (71/453) in 2010 to 33% (214/358) in 2007, with no discernable trend over time.

Three percent (10/384) of Typhimurium isolates in 2013 were recovered from blood samples, which is within the historical range (low of 1% in 2010, high of 3% in 2008). The proportion of isolates recovered from urine in 2013 was 3% (11/384), which is the highest proportion seen in CIPARS data.

Similar to 2012, the most common resistance pattern was resistance to ACSSuT (12%, 47/384). The pattern involving the greatest number of antimicrobials was ACSSuT-A2C-CRO-CIP-NAL-SXT (1 PT 193 isolate from Alberta). Historically, resistance to ACSSuT has been linked mainly to PT 104. However, since 2010 there has been a marked increase among isolates resistant to ACSSuT comprising of PT 104b since 2010. In 2013, 34% (23/67) of all ACSSuT resistant isolates were PT104b while PT 104 represented 33% (22/67). In addition, the percentage of all PT 104 Typhimurium isolates susceptible to all antimicrobials has been increasing over time, with 0% (0/55) observed in 2009 and 33% (15/46) observed in 2013.

The proportion of Typhimurium isolates from patients aged 13 to 17 decreased significantly between 2012 and 2013, from 19/378 (5%) to 9/384 (2%) (Figure 7). In contrast, the proportion of isolates from patients aged 30 à 49 increased significantly, from 34/378 (9%) to 52/332 (16%) (Figure 7).

4,[5],12:i:- (n = 166)

The most common PTs recovered were PT 193 (42%, 70/166), PT U291 (14%, 23/166) and PT 191 (10%, 16/166). A dramatic increase in PT 193 isolations has occurred over 2003 (2%, 1/42) to 2013, with the most dramatic increase occurring from 2011 (9%, 25/122) to 2013.

Two percent (2/166) of isolates were recovered from each of blood and urine isolates in 2013. This is a low for CIPARS 4,[5],12:i:- isolates with the exception of 2003, when 0/42 isolates were recovered from either specimen source.

Overall, significant changes were observed among the following antimicrobials between 2012 and 2013:

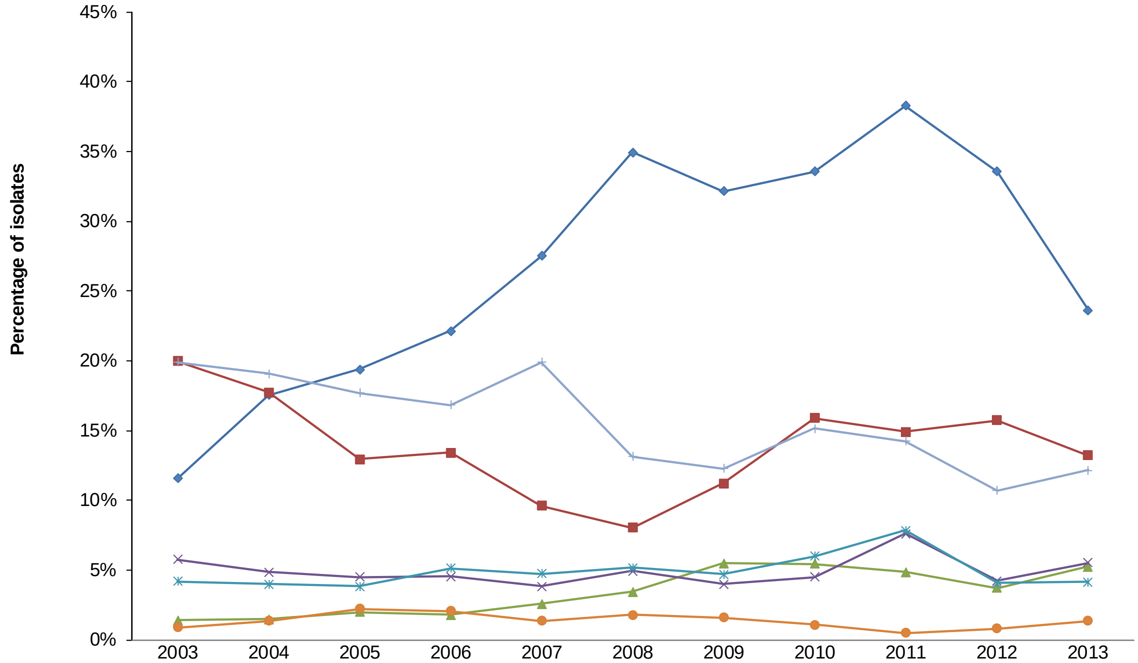
- Ampicillin resistance increased from 34% (44/131) in 2012 to 51% (84/166) in 2013. Resistance to ampicillin in 2013 was also significantly higher than resistance in 2004 (15%, 7/46) and 2006 (26%, 15/57)
- Streptomycin resistance increased from 31% (41/131) in 2012 to 47% (78/166) in 2013. This increase may be attributed to an increase in Ontario from 22% (13/59) to 58% (38/65).
- Sulfisoxazole resistance increased from 31% (40/131) in 2012 to 48% (79/166) in 2013. This increase may be attributed to an increase in Ontario from 20% (12/59) to 58% (38/65).
- Tetracycline resistance increased from 43% (56/131) in 2012 to 61% (101/166) in 2013. This may be attributed to an increase in Ontario from 29% (17/59) to 62% (40/65).

The most common resistance pattern was AMP-STR-SSS-TET (36%, 60/166), an increase from (25%, 31/122) in 2012. Similar to 2012, the second most common resistance pattern was resistance to TET (resistance to tetracycline alone) (14%, 24/166) in 2013, an increase from 9% (11/122) in 2012. The pattern involving the greatest number of antimicrobials was ACKSSuT-TIO-CRO-GEN-SXT (1 PT 193 isolate in Manitoba).

When looking at AMP-STR-SSS-TET resistance with or without resistance to additional antimicrobials, levels of resistance have significantly increased between 2012 (29%, 38/131) and 2013 (42%, 70/166). This increase appears to be driven by presence of PT 193 which has been increasing over time and has high levels of resistance to these antimicrobials (89%, 62/70 isolates in 2013).

A significant increase in the proportion of cases aged 30 to 49 occurred between 2012 and 2013, from 16/131 (12%) in 2012 to 37/166 (22%) in 2013 (Figure 8).

Figure 2. Proportional representation of human *Salmonella* isolates

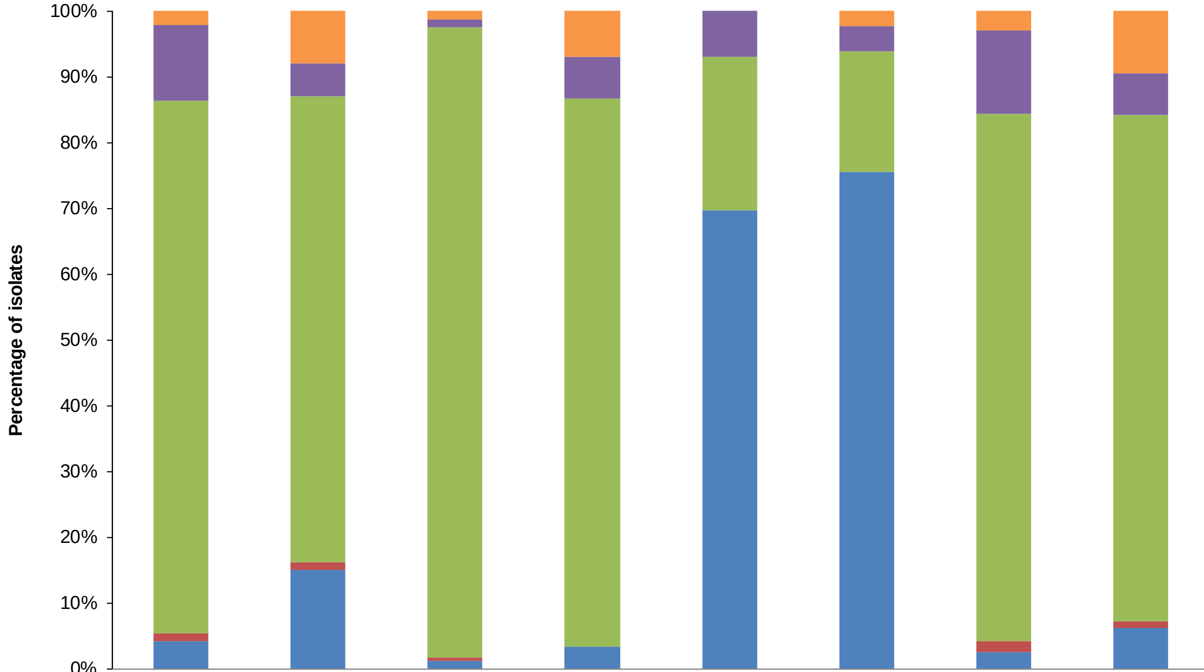


	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Enteritidis	12%	18%	19%	22%	28%	35%	32%	34%	38%	34%	24%
Heidelberg	20%	18%	13%	13%	10%	8%	11%	16%	15%	16%	13%
4,[5],12:i:-	1%	1%	2%	2%	3%	3%	5%	5%	5%	4%	5%
Newport	6%	5%	4%	5%	4%	5%	4%	5%	8%	4%	6%
Paratyphi A and B	1%	1%	2%	2%	1%	2%	2%	1%	0%	1%	1%
Typhi	4%	4%	4%	5%	5%	5%	5%	6%	8%	4%	4%
Typhimurium	20%	19%	18%	17%	20%	13%	12%	15%	14%	11%	12%

Year

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

Figure 3. Proportion of human *Salmonella* serovars from all sample sources



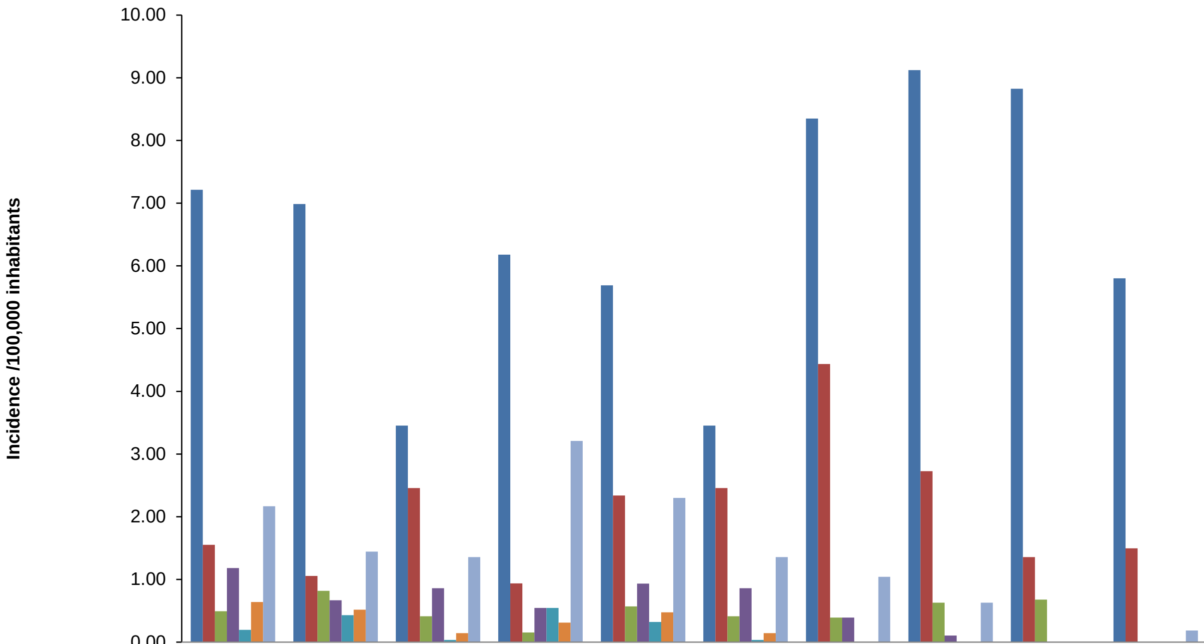
	Enteritidis	Heidelberg	4,[5],12:i:-	Newport	Paratyphi A and B	Typhi	Typhimurium	Other serovars
Urine	16	33	2	12	0	3	11	103
Unknown	85	21	2	11	3	5	49	70
Stool	605	296	159	145	10	24	308	845
Other	8	5	1	0	0	0	6	10
Blood	32	63	2	6	30	99	10	69

Serovars and number of isolates

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

SEROVAR DISTRIBUTION

Figure 4. Provincial incidence rates for specific human *Salmonella* serovars

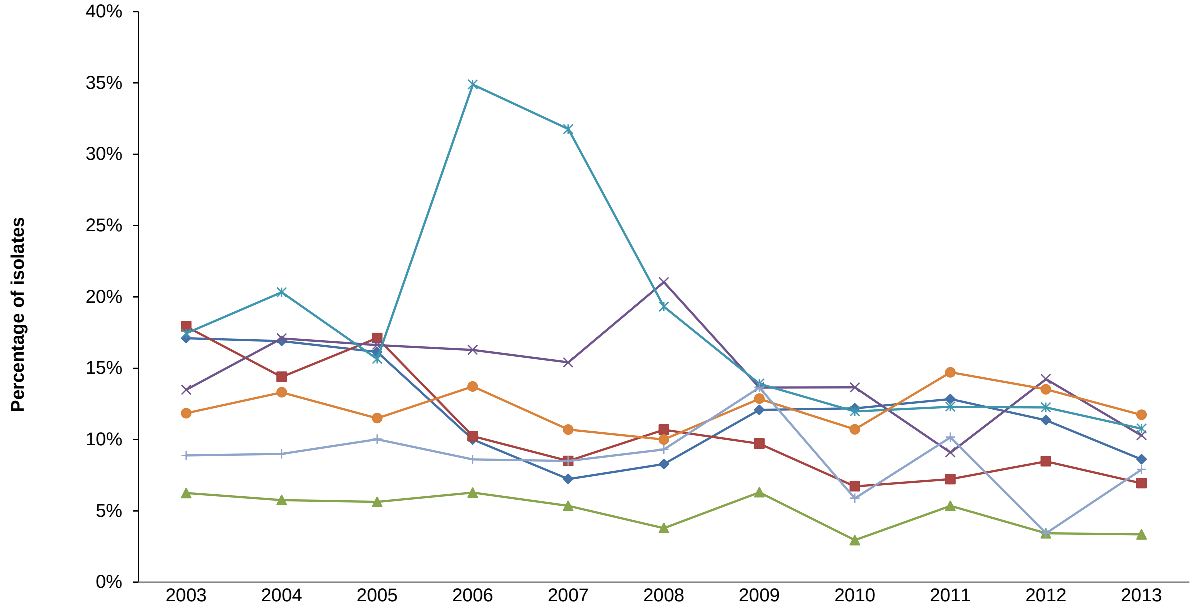


	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL
Enteriditis	7.21	6.99	3.45	6.18	5.69	3.45	8.35	9.12	8.83	5.80
Heidelberg	1.55	1.06	2.46	0.94	2.34	2.46	4.44	2.73	1.36	1.50
Newport	0.49	0.82	0.41	0.16	0.57	0.41	0.39	0.63	0.68	0.00
4,[5],12,:i:-	1.18	0.67	0.86	0.55	0.94	0.86	0.39	0.10	0.00	0.00
Paratyphi A and B	0.20	0.43	0.04	0.55	0.32	0.04	0.00	0.00	0.00	0.00
Typhi	0.64	0.52	0.15	0.31	0.47	0.15	0.00	0.00	0.00	0.00
Typhimurium	2.17	1.44	1.36	3.21	2.30	1.36	1.04	0.63	0.00	0.19

Province

Provincial abbreviations are defined in the section *How To Read This Chapter*.
No *S.* 4,[5],12,:i:- isolates were received from Prince Edward Island or Newfoundland and Labrador.
No *S.* Paratyphi A or B isolates were received from New Brunswick, Nova Scotia, Prince Edward Island, or Newfoundland and Labrador.
No *S.* Typhi isolates were received from New Brunswick, Nova Scotia, Prince Edward Island, or Newfoundland and Labrador.
Salmonella Paratyphi B does not include *S*. Paratyphi B var. L (+) tartrate (+), formerly called *S*. Paratyphi var. Java. The biotype of *S*. Paratyphi B included here is tartrate (-) and associated with severe typhoid-like fever. *Salmonella* Paratyphi B var. L (+) tartrate (+) is commonly associated with gastrointestinal illness.

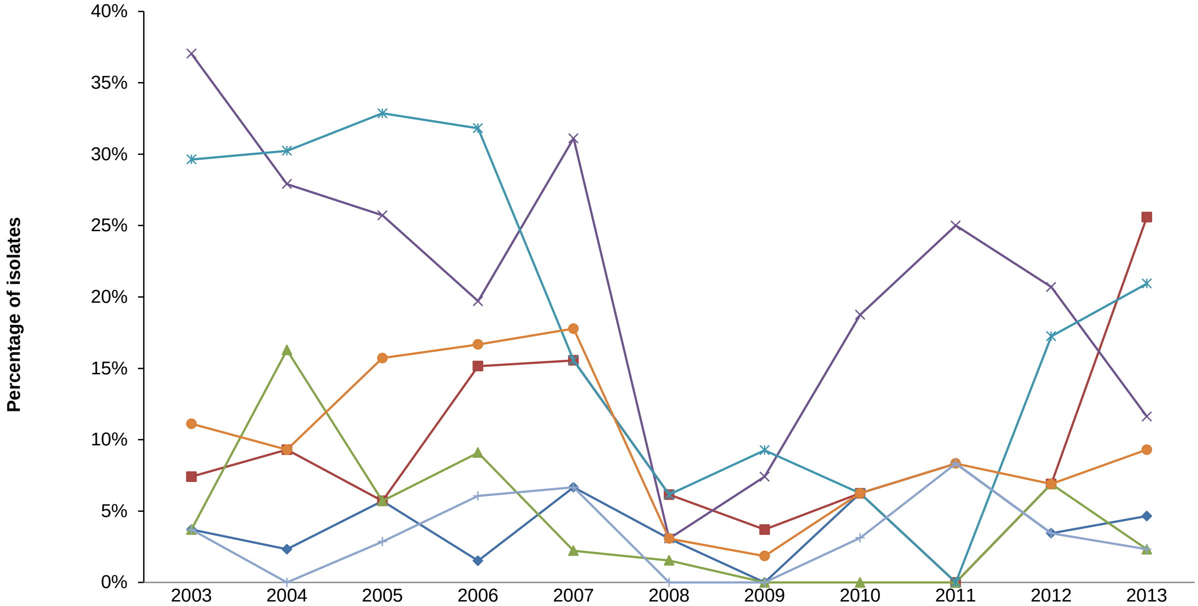
Figure 5. Temporal variations of age groups represented within *Salmonella* Heidelberg isolates



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Less than 5	17%	17%	16%	10%	7%	8%	12%	12%	13%	11%	9%
5-12	18%	14%	17%	10%	8%	11%	10%	7%	7%	8%	7%
13-17	6%	6%	6%	6%	5%	4%	6%	3%	5%	3%	3%
18-29	13%	17%	17%	16%	15%	21%	14%	14%	9%	14%	10%
30-49	17%	20%	16%	35%	32%	19%	14%	12%	12%	12%	11%
50-69	12%	13%	11%	14%	11%	10%	13%	11%	15%	14%	12%
70 or older	9%	9%	10%	9%	8%	9%	14%	6%	10%	3%	8%

Year

Figure 6. Temporal variations of age groups represented within *Salmonella* Paratyphi A and B isolates

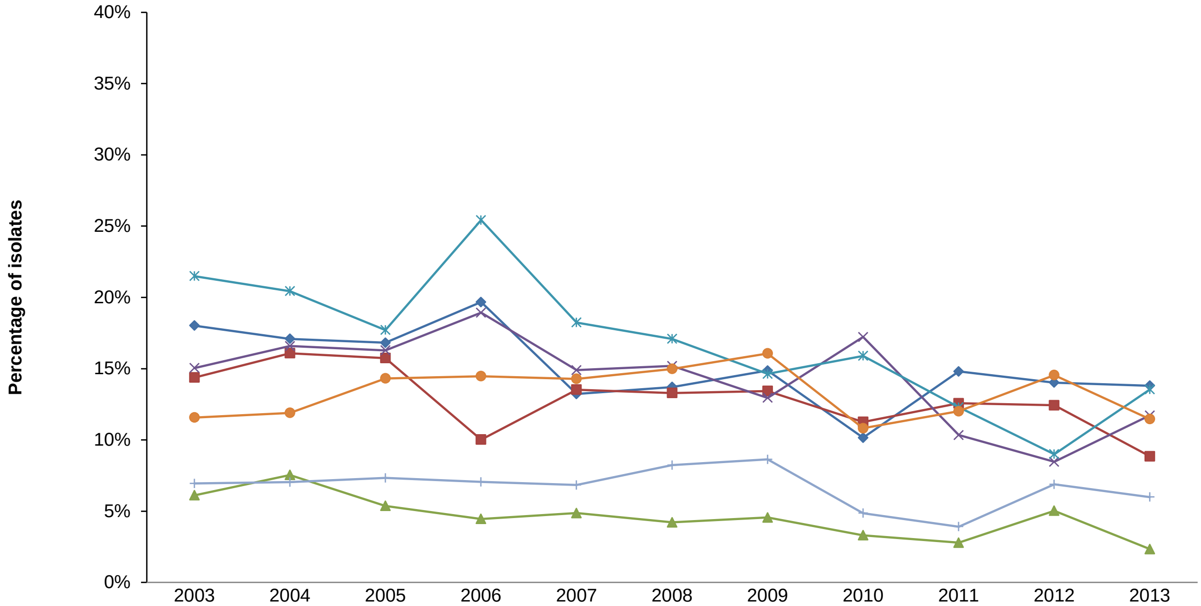


	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Less than 5	4%	2%	6%	2%	7%	3%	0%	6%	8%	3%	5%
5-12	7%	9%	6%	15%	16%	6%	4%	6%	0%	7%	26%
13-17	4%	16%	6%	9%	2%	2%	0%	0%	0%	7%	2%
18-29	37%	28%	26%	20%	31%	3%	7%	19%	25%	21%	12%
30-49	30%	30%	33%	32%	16%	6%	9%	6%	0%	17%	21%
50-69	11%	9%	16%	17%	18%	3%	2%	6%	8%	7%	9%
70 or older	4%	0%	3%	6%	7%	0%	0%	3%	8%	3%	2%

Year

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

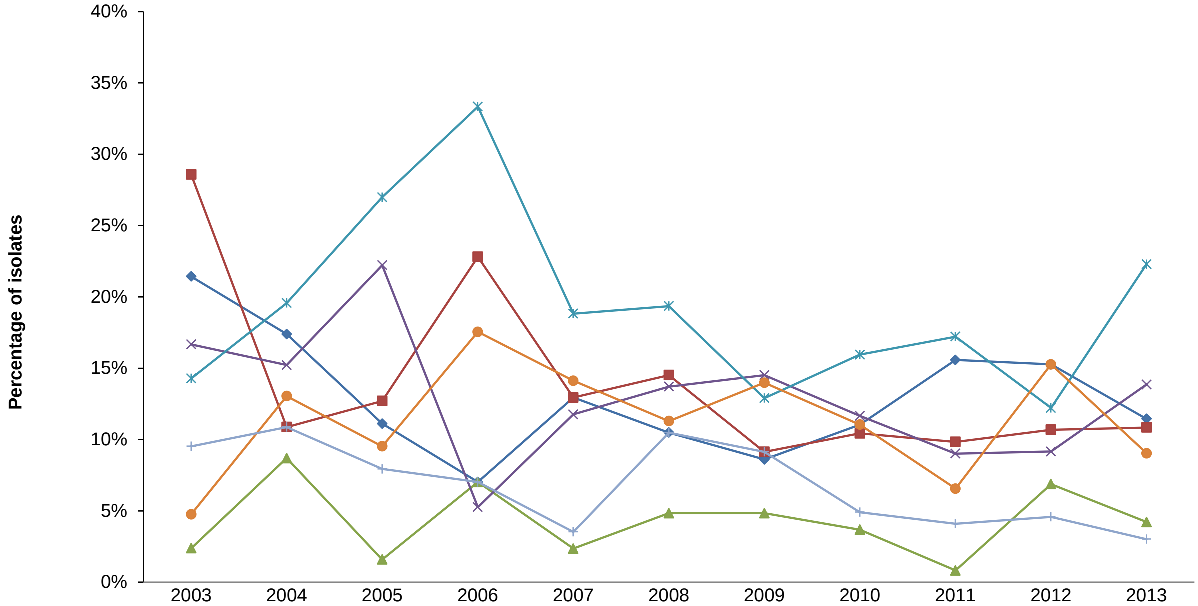
Figure 7. Temporal variations of age groups represented within *Salmonella* Typhimurium isolates



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Less than 5	18%	17%	17%	20%	13%	14%	15%	10%	15%	14%	14%
5-12	14%	16%	16%	10%	14%	13%	13%	11%	13%	12%	9%
13-17	6%	8%	5%	4%	5%	4%	5%	3%	3%	5%	2%
18-29	15%	17%	16%	19%	15%	15%	13%	17%	10%	8%	12%
30-49	21%	20%	18%	25%	18%	17%	15%	16%	12%	9%	14%
50-69	12%	12%	14%	14%	14%	15%	16%	11%	12%	15%	11%
70 or older	7%	7%	7%	7%	7%	8%	9%	5%	4%	7%	6%

Year

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



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Less than 5	21%	17%	11%	7%	13%	10%	9%	11%	16%	15%	11%
5-12	29%	11%	13%	23%	13%	15%	9%	10%	10%	11%	11%
13-17	2%	9%	2%	7%	2%	5%	5%	4%	1%	7%	4%
18-29	17%	15%	22%	5%	12%	14%	15%	12%	9%	9%	14%
30-49	14%	20%	27%	33%	19%	19%	13%	16%	17%	12%	22%
50-69	5%	13%	10%	18%	14%	11%	14%	11%	7%	15%	9%
70 or older	10%	11%	8%	7%	4%	10%	9%	5%	4%	5%	3%

Year

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	88 (44.2)	73	9	4	1	1		1	2	3	2	2	3	2	2		1	4		10	5
Heidelberg	30 (15.1)	13	15	2				2	2	15	9	9	9	9							2
Typhi	27 (13.6)	3	22	2											1	1	1	1	7	24	
Typhimurium	25 (12.6)	17	1	2	5			3	6	6	1	1	1	1	7	2		4			7
Newport	18 (9)	15			3				3	3	3	3	3	3	3			3			3
4,[5],12:i:-	7 (3.5)		2		5				5	5					5						7
Paratyphi A and B	4 (2.0)		4																	4	
Total	**199 (100)**	**121**	**53**	**10**	**14**	**1**		**6**	**18**	**32**	**15**	**15**	**16**	**15**	**18**	**3**	**2**	**12**	**7**	**38**	**24**
Alberta																					
Enteritidis	74 (30.6)	64	6	2	2				2	3					4	2			1	7	2
Typhimurium	46 (19)	28	1	2	13	2	2	4	16	15	1	1	1	1	15	3		13	2	2	18
Heidelberg	36 (14.9)	16	13	7			3	4	7	13	12	12	12	12	3					1	4
4,[5],12:i:-	31 (12.8)	7	13	3	8		1	1	11	10	1	1	1	1	11	1		1			22
Typhi	26 (10.7)	7	14		5				3	5					5	4		4	5	17	2
Newport	23 (9.5)	18		3		2	4	1	5	5	2	2	2	2	2	2	2	2	1	1	5
Paratyphi A and B	6 (2.5)		6																3	6	
Total	**242 (100)**	**140**	**53**	**17**	**28**	**4**	**10**	**10**	**44**	**51**	**16**	**16**	**16**	**16**	**40**	**12**	**2**	**20**	**12**	**34**	**53**
Saskatchewan																					
Enteritidis	57 (48.7)	52	5																1	5	
Typhimurium	29 (24.8)	20	3	5	1			4	4	2					5	1	1				3
Heidelberg	11 (9.4)	5	6							6	6	6	6	6							
4,[5],12:i:-	10 (8.5)	4	6							3	3	3	3	3							3
Newport	6 (5.1)	6																			
Paratyphi A and B	2 (1.7)	1	1																1	1	
Typhi	2 (1.7)		2																1	2	
Total	**117 (100)**	**88**	**23**	**5**	**1**			**4**	**4**	**11**	**9**	**9**	**9**	**9**	**5**	**1**	**1**		**3**	**8**	**6**
Manitoba																					
Enteritidis	81 (48.5)	68	9	2	2		1		1	2					2	2	1		1	13	2
Typhimurium	46 (27.5)	31		5	9	1	1	1	15	11	1	1	1	1	15	1		8	1	1	10
Heidelberg	14 (8.4)	11	3							3	3	3	3	3							
4,[5],12:i:-	14 (8.4)	9	1		4		1	1	4	5	1	2	1	2	4	1		1			4
Paratyphi A and B	5 (3.0)		2	3									1		2	2		1	1	3	2
Typhi	5 (3.0)	4	1																	1	
Newport	2 (1.2)	2																			
Total	**167 (100)**	**125**	**16**	**10**	**15**	**1**	**3**	**2**	**20**	**21**	**5**	**6**	**6**	**6**	**23**	**6**	**1**	**10**	**3**	**18**	**18**
Ontario																					
Enteritidis	190 (26.1)	158	28	3	1				1	4	1	1	1	1	2	1			2	27	5
Typhimurium	164 (22.5)	119	7	5	32	1	1	5	37	33	1	1	1	1	38	3		29	2	3	35
Heidelberg	147 (20.2)	91	48	8			5	2	7	44	44	44	44	44	8	2		1		2	4
Newport	80 (11)	72	1	2	5		1		6	6	4	4	4	4	6	1		4		2	5
4,[5],12:i:-	65 (8.9)	20	4	5	36		1	7	38	40	1	2	1	2	38	3	1	4		2	40
Typhi	60 (8.2)	8	41	1	8	2			10	9					10	9		7	9	52	4
Paratyphi A and B	23 (3.2)	8	15																3	15	
Total	**729 (100)**	**476**	**144**	**24**	**82**	**3**	**8**	**14**	**99**	**136**	**51**	**52**	**51**	**52**	**102**	**19**	**1**	**45**	**16**	**103**	**93**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.

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

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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																					
Heidelberg	112 (34)	76	28	8			2	1	6	28	26	27	26	27	6	1		2			5
Enteritidis	75 (22.8)	57	13	5					1						4	4			4	13	5
Typhimurium	61 (18.5)	33	1	5	19	3		7	23	23	2	2	1	2	26	5	2	21		3	24
Newport	35 (10.6)	30	2	1	2				2	3	2	3	2	3	2	1	2	2			2
4,[5],12:i:-	32 (9.7)	7	4	1	20		1	2	20	20	1	1	1	1	21		1			1	23
Typhi	11 (3.3)	5	5	1													1		1	6	
Paratyphi A and B	3 (0.9)		2		1				1	1					1			1		2	1
Total	**329 (100)**	**208**	**55**	**21**	**42**	**3**	**3**	**10**	**53**	**75**	**31**	**33**	**30**	**33**	**60**	**11**	**6**	**26**	**5**	**25**	**60**
New Brunswick																					
Enteritidis	64 (54.2)	60	3	1											1	1			1	4	1
Heidelberg	39 (33.1)	26	12	1			1		1	11	11	11	11	11	1		1				
Typhimurium	8 (6.8)	4		2	2			1	3	2	1	1		1	4			1	1		3
4,[5],12:i:-	4 (3.4)	3	1																		1
Newport	3 (2.5)	3																			
Total	**118 (100)**	**96**	**16**	**4**	**2**		**1**	**1**	**4**	**13**	**12**	**12**	**11**	**12**	**6**	**1**	**1**	**1**	**2**	**4**	**5**
Nova Scotia																					
Enteritidis	88 (70.4)	75	9	1	3				3	3					4	1			1	11	4
Heidelberg	26 (20.8)	9	14	3					3	17	16	15	15	15	2	2					1
Newport	6 (4.8)	6																			
Typhimurium	4 (3.2)	4																			
4,[5],12:i:-	1 (0.8)	1																			
Total	**125 (100)**	**95**	**23**	**4**	**3**				**6**	**20**	**16**	**15**	**15**	**15**	**6**	**3**			**1**	**11**	**5**
Prince Edward Island																					
Enteritidis	13 (81.3)	13																			
Heidelberg	2 (12.5)	1	1							1	1	1	1	1							
Newport	1 (6.3)			1				1											1		
Total	**16 (100)**	**14**	**1**	**1**				**1**		**1**	**1**	**1**	**1**	**1**					**1**		
Newfoundland and Labrador																					
Enteritidis	16 (80.0)	15	1																	1	
4,[5],12:i:-	2 (10.0)		1	1				1		1	1	1	1	1			1				1
Heidelberg	1 (5.0)		1							1	1	1	1	1							
Typhimurium	1 (5.0)	1																			
Total	**20 (100)**	**16**	**3**	**1**				**1**		**2**	**2**	**2**	**2**	**2**			**1**			**1**	**1**
TOTAL	**2,062 (100)**	**1379**	**387**	**97**	**187**	**12**	**25**	**49**	**248**	**362**	**158**	**161**	**157**	**161**	**260**	**56**	**15**	**114**	**50**	**242**	**265**

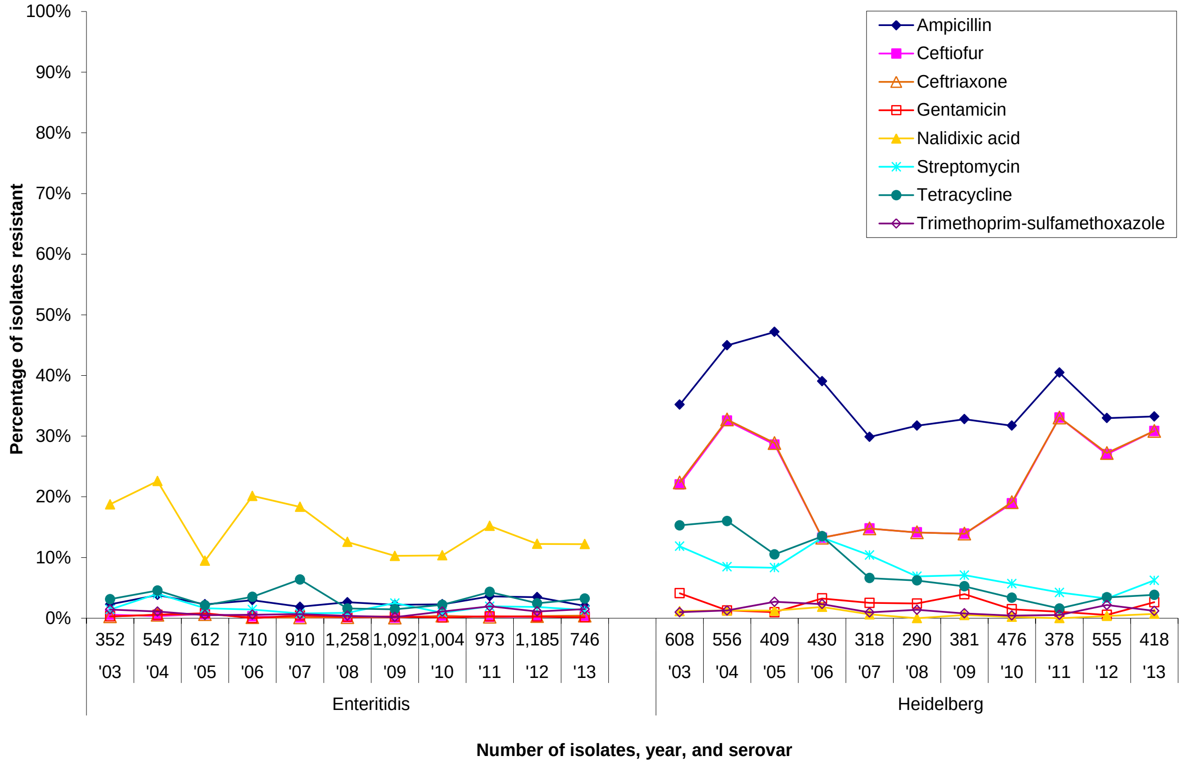
Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.

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

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

TEMPORAL ANTIMICROBIAL RESISTANCE SUMMARY

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



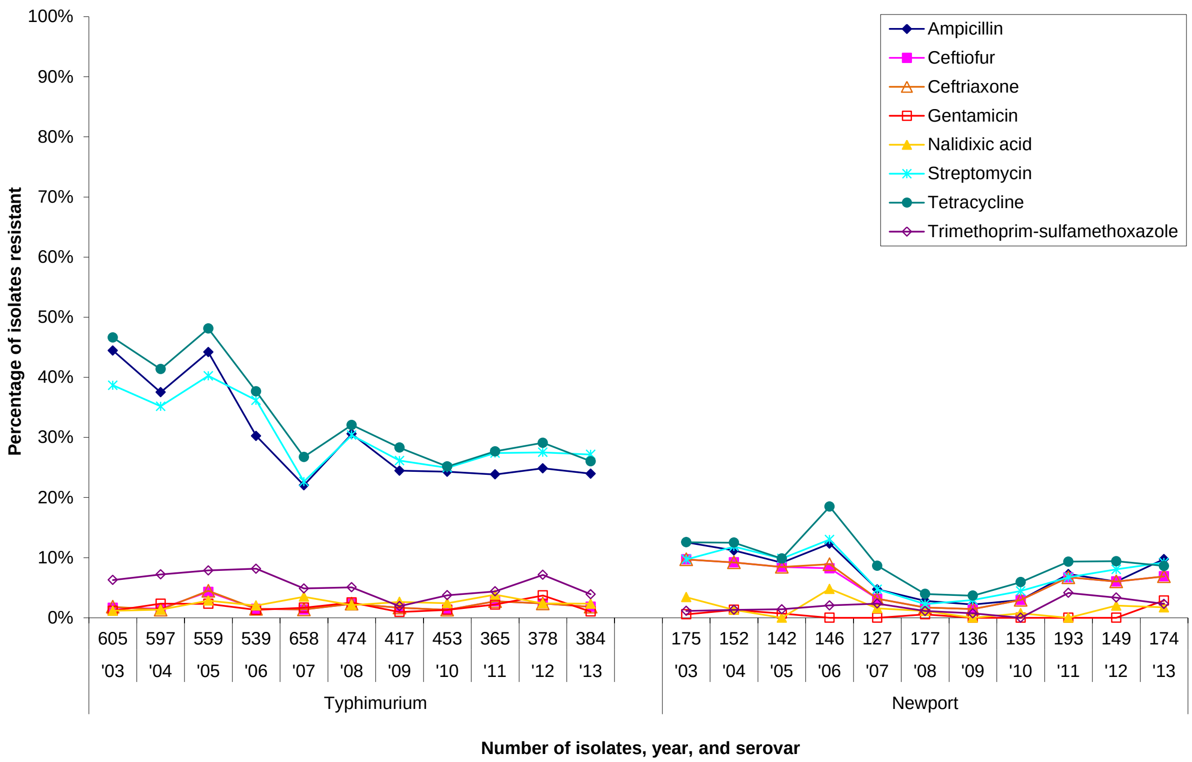
Serovar	Enteritidis										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	352	549	612	710	910	1,258	1,092	1,004	973	1,185	746
Antimicrobial											
Ampicillin	**2%**	4%	2%	3%	2%	3%	2%	2%	4%	**3%**	**2%**
Ceftiofur	**1%**	0%	1%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Ceftriaxone	**0%**	1%	1%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Gentamicin	**0%**	1%	1%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Nalidixic acid	**19%**	23%	9%	20%	18%	13%	10%	10%	15%	**12%**	**12%**
Streptomycin	**1%**	4%	2%	1%	1%	1%	2%	1%	2%	**2%**	**1%**
Tetracycline	**3%**	5%	2%	4%	6%	2%	1%	2%	4%	**2%**	**3%**
Trimethoprim-sulfamethoxazole	**1%**	1%	0%	1%	1%	0%	0%	1%	2%	**1%**	**1%**

Serovar	Heidelberg										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	608	556	409	430	318	290	381	476	378	555	418
Antimicrobial											
Ampicillin	**35%**	<u>**45%**</u>	47%	**39%**	30%	32%	33%	32%	40%	**33%**	<u>**33%**</u>
Ceftiofur	**22%**	**33%**	29%	<u>**13%**</u>	15%	14%	14%	19%	33%	**27%**	<u>**31%**</u>
Ceftriaxone	**22%**	33%	29%	13%	15%	14%	14%	19%	33%	**27%**	**31%**
Gentamicin	**4%**	1%	1%	3%	3%	2%	4%	1%	1%	**1%**	**3%**
Nalidixic acid	**1%**	1%	1%	2%	1%	0%	1%	0%	0%	**0%**	**1%**
Streptomycin	**12%**	8%	8%	13%	10%	7%	7%	6%	4%	**3%**	**6%**
Tetracycline	**15%**	16%	11%	13%	7%	6%	5%	3%	2%	**3%**	**4%**
Trimethoprim-sulfamethoxazole	**1%**	1%	3%	2%	1%	1%	1%	0%	1%	**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.

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)

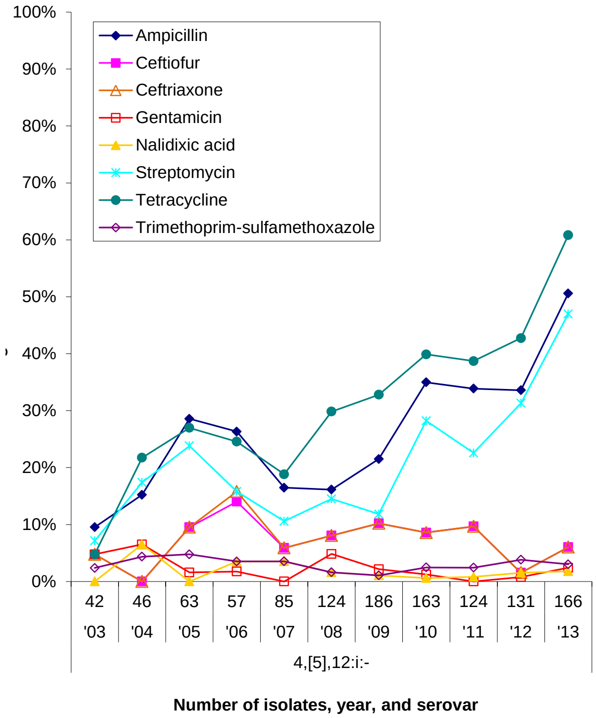


Serovar	Typhimurium										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	605	597	559	539	658	474	417	453	365	378	384
Antimicrobial											
Ampicillin	**44%**	38%	44%	30%	22%	31%	24%	24%	24%	**25%**	**24%**
Ceftiofur	**2%**	2%	4%	1%	1%	2%	2%	1%	3%	**2%**	**2%**
Ceftriaxone	**2%**	1%	4%	1%	1%	2%	2%	1%	3%	**2%**	**2%**
Gentamicin	**1%**	2%	2%	1%	2%	3%	1%	1%	2%	**4%**	**1%**
Nalidixic acid	**1%**	1%	3%	2%	3%	2%	3%	2%	4%	**2%**	**2%**
Streptomycin	**39%**	35%	40%	36%	23%	30%	26%	25%	27%	**28%**	**27%**
Tetracycline	**47%**	41%	48%	38%	27%	32%	28%	25%	28%	**29%**	**26%**
Trimethoprim-sulfamethoxazole	**6%**	7%	8%	8%	5%	5%	2%	4%	4%	**7%**	**4%**

Serovar	Newport										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	175	152	142	146	127	177	136	135	193	149	174
Antimicrobial											
Ampicillin	**13%**	11%	9%	12%	5%	3%	2%	3%	7%	**6%**	**10%**
Ceftiofur	**10%**	9%	8%	8%	3%	2%	1%	3%	7%	**6%**	**7%**
Ceftriaxone	**10%**	9%	8%	9%	3%	2%	1%	3%	7%	**6%**	**7%**
Gentamicin	**1%**	1%	1%	0%	0%	1%	0%	0%	0%	**0%**	**3%**
Nalidixic acid	**3%**	1%	0%	5%	2%	1%	0%	1%	0%	**2%**	**2%**
Streptomycin	**10%**	12%	10%	13%	5%	2%	3%	4%	7%	**8%**	**9%**
Tetracycline	**13%**	13%	10%	18%	9%	4%	4%	6%	9%	**9%**	**9%**
Trimethoprim-sulfamethoxazole	**1%**	1%	1%	2%	2%	1%	1%	0%	4%	**3%**	**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 antimicrobial.

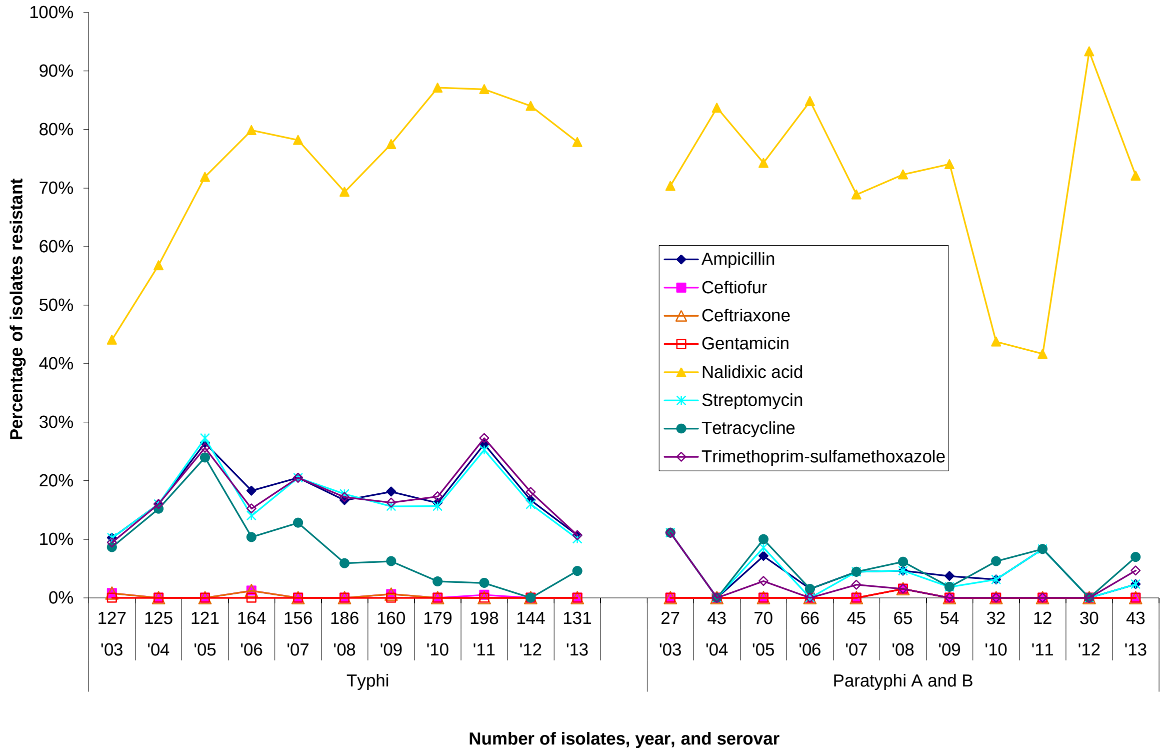
Figure 9. Temporal variations in resistance of *Salmonella* serovars from humans (cont'd)



Serovar	4,[5],12:i:-										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	42	46	63	57	85	124	186	163	124	131	166
Antimicrobial											
Ampicillin	**10%**	15%	29%	26%	16%	16%	22%	35%	34%	**34%**	**51%**
Ceftiofur	**5%**	0%	10%	14%	6%	8%	10%	9%	10%	**2%**	**6%**
Ceftriaxone	**5%**	0%	10%	16%	6%	8%	10%	9%	10%	**2%**	**6%**
Gentamicin	**5%**	7%	2%	2%	0%	5%	2%	1%	0%	**1%**	**2%**
Nalidixic acid	**0%**	7%	0%	4%	4%	2%	1%	1%	1%	**2%**	**2%**
Streptomycin	**7%**	17%	24%	16%	11%	15%	12%	28%	23%	**31%**	**47%**
Tetracycline	**5%**	22%	27%	25%	19%	30%	33%	40%	39%	**43%**	**61%**
Trimethoprim-sulfamethoxazole	**2%**	4%	5%	4%	4%	2%	1%	2%	2%	**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.

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



Serovar	Typhi										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	127	125	121	164	156	186	160	179	198	144	131
Antimicrobial											
Ampicillin	**10%**	16%	26%	18%	21%	17%	18%	16%	26%	**17%**	**11%**
Ceftiofur	**1%**	0%	0%	1%	0%	0%	1%	0%	1%	**0%**	**0%**
Ceftriaxone	**1%**	0%	0%	1%	0%	0%	1%	0%	0%	**0%**	**0%**
Gentamicin	**0%**	0%	0%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Nalidixic acid	**44%**	57%	72%	80%	78%	69%	78%	87%	87%	**84%**	**78%**
Streptomycin	**10%**	16%	27%	14%	21%	18%	16%	16%	25%	**16%**	**10%**
Tetracycline	**9%**	15%	24%	10%	13%	6%	6%	3%	3%	**0%**	**5%**
Trimethoprim-sulfamethoxazole	**9%**	16%	26%	15%	21%	17%	16%	17%	27%	**18%**	**11%**

Serovar	Paratyphi A and B										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	27	43	70	66	45	65	54	32	12	30	43
Antimicrobial											
Ampicillin	**11%**	0%	7%	2%	4%	5%	4%	3%	8%	**0%**	**2%**
Ceftiofur	**0%**	0%	0%	0%	0%	2%	0%	0%	0%	**0%**	**0%**
Ceftriaxone	**0%**	0%	0%	0%	0%	2%	0%	0%	0%	**0%**	**0%**
Gentamicin	**0%**	0%	0%	0%	0%	2%	0%	0%	0%	**0%**	**0%**
Nalidixic acid	**70%**	84%	74%	85%	69%	72%	74%	44%	42%	**93%**	**72%**
Streptomycin	**11%**	0%	9%	0%	4%	5%	2%	3%	8%	**0%**	**2%**
Tetracycline	**11%**	0%	10%	2%	4%	6%	2%	6%	8%	**0%**	**7%**
Trimethoprim-sulfamethoxazole	**11%**	0%	3%	0%	2%	2%	0%	0%	0%	**0%**	**5%**

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.

Salmonella Paratyphi B does not include *S*. Paratyphi B var. L (+) tartrate (+), formerly called *S.* Paratyphi var. Java. The biotype of *S*. Paratyphi B included here is tartrate (-) and associated with severe typhoid-like fever. *Salmonella* Paratyphi B var. L (+) tartrate (+) is commonly associated with gastrointestinal illness. However, there were no Paratyphi B isolates received for antimicrobial susceptibility testing in 2012.

MINIMUM INHIBITORY CONCENTRATIONS

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

	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
	Amoxicillin-clavulanic acid	746	≤ 1	2	0.4							83.8	13.7	0.7	1.5			0.4			
I	Ceftiofur	746	1	1	0.4					0.1	0.5	95.2	3.6	0.1		0.4					
	Ceftriaxone	746	≤ 0.25	≤ 0.25	0.4					99.1	0.4	0.1					0.4				
	Ciprofloxacin	746	0.03	0.25	1.5	28.2	56.4	1.7	1.2	6.7	4.3	0.5	0.9								
	Ampicillin	746	≤ 1	2	2.0							63.8	33.4	0.5	0.3			2.0			
	Azithromycin	746	4	8	0.3								2.3	81.2	15.8	0.4	0.3				
	Cefoxitin	746	2	4	0.5							0.8	75.7	20.5	2.3	0.1	0.1	0.4			
II	Gentamicin	746	0.50	0.50	0.1					20.4	74.1	5.2	0.1				0.1				
	Kanamycin	738	≤ 8	≤ 8	0.1										99.2	0.7			0.1		
	Nalidixic acid	746	4	> 32	12.2							0.3	13.1	66.4	6.4	1.6	0.7	11.5			
	Streptomycin	746	≤ 32	≤ 32	1.3								0.7	0.4			97.6	0.3	1.1		
	Trimethoprim-sulfamethoxazole	746	≤ 0.12	≤ 0.12	1.5				97.5	0.9	0.1				1.5						
	Chloramphenicol	746	8	8	0.5								0.1	10.1	88.5	0.8		0.5			
III	Sulfisoxazole	746	32	64	2.5											2.3	75.3	19.6	0.3		2.5
	Tetracycline	746	≤ 4	≤ 4	3.2									96.6	0.1			3.2			
IV																					

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

	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
	Amoxicillin-clavulanic acid	418	≤ 1	> 32	30.9							66.0	0.7		1.4	1.0	2.6	28.2			
I	Ceftiofur	418	1	> 8	30.9						17.7	50.7	0.7			30.9					
	Ceftriaxone	418	≤ 0.25	16	30.9					69.1					0.2	24.4	4.8	0.7	0.7		
	Ciprofloxacin	418	≤ 0.015	≤ 0.015	0.0	95.7	2.6	0.5		0.5	0.7										
	Ampicillin	418	≤ 1	> 32	33.3							65.1	1.2	0.5			0.2	33.0			
	Azithromycin	418	4	4	0.2									93.8	6.0		0.2				
	Cefoxitin	418	2	> 32	30.6							26.8	38.5	3.6	0.5		17.5	13.2			
II	Gentamicin	418	0.50	1	2.6					3.3	84.4	9.3			0.2	0.2	2.4				
	Kanamycin	414	≤ 8	≤ 8	2.2										96.9	1.0			2.2		
	Nalidixic acid	418	4	4	0.7								8.1	89.7	1.4			0.7			
	Streptomycin	418	≤ 32	≤ 32	6.2										0.2	0.7	92.8	1.7	4.5		
	Trimethoprim-sulfamethoxazole	418	≤ 0.12	≤ 0.12	1.2				98.3	0.5					1.2						
	Chloramphenicol	418	8	8	0.7									4.8	94.0	0.5		0.7			
III	Sulfisoxazole	418	32	64	4.8											9.3	72.2	13.6			4.8
	Tetracycline	418	≤ 4	≤ 4	3.8									96.2				3.8			
IV																					

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

	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
	Amoxicillin-clavulanic acid	174	≤ 1	2	6.3							89.7	0.6	0.6	2.9		2.9	3.4			
I	Ceftiofur	174	1	1	6.9					1.1	9.8	82.2				6.9					
	Ceftriaxone	174	≤ 0.25	≤ 0.25	6.9					92.0	1.1					4.0	1.7	0.6	0.6		
	Ciprofloxacin	174	≤ 0.015	0.03	1.1	85.6	10.9			1.7	0.6		0.6		0.6						
	Ampicillin	174	≤ 1	2	9.8							87.4	2.9					9.8			
	Azithromycin	174	4	4	2.3								4.0	87.4	6.3		2.3				
	Cefoxitin	174	2	4	6.3							3.4	79.9	9.8	0.6		2.9	3.4			
	Gentamicin	174	0.50	1	2.9						87.4	9.2	0.6				2.9				
II	Kanamycin	172	≤ 8	≤ 8	1.2										97.7	1.2		0.6	0.6		
	Nalidixic acid	174	4	4	1.7								39.7	56.9	0.6	1.1		1.7			
	Streptomycin	174	≤ 32	≤ 32	9.2										0.6		90.2	2.3	6.9		
	Trimethoprim-sulfamethoxazole	174	≤ 0.12	≤ 0.12	2.3				96.6	1.1				0.6	1.7						
	Chloramphenicol	174	8	8	6.3								0.6	42.5	50.6			6.3			
III	Sulfisoxazole	174	32	64	7.5											5.7	63.2	23.0	0.6		7.5
	Tetracycline	174	≤ 4	≤ 4	8.6									90.8	0.6			8.6			
IV																					

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

	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
	Amoxicillin-clavulanic acid	43	2	2	0.0							23.3	72.1	2.3		2.3					
I	Ceftiofur	43	1	1	0.0						9.3	86.0	4.7								
	Ceftriaxone	43	≤ 0.25	≤ 0.25	0.0					100.0											
	Ciprofloxacin	43	0.50	1	18.6	23.3	4.7				53.5	18.6									
	Ampicillin	43	2	4	2.3							18.6	65.1	11.6	2.3			2.3			
	Azithromycin	43	8	8	0.0								2.3	46.5	48.8	2.3					
	Cefoxitin	43	4	8	2.3							4.7	14.0	48.8	30.2		2.3				
	Gentamicin	43	≤ 0.25	0.50	0.0					72.1	23.3	4.7									
II	Kanamycin	43	≤ 8	≤ 8	0.0										100.0						
	Nalidixic acid	43	> 32	> 32	72.1								7.0	18.6	2.3			72.1			
	Streptomycin	43	≤ 32	≤ 32	2.3												97.7		2.3		
	Trimethoprim-sulfamethoxazole	43	≤ 0.12	0.25	4.7				81.4	9.3	4.7				4.7						
	Chloramphenicol	43	8	16	4.7									2.3	86.0	7.0	2.3	2.3			
III	Sulfisoxazole	43	32	64	7.0											7.0	53.5	30.2	2.3		7.0
	Tetracycline	43	≤ 4	8	7.0									88.4	4.7		2.3	4.7			
IV																					

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

	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
	Amoxicillin-clavulanic acid	131	≤ 1	4	0.0							89.3		1.5	8.4	0.8					
I	Ceftiofur	131	1	1	0.0					0.8	39.7	58.0	1.5								
	Ceftriaxone	131	≤ 0.25	≤ 0.25	0.0					96.9	3.1										
	Ciprofloxacin	131	0.25	2	17.6	19.1	1.5		6.1	33.6	22.1	6.9	1.5	0.8	8.4						
	Ampicillin	131	≤ 1	>32	10.7							86.3	3.1					10.7			
	Azithromycin	131	4	8	1.5								11.5	77.9	9.2		1.5				
	Cefoxitin	131	4	8	0.0							16.8	16.0	32.8	32.1	2.3					
	Gentamicin	131	0.5	0.5	0.0					37.4	61.8	0.8									
II	Kanamycin	124	≤ 8	≤ 8	0.0										100.0						
	Nalidixic acid	131	>32	>32	77.9								16.0	4.6	0.8	0.8	0.8	77.1			
	Streptomycin	129	≤ 32	64	10.1										0.8	2.3	86.8	0.8	9.3		
	Trimethoprim-sulfamethoxazole	131	≤ 0.12	>4	10.7				87.8	1.5					10.7						
	Chloramphenicol	131	8	16	9.2									28.2	61.1	1.5		9.2			
III	Sulfisoxazole	131	32	> 256	12.2											14.5	58.0	14.5	0.8		12.2
	Tetracycline	131	≤ 4	≤ 4	4.6									95.4				4.6			
IV																					

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

	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	384	≤ 1	16	1.8							71.9	4.2	0.8	8.3	13.0	0.3	1.6			
I	Ceftiofur	384	1	1	1.8						6.0	90.1	1.8	0.3		1.8					
I	Ceftriaxone	384	≤ 0.25	≤ 0.25	1.8					97.7	0.5				0.3	1.0	0.5				
I	Ciprofloxacin	384	≤ 0.015	0.03	1.6	74.5	19.8	1.6	0.3	1.3	1.0	1.6									
II	Ampicillin	384	≤ 1	>32	24.0							65.6	9.9	0.5			0.3	23.7			
II	Azithromycin	384	4	8	0.8								3.6	85.2	9.9	0.5	0.8				
II	Cefoxitin	384	2	4	1.3							4.4	78.4	13.3	2.3	0.3	0.5	0.8			
II	Gentamicin	384	0.5	1	1.0					2.9	79.7	14.8	1.3	0.3		0.5	0.5				
II	Kanamycin	373	≤ 8	≤ 8	6.7										92.2	0.8	0.3		6.7		
II	Nalidixic acid	384	4	4	2.3								26.3	67.2	2.3	1.8		2.3			
II	Streptomycin	383	≤ 32	>64	27.1											1.0	71.8	7.0	20.1		
II	Trimethoprim-sulfamethoxazole	384	≤ 0.12	0.25	3.9				76.8	17.2	1.8	0.3			3.9						
III	Chloramphenicol	384	8	> 32	19.8									12.5	66.1	1.6	0.3	19.5			
III	Sulfisoxazole	384	32	> 256	28.6											6.3	58.1	7.0			28.6
III	Tetracycline	384	≤ 4	> 32	26.0									73.2	0.8		11.7	14.3			
IV																					

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

	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	166	4	8	4.8							44.6	4.8	9.6	34.9	1.2		4.8			
I	Ceftiofur	166	1	1	6.0						8.4	83.1	2.4			6.0					
I	Ceftriaxone	166	≤ 0.25	≤ 0.25	6.0					92.2	1.8					4.2	0.6		1.2		
I	Ciprofloxacin	166	≤ 0.015	0.03	0.0	68.7	28.3			0.6	2.4										
II	Ampicillin	166	> 32	> 32	50.6							44.0	3.6	1.2		0.6		50.6			
II	Azithromycin	166	4	4	1.8								4.8	88.6	4.8		1.8				
II	Cefoxitin	166	2	4	4.8							3.6	81.9	7.8	1.8		0.6	4.2			
II	Gentamicin	166	0.50	1	2.4					1.2	79.5	16.3	0.6				2.4				
II	Kanamycin	166	≤ 8	≤ 8	7.2										92.8				7.2		
II	Nalidixic acid	166	4	4	1.8								19.9	76.5	1.8			1.8			
II	Streptomycin	166	≤ 32	> 64	47.0												53.0	1.2	45.8		
II	Trimethoprim-sulfamethoxazole	166	≤ 0.12	0.25	3.0				88.6	8.4					3.0						
III	Chloramphenicol	166	8	8	3.6									13.3	82.5	0.6		3.6			
III	Sulfisoxazole	166	64	> 256	47.6												44.0	8.4			47.6
III	Tetracycline	166	> 32	> 32	60.8									39.2				60.8			
IV																					

RETAIL MEAT SURVEILLANCE

KEY FINDINGS

BEEF

ESCHERICHIA COLI (n =286)

As in previous years, resistance levels of category I β-lactams (amoxicillin-clavulanic acid, ceftriaxone, and ceftiofur) remained low (< 4%) in beef *E. coli* isolates in 2013 with the exception of British Columbia where category I β-lactam resistance ranged between 6% (amoxicillin-clavulanic acid) and 9% (ceftriaxone and ceftiofur) (Table 9). One isolate (1%, 1/79) from Québec was resistant to all 7 classes of antimicrobials tested (Table 9) and had the ACSSuT-AZM-TIO-CRO-CIP-NAL-SXT resistance pattern.

CHICKEN

SALMONELLA (n = 264)

Across all provinces sampled, the top 3 chicken *Salmonella* serovars were *S.* Heidelberg, *S*. Kentucky, and *S*. Enteritidis as in previous years. Regional differences in serovar distribution were observed in 2013 with *S*. Enteritidis being the most common serovar in both British Columbia (46%, 15/33) and Saskatchewan (33%, 14/43) unlike Ontario and Québec where the most common serovar was *S*. Heidelberg (46%, 43/94 and 39%, 37/94 respectively) (Table 10). No *S*. Enteritidis was recovered in Ontario and only a single isolate (1%, 1/94) of *S*. Enteritidis was recovered in Québec.
All *S.* Enteritidis isolates were susceptible to all antimicrobials tested in 2013. No ciprofloxacin or nalidixic acid resistance was observed in 2013 (Table 10). Across all provinces[12] sampled, resistance levels of category I β-lactams (amoxicillin-clavulanic acid, ceftriaxone, and ceftiofur) (25%, 65/264) remained similar to levels in 2012 (26%, 80/307). Resistance to ceftiofur was significantly lower (22%, 21/94) in 2013 than 2004 (45%, 25/55) in Ontario (Figure 11). Resistance to ceftiofur was significantly higher (30%, 28/94) in 2013 than 2006 (5%, 4/77) in Québec (Figure 11). Resistance to gentamicin was significantly higher (6%, 6/94) in 2013 in Ontario compared to 2012 (0%; no resistance) (Figure 11).

[12] At the time this chapter was published, with the exception of *Salmonella*, all data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

ESCHERICHIA COLI (n = 358)

Ciprofloxacin resistance was observed in a single (1%, 1/117) chicken *E. coli* isolate in Québec (Table 11). Resistance levels of category I β-lactams (amoxicillin-clavulanic acid, ceftriaxone, and ceftiofur) remain similar to those in 2012 across all provinces[13] sampled. Resistance to ceftiofur was significantly higher (58%, 38/65) in 2013 than 2012 (40%, 33/82) and 2007 (29%, 12/42) in British Columbia (Figure 12). Resistance to ceftiofur was significantly higher (19%, 12/62) in 2013 than 2005 (4%, 3/81) in Saskatchewan (Figure 12). Resistance to ceftiofur was significantly higher (24%, 28/117) in 2013 than 2006 (6%, 8/135) in Québec (Figure 12). Resistance to gentamicin was significantly higher (19%, 12/62) in 2013 than 2005 (6%, 5/81) in Saskatchewan (Figure 12). Resistance to gentamicin was significantly higher (24%, 27/114) in 2013 than 2012 (12%, 13/107) and 2003 (7%, 9/136) in Ontario (Figure 12).

CAMPYLOBACTER (n = 220)

In 2013, ciprofloxacin resistance was significantly higher in British Columbia (26%, 15/57) compared to 2012 (8%, 6/73) and 2007 (4%, 1/28) (Figure 13). Ciprofloxacin resistance remains at a similar level in Saskatchewan (4%, 1/24) compared to 2012 (5%, 2/40) (Figure 13). In isolates from Ontario, ciprofloxacin resistance has decreased in 2013 (8%, 7/84) compared to 2012 (16%, 14/88) but this decline is not significant (Figure 13). Ciprofloxacin resistance remains at a low, similar level in Québec (4%, 2/54) compared to 2012 (3%, 2/79) (Figure 13). Telithromycin resistance was relatively low in *Campylobacter* isolates from Ontario (2%, 2/84) and Québec (2%, 1/54) in 2013 (Table 12); this is similar to levels in recent previous years.

PORK

ESCHERICHIA COLI (n = 221)

In 2013, category I β-lactam amoxicillin-clavulanic acid, ceftriaxone, and ceftiofur resistance levels in pork *E. coli* isolates remained at low (3%, 6/221), similar levels compared to 2012 (3%, 6/199) (Table 13 and Figure 14).

TURKEY

No temporal variation figures are presented as 2013 was only the second full year for retail ground turkey sampling.

SALMONELLA (n = 150)

The distribution of *Salmonella* serovars varies greatly by province in the second full year of retail surveillance of ground turkey (Table 14). No ciprofloxacin or nalidixic acid resistance was

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observed (Table 14). Category I β-lactam (amoxicillin-clavulanic acid, ceftriaxone, and ceftiofur) resistance levels in turkey *Salmonella* isolates were quite variable ranging from a low of 4% (1/27) in Saskatchewan to a high of 38% (11/29) in Ontario (Table 14).

ESCHERICHIA COLI (n = 352)

No ciprofloxacin or nalidixic acid resistance was observed in turkey *E. coli* isolates (Table 15). In 2013, resistance levels of category I β-lactams (amoxicillin-clavulanic acid, ceftriaxone, and ceftiofur) in turkey *E. coli* isolates ranged from 3% in Saskatchewan (2/59) and Ontario (4/119) to 7% in British Columbia (5/67) and Québec (7/107) (Table 15).

CAMPYLOBACTER (n = 76)

One isolate (4%, 2/20) from Ontario was resistant to telithromycin in 2013 (Table 16). Ciprofloxacin resistance was observed in 32% (9/28) of isolates from British Columbia, 20% (1/5) isolate from Saskatchewan and 13% (2/16) of isolates from Québec. No ciprofloxacin resistance was observed in turkey *Campylobacter* isolates in Ontario in 2013 (Table 16) which was similar to 2012.

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	47 (16.4)	34	5	5	3		3	1	6	6	3	4	3	4	8	1		1		1	10
Saskatchewan	54 (18.9)	38	9	5	2			1	6	4	2	1	1	1	5	1		1		1	13
Ontario	106 (37.1)	78	11	12	5		2		13	7	1	1	1	1	13	2		4			25
Québec	79 (27.6)	63	5	9	1	1		1	9	5		1		1	7	3	1	2	1	1	15
TOTAL	**286 (100)**	**213**	**30**	**31**	**11**	**1**	**5**	**3**	**34**	**22**	**6**	**7**	**5**	**7**	**33**	**7**	**1**	**8**	**1**	**3**	**63**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.
At the time this chapter was published, with the exception of *Salmonella*, all data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

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	15 (45.5)	15																			
Kentucky	8 (24.2)	1	1	6					6	6	6	6	5	6							7
Heidelberg	5 (15.2)	1	3	1						4	3	4	3	4							1
Agona	1 (3.0)			1						1		1			1						1
Cubana	1 (3.0)	1																			
4,5,12:i:-	1 (3.0)	1																			
Schwarzengrund	1 (3.0)	1																			
Typhimurium	1 (3.0)	1																			
Total	**33 (100)**	**21**	**4**	**8**					**6**	**11**	**9**	**11**	**8**	**10**	**1**						**9**
Saskatchewan																					
Enteritidis	14 (32.6)	14																			
Heidelberg	7 (16.3)	4	2	1				1	1	2	2	2	2	2							1
Infantis	6 (14.0)	5	1							1	1	1	1	1							
Kentucky	5 (11.6)		1	4					4	3	3	3	3	3							4
Schwarzengrund	5 (11.6)	5																			
Thompson	3 (7.0)	1	2						2												
Kiambu	1 (2.3)	1																			
Stanley	1 (2.3)	1																			
Typhimurium	1 (2.3)	1																			
Total	**43 (100)**	**32**	**6**	**5**				**1**	**7**	**6**	**6**	**6**	**6**	**6**							**5**
Ontario																					
Heidelberg	43 (45.7)	27	11	5			2		6	14	11	11	11	11	4						
Kentucky	30 (31.9)	7	2	21					21	6	6	6	5	6							22
Thompson	5 (5.3)	4	1							1	1	1	1	1							
Infantis	2 (2.1)		1		1		1		1	2	2	2	2	2	1			1			1
Livingstone	2 (2.1)			2					2						2						2
Schwarzengrund	2 (2.1)	1		1											1						1
Less common serovars	10 (10.6)	3	1	6			3	2	4	1	1	1	1	1	5						5
Total	**94 (100)**	**42**	**16**	**35**	**1**		**6**	**2**	**34**	**24**	**21**	**21**	**20**	**21**	**13**			**1**			**31**
Québec																					
Heidelberg	37 (39.4)	19	17	1			1	1	1	16	16	16	16	16	1						
Kentucky	24 (25.5)	3	2	19					19	6	6	6	6	6							21
Thompson	7 (7.4)	6		1			1		1						1						
Infantis	5 (5.3)	1	1		3		3		3	4	4	4	4	4	3			3			3
Hadar	4 (4.3)			4					4												4
Braenderup	2 (2.1)	1	1																		1
6,7:-:1,5	2 (2.1)	2																			
Typhimurium	2 (2.1)			2			1								2						2
Typhimurium var. 5-	2 (2.1)			2			1		1						2						2
Less common serovars	9 (9.6)	7	2							2	2	2	2	2							
Total	**94 (100)**	**39**	**23**	**29**	**3**		**7**	**1**	**29**	**28**	**28**	**28**	**28**	**28**	**9**			**3**			**33**
Maritimes																					
Heidelberg	24 (55.8)	11	11	2			2		2	12	10	10	10	10	2						
Kentucky	7 (16.3)	1	1	5					5	2	2	2	2	2							5
Thompson	4 (9.3)	3	1							1	1	1	1	1							
Ohio	2 (4.7)	2																			
Enteritidis	1 (2.3)	1																			
4,5,12:i:-	1 (2.3)	1																			
8,20:-:z6	1 (2.3)			1					1												1
Kiambu	1 (2.3)	1																			
Litchfield	1 (2.3)	1																			
Typhimurium var. 5-	1 (2.3)			1											1						1
Total	**43 (100)**	**21**	**13**	**9**			**2**		**8**	**15**	**13**	**13**	**13**	**13**	**3**						**7**
TOTAL	**307 (100)**	**155**	**62**	**86**	**4**		**15**	**4**	**84**	**84**	**77**	**79**	**75**	**78**	**26**			**4**			**85**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
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 Maritimes is a region including the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

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	65 (18.2)	9	18	23	14	1	5	3	26	48	40	39	40	38	24	7		7		2	32
Saskatchewan	62 (17.3)	21	9	25	7		12	4	20	21	13	13	12	12	19	2		4		5	27
Ontario	114 (31.8)	25	26	43	18	2	27	13	52	42	27	27	27	25	58	24		7		2	62
Québec	117 (32.7)	10	15	66	25	1	32	17	68	63	29	29	29	28	71	30	1	8	1	5	71
TOTAL	**358 (100)**	**65**	**68**	**157**	**64**	**4**	**76**	**37**	**166**	**174**	**109**	**108**	**108**	**103**	**172**	**63**	**1**	**26**	**1**	**14**	**192**

Antimicrobial abbreviations are defined in the *How To Read This Chapter*.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.
At the time this chapter was published, with the exception of *Salmonella*, all data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

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	48 (84.2)	28	11	9									9	9	20
Campylobacter spp.	5 (8.8)	2		3									3	3	3
Campylobacter coli	4 (7.0)	1	2	1									3	3	1
Total	**57 (100)**	**31**	**13**	**13**									**15**	**15**	**24**
Saskatchewan															
Campylobacter jejuni	22 (88.0)	9	13												13
Campylobacter coli	3 (12.0)		3										1	1	2
Total	**25 (100)**	**9**	**16**										**1**	**1**	**15**
Ontario															
Campylobacter jejuni	69 (82.1)	29	35	5				1	1	3	3		3	3	38
Campylobacter coli	10 (11.9)	4	2	3	1			1	4	5	5		2	2	1
Campylobacter spp.	5 (6.0)	2	2	1									2	2	2
Total	**84 (100)**	**35**	**39**	**9**	**1**			**2**	**5**	**8**	**8**		**7**	**7**	**41**
Québec															
Campylobacter jejuni	49 (90.7)	17	28	4						4	4		1	1	31
Campylobacter coli	3 (5.6)	1			2			1	2	2	2		1	1	2
Campylobacter spp.	2 (3.7)		2												2
Total	**54 (100)**	**18**	**30**	**4**	**2**			**1**	**2**	**6**	**6**		**2**	**2**	**35**
TOTAL	**220 (100)**	**93**	**98**	**26**	**3**			**3**	**7**	**14**	**14**		**25**	**25**	**115**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
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.
At the time this chapter was published, with the exception of *Salmonella*, all data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

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	38 (17.2)	26	5	6	1		1		4	4	3	3	3	3	5	1		2			9
Saskatchewan	29 (13.1)	16	6	6	1			2	3	4	1	1	1	1	3	2		1			11
Ontario	102 (46.2)	61	11	19	11		3	3	17	21	2	3	3	2	18	6		4		2	38
Québec	52 (23.5)	27	6	16	3			1	6	14					8	6		3		1	23
TOTAL	**221 (100)**	**130**	**28**	**47**	**16**		**4**	**6**	**30**	**43**	**6**	**7**	**7**	**6**	**34**	**15**		**10**		**3**	**81**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.
At the time this chapter was published, with the exception of *Salmonella*, all data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

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																					
Kentucky	6 (16.7)			6					6	5	5	5	4	5							6
Newport	6 (16.7)	5		1			1			1											1
Reading	5 (13.9)	5																			
Schwarzengrund	5 (13.9)	3		2					2						2						2
Enteritidis	4 (11.1)	4																			
Liverpool	4 (11.1)	4																			
Hadar	3 (8.3)			3			1		3						1						3
Anatum	1 (2.8)			1			1		1						1						1
Johannesburg	1 (2.8)	1																			
Mbandaka	1 (2.8)	1																			
Total	**36 (100)**	**23**		**13**			**3**		**12**	**6**	**5**	**5**	**4**	**5**	**4**						**13**
Saskatchewan																					
Schwarzengrund	7 (25.9)	7																			
Heidelberg	6 (22.2)	4		1	1		2	1	2	2	1	1	1	1	2						1
Reading	6 (22.2)	6																			
Anatum	1 (3.7)			1			1		1						1						1
Cubana	1 (3.7)	1																			
Derby	1 (3.7)			1					1						1						1
4,5,12:i:-	1 (3.7)				1				1	1					1						1
Meleagridis	1 (3.7)	1																			
Muenchen	1 (3.7)			1											1						1
Newport	1 (3.7)			1			1			1											1
Senftenberg	1 (3.7)			1			1			1											
Total	**27 (100)**	**19**		**6**	**2**		**5**	**1**	**5**	**5**	**1**	**1**	**1**	**1**	**6**						**6**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
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 14. Number of antimicrobial classes in resistance patterns of *Salmonella* from turkey (cont'd)

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
Ontario																					
Heidelberg	14 (48.3)	6	6	2			2		2	7	6	6	5	6	2						1
Agona	3 (10.3)		1	2						2	2	2	2	2	2						2
Indiana	3 (10.3)				3				3	3	3	3	3	3	3			3			3
Hadar	2 (6.9)			2					2	1											2
Muenchen	2 (6.9)	1		1					1						1						1
Enteritidis	1 (3.4)	1																			
4,5,12:i:-	1 (3.4)				1				1	1					1						1
Saintpaul	1 (3.4)	1																			
Senftenberg	1 (3.4)			1			1			1											
Thompson	1 (3.4)	1																			
Total	**29 (100)**	**10**	**7**	**8**	**4**		**3**		**9**	**15**	**11**	**11**	**10**	**11**	**9**			**3**			**10**
Québec																					
Heidelberg	20 (34.5)	13	4	3			3		3	5	4	4	4	4	2						1
Schwarzengrund	12 (20.7)	3		9			4	4	7	1	1	1	1	1	9						9
Agona	9 (15.5)		5	4						3	3	3	3	3	4						7
Worthington	3 (5.2)	2		1			1		1						1						1
Albany	2 (3.4)		2							2	2	2	2	2							
Hadar	2 (3.4)			2					2												2
Muenster	2 (3.4)	2																			
Saintpaul	2 (3.4)	2																			
Less common serovars	6 (10.3)	2	2	2			1		2						2	1					2
Total	**58 (100)**	**24**	**13**	**21**			**9**	**4**	**15**	**11**	**10**	**10**	**10**	**10**	**18**	**1**					**22**
Maritimes																					
Heidelberg	5 (27.8)	3	2							2	2	2	2	2							
Hadar	3 (16.7)			3					3	1											3
Orion var. 15+ 34+	2 (11.1)			2			2		2	2											2
Panama	2 (11.1)	2																			
Agona	1 (5.6)			1			1		1						1						
Albany	1 (5.6)		1				1														
Rough:f,g,s:-	1 (5.6)		1							1	1	1	1	1							
Kentucky	1 (5.6)			1					1												1
Saintpaul	1 (5.6)	1																			
Typhimurium var. 5-	1 (5.6)				1				1	1					1			1			1
Total	**18 (100)**	**6**	**4**	**7**	**1**		**4**		**8**	**7**	**3**	**3**	**3**	**3**	**2**			**1**			**7**
TOTAL	**97 (100)**	**43**	**23**	**30**	**1**		**15**	**4**	**25**	**25**	**19**	**19**	**18**	**19**	**22**	**1**		**1**			**30**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
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''.
At the time this chapter was published, with the exception of *Salmonella*, all data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

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	67 (18.9)	28	14	19	6		9	5	21	19	5	3	2	2	17	3		2		2	28
Saskatchewan	59 (16.6)	22	11	21	5		6	7	21	16	2	2	2	2	14	4				1	28
Ontario	119 (33.5)	32	31	40	16		13	15	36	30	4	3	4	3	37	11		3		1	78
Québec	107 (30.1)	30	18	48	11		16	11	38	34	6	7	6	6	42	10		3			69
TOTAL	**352 (100)**	**112**	**74**	**128**	**38**		**44**	**38**	**116**	**99**	**17**	**15**	**14**	**13**	**110**	**28**		**8**		**4**	**203**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.
At the time this chapter was published, with the exception of *Salmonella*, all data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

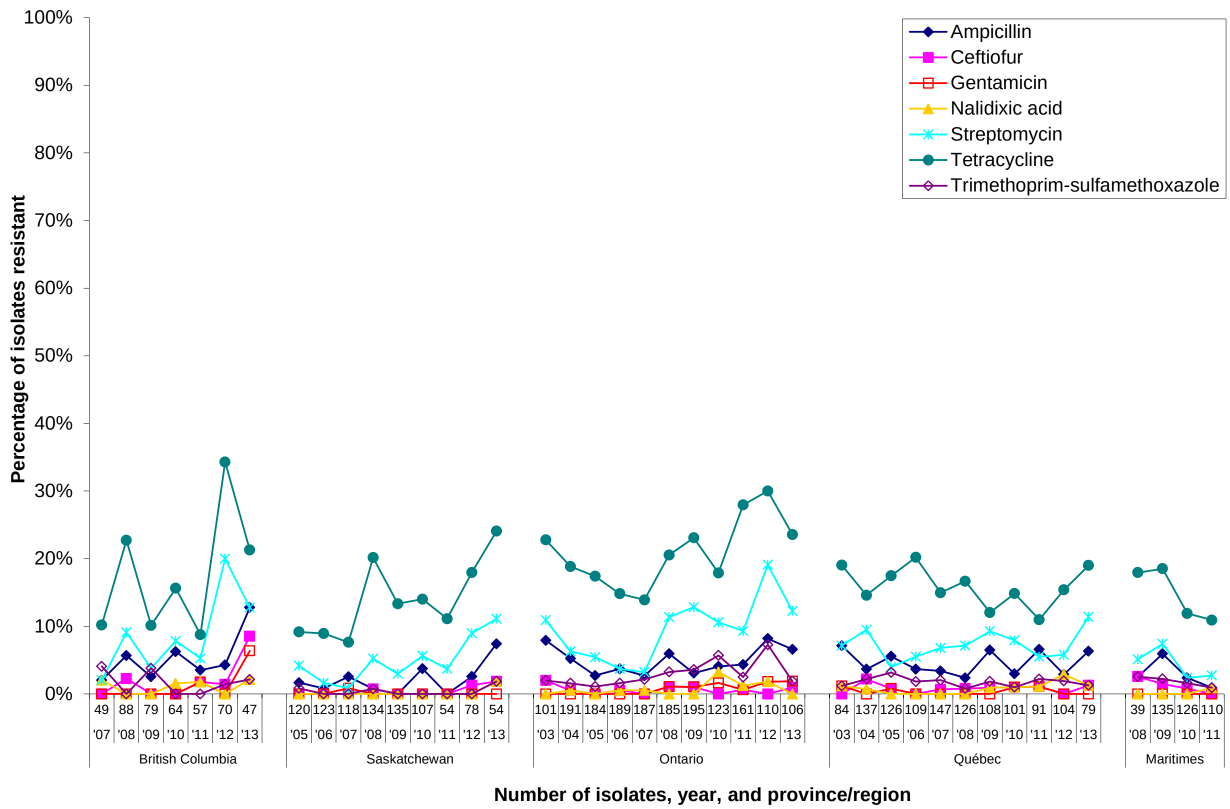
Table 16. Number of antimicrobial classes in resistance patterns of *Campylobacter* from turkey

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	19 (67.9)	12	6	1									3	3	5
Campylobacter coli	7 (25.0)	1	1	5									5	5	6
Campylobacter spp.	2 (7.1)	1		1									1	1	1
Total	**28 (100)**	**14**	**7**	**7**									**9**	**9**	**12**
Saskatchewan															
Campylobacter jejuni	5 (100)	1	3	1									1	1	4
Total	**5 (100)**	**1**	**3**	**1**									**1**	**1**	**4**
Ontario															
Campylobacter jejuni	19 (70.4)	6	13												13
Campylobacter coli	7 (25.9)	2	4	1				1	1	1	1				4
Campylobacter spp.	1 (3.7)		1												1
Total	**27 (100)**	**8**	**18**	**1**				**1**	**1**	**1**	**1**				**18**
Québec															
Campylobacter jejuni	12 (75.0)	3	8	1									1	1	9
Campylobacter coli	4 (25.0)	3	1										1	1	
Total	**16 (100)**	**6**	**9**	**1**									**2**	**2**	**9**
TOTAL	**29 (100)**	**8**	**14**	**7**									**8**	**8**	**20**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
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.
At the time this chapter was published, with the exception of *Salmonella*, all data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

TEMPORAL ANTIMICROBIAL RESISTANCE SUMMARY

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



Province / region	British Columbia							Saskatchewan								
Year	'07	'08	'09	'10	'11	'12	'13	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	49	88	79	64	57	70	47	120	123	118	134	135	107	54	78	54
Antimicrobial																
Ampicillin	2%	6%	3%	6%	4%	4%	13%	2%	1%	3%	1%	0%	4%	0%	3%	7%
Ceftiofur	0%	2%	0%	0%	2%	1%	9%	0%	0%	0%	1%	0%	0%	0%	1%	2%
Gentamicin	0%	0%	0%	0%	2%	0%	6%	0%	0%	1%	0%	0%	0%	0%	0%	0%
Nalidixic acid	2%	0%	0%	2%	2%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	2%
Streptomycin	2%	9%	4%	8%	5%	20%	13%	4%	2%	1%	5%	3%	6%	4%	9%	11%
Tetracycline	10%	23%	10%	16%	9%	34%	21%	9%	9%	8%	20%	13%	14%	11%	18%	24%
Trimethoprim-sulfamethoxazole	4%	0%	4%	0%	0%	1%	2%	1%	0%	0%	1%	0%	0%	0%	0%	2%

Province / region	Ontario										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	101	191	184	189	187	185	195	123	161	110	106
Antimicrobial											
Ampicillin	8%	5%	3%	4%	3%	6%	3%	4%	4%	8%	7%
Ceftiofur	2%	1%	0%	1%	0%	1%	1%	0%	1%	0%	1%
Gentamicin	0%	0%	0%	0%	0%	1%	1%	2%	1%	2%	2%
Nalidixic acid	0%	1%	0%	1%	1%	0%	0%	3%	1%	2%	0%
Streptomycin	11%	6%	5%	4%	3%	11%	13%	11%	9%	19%	12%
Tetracycline	23%	19%	17%	15%	14%	21%	23%	18%	28%	30%	24%
Trimethoprim-sulfamethoxazole	2%	2%	1%	2%	2%	3%	4%	6%	2%	7%	2%

Province / region	Québec											Maritimes			
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'08	'09	'10	'11
Number of isolates	84	137	126	109	147	126	108	101	91	104	79	39	135	126	110
Antimicrobial															
Ampicillin	7%	4%	6%	4%	3%	2%	6%	3%	7%	3%	6%	3%	6%	2%	1%
Ceftiofur	0%	2%	1%	0%	1%	1%	1%	1%	1%	0%	1%	3%	1%	1%	0%
Gentamicin	1%	0%	1%	0%	0%	0%	0%	1%	1%	0%	0%	0%	0%	0%	0%
Nalidixic acid	1%	1%	0%	0%	0%	0%	1%	1%	1%	3%	1%	0%	0%	0%	1%
Streptomycin	7%	9%	4%	6%	7%	7%	9%	8%	5%	6%	11%	5%	7%	2%	3%
Tetracycline	19%	15%	17%	20%	15%	17%	12%	15%	11%	15%	19%	18%	19%	12%	11%
Trimethoprim-sulfamethoxazole	1%	2%	3%	2%	2%	1%	2%	1%	2%	2%	1%	3%	2%	2%	1%

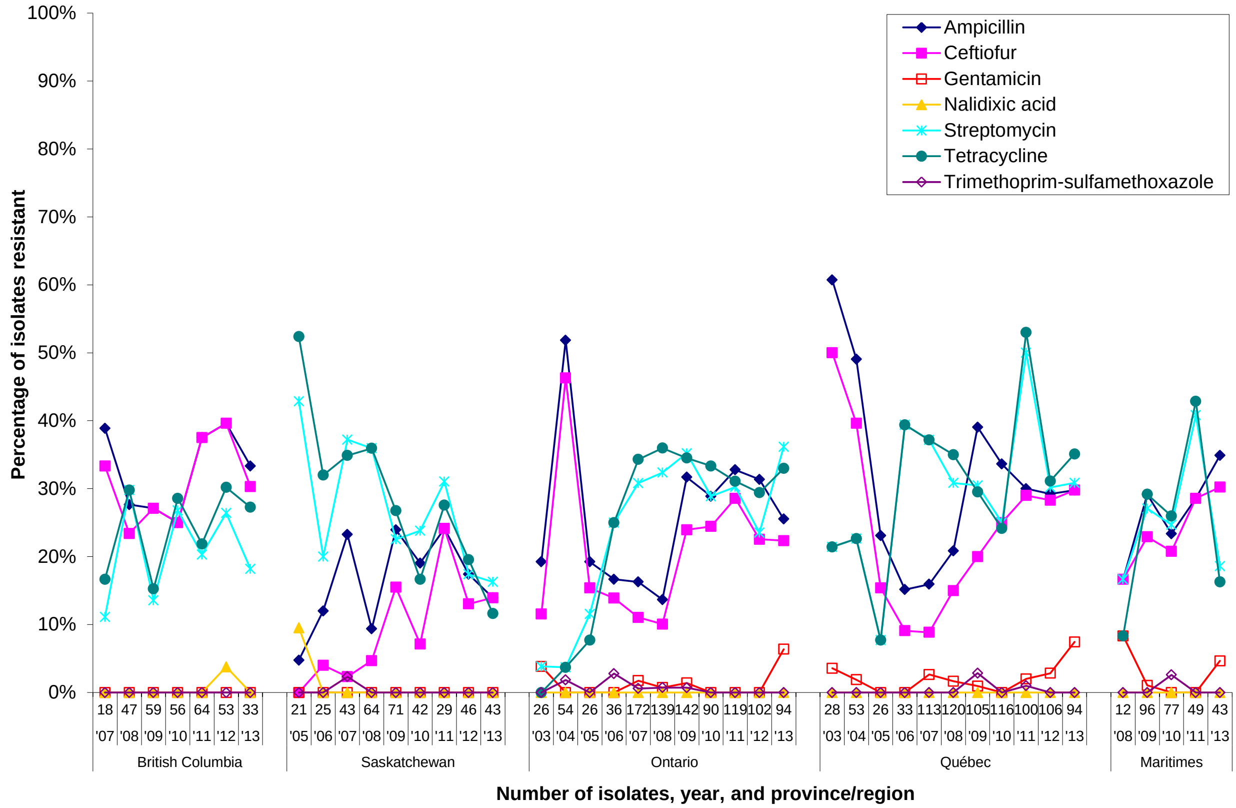
For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence of blue areas indicates 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.

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

At the time this chapter was published, with the exception of *Salmonella*, all data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

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



Province / region	British Columbia						
Year	'07	'08	'09	'10	'11	'12	'13
Number of isolates	18	47	59	56	64	53	33
Antimicrobial							
Ampicillin	**39%**	28%	27%	25%	38%	**40%**	**33%**
Ceftiofur	**33%**	23%	27%	25%	38%	**40%**	**30%**
Gentamicin	**0%**	0%	0%	0%	0%	**0%**	**0%**
Nalidixic acid	**0%**	0%	0%	0%	0%	**4%**	**0%**
Streptomycin	**11%**	30%	14%	27%	20%	**26%**	**18%**
Tetracycline	**17%**	30%	15%	29%	22%	**30%**	**27%**
Trimethoprim-sulfamethoxazole	**0%**	0%	0%	0%	0%	**0%**	**0%**

Province / region	Saskatchewan								
Year	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	21	25	43	64	71	42	29	46	43
Antimicrobial									
Ampicillin	**5%**	12%	23%	9%	24%	19%	24%	**17%**	**14%**
Ceftiofur	**0%**	4%	2%	5%	15%	7%	24%	**13%**	**14%**
Gentamicin	**0%**	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Nalidixic acid	**10%**	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Streptomycin	**43%**	20%	37%	36%	23%	24%	31%	**17%**	**16%**
Tetracycline	**52%**	32%	35%	36%	27%	17%	28%	**20%**	**12%**
Trimethoprim-sulfamethoxazole	**0%**	0%	2%	0%	0%	0%	0%	**0%**	**0%**

Province / region	Ontario										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	26	54	26	36	172	139	142	90	119	102	94
Antimicrobial											
Ampicillin	**19%**	**52%**	19%	**17%**	16%	14%	32%	29%	33%	**31%**	**26%**
Ceftiofur	**12%**	**46%**	15%	**14%**	11%	10%	24%	24%	29%	**23%**	**22%**
Gentamicin	**4%**	0%	0%	0%	2%	1%	1%	0%	0%	**0%**	**6%**
Nalidixic acid	**0%**	0%	0%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Streptomycin	**4%**	4%	12%	25%	31%	32%	35%	29%	30%	**24%**	**36%**
Tetracycline	**0%**	4%	8%	25%	34%	36%	35%	33%	31%	**29%**	**33%**
Trimethoprim-sulfamethoxazole	**0%**	2%	0%	3%	1%	1%	1%	0%	0%	**0%**	**0%**

Province / region	Québec										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	28	53	26	33	113	120	105	116	100	106	94
Antimicrobial											
Ampicillin	**61%**	**49%**	23%	**15%**	16%	21%	39%	34%	30%	**29%**	**30%**
Ceftiofur	**50%**	**40%**	15%	**9%**	9%	15%	20%	25%	29%	**28%**	**30%**
Gentamicin	**4%**	2%	0%	0%	3%	2%	1%	0%	2%	**3%**	**7%**
Nalidixic acid	**0%**	0%	0%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Streptomycin	**21%**	23%	8%	39%	37%	31%	30%	25%	50%	**30%**	**31%**
Tetracycline	**21%**	23%	8%	39%	37%	35%	30%	24%	53%	**31%**	**35%**
Trimethoprim-sulfamethoxazole	**0%**	0%	0%	0%	0%	0%	3%	0%	1%	**0%**	**0%**

Province / region	Maritimes				
Year	'08	'09	'10	'11	'13
Number of isolates	12	96	77	49	43
Antimicrobial					
Ampicillin	17%	**29%**	23%	**29%**	**35%**
Ceftiofur	17%	**23%**	21%	**29%**	**30%**
Gentamicin	8%	**1%**	0%	**0%**	**5%**
Nalidixic acid	0%	**0%**	0%	**0%**	**0%**
Streptomycin	17%	**27%**	25%	**41%**	**19%**
Tetracycline	8%	**29%**	26%	**43%**	**16%**
Trimethoprim-sulfamethoxazole	0%	**0%**	3%	**0%**	**0%**

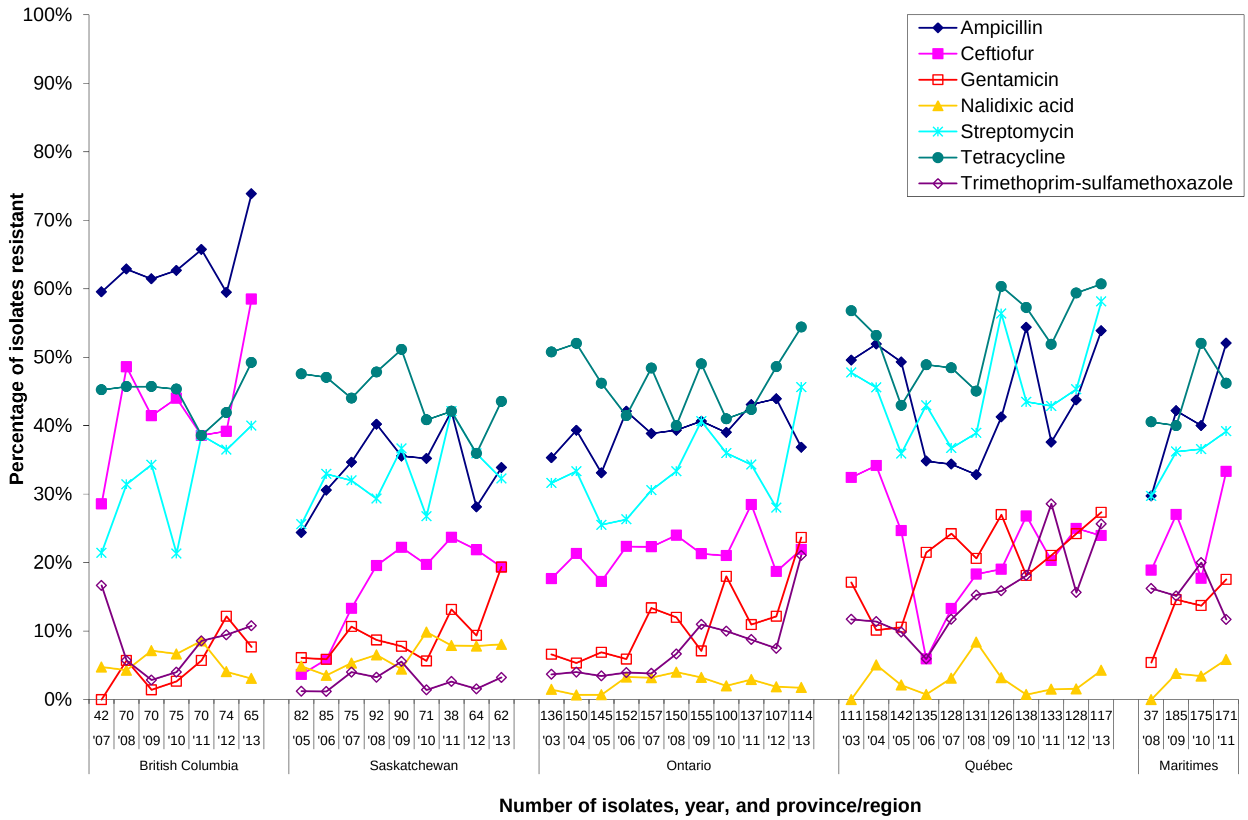
For the temporal analyses by province/region, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the first and the previous surveillance year (grey areas). The presence 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..

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 / region	British Columbia							Saskatchewan								
Year	'07	'08	'09	'10	'11	'12	'13	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	42	70	70	75	70	74	65	82	85	75	92	90	71	38	64	62
Antimicrobial																
Ampicillin	60%	63%	61%	63%	66%	59%	74%	24%	31%	35%	40%	36%	35%	42%	28%	34%
Ceftiofur	29%	49%	41%	44%	39%	39%	58%	4%	6%	13%	20%	22%	20%	24%	22%	19%
Gentamicin	0%	6%	1%	3%	6%	12%	8%	6%	6%	11%	9%	8%	6%	13%	9%	19%
Nalidixic acid	5%	4%	7%	7%	9%	4%	3%	5%	4%	5%	7%	4%	10%	8%	8%	8%
Streptomycin	21%	31%	34%	21%	39%	36%	40%	26%	33%	32%	29%	37%	27%	42%	36%	32%
Tetracycline	45%	46%	46%	45%	39%	42%	49%	48%	47%	44%	48%	51%	41%	42%	36%	44%
Trimethoprim-sulfamethoxazole	17%	6%	3%	4%	9%	9%	11%	1%	1%	4%	3%	6%	1%	3%	2%	3%

Province / region	Ontario										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	136	150	145	152	157	150	155	100	137	107	114
Antimicrobial											
Ampicillin	35%	39%	33%	42%	39%	39%	41%	39%	43%	44%	37%
Ceftiofur	18%	21%	17%	22%	22%	24%	21%	21%	28%	19%	22%
Gentamicin	7%	5%	7%	6%	13%	12%	7%	18%	11%	12%	24%
Nalidixic acid	1%	1%	1%	3%	3%	4%	3%	2%	3%	2%	2%
Streptomycin	32%	33%	26%	26%	31%	33%	41%	36%	34%	28%	46%
Tetracycline	51%	52%	46%	41%	48%	40%	49%	41%	42%	49%	54%
Trimethoprim-sulfamethoxazole	4%	4%	3%	4%	4%	7%	11%	10%	9%	7%	21%

Province / region	Québec											Maritimes			
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'08	'09	'10	'11
Number of isolates	111	158	142	135	128	131	126	138	133	128	117	37	185	175	171
Antimicrobial															
Ampicillin	50%	52%	49%	35%	34%	33%	41%	54%	38%	44%	54%	30%	42%	40%	52%
Ceftiofur	32%	34%	25%	6%	13%	18%	19%	27%	20%	25%	24%	19%	27%	18%	33%
Gentamicin	17%	10%	11%	21%	24%	21%	27%	18%	21%	24%	27%	5%	15%	14%	18%
Nalidixic acid	0%	5%	2%	1%	3%	8%	3%	1%	2%	2%	4%	0%	4%	3%	6%
Streptomycin	48%	46%	36%	43%	37%	39%	56%	43%	43%	45%	58%	30%	36%	37%	39%
Tetracycline	57%	53%	43%	49%	48%	45%	60%	57%	52%	59%	61%	41%	40%	52%	46%
Trimethoprim-sulfamethoxazole	12%	11%	10%	6%	12%	15%	16%	18%	29%	16%	26%	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.

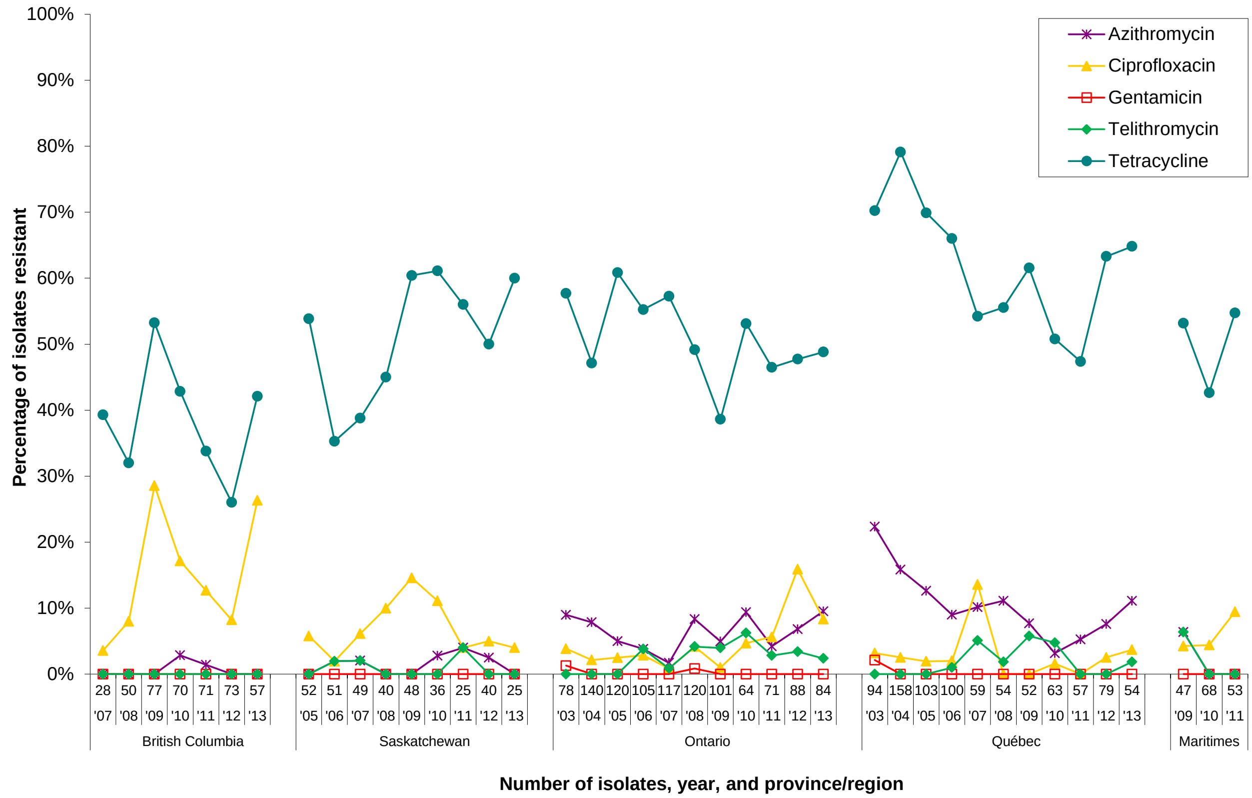
Additional temporal analyses for ampicillin and ceftiofur were conducted for *E. coli* isolates from Ontario and Québec. These two antimicrobials, provinces, and years (2004 and 2006) were selected due to a change in ceftiofur use practices by Québec chicken hatcheries in early 2005 and in 2007 (start 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.

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

At the time this chapter was published, with the exception of *Salmonella*, all data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

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



Province / region	British Columbia						
Year	'07	'08	'09	'10	'11	'12	'13
Number of isolates	28	50	77	70	71	73	57
Antimicrobial							
Azithromycin	0%	0%	0%	3%	1%	0%	0%
Ciprofloxacin	4%	8%	29%	17%	13%	8%	26%
Gentamicin	0%	0%	0%	0%	0%	0%	0%
Telithromycin	0%	0%	0%	0%	0%	0%	0%
Tetracycline	39%	32%	53%	43%	34%	26%	42%

Province / region	Saskatchewan								
Year	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	52	51	49	40	48	36	25	40	25
Antimicrobial									
Azithromycin	0%	2%	2%	0%	0%	3%	4%	3%	0%
Ciprofloxacin	6%	2%	6%	10%	15%	11%	4%	5%	4%
Gentamicin	0%	0%	0%	0%	0%	0%	0%	0%	0%
Telithromycin	0%	2%	2%	0%	0%	0%	4%	0%	0%
Tetracycline	54%	35%	39%	45%	60%	61%	56%	50%	60%

Province / region	Ontario										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	78	140	120	105	117	120	101	64	71	88	84
Antimicrobial											
Azithromycin	9%	8%	5%	4%	2%	8%	5%	9%	4%	7%	10%
Ciprofloxacin	4%	2%	3%	3%	1%	4%	1%	5%	6%	16%	8%
Gentamicin	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%
Telithromycin	0%	0%	0%	4%	1%	4%	4%	6%	3%	3%	2%
Tetracycline	58%	47%	61%	55%	57%	49%	39%	53%	46%	48%	49%

Province / region	Québec										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	94	158	103	100	59	54	52	63	57	79	54
Antimicrobial											
Azithromycin	22%	16%	13%	9%	10%	11%	8%	3%	5%	8%	11%
Ciprofloxacin	3%	3%	2%	2%	14%	0%	0%	2%	0%	3%	4%
Gentamicin	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Telithromycin	0%	0%	0%	1%	5%	2%	6%	5%	0%	0%	2%
Tetracycline	70%	79%	70%	66%	54%	56%	62%	51%	47%	63%	65%

Province / region	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.

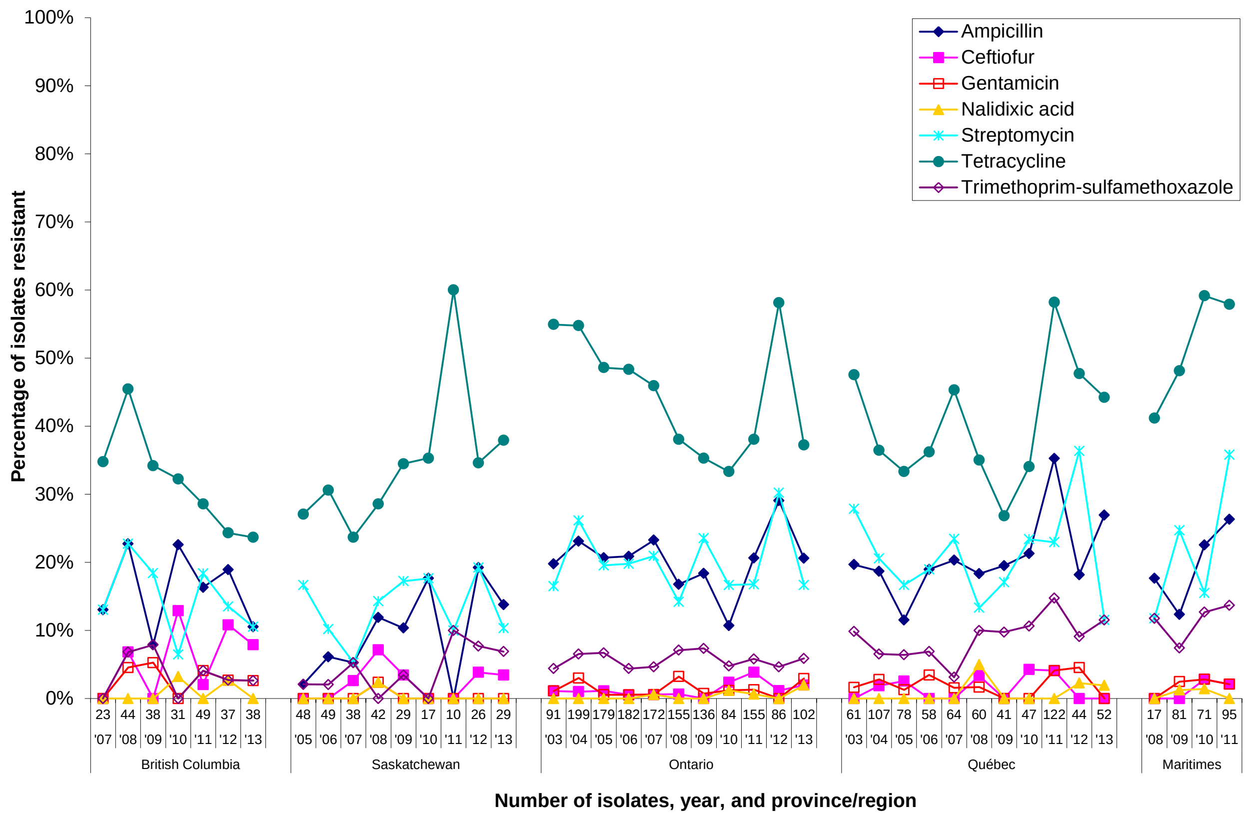
Due to unforeseen and lengthy delays in retail sampling in the Maritimes in 2012, data are not presented for this year in the interest of precision. Data for this region will be presented again in 2013.

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.

At the time this chapter was published, with the exception of *Salmonella*, all data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

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



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

Province / region	Saskatchewan								
Year	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	48	49	38	42	29	17	10	26	29
Antimicrobial									
Ampicillin	**2%**	6%	5%	12%	10%	18%	0%	**19%**	**14%**
Ceftiofur	**0%**	0%	3%	7%	3%	0%	0%	**4%**	**3%**
Gentamicin	**0%**	0%	0%	2%	0%	0%	0%	**0%**	**0%**
Nalidixic acid	**0%**	0%	0%	2%	0%	0%	0%	**0%**	**0%**
Streptomycin	**17%**	10%	5%	14%	17%	18%	10%	**19%**	**10%**
Tetracycline	**27%**	31%	24%	29%	34%	35%	60%	**35%**	**38%**
Trimethoprim-sulfamethoxazole	**2%**	2%	5%	0%	3%	0%	10%	**8%**	**7%**

Province / region	Ontario										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	91	199	179	182	172	155	136	84	155	86	102
Antimicrobial											
Ampicillin	**20%**	23%	21%	21%	23%	17%	18%	11%	21%	**29%**	**21%**
Ceftiofur	**1%**	1%	1%	1%	1%	1%	0%	2%	4%	**1%**	**2%**
Gentamicin	**1%**	3%	1%	1%	1%	3%	1%	1%	1%	**0%**	**3%**
Nalidixic acid	**0%**	0%	0%	0%	1%	0%	0%	1%	1%	**0%**	**2%**
Streptomycin	**16%**	26%	20%	20%	21%	14%	24%	17%	17%	**30%**	**17%**
Tetracycline	**55%**	55%	49%	48%	46%	38%	35%	33%	38%	**58%**	**37%**
Trimethoprim-sulfamethoxazole	**4%**	7%	7%	4%	5%	7%	7%	5%	6%	**5%**	**6%**

Province / region	Québec										
Year	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13
Number of isolates	61	107	78	58	64	60	41	47	122	44	52
Antimicrobial											
Ampicillin	**20%**	19%	12%	19%	20%	18%	20%	21%	35%	**18%**	**27%**
Ceftiofur	**0%**	2%	3%	0%	0%	3%	0%	4%	4%	**0%**	**0%**
Gentamicin	**2%**	3%	1%	3%	2%	2%	0%	0%	4%	**5%**	**0%**
Nalidixic acid	**0%**	0%	0%	0%	0%	5%	0%	0%	0%	**2%**	**2%**
Streptomycin	**28%**	21%	17%	19%	23%	13%	17%	23%	23%	**36%**	**12%**
Tetracycline	**48%**	36%	33%	36%	45%	35%	27%	34%	58%	**48%**	**44%**
Trimethoprim-sulfamethoxazole	**10%**	7%	6%	7%	3%	10%	10%	11%	15%	**9%**	**12%**

Province / region	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.

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

At the time this chapter was published, with the exception of *Salmonella*, all data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

MINIMUM INHIBITORY CONCENTRATIONS

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

	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	47	4	8	6.4							4.3	6.4	72.3	10.6		4.3	2.1			
		Saskatchewan	54	4	8	3.7								18.5	66.7	11.1			3.7			
		Ontario	106	4	8	0.9							3.8	18.9	61.3	14.2	0.9		0.9			
		Québec	79	4	8	0.0							2.5	29.1	55.7	11.4	1.3					
	Ceftiofur	British Columbia	47	0.50	1	8.5				6.4	27.7	55.3	2.1			6.4	2.1					
		Saskatchewan	54	0.50	0.50	1.9				1.9	37.0	57.4	1.9			1.9						
		Ontario	106	0.50	0.50	0.9				7.5	20.8	68.9	1.9				0.9					
I		Québec	79	0.50	0.50	1.3				5.1	44.3	48.1		1.3			1.3					
	Ceftriaxone	British Columbia	47	≤ 0.25	0.50	8.5					89.4	2.1				4.3	2.1	2.1				
		Saskatchewan	54	≤ 0.25	≤ 0.25	1.9					96.3		1.9				1.9					
		Ontario	106	≤ 0.25	≤ 0.25	0.9					99.1						0.9					
		Québec	79	≤ 0.25	≤ 0.25	1.3					98.7								1.3			
	Ciprofloxacin	British Columbia	47	≤ 0.015	≤ 0.015	0.0	97.9				2.1											
		Saskatchewan	54	≤ 0.015	≤ 0.015	0.0	90.7	7.4		1.9												
		Ontario	106	≤ 0.015	≤ 0.015	0.0	95.3	4.7														
		Québec	79	≤ 0.015	≤ 0.015	1.3	96.2	2.5								1.3						
	Ampicillin	British Columbia	47	4	> 32	12.8							4.3	42.6	40.4				12.8			
		Saskatchewan	54	4	4	7.4							1.9	46.3	44.4			1.9	5.6			
		Ontario	106	4	4	6.6							15.1	33.0	44.3	0.9			6.6			
		Québec	79	2	8	6.3							8.9	41.8	39.2	3.8			6.3			
	Azithromycin	British Columbia	47	4	8	0.0								10.6	76.6	12.8						
		Saskatchewan	54	4	8	0.0								7.4	74.1	18.5						
		Ontario	106	4	8	0.0							0.9	19.8	68.9	10.4						
		Québec	79	4	8	1.3							2.5	21.5	60.8	12.7	1.3	1.3				
	Cefoxitin	British Columbia	47	4	8	6.4								27.7	51.1	14.9		2.1	4.3			
		Saskatchewan	54	4	8	1.9								14.8	64.8	16.7	1.9		1.9			
		Ontario	106	4	8	0.9							0.9	18.9	61.3	17.0	0.9		0.9			
		Québec	79	4	4	0.0							2.5	25.3	63.3	7.6	1.3					
	Gentamicin	British Columbia	47	0.50	1	6.4						70.2	21.3	2.1			2.1	4.3				
		Saskatchewan	54	0.50	1	0.0					1.9	50.0	44.4	1.9	1.9							
		Ontario	106	0.50	1	1.9					1.9	63.2	30.2	2.8			0.9	0.9				
		Québec	79	0.50	1	0.0						58.2	38.0	3.8								
II	Kanamycin	British Columbia	47	≤ 8	≤ 8	2.1										97.9				2.1		
		Saskatchewan	54	≤ 8	≤ 8	1.9										98.1				1.9		
		Ontario	106	≤ 8	≤ 8	0.0										98.1	1.9					
		Québec	79	≤ 8	≤ 8	1.3										98.7				1.3		
	Nalidixic acid	British Columbia	47	2	4	2.1							6.4	80.9	10.6				2.1			
		Saskatchewan	54	2	4	1.9							7.4	77.8	13.0			1.9				
		Ontario	106	2	4	0.0							13.2	73.6	13.2							
		Québec	79	2	4	1.3							10.1	78.5	7.6	2.5			1.3			
	Streptomycin	British Columbia	47	≤ 32	> 64	12.8												87.2	2.1	10.6		
		Saskatchewan	54	≤ 32	64	11.1												88.9	1.9	9.3		
		Ontario	106	≤ 32	64	12.3												87.7	4.7	7.5		
		Québec	79	≤ 32	64	11.4												88.6	5.1	6.3		
	Trimethoprim-sulfamethoxazole	British Columbia	47	≤ 0.12	≤ 0.12	2.1				91.5	6.4					2.1						
		Saskatchewan	54	≤ 0.12	≤ 0.12	1.9				96.3	1.9					1.9						
		Ontario	106	≤ 0.12	≤ 0.12	1.9				95.3	2.8					1.9						
		Québec	79	≤ 0.12	≤ 0.12	1.3				98.7						1.3						
	Chloramphenicol	British Columbia	47	8	8	2.1									29.8	68.1			2.1			
		Saskatchewan	54	8	8	1.9									38.9	51.9	7.4		1.9			
		Ontario	106	8	8	3.8								1.9	43.4	48.1	2.8		3.8			
		Québec	79	4	8	2.5								2.5	53.2	36.7	5.1		2.5			
	Sulfisoxazole	British Columbia	47	≤ 16	> 256	17.0											76.6	6.4				17.0
		Saskatchewan	54	≤ 16	32	9.3											74.1	16.7				9.3
III		Ontario	106	≤ 16	> 256	12.3											67.9	19.8				12.3
		Québec	79	≤ 16	32	8.9											74.7	16.5				8.9
	Tetracycline	British Columbia	47	≤ 4	> 32	21.3									72.3	6.4			21.3			
		Saskatchewan	54	≤ 4	> 32	24.1									75.9		3.7	1.9	18.5			
		Ontario	106	≤ 4	> 32	23.6									76.4		1.9	3.8	17.9			
		Québec	79	≤ 4	> 32	19.0									78.5	2.5			19.0			
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
	Amoxicillin-clavulanic acid	British Columbia	33	≤ 1	> 32	27.3							66.7		3.0	3.0		12.1	15.2			
		Saskatchewan	43	≤ 1	> 32	14.0							83.7	2.3					14.0			
		Ontario	94	≤ 1	> 32	22.3							73.4	1.1		3.2		6.4	16.0			
		Québec	94	≤ 1	> 32	29.8							70.2					9.6	20.2			
		Maritimes	43	≤ 1	> 32	30.2							65.1				4.7	2.3	27.9			
	Ceftiofur	British Columbia	33	1	> 8	30.3						6.1	60.6		3.0	3.0	27.3					
		Saskatchewan	43	1	> 8	14.0						20.9	65.1				14.0					
		Ontario	94	1	> 8	22.3						35.1	41.5	1.1			22.3					
I		Québec	94	1	> 8	29.8					1.1	33.0	35.1	1.1			29.8					
		Maritimes	43	1	> 8	30.2						25.6	44.2				30.2					
	Ceftriaxone	British Columbia	33	≤ 0.25	16	33.3					66.7				6.1	3.0	18.2	6.1				
		Saskatchewan	43	≤ 0.25	8	14.0					86.0					4.7	4.7	2.3	2.3			
		Ontario	94	≤ 0.25	16	22.3					77.7					4.3	9.6	8.5				
		Québec	94	≤ 0.25	16	29.8					70.2					3.2	20.2	6.4				
		Maritimes	43	≤ 0.25	16	30.2					69.8						27.9	2.3				
	Ciprofloxacin	British Columbia	33	≤ 0.015	0.03	0.0	78.8	21.2														
		Saskatchewan	43	≤ 0.015	0.03	0.0	88.4	11.6														
		Ontario	94	≤ 0.015	≤ 0.015	0.0	90.4	9.6														
		Québec	94	≤ 0.015	0.03	0.0	87.2	12.8														
		Maritimes	43	≤ 0.015	≤ 0.015	0.0	100.0															
	Ampicillin	British Columbia	33	≤ 1	> 32	33.3							60.6	6.1					33.3			
		Saskatchewan	43	≤ 1	> 32	14.0							79.1	7.0					14.0			
		Ontario	94	≤ 1	> 32	25.5							70.2	4.3					25.5			
		Québec	94	≤ 1	> 32	29.8							68.1	2.1					29.8			
		Maritimes	43	≤ 1	> 32	34.9							62.8	2.3					34.9			
	Azithromycin	British Columbia	33	4	4	0.0								15.2	81.8	3.0						
		Saskatchewan	43	4	8	0.0								4.7	79.1	16.3						
		Ontario	94	4	8	0.0								12.8	73.4	12.8	1.1					
		Québec	94	4	4	0.0							1.1	12.8	80.9	5.3						
		Maritimes	43	4	8	0.0								2.3	83.7	11.6	2.3					
	Cefoxitin	British Columbia	33	2	32	24.2							12.1	51.5	9.1		3.0	18.2	6.1			
		Saskatchewan	43	2	32	14.0							11.6	65.1	9.3			7.0	7.0			
		Ontario	94	2	32	21.3							27.7	44.7	4.3	1.1	1.1	14.9	6.4			
		Québec	94	2	32	29.8							25.5	36.2	7.4	1.1		23.4	6.4			
		Maritimes	43	2	32	30.2							32.6	30.2	7.0			23.3	7.0			
	Gentamicin	British Columbia	33	0.50	1	0.0					27.3	60.6	6.1	3.0	3.0							
		Saskatchewan	43	0.50	0.50	0.0					37.2	53.5	4.7	4.7								
		Ontario	94	0.50	1	6.4					29.8	57.4	6.4				1.1	5.3				
		Québec	94	0.50	1	7.4					25.5	56.4	8.5	1.1		1.1	2.1	5.3				
II		Maritimes	43	0.50	1	4.7					4.7	76.7	14.0					4.7				
	Kanamycin	British Columbia	33	≤ 8	≤ 8	0.0										100.0						
		Saskatchewan	43	≤ 8	≤ 8	2.3										97.7				2.3		
		Ontario	94	≤ 8	≤ 8	2.1										95.7	2.1		1.1	1.1		
		Québec	94	≤ 8	≤ 8	1.1										98.9				1.1		
		Maritimes	43	≤ 8	≤ 8	0.0										100.0						
	Nalidixic acid	British Columbia	33	4	8	0.0								27.3	57.6	15.2						
		Saskatchewan	43	4	4	0.0								23.3	74.4	2.3						
		Ontario	94	4	4	0.0							1.1	36.2	60.6	2.1						
		Québec	94	4	4	0.0							1.1	41.5	56.4	1.1						
		Maritimes	43	4	4	0.0								25.6	72.1	2.3						
	Streptomycin	British Columbia	33	≤ 32	> 64	18.2												81.8	3.0	15.2		
		Saskatchewan	43	≤ 32	64	16.3												83.7	7.0	9.3		
		Ontario	94	≤ 32	> 64	36.2												63.8	17.0	19.1		
		Québec	94	≤ 32	> 64	30.9												69.1	11.7	19.1		
		Maritimes	43	≤ 32	64	18.6												81.4	16.3	2.3		
	Trimethoprim-sulfamethoxazole	British Columbia	33	≤ 0.12	≤ 0.12	0.0				100.0												
		Saskatchewan	43	≤ 0.12	≤ 0.12	0.0				100.0												
		Ontario	94	≤ 0.12	≤ 0.12	0.0				94.7	5.3											
		Québec	94	≤ 0.12	≤ 0.12	0.0				96.8	3.2											
		Maritimes	43	≤ 0.12	≤ 0.12	0.0				100.0												
	Chloramphenicol	British Columbia	33	8	8	0.0									39.4	60.6						
		Saskatchewan	43	8	8	0.0									30.2	69.8						
		Ontario	94	8	8	1.1								3.2	31.9	61.7	2.1		1.1			
		Québec	94	8	8	3.2								3.2	39.4	54.3			3.2			
		Maritimes	43	8	8	0.0									30.2	69.8						
	Sulfisoxazole	British Columbia	33	32	64	3.0											15.2	60.6	21.2			3.0
III		Saskatchewan	43	32	64	0.0											14.0	72.1	14.0			
		Ontario	94	32	> 256	13.8											26.6	54.3	5.3			13.8
		Québec	94	32	64	9.6											28.7	53.2	8.5			9.6
		Maritimes	43	32	64	7.0											30.2	55.8	7.0			7.0
	Tetracycline	British Columbia	33	≤ 4	> 32	27.3									72.7				27.3			
		Saskatchewan	43	≤ 4	> 32	11.6									88.4				11.6			
		Ontario	94	≤ 4	> 32	33.0									67.0			1.1	31.9			
		Québec	94	≤ 4	> 32	35.1									64.9				35.1			
		Maritimes	43	≤ 4	> 32	16.3									83.7				16.3			
IV																						

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

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	65	32	> 32	61.5								7.7	21.5	9.2		30.8	30.8			
		Saskatchewan	62	4	> 32	21.0							3.2	12.9	41.9	19.4	1.6	8.1	12.9			
		Ontario	114	4	> 32	23.7							1.8	21.1	33.3	17.5	2.6	8.8	14.9			
		Québec	117	8	> 32	24.8								11.1	35.0	25.6	3.4	8.5	16.2			
	Ceftiofur	British Columbia	65	8	> 8	58.5					6.2	24.6	9.2		1.5	23.1	35.4					
		Saskatchewan	62	0.50	8	19.4					22.6	53.2	3.2		1.6	14.5	4.8					
		Ontario	114	0.50	8	21.9				1.8	21.1	50.9	2.6		1.8	13.2	8.8					
I		Québec	117	0.50	8	23.9				0.9	20.5	50.4	3.4		0.9	16.2	7.7					
	Ceftriaxone	British Columbia	65	8	16	60.0					33.8	1.5	3.1	1.5		13.8	36.9	7.7	1.5			
		Saskatchewan	62	≤ 0.25	16	21.0					79.0					4.8	14.5	1.6				
		Ontario	114	≤ 0.25	16	23.7					76.3					6.1	14.9	2.6				
		Québec	117	≤ 0.25	16	24.8					75.2					5.1	17.1	2.6				
	Ciprofloxacin	British Columbia	65	≤ 0.015	≤ 0.015	0.0	92.3	4.6			3.1											
		Saskatchewan	62	≤ 0.015	0.03	0.0	85.5	6.5		3.2	4.8											
		Ontario	114	≤ 0.015	≤ 0.015	0.0	95.6	2.6			1.8											
		Québec	117	≤ 0.015	0.03	0.9	89.7	4.3	1.7		3.4		0.9									
	Ampicillin	British Columbia	65	> 32	> 32	73.8								10.8	15.4				73.8			
		Saskatchewan	62	4	> 32	33.9							6.5	33.9	25.8				33.9			
		Ontario	114	4	> 32	36.8							6.1	24.6	28.1	4.4			36.8			
		Québec	117	> 32	> 32	53.8							3.4	23.9	18.8				53.8			
	Azithromycin	British Columbia	65	4	4	0.0								21.5	70.8	7.7						
		Saskatchewan	62	4	8	0.0								19.4	69.4	11.3						
		Ontario	114	4	8	0.0							0.9	17.5	68.4	13.2						
		Québec	117	4	8	0.9							2.6	18.8	64.1	13.7		0.9				
	Cefoxitin	British Columbia	65	> 32	> 32	61.5								3.1	24.6	10.8		6.2	55.4			
		Saskatchewan	62	4	> 32	19.4								12.9	43.5	21.0	3.2	3.2	16.1			
		Ontario	114	4	> 32	23.7								9.6	48.2	18.4		5.3	18.4			
		Québec	117	4	> 32	24.8							0.9	6.8	48.7	17.1	1.7	4.3	20.5			
	Gentamicin	British Columbia	65	1	8	7.7						40.0	44.6		3.1	4.6		7.7				
		Saskatchewan	62	1	> 16	19.4					1.6	33.9	41.9	1.6		1.6	1.6	17.7				
		Ontario	114	1	> 16	23.7						43.0	31.6	0.9		0.9	7.0	16.7				
		Québec	117	1	> 16	27.4					0.9	35.0	33.3	0.9		2.6	5.1	22.2				
II	Kanamycin	British Columbia	65	≤ 8	≤ 8	4.6										93.8		1.5		4.6		
		Saskatchewan	62	≤ 8	16	6.5										88.7	4.8			6.5		
		Ontario	114	≤ 8	64	11.4										85.1	3.5		1.8	9.6		
		Québec	117	≤ 8	> 64	14.5										81.2	2.6	1.7		14.5		
	Nalidixic acid	British Columbia	65	2	4	3.1							9.2	72.3	15.4				3.1			
		Saskatchewan	62	2	4	8.1							4.8	75.8	11.3			1.6	6.5			
		Ontario	114	2	4	1.8							7.0	77.2	14.0				1.8			
		Québec	117	2	4	4.3						0.9	8.5	70.9	15.4				4.3			
	Streptomycin	British Columbia	65	≤ 32	> 64	40.0												60.0	10.8	29.2		
		Saskatchewan	62	≤ 32	> 64	32.3												67.7	9.7	22.6		
		Ontario	114	≤ 32	> 64	45.6												54.4	18.4	27.2		
		Québec	117	64	> 64	58.1												41.9	14.5	43.6		
	Trimethoprim-sulfamethoxazole	British Columbia	65	≤ 0.12	> 4	10.8				78.5	7.7	1.5	1.5			10.8						
		Saskatchewan	62	≤ 0.12	0.25	3.2				83.9	6.5	3.2	1.6	1.6		3.2						
		Ontario	114	≤ 0.12	> 4	21.1				65.8	9.6	3.5				21.1						
		Québec	117	≤ 0.12	> 4	25.6				60.7	7.7	6.0				25.6						
	Chloramphenicol	British Columbia	65	8	> 32	10.8								1.5	24.6	60.0	3.1		10.8			
		Saskatchewan	62	8	8	6.5								3.2	37.1	51.6	1.6		6.5			
		Ontario	114	8	16	6.1								2.6	36.8	49.1	5.3		6.1			
		Québec	117	8	8	6.8								2.6	32.5	56.4	1.7		6.8			
	Sulfisoxazole	British Columbia	65	32	> 256	36.9											47.7	15.4				36.9
III		Saskatchewan	62	32	> 256	30.6											48.4	19.4	1.6			30.6
		Ontario	114	> 256	> 256	50.9											35.1	13.2	0.9			50.9
		Québec	117	> 256	> 256	60.7											29.9	9.4				60.7
	Tetracycline	British Columbia	65	≤ 4	> 32	49.2									50.8			4.6	44.6			
		Saskatchewan	62	≤ 4	> 32	43.5									56.5			1.6	41.9			
		Ontario	114	> 32	> 32	54.4									45.6			4.4	50.0			
		Québec	117	> 32	> 32	60.7									39.3			6.0	54.7			
IV																						

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

Antimicrobial	Species	Province / region	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
Ciprofloxacin	*Campylobacter coli*	British Columbia	2	16	16	50.0				50.0							50.0			
Ciprofloxacin	*Campylobacter coli*	Saskatchewan	3	0.125	0.125	0.0			33.3	66.7										
Ciprofloxacin	*Campylobacter coli*	Ontario	7	0.125	16	14.3			42.9	14.3	28.6						14.3			
Ciprofloxacin	*Campylobacter coli*	Québec	3	0.25	16	33.3				33.3	33.3						33.3			
Ciprofloxacin	*Campylobacter jejuni*	British Columbia	50	0.125	0.125	6.0			32.0	60.0	2.0						6.0			
Ciprofloxacin	*Campylobacter jejuni*	Saskatchewan	30	0.125	0.125	6.7			43.3	50.0						6.7				
Ciprofloxacin	*Campylobacter jejuni*	Ontario	52	0.125	0.25	5.8			32.7	46.2	15.4					1.9	3.8			
Ciprofloxacin	*Campylobacter jejuni*	Québec	51	0.125	0.25	2.0			29.4	41.2	27.5					2.0				
Ciprofloxacin	*Campylobacter* spp.	British Columbia	21	0.064	0.25	9.5			52.4	28.6	9.5					4.8	4.8			
Ciprofloxacin	*Campylobacter* spp.	Saskatchewan	7	0.125	0.25	0.0			42.9	42.9	14.3									
Ciprofloxacin	*Campylobacter* spp.	Ontario	28	0.125	16	35.7			25.0	32.1	7.1				10.7	7.1	17.9			
Ciprofloxacin	*Campylobacter* spp.	Québec	24	0.125	0.25	0.0			29.2	58.3	12.5									
Telithromycin	*Campylobacter coli*	British Columbia	2	1	1	0.0					50.0		50.0							
Telithromycin	*Campylobacter coli*	Saskatchewan	3	2	2	0.0							33.3	66.7						
Telithromycin	*Campylobacter coli*	Ontario	7	2	16	14.3					28.6	14.3		28.6	14.3		14.3			
Telithromycin	*Campylobacter coli*	Québec	3	2	4	0.0								66.7	33.3					
Telithromycin	*Campylobacter jejuni*	British Columbia	50	0.5	1	0.0					8.0	72.0	20.0							
Telithromycin	*Campylobacter jejuni*	Saskatchewan	30	0.5	1	0.0					23.3	43.3	26.7	3.3		3.3				
Telithromycin	*Campylobacter jejuni*	Ontario	52	0.5	2	3.8					15.4	44.2	25.0	11.5			3.8			
Telithromycin	*Campylobacter jejuni*	Québec	51	0.5	2	0.0					7.8	43.1	25.5	15.7	5.9	2.0				
Telithromycin	*Campylobacter* spp.	British Columbia	21	0.5	1	0.0					28.6	42.9	19.0	9.5						
Telithromycin	*Campylobacter* spp.	Saskatchewan	7	0.5	2	0.0					28.6	42.9	14.3	14.3						
Telithromycin	*Campylobacter* spp.	Ontario	28	0.5	2	0.0					14.3	39.3	32.1	7.1	3.6	3.6				
Telithromycin	*Campylobacter* spp.	Québec	24	1	4	0.0					16.7	25.0	37.5	8.3	4.2	8.3				
Azithromycin	*Campylobacter coli*	British Columbia	2	0.064	0.064	0.0		50.0	50.0											
Azithromycin	*Campylobacter coli*	Saskatchewan	3	0.125	0.125	0.0			33.3	66.7										
Azithromycin	*Campylobacter coli*	Ontario	7	0.064	> 64	14.3			57.1	28.6										14.3
Azithromycin	*Campylobacter coli*	Québec	3	0.125	0.125	0.0				100.0										
Azithromycin	*Campylobacter jejuni*	British Columbia	50	0.064	0.064	0.0		34.0	64.0	2.0										
Azithromycin	*Campylobacter jejuni*	Saskatchewan	30	0.064	0.125	3.3	3.3	30.0	56.7	6.7										3.3
Azithromycin	*Campylobacter jejuni*	Ontario	52	0.064	0.064	3.8		38.5	55.8	1.9										3.8
Azithromycin	*Campylobacter jejuni*	Québec	51	0.064	0.125	5.9	3.9	39.2	39.2	11.8										5.9
Azithromycin	*Campylobacter* spp.	British Columbia	21	0.032	0.064	0.0	9.5	47.6	38.1	4.8										
Azithromycin	*Campylobacter* spp.	Saskatchewan	7	0.032	0.064	0.0		57.1	42.9											
Azithromycin	*Campylobacter* spp.	Ontario	28	0.032	0.5	7.1	7.1	50.0	17.9	14.3		3.6								7.1
Azithromycin	*Campylobacter* spp.	Québec	24	0.064	> 64	12.5		29.2	58.3											12.5
Clindamycin	*Campylobacter coli*	British Columbia	2	0.5	0.5	0.0					50.0	50.0								
Clindamycin	*Campylobacter coli*	Saskatchewan	3	0.25	0.5	0.0					66.7	33.3								
Clindamycin	*Campylobacter coli*	Ontario	7	0.25	16	28.6					57.1	14.3				14.3	14.3			
Clindamycin	*Campylobacter jejuni*	Québec	3	1	8	33.3						33.3	33.3			33.3				
Clindamycin	*Campylobacter jejuni*	British Columbia	50	0.125	0.25	0.0			6.0	58.0	34.0	2.0								
Clindamycin	*Campylobacter jejuni*	Saskatchewan	30	0.125	0.25	0.0			3.3	70.0	23.3				3.3					
Clindamycin	*Campylobacter jejuni*	Ontario	52	0.125	0.25	0.0			7.7	50.0	36.5	1.9			3.8					
Clindamycin	*Campylobacter jejuni*	Québec	51	0.125	0.5	0.0			2.0	64.7	19.6	7.8		2.0	3.9					
Clindamycin	*Campylobacter* spp.	British Columbia	21	0.125	0.25	0.0			9.5	47.6	33.3	4.8	4.8							
Clindamycin	*Campylobacter* spp.	Saskatchewan	7	0.25	0.5	0.0				28.6	57.1	14.3								
Clindamycin	*Campylobacter* spp.	Ontario	28	0.125	0.5	7.1			21.4	39.3	28.6	3.6				7.1				
Clindamycin	*Campylobacter* spp.	Québec	24	0.125	4	4.2			12.5	45.8	25.0	4.2			8.3	4.2				
Erythromycin	*Campylobacter coli*	British Columbia	2	1	1	0.0					50.0		50.0							
Erythromycin	*Campylobacter coli*	Saskatchewan	3	1	2	0.0					33.3		33.3	33.3						
Erythromycin	*Campylobacter coli*	Ontario	7	1	> 64	14.3					28.6	14.3	14.3	28.6						14.3
Erythromycin	*Campylobacter coli*	Québec	3	2	2	0.0							33.3	66.7						
Erythromycin	*Campylobacter jejuni*	British Columbia	50	0.25	0.5	0.0					76.0	24.0								
Erythromycin	*Campylobacter jejuni*	Saskatchewan	30	0.25	0.5	3.3				3.3	76.7	13.3	3.3						3.3	
Erythromycin	*Campylobacter jejuni*	Ontario	52	0.25	0.5	3.8				5.8	53.8	32.7	3.8							3.8
Erythromycin	*Campylobacter jejuni*	Québec	51	0.5	1	5.9					49.0	33.3	7.8	3.9						5.9
Erythromycin	*Campylobacter* spp.	British Columbia	21	0.25	0.5	0.0				4.8	81.0	9.5		4.8						
Erythromycin	*Campylobacter* spp.	Saskatchewan	7	0.25	0.5	0.0				14.3	57.1	28.6								
Erythromycin	*Campylobacter* spp.	Ontario	28	0.25	1	7.1				7.1	50.0	25.0	10.7							7.1
Erythromycin	*Campylobacter* spp.	Québec	24	0.5	> 64	12.5				4.2	29.2	41.7	12.5							12.5

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

Antimicrobial	Species	Province / region	n	Percentiles MIC 50	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
Gentamicin	*Campylobacter coli*	British Columbia	2	0.5	0.5	0.0						100.0								
Gentamicin	*Campylobacter coli*	Saskatchewan	3	1	1	0.0							100.0							
Gentamicin	*Campylobacter coli*	Ontario	7	1	1	0.0						42.9	57.1							
Gentamicin	*Campylobacter coli*	Québec	3	1	2	0.0							66.7	33.3						
Gentamicin	*Campylobacter jejuni*	British Columbia	50	1	1	0.0						40.0	60.0							
Gentamicin	*Campylobacter jejuni*	Saskatchewan	30	1	1	0.0						23.3	76.7							
Gentamicin	*Campylobacter jejuni*	Ontario	52	1	1	0.0						48.1	51.9							
Gentamicin	*Campylobacter jejuni*	Québec	51	0.5	1	0.0					2.0	54.9	43.1							
Gentamicin	*Campylobacter* spp.	British Columbia	21	0.5	1	0.0						71.4	28.6							
Gentamicin	*Campylobacter* spp.	Saskatchewan	7	1	1	0.0						42.9	57.1							
Gentamicin	*Campylobacter* spp.	Ontario	28	0.5	1	0.0						57.1	39.3	3.6						
Gentamicin	*Campylobacter* spp.	Québec	24	0.5	1	0.0						58.3	41.7							
II Nalidixic acid	*Campylobacter coli*	British Columbia	2	> 64	> 64	50.0										50.0				50.0
Nalidixic acid	*Campylobacter coli*	Saskatchewan	3	8	16	0.0									33.3	33.3	33.3			
Nalidixic acid	*Campylobacter coli*	Ontario	7	8	> 64	14.3									42.9	14.3	28.6			14.3
Nalidixic acid	*Campylobacter coli*	Québec	3	8	> 64	33.3									33.3	33.3				33.3
Nalidixic acid	*Campylobacter jejuni*	British Columbia	50	≤ 4	8	6.0									62.0	32.0				6.0
Nalidixic acid	*Campylobacter jejuni*	Saskatchewan	30	≤ 4	8	6.7									80.0	13.3				6.7
Nalidixic acid	*Campylobacter jejuni*	Ontario	52	≤ 4	8	5.8									67.3	26.9				5.8
Nalidixic acid	*Campylobacter jejuni*	Québec	51	8	8	2.0									45.1	52.9				2.0
Nalidixic acid	*Campylobacter* spp.	British Columbia	21	≤ 4	16	9.5									57.1	28.6	4.8		4.8	4.8
Nalidixic acid	*Campylobacter* spp.	Saskatchewan	7	≤ 4	8	0.0									57.1	42.9				
Nalidixic acid	*Campylobacter* spp.	Ontario	28	8	> 64	35.7									46.4	17.9			3.6	32.1
Nalidixic acid	*Campylobacter* spp.	Québec	24	≤ 4	8	0.0									83.3	16.7				
Florfenicol	*Campylobacter coli*	British Columbia	2	2	2	0.0							50.0	50.0						
Florfenicol	*Campylobacter coli*	Saskatchewan	3	1	1	0.0							100.0							
Florfenicol	*Campylobacter coli*	Ontario	7	1	2	0.0							71.4	28.6						
Florfenicol	*Campylobacter coli*	Québec	3	1	2	0.0						33.3	33.3	33.3						
Florfenicol	*Campylobacter jejuni*	British Columbia	50	1	1	0.0					2.0	10.0	88.0							
Florfenicol	*Campylobacter jejuni*	Saskatchewan	30	1	1	0.0						16.7	83.3							
Florfenicol	*Campylobacter jejuni*	Ontario	52	1	1	0.0						9.6	86.5	3.8						
Florfenicol	*Campylobacter jejuni*	Québec	51	1	2	0.0						7.8	76.5	15.7						
Florfenicol	*Campylobacter* spp.	British Columbia	21	1	1	0.0							90.5	9.5						
Florfenicol	*Campylobacter* spp.	Saskatchewan	7	1	2	0.0						14.3	71.4	14.3						
Florfenicol	*Campylobacter* spp.	Ontario	28	1	1	0.0						3.6	96.4							
Florfenicol	*Campylobacter* spp.	Québec	24	1	2	0.0						12.5	75.0	12.5						
III Tetracycline	*Campylobacter coli*	British Columbia	2	1	1	0.0						50.0	50.0							
Tetracycline	*Campylobacter coli*	Saskatchewan	3	0.5	> 64	33.3				33.3		33.3								33.3
Tetracycline	*Campylobacter coli*	Ontario	7	0.5	> 64	42.9					42.9	14.3							14.3	28.6
Tetracycline	*Campylobacter coli*	Québec	3	8	> 64	33.3							33.3			33.3				33.3
Tetracycline	*Campylobacter jejuni*	British Columbia	50	0.25	64	26.0				18.0	50.0	4.0	2.0					2.0	16.0	8.0
Tetracycline	*Campylobacter jejuni*	Saskatchewan	30	32	> 64	53.3				20.0	26.7							6.7	20.0	26.7
Tetracycline	*Campylobacter jejuni*	Ontario	52	0.5	> 64	46.2				21.2	21.2	9.6	1.9						15.4	30.8
Tetracycline	*Campylobacter jejuni*	Québec	51	64	> 64	66.7				9.8	9.8	5.9	5.9		2.0				29.4	37.3
Tetracycline	*Campylobacter* spp.	British Columbia	21	0.25	64	28.6				19.0	38.1	4.8	9.5					4.8	19.0	4.8
Tetracycline	*Campylobacter* spp.	Saskatchewan	7	0.5	> 64	42.9				42.9		14.3							28.6	14.3
Tetracycline	*Campylobacter* spp.	Ontario	28	32	> 64	53.6				14.3	21.4	7.1	3.6					17.9	14.3	21.4
Tetracycline	*Campylobacter* spp.	Québec	24	64	> 64	58.3				12.5	25.0	4.2							12.5	45.8
IV																				

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

	Antimicrobial	Province/region	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
	Amoxicillin-clavulanic acid	British Columbia	38	4	8	7.9								18.4	55.3	18.4		2.6	5.3			
		Saskatchewan	29	4	8	3.4							3.4	6.9	65.5	20.7			3.4			
		Ontario	102	4	8	2.9							2.0	21.6	45.1	28.4		1.0	2.0			
		Québec	52	4	8	0.0							1.9	17.3	51.9	26.9	1.9					
	Ceftiofur	British Columbia	38	0.50	1	7.9					18.4	71.1	2.6			2.6	5.3					
		Saskatchewan	29	0.50	0.50	3.4					31.0	62.1	3.4				3.4					
		Ontario	102	0.50	0.50	2.0				1.0	48.0	48.0			1.0	1.0	1.0					
I		Québec	52	0.50	0.50	0.0				3.8	38.5	55.8	1.9									
	Ceftriaxone	British Columbia	38	≤ 0.25	≤ 0.25	7.9					92.1						7.9					
		Saskatchewan	29	≤ 0.25	≤ 0.25	3.4					96.6							3.4				
		Ontario	102	≤ 0.25	≤ 0.25	2.9					97.1					2.0	1.0					
		Québec	52	≤ 0.25	≤ 0.25	0.0					100.0											
	Ciprofloxacin	British Columbia	38	≤ 0.015	≤ 0.015	0.0	100.0															
		Saskatchewan	29	≤ 0.015	0.03	0.0	89.7	10.3														
		Ontario	102	≤ 0.015	≤ 0.015	0.0	96.1	2.0			2.0											
		Québec	52	≤ 0.015	≤ 0.015	0.0	96.2	1.9			1.9											
	Ampicillin	British Columbia	38	4	> 32	10.5							5.3	28.9	52.6	2.6			10.5			
		Saskatchewan	29	2	> 32	13.8							3.4	48.3	31.0	3.4			13.8			
		Ontario	102	2	> 32	20.6							3.9	47.1	26.5	2.0			20.6			
		Québec	52	4	> 32	26.9							7.7	34.6	23.1	3.8	3.8		26.9			
	Azithromycin	British Columbia	38	4	8	0.0							5.3	10.5	73.7	10.5						
		Saskatchewan	29	4	8	0.0								20.7	65.5	13.8						
		Ontario	102	4	4	0.0								19.6	71.6	7.8	1.0					
		Québec	52	4	4	0.0						1.9	1.9	19.2	67.3	7.7	1.9					
	Cefoxitin	British Columbia	38	4	16	7.9								2.6	60.5	23.7	5.3		7.9			
		Saskatchewan	29	4	8	3.4								17.2	55.2	20.7	3.4		3.4			
		Ontario	102	4	8	2.9								25.5	57.8	13.7		1.0	2.0			
		Québec	52	4	8	0.0								34.6	48.1	15.4	1.9					
	Gentamicin	British Columbia	38	1	2	2.6					2.6	47.4	39.5	7.9			2.6					
		Saskatchewan	29	0.50	1	0.0						69.0	27.6	3.4								
		Ontario	102	0.50	1	2.9						57.8	34.3	4.9			1.0	2.0				
		Québec	52	0.50	1	0.0					1.9	55.8	40.4	1.9								
II	Kanamycin	British Columbia	38	≤ 8	≤ 8	0.0										100.0						
		Saskatchewan	29	≤ 8	≤ 8	6.9										93.1				6.9		
		Ontario	102	≤ 8	≤ 8	2.9										96.1	1.0			2.9		
		Québec	52	≤ 8	≤ 8	1.9										98.1				1.9		
	Nalidixic acid	British Columbia	38	2	2	0.0							7.9	86.8	5.3							
		Saskatchewan	29	2	4	0.0							10.3	79.3	10.3							
		Ontario	102	2	4	2.0							13.7	70.6	13.7				2.0			
		Québec	52	2	4	1.9							17.3	65.4	13.5	1.9			1.9			
	Streptomycin	British Columbia	38	≤ 32	64	10.5												89.5	5.3	5.3		
		Saskatchewan	29	≤ 32	> 64	10.3												89.7		10.3		
		Ontario	102	≤ 32	> 64	16.7												83.3	3.9	12.7		
		Québec	52	≤ 32	64	11.5												88.5	5.8	5.8		
	Trimethoprim-sulfamethoxazole	British Columbia	38	≤ 0.12	≤ 0.12	2.6				92.1	5.3					2.6						
		Saskatchewan	29	≤ 0.12	≤ 0.12	6.9				93.1						6.9						
		Ontario	102	≤ 0.12	0.25	5.9				85.3	6.9	1.0	1.0			5.9						
		Québec	52	≤ 0.12	> 4	11.5				86.5		1.9				11.5						
	Chloramphenicol	British Columbia	38	8	8	5.3									21.1	73.7		5.3				
		Saskatchewan	29	8	8	3.4								3.4	37.9	55.2		3.4				
		Ontario	102	8	8	3.9									45.1	50.0	1.0	2.9	1.0			
		Québec	52	8	8	5.8								5.8	38.5	50.0		5.8				
	Sulfisoxazole	British Columbia	38	≤ 16	> 256	13.2											71.1	15.8				13.2
III		Saskatchewan	29	≤ 16	> 256	10.3											69.0	20.7				10.3
		Ontario	102	≤ 16	> 256	17.6											67.6	14.7				17.6
		Québec	52	≤ 16	> 256	15.4											80.8	3.8				15.4
	Tetracycline	British Columbia	38	≤ 4	> 32	23.7									76.3			2.6	21.1			
		Saskatchewan	29	≤ 4	> 32	37.9									62.1			3.4	34.5			
		Ontario	102	≤ 4	> 32	37.3									62.7			2.0	35.3			
		Québec	52	≤ 4	> 32	44.2									55.8			3.8	40.4			
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	36	≤ 1	> 32	13.9							75.0	11.1					13.9			
		Saskatchewan	27	≤ 1	8	3.7							81.5		3.7	7.4	3.7	3.7				
		Ontario	29	4	> 32	37.9							48.3		3.4	10.3		10.3	27.6			
		Québec	58	≤ 1	> 32	17.2							77.6	3.4		1.7			17.2			
		Maritimes	18	≤ 1	> 32	16.7							55.6	5.6		11.1	11.1		16.7			
	Ceftiofur	British Columbia	36	1	> 8	13.9						13.9	63.9	8.3			13.9					
		Saskatchewan	27	1	1	3.7						11.1	81.5	3.7			3.7					
		Ontario	29	1	> 8	37.9						24.1	37.9				37.9					
I		Québec	58	1	> 8	17.2						17.2	65.5				17.2					
		Maritimes	18	1	> 8	16.7						5.6	77.8				16.7					
	Ceftriaxone	British Columbia	36	≤ 0.25	8	13.9					86.1					5.6	8.3					
		Saskatchewan	27	≤ 0.25	≤ 0.25	3.7					96.3						3.7					
		Ontario	29	≤ 0.25	32	37.9					62.1					3.4	13.8	13.8	6.9			
		Québec	58	≤ 0.25	32	17.2					82.8						5.2	12.1				
		Maritimes	18	≤ 0.25	32	16.7					83.3						5.6	5.6	5.6			
	Ciprofloxacin	British Columbia	36	≤ 0.015	0.03	0.0	77.8	22.2														
		Saskatchewan	27	≤ 0.015	0.03	0.0	77.8	22.2														
		Ontario	29	≤ 0.015	≤ 0.015	0.0	93.1	6.9														
		Québec	58	≤ 0.015	0.03	0.0	87.9	12.1														
		Maritimes	18	≤ 0.015	≤ 0.015	0.0	94.4	5.6														
	Ampicillin	British Columbia	36	≤ 1	> 32	16.7							72.2	8.3	2.8				16.7			
		Saskatchewan	27	≤ 1	> 32	18.5							74.1	7.4					18.5			
		Ontario	29	> 32	> 32	51.7							44.8	3.4					51.7			
		Québec	58	≤ 1	> 32	19.0							75.9	5.2					19.0			
		Maritimes	18	≤ 1	> 32	38.9							61.1						38.9			
	Azithromycin	British Columbia	36	4	8	0.0							5.6	19.4	50.0	25.0						
		Saskatchewan	27	4	8	0.0								3.7	77.8	18.5						
		Ontario	29	4	8	0.0								17.2	69.0	10.3	3.4					
		Québec	58	4	8	0.0								5.2	75.9	17.2	1.7					
		Maritimes	18	4	8	0.0								5.6	83.3	11.1						
	Cefoxitin	British Columbia	36	4	32	11.1							19.4	27.8	36.1	2.8	2.8	8.3	2.8			
		Saskatchewan	27	2	4	3.7							11.1	59.3	25.9				3.7			
		Ontario	29	2	> 32	34.5							24.1	34.5	3.4		3.4	17.2	17.2			
		Québec	58	2	> 32	17.2							8.6	55.2	17.2	1.7		6.9	10.3			
		Maritimes	18	2	> 32	16.7							11.1	55.6	16.7			5.6	11.1			
	Gentamicin	British Columbia	36	0.50	0.50	8.3					27.8	63.9					2.8	5.6				
		Saskatchewan	27	0.50	> 16	18.5					22.2	51.9	7.4				3.7	14.8				
		Ontario	29	0.50	> 16	10.3					31.0	51.7	3.4	3.4				10.3				
		Québec	58	0.50	> 16	15.5					19.0	62.1	3.4					15.5				
		Maritimes	18	0.50	> 16	22.2					16.7	55.6	5.6				5.6	16.7				
II	Kanamycin	British Columbia	36	≤ 8	≤ 8	0.0										100.0						
		Saskatchewan	27	≤ 8	≤ 8	3.7										96.3				3.7		
		Ontario	29	≤ 8	≤ 8	0.0										100.0						
		Québec	58	≤ 8	16	6.9										89.7	1.7	1.7		6.9		
		Maritimes	18	≤ 8	≤ 8	0.0										100.0						
	Nalidixic acid	British Columbia	36	4	4	0.0								44.4	52.8	2.8						
		Saskatchewan	27	4	4	0.0								18.5	74.1	7.4						
		Ontario	29	4	4	0.0								20.7	79.3							
		Québec	58	4	4	0.0								34.5	63.8	1.7						
		Maritimes	18	4	4	0.0								22.2	77.8							
	Streptomycin	British Columbia	36	≤ 32	> 64	33.3												66.7	13.9	19.4		
		Saskatchewan	27	≤ 32	> 64	18.5												81.5	3.7	14.8		
		Ontario	29	≤ 32	> 64	31.0												69.0	6.9	24.1		
		Québec	58	≤ 32	> 64	25.9												74.1	10.3	15.5		
		Maritimes	18	≤ 32	> 64	44.4												55.6	33.3	11.1		
	Trimethoprim-sulfamethoxazole	British Columbia	36	≤ 0.12	≤ 0.12	0.0				100.0												
		Saskatchewan	27	≤ 0.12	≤ 0.12	0.0				96.3	3.7											
		Ontario	29	≤ 0.12	≤ 0.12	0.0				96.6	3.4											
		Québec	58	≤ 0.12	≤ 0.12	1.7				91.4	5.2		1.7			1.7						
		Maritimes	18	≤ 0.12	≤ 0.12	0.0				100.0												
	Chloramphenicol	British Columbia	36	8	8	0.0								2.8	36.1	58.3	2.8					
		Saskatchewan	27	8	8	0.0									14.8	85.2						
		Ontario	29	8	> 32	10.3									24.1	65.5			10.3			
		Québec	58	8	8	0.0									13.8	84.5	1.7					
		Maritimes	18	8	8	5.6									33.3	61.1			5.6			
	Sulfisoxazole	British Columbia	36	32	> 256	11.1											8.3	66.7	13.9			11.1
III		Saskatchewan	27	32	> 256	22.2											14.8	44.4	18.5			22.2
		Ontario	29	32	> 256	31.0											17.2	48.3	3.4			31.0
		Québec	58	32	> 256	31.0											20.7	46.6	1.7			31.0
		Maritimes	18	32	> 256	11.1											27.8	44.4	16.7			11.1
	Tetracycline	British Columbia	36	≤ 4	> 32	36.1									63.9			2.8	33.3			
		Saskatchewan	27	≤ 4	> 32	22.2									77.8				22.2			
		Ontario	29	≤ 4	> 32	34.5									65.5			3.4	31.0			
		Québec	58	≤ 4	> 32	37.9									62.1			1.7	36.2			
		Maritimes	18	≤ 4	> 32	38.9									61.1			5.6	33.3			
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	67	4	16	7.5							3.0	11.9	47.8	26.9	3.0	3.0	4.5			
		Saskatchewan	59	4	16	3.4							1.7	11.9	57.6	18.6	6.8	1.7	1.7			
		Ontario	119	4	8	3.4							2.5	19.3	45.4	27.7	1.7	2.5	0.8			
		Québec	107	4	8	5.6							0.9	20.6	43.0	29.0	0.9	2.8	2.8			
	Ceftiofur	British Columbia	67	0.50	1	3.0					17.9	70.1	6.0	1.5	1.5	1.5	1.5					
		Saskatchewan	59	0.50	0.50	3.4				1.7	22.0	71.2	1.7			1.7	1.7					
		Ontario	119	0.50	0.50	2.5				2.5	33.6	58.0	2.5	0.8		2.5						
I		Québec	107	0.50	0.50	5.6					26.2	64.5	2.8		0.9	1.9	3.7					
	Ceftriaxone	British Columbia	67	≤ 0.25	≤ 0.25	4.5					92.5		1.5	1.5	1.5		3.0					
		Saskatchewan	59	≤ 0.25	≤ 0.25	3.4					96.6						3.4					
		Ontario	119	≤ 0.25	≤ 0.25	2.5					95.8	0.8		0.8		0.8	1.7					
		Québec	107	≤ 0.25	≤ 0.25	6.5					92.5			0.9	0.9		3.7	1.9				
	Ciprofloxacin	British Columbia	67	≤ 0.015	≤ 0.015	0.0	92.5	4.5			3.0											
		Saskatchewan	59	≤ 0.015	≤ 0.015	0.0	94.9	1.7			3.4											
		Ontario	119	≤ 0.015	≤ 0.015	0.0	99.2				0.8											
		Québec	107	≤ 0.015	≤ 0.015	0.0	98.1	1.9														
	Ampicillin	British Columbia	67	4	> 32	28.4							4.5	29.9	37.3				28.4			
		Saskatchewan	59	4	> 32	27.1							3.4	35.6	32.2	1.7			27.1			
		Ontario	119	4	> 32	25.2							5.9	42.0	26.1	0.8			25.2			
		Québec	107	4	> 32	31.8							6.5	32.7	27.1	1.9			31.8			
	Azithromycin	British Columbia	67	4	4	0.0							3.0	20.9	67.2	9.0						
		Saskatchewan	59	4	4	0.0							3.4	27.1	64.4	5.1						
		Ontario	119	4	4	0.0							4.2	26.9	60.5	8.4						
		Québec	107	4	4	0.0							3.7	21.5	68.2	6.5						
	Cefoxitin	British Columbia	67	4	8	3.0								10.4	52.2	31.3	3.0		3.0			
		Saskatchewan	59	4	8	3.4								10.2	69.5	16.9			3.4			
		Ontario	119	4	8	3.4							0.8	26.9	55.5	13.4		1.7	1.7			
		Québec	107	4	8	5.6								6.5	70.1	16.8	0.9	2.8	2.8			
	Gentamicin	British Columbia	67	1	> 16	13.4						40.3	41.8	1.5		3.0	1.5	11.9				
		Saskatchewan	59	0.50	16	10.2					1.7	50.8	30.5			6.8	5.1	5.1				
		Ontario	119	0.50	16	10.9					1.7	49.6	34.5	0.8		2.5	1.7	9.2				
		Québec	107	0.50	> 16	15.0					1.9	56.1	16.8	5.6	1.9	2.8	3.7	11.2				
II	Kanamycin	British Columbia	67	≤ 8	≤ 8	7.5										91.0	1.5			7.5		
		Saskatchewan	59	≤ 8	> 64	11.9										88.1				11.9		
		Ontario	119	≤ 8	> 64	12.6										85.7	1.7			12.6		
		Québec	107	≤ 8	64	10.3										88.8	0.9		0.9	9.3		
	Nalidixic acid	British Columbia	67	2	4	3.0							4.5	74.6	17.9				3.0			
		Saskatchewan	59	2	4	1.7						1.7	8.5	78.0	8.5	1.7			1.7			
		Ontario	119	2	4	0.8							11.8	77.3	10.1				0.8			
		Québec	107	2	4	0.0							13.1	76.6	9.3	0.9						
	Streptomycin	British Columbia	67	≤ 32	> 64	31.3												68.7	11.9	19.4		
		Saskatchewan	59	≤ 32	> 64	35.6												64.4	15.3	20.3		
		Ontario	119	≤ 32	> 64	30.3												69.7	10.1	20.2		
		Québec	107	≤ 32	> 64	35.5												64.5	19.6	15.9		
	Trimethoprim-sulfamethoxazole	British Columbia	67	≤ 0.12	0.25	4.5				88.1	7.5					4.5						
		Saskatchewan	59	≤ 0.12	0.25	6.8				86.4	6.8					6.8						
		Ontario	119	≤ 0.12	0.25	9.2				83.2	7.6					9.2						
		Québec	107	≤ 0.12	1	9.3				77.6	11.2	0.9	0.9			9.3						
	Chloramphenicol	British Columbia	67	8	8	3.0									38.8	56.7	1.5		3.0			
		Saskatchewan	59	8	8	0.0								3.4	45.8	49.2	1.7					
		Ontario	119	8	8	2.5								1.7	37.0	58.8		0.8	1.7			
		Québec	107	8	8	2.8								2.8	39.3	49.5	5.6		2.8			
	Sulfisoxazole	British Columbia	67	≤ 16	> 256	25.4											61.2	13.4				25.4
III		Saskatchewan	59	≤ 16	> 256	23.7											57.6	16.9	1.7			23.7
		Ontario	119	≤ 16	> 256	31.1											56.3	12.6				31.1
		Québec	107	32	> 256	39.3											41.1	17.8	1.9			39.3
	Tetracycline	British Columbia	67	≤ 4	> 32	41.8									58.2			6.0	35.8			
		Saskatchewan	59	≤ 4	> 32	47.5									52.5			3.4	44.1			
		Ontario	119	> 32	> 32	65.5									34.5			12.6	52.9			
		Québec	107	> 32	> 32	64.5									35.5			11.2	53.3			
IV																						

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

Antimicrobial	Species	Province / region	n	Percentiles MIC 50	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
Ciprofloxacin	*Campylobacter coli*	British Columbia	2	16	16	50.0				50.0							50.0			
Ciprofloxacin	*Campylobacter coli*	Saskatchewan	3	0.125	0.125	0.0			33.3	66.7										
Ciprofloxacin	*Campylobacter coli*	Ontario	7	0.125	16	14.3			42.9	14.3	28.6						14.3			
Ciprofloxacin	*Campylobacter coli*	Québec	3	0.25	16	33.3				33.3	33.3						33.3			
Ciprofloxacin	*Campylobacter jejuni*	British Columbia	50	0.125	0.125	6.0			32.0	60.0	2.0						6.0			
Ciprofloxacin	*Campylobacter jejuni*	Saskatchewan	30	0.125	0.125	6.7			43.3	50.0						6.7				
Ciprofloxacin	*Campylobacter jejuni*	Ontario	52	0.125	0.25	5.8			32.7	46.2	15.4					1.9	3.8			
Ciprofloxacin	*Campylobacter jejuni*	Québec	51	0.125	0.25	2.0			29.4	41.2	27.5					2.0				
Ciprofloxacin	*Campylobacter* spp.	British Columbia	21	0.064	0.25	9.5			52.4	28.6	9.5					4.8	4.8			
Ciprofloxacin	*Campylobacter* spp.	Saskatchewan	7	0.125	0.25	0.0			42.9	42.9	14.3									
Ciprofloxacin	*Campylobacter* spp.	Ontario	28	0.125	16	35.7			25.0	32.1	7.1				10.7	7.1	17.9			
Ciprofloxacin	*Campylobacter* spp.	Québec	24	0.125	0.25	0.0			29.2	58.3	12.5									
Telithromycin	*Campylobacter coli*	British Columbia	2	1	1	0.0					50.0		50.0							
Telithromycin	*Campylobacter coli*	Saskatchewan	3	2	2	0.0							33.3	66.7						
Telithromycin	*Campylobacter coli*	Ontario	7	2	16	14.3					28.6	14.3		28.6	14.3		14.3			
Telithromycin	*Campylobacter coli*	Québec	3	2	4	0.0								66.7	33.3					
Telithromycin	*Campylobacter jejuni*	British Columbia	50	0.5	1	0.0					8.0	72.0	20.0							
Telithromycin	*Campylobacter jejuni*	Saskatchewan	30	0.5	1	0.0					23.3	43.3	26.7	3.3		3.3				
Telithromycin	*Campylobacter jejuni*	Ontario	52	0.5	2	3.8					15.4	44.2	25.0	11.5			3.8			
Telithromycin	*Campylobacter jejuni*	Québec	51	0.5	2	0.0					7.8	43.1	25.5	15.7	5.9	2.0				
Telithromycin	*Campylobacter* spp.	British Columbia	21	0.5	1	0.0					28.6	42.9	19.0	9.5						
Telithromycin	*Campylobacter* spp.	Saskatchewan	7	0.5	2	0.0					28.6	42.9	14.3	14.3						
Telithromycin	*Campylobacter* spp.	Ontario	28	0.5	2	0.0					14.3	39.3	32.1	7.1	3.6	3.6				
Telithromycin	*Campylobacter* spp.	Québec	24	1	4	0.0					16.7	25.0	37.5	8.3	4.2	8.3				
Azithromycin	*Campylobacter coli*	British Columbia	2	0.064	0.064	0.0		50.0	50.0											
Azithromycin	*Campylobacter coli*	Saskatchewan	3	0.125	0.125	0.0			33.3	66.7										
Azithromycin	*Campylobacter coli*	Ontario	7	0.064	> 64	14.3			57.1	28.6										14.3
Azithromycin	*Campylobacter coli*	Québec	3	0.125	0.125	0.0				100.0										
Azithromycin	*Campylobacter jejuni*	British Columbia	50	0.064	0.064	0.0		34.0	64.0	2.0										
Azithromycin	*Campylobacter jejuni*	Saskatchewan	30	0.064	0.125	3.3	3.3	30.0	56.7	6.7										3.3
Azithromycin	*Campylobacter jejuni*	Ontario	52	0.064	0.064	3.8		38.5	55.8	1.9										3.8
Azithromycin	*Campylobacter jejuni*	Québec	51	0.064	0.125	5.9	3.9	39.2	39.2	11.8										5.9
Azithromycin	*Campylobacter* spp.	British Columbia	21	0.032	0.064	0.0	9.5	47.6	38.1	4.8										
Azithromycin	*Campylobacter* spp.	Saskatchewan	7	0.032	0.064	0.0		57.1	42.9											
Azithromycin	*Campylobacter* spp.	Ontario	28	0.032	0.5	7.1	7.1	50.0	17.9	14.3		3.6								7.1
Azithromycin	*Campylobacter* spp.	Québec	24	0.064	> 64	12.5		29.2	58.3											12.5
Clindamycin	*Campylobacter coli*	British Columbia	2	0.5	0.5	0.0					50.0	50.0								
Clindamycin	*Campylobacter coli*	Saskatchewan	3	0.25	0.5	0.0					66.7	33.3								
Clindamycin	*Campylobacter coli*	Ontario	7	0.25	16	28.6					57.1	14.3				14.3	14.3			
Clindamycin	*Campylobacter jejuni*	Québec	3	1	8	33.3						33.3	33.3			33.3				
Clindamycin	*Campylobacter jejuni*	British Columbia	50	0.125	0.25	0.0			6.0	58.0	34.0	2.0								
Clindamycin	*Campylobacter jejuni*	Saskatchewan	30	0.125	0.25	0.0			3.3	70.0	23.3				3.3					
Clindamycin	*Campylobacter jejuni*	Ontario	52	0.125	0.25	0.0			7.7	50.0	36.5	1.9			3.8					
Clindamycin	*Campylobacter jejuni*	Québec	51	0.125	0.5	0.0			2.0	64.7	19.6	7.8		2.0	3.9					
Clindamycin	*Campylobacter* spp.	British Columbia	21	0.125	0.25	0.0			9.5	47.6	33.3	4.8	4.8							
Clindamycin	*Campylobacter* spp.	Saskatchewan	7	0.25	0.5	0.0				28.6	57.1	14.3								
Clindamycin	*Campylobacter* spp.	Ontario	28	0.125	0.5	7.1			21.4	39.3	28.6	3.6				7.1				
Clindamycin	*Campylobacter* spp.	Québec	24	0.125	4	4.2			12.5	45.8	25.0	4.2			8.3	4.2				
Erythromycin	*Campylobacter coli*	British Columbia	2	1	1	0.0					50.0		50.0							
Erythromycin	*Campylobacter coli*	Saskatchewan	3	1	2	0.0					33.3		33.3	33.3						
Erythromycin	*Campylobacter coli*	Ontario	7	1	> 64	14.3					28.6	14.3	14.3	28.6						14.3
Erythromycin	*Campylobacter coli*	Québec	3	2	2	0.0							33.3	66.7						
Erythromycin	*Campylobacter jejuni*	British Columbia	50	0.25	0.5	0.0					76.0	24.0								
Erythromycin	*Campylobacter jejuni*	Saskatchewan	30	0.25	0.5	3.3				3.3	76.7	13.3	3.3						3.3	
Erythromycin	*Campylobacter jejuni*	Ontario	52	0.25	0.5	3.8				5.8	53.8	32.7	3.8							3.8
Erythromycin	*Campylobacter jejuni*	Québec	51	0.5	1	5.9					49.0	33.3	7.8	3.9						5.9
Erythromycin	*Campylobacter* spp.	British Columbia	21	0.25	0.5	0.0				4.8	81.0	9.5		4.8						
Erythromycin	*Campylobacter* spp.	Saskatchewan	7	0.25	0.5	0.0				14.3	57.1	28.6								
Erythromycin	*Campylobacter* spp.	Ontario	28	0.25	1	7.1				7.1	50.0	25.0	10.7							7.1
Erythromycin	*Campylobacter* spp.	Québec	24	0.5	> 64	12.5				4.2	29.2	41.7	12.5							12.5

Table24.Distribution of minimum inhibitory concentrations in *Campylobacter* from turkey (cont'd)

Antimicrobial	Species	Province / region	n	Percentiles MIC 50	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
Gentamicin	*Campylobacter coli*	British Columbia	2	0.5	0.5	0.0						100.0								
Gentamicin	*Campylobacter coli*	Saskatchewan	3	1	1	0.0							100.0							
Gentamicin	*Campylobacter coli*	Ontario	7	1	1	0.0						42.9	57.1							
Gentamicin	*Campylobacter coli*	Québec	3	1	2	0.0							66.7	33.3						
Gentamicin	*Campylobacter jejuni*	British Columbia	50	1	1	0.0						40.0	60.0							
Gentamicin	*Campylobacter jejuni*	Saskatchewan	30	1	1	0.0						23.3	76.7							
Gentamicin	*Campylobacter jejuni*	Ontario	52	1	1	0.0						48.1	51.9							
Gentamicin	*Campylobacter jejuni*	Québec	51	0.5	1	0.0					2.0	54.9	43.1							
Gentamicin	*Campylobacter* spp.	British Columbia	21	0.5	1	0.0						71.4	28.6							
Gentamicin	*Campylobacter* spp.	Saskatchewan	7	1	1	0.0						42.9	57.1							
Gentamicin	*Campylobacter* spp.	Ontario	28	0.5	1	0.0						57.1	39.3	3.6						
Gentamicin	*Campylobacter* spp.	Québec	24	0.5	1	0.0						58.3	41.7							
II																				
Nalidixic acid	*Campylobacter coli*	British Columbia	2	> 64	> 64	50.0										50.0				50.0
Nalidixic acid	*Campylobacter coli*	Saskatchewan	3	8	16	0.0									33.3	33.3	33.3			
Nalidixic acid	*Campylobacter coli*	Ontario	7	8	> 64	14.3									42.9	14.3	28.6			14.3
Nalidixic acid	*Campylobacter coli*	Québec	3	8	> 64	33.3									33.3	33.3				33.3
Nalidixic acid	*Campylobacter jejuni*	British Columbia	50	≤ 4	8	6.0									62.0	32.0				6.0
Nalidixic acid	*Campylobacter jejuni*	Saskatchewan	30	≤ 4	8	6.7									80.0	13.3				6.7
Nalidixic acid	*Campylobacter jejuni*	Ontario	52	≤ 4	8	5.8									67.3	26.9				5.8
Nalidixic acid	*Campylobacter jejuni*	Québec	51	8	8	2.0									45.1	52.9				2.0
Nalidixic acid	*Campylobacter* spp.	British Columbia	21	≤ 4	16	9.5									57.1	28.6	4.8		4.8	4.8
Nalidixic acid	*Campylobacter* spp.	Saskatchewan	7	≤ 4	8	0.0									57.1	42.9				
Nalidixic acid	*Campylobacter* spp.	Ontario	28	8	> 64	35.7									46.4	17.9			3.6	32.1
Nalidixic acid	*Campylobacter* spp.	Québec	24	≤ 4	8	0.0									83.3	16.7				
Florfenicol	*Campylobacter coli*	British Columbia	2	2	2	0.0							50.0	50.0						
Florfenicol	*Campylobacter coli*	Saskatchewan	3	1	1	0.0							100.0							
Florfenicol	*Campylobacter coli*	Ontario	7	1	2	0.0							71.4	28.6						
Florfenicol	*Campylobacter coli*	Québec	3	1	2	0.0						33.3	33.3	33.3						
Florfenicol	*Campylobacter jejuni*	British Columbia	50	1	1	0.0					2.0	10.0	88.0							
Florfenicol	*Campylobacter jejuni*	Saskatchewan	30	1	1	0.0						16.7	83.3							
Florfenicol	*Campylobacter jejuni*	Ontario	52	1	1	0.0						9.6	86.5	3.8						
Florfenicol	*Campylobacter jejuni*	Québec	51	1	2	0.0						7.8	76.5	15.7						
Florfenicol	*Campylobacter* spp.	British Columbia	21	1	1	0.0							90.5	9.5						
Florfenicol	*Campylobacter* spp.	Saskatchewan	7	1	2	0.0						14.3	71.4	14.3						
Florfenicol	*Campylobacter* spp.	Ontario	28	1	1	0.0						3.6	96.4							
Florfenicol	*Campylobacter* spp.	Québec	24	1	2	0.0						12.5	75.0	12.5						
III																				
Tetracycline	*Campylobacter coli*	British Columbia	2	1	1	0.0						50.0	50.0							
Tetracycline	*Campylobacter coli*	Saskatchewan	3	0.5	> 64	33.3				33.3		33.3								33.3
Tetracycline	*Campylobacter coli*	Ontario	7	0.5	> 64	42.9					42.9	14.3							14.3	28.6
Tetracycline	*Campylobacter coli*	Québec	3	8	> 64	33.3							33.3			33.3				33.3
Tetracycline	*Campylobacter jejuni*	British Columbia	50	0.25	64	26.0				18.0	50.0	4.0	2.0					2.0	16.0	8.0
Tetracycline	*Campylobacter jejuni*	Saskatchewan	30	32	> 64	53.3				20.0	26.7							6.7	20.0	26.7
Tetracycline	*Campylobacter jejuni*	Ontario	52	0.5	> 64	46.2				21.2	21.2	9.6	1.9						15.4	30.8
Tetracycline	*Campylobacter jejuni*	Québec	51	64	> 64	66.7				9.8	9.8	5.9	5.9		2.0				29.4	37.3
Tetracycline	*Campylobacter* spp.	British Columbia	21	0.25	64	28.6				19.0	38.1	4.8	9.5					4.8	19.0	4.8
Tetracycline	*Campylobacter* spp.	Saskatchewan	7	0.5	> 64	42.9				42.9		14.3							28.6	14.3
Tetracycline	*Campylobacter* spp.	Ontario	28	32	> 64	53.6				14.3	21.4	7.1	3.6					17.9	14.3	21.4
Tetracycline	*Campylobacter* spp.	Québec	24	64	> 64	58.3				12.5	25.0	4.2							12.5	45.8
IV																				

RECOVERY RESULTS

Table 25. *Retail Meat Surveillance* recovery rates

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						
		2013	**47%**	40/85						
	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						
		2013	**53%**	48/90						
	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						
		2013	**58%**	104/180						
	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						
		2013	**58%**	104/180						
	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						
		2013[e]	**TBD**							

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.
TBD = To be determined.

[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.

[e] At the time this chapter was published, all recovery data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

Table 25. *Retail Meat Surveillance* recovery rates (cont'd)

CIPARS 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		
		2013	**95%**	57/60	**24%**	28/118	**42%**	50/118		
	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		
		2013	**97%**	58/60	**32%**	38/120	**20%**	24/120		
	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		
		2013	**93%**	110/118	**39%**	89/231	**35%**	83/234		
	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		
		2013	**90%**	105/117	**37%**	89/243	**23%**	55/243		
	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		
		2013[e]	**TBD**		**TBD**		**TBD**			

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.

TBD = To be determined.

[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 Maritime provinces, 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.

[e] At the time this chapter was published, all recovery data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

Table 25. *Retail Meat Surveillance* recovery rates (cont'd)

CIPARS 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				
		2013	28%	33/118	0%	0/118				
	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				
		2013	24%	28/119	3%	3/120				
	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				
		2013	43%	100/233	1%	3/232				
	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				
		2013	20%	48/239	<1%	1/239				
	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				
		2013[e]	TBD		TBD					
Turkey	British Columbia	2011	97%	59/61	11%	8/71	24%	17/71		
		2012	97%	101/104	18%	27/153	22%	33/153		
		2013	98%	59/60	26%	30/115	22%	25/115		
	Saskatchewan	2011[a]	100%	10/10	20%	2/10	10%	1/10		
		2012	91%	81/89	14%	18/128	5%	6/128		
		2013	90%	56/62	23%	25/107	4%	4/105		
	Ontario	2011	95%	162/171	14%	27/191	9%	18/191		
		2012	97%	152/156	20%	44/223	9%	20/223		
		2013	95%	115/121	12%	'28/228	12%	27/227		
	Québec	2011	91%	138/152	17%	27/163	10%	16/163		
		2012	96%	170/178	21%	51/246	6%	15/246		
		2013	89%	98/110	32%	57/177	9%	16/178		

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.

TBD = To be determined.

[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.

[e] At the time this chapter was published, all recovery data from the Maritimes region were pending entry into the CIPARS laboratory software and central data repository. These data will be presented in future publications as soon as a technical solution is available.

ABATTOIR SURVEILLANCE

KEY FINDINGS

BEEF CATTLE

ESCHERICHIA COLI (n = 64)

Three percent of *E. coli* isolates (2/64) were resistant to nalidixic acid in 2013, and in 2012 only 1 isolate (1%, 1/165) was resistant to this antimicrobial. Prior to 2012, the previous occurrence of this resistance in CIPARS Abattoir surveillance was 1 isolate (less than 1%, 1/167) in 2004 (Figure 15).
Six percent (4/64) of isolates were resistant to ampicillin. Although low, this is the highest level seen since 2004 and is significantly higher than in 2012 (1%, 2/165) (Figure 15).
Ceftiofur resistance remains at zero for *E. coli* isolates from beef cattle.
Five percent of isolates (3/64) were resistant to trimethoprim-sulfamethoxazole which is significantly higher than in 2012 (0%, 0/165) (Figure 15). The previous high was 1% (1/119) in 2009 (Figure 15).
The percentage of isolates with resistance to 4 or 5 classes of antimicrobials has risen from 1% (1/165) in 2012 to 8% (5/64) in 2013 and resistance to 1 class of antimicrobials has dropped from 19% (32/165) in 2012 to 9% (6/64) in 2013 (Table 26).

CAMPYLOBACTER (n = 59)

The slight increase in resistance to ciprofloxacin that was observed from 2011 (1%, 1/108) to 2012 (5%, 8/152) continued into 2013 (5%, 3/59) (Figure 16).

CHICKENS

SALMONELLA (n = 107)

Recovery of *Salmonella* in chickens continued to decline to 16% (105/672) from a peak of 28% (234/851) in 2008. This is similar to levels from the first 3 years of the program (2003 to 2005) (Table 42).
All *S*. Enteritidis isolates were susceptible to all antimicrobials tested (Table 28).
The decrease in the proportion of isolates resistant to ampicillin and ceftiofur between 2011 (36% 50/140 and 31% 43/140, respectively) and 2012 (24%, 30/126 and 20%, 25/126, respectively) was maintained in 2013, (21%, 22/107 and 19%, 20/107, respectively). However,

resistance to ceftiofur was significantly higher in 2013 (19%, 20/107) than in 2006 (10%, 19/187) (Figure 17).
Resistance to streptomycin and tetracycline was significantly higher in 2013 (41%, 44/107 and 39%, 42/107, respectively) than in 2003(24%, 30/126 and 19%, 14/126, respectively) (Figure 17).
The Livingstone serovar was the 4th most common in 2013 and all 8 isolates were resistant to 2 or 3 classes of antimicrobials (Table 28).
The percentage of isolates classified as "Less common serovars" increased from 12% of isolates (12/104) in 2012 to 20% of isolates (21/107) in 2013 indicating more diversity in this population (Table 28).

ESCHERICHIA COLI (n = 174)

Resistance to nalidixic acid was at a high of 8% (14/173) in 2012 but returned to a more typical 4% (7/174) in 2013 (Figure 18).
Resistance to tetracycline was significantly lower in 2013 (49%, 85/174) than in 2003 (69%, 106/153) (Figure 18).
Resistance to trimethoprim-sulfamethoxazole was significantly higher in 2013 (18%, 31/174) than in 2003 (8%, 12/153) (Figure 18).

CAMPYLOBACTER (n = 138)

Resistance to ciprofloxacin significantly increased from 4% (4/111) in 2010 to 14% (19/138) in 2013 (Figure 19).

PIGS

SALMONELLA (n = 181)

Resistance to trimethoprim-sulfamethoxazole was significantly higher in 2013 (7%, 13/181) than in 2003 (2%, 8/391) (Figure 20).

ESCHERICHIA COLI (n = 171)

Resistance to tetracycline was significantly lower in 2013 (74%, 127/171) than in 2012 (84%, 154/184) (Figure 21).

CAMPYLOBACTER (n = 254)

Thirty-two percent (79/248) of *C. coli* isolates were resistant to 4 or 5 classes of antimicrobials (Table 33).

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					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	64	47	6	6	5		1		7	4					10	3		4		2	17

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively
In 2013, the number of samples received from abattoir beef cattle was much lower than anticipated due to a drop in submissions related to unavoidable operational issues at 2 major participating abattoirs.

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					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	50 (84.7)	21	27	2									2	2	29
Campylobacter coli	9 (15.3)	2	6	1									1	1	7
Total	**59 (100)**	**23**	**33**	**3**									**3**	**3**	**36**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance in human medicine, respectively.
In 2013, the number of samples received from abattoir beef cattle was much lower than anticipated due to a drop in submissions related to unavoidable operational issues at 2 major participating abattoirs.

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					Number of isolates resistant by antimicrobial class and antimicrobial															
							Aminoglycosides			β-Lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Kentucky	40 (37.4)	9	4	27					27	16	16	16	16	16							27
Heidelberg	15 (14.0)	12	3							3	3	3	3	3							
Enteritidis	14 (13.1)	14																			
Livingstone	8 (7.5)			8					8						8						8
Anatum	3 (2.8)	2	1						1												
Infantis	3 (2.8)	3																			
Kiambu	3 (2.8)	1	2												2	2					
Less common serovars	21 (19.6)	12	1	8			1		8	3	1	1	1	1	5						7
Total	**107 (100)**	**53**	**11**	**43**			**1**		**44**	**22**	**20**	**20**	**20**	**20**	**15**	**2**					**42**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
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 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					Number of isolates resistant by antimicrobial class and antimicrobial															
							Aminoglycosides			β-Lactams					Folate pathway inhibitors		Macrolides	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	AZM	CHL	CIP	NAL	TET
Chickens	174	48	21	69	33		20	29	79	68	35	36	35	36	78	31		5		7	86

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
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					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	123 (89.1)	67	41	14	1			3	2	4	4		16	16	49
Campylobacter coli	12 (8.7)	6	4	1	1			2	2	2	2		1	1	4
Campylobacter spp.	3 (2.2)		2		1				1	1	1		2	3	1
Total	**138 (100)**	**73**	**47**	**15**	**3**			**5**	**5**	**7**	**7**		**19**	**20**	**54**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
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 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	48 (26.5)	5	9	33	1		2	1	27	4	1	1	1	1	32	6		1			41
Typhimurium var. 5-	19 (10.5)	2	5		12			4	12	12					12	1		9			16
Infantis	18 (9.9)	13	3		2		1	1	2	4	3	3	3	3	2	1		2			3
Bovismorbificans	11 (6.1)	6	2		3				3	5					3						3
Typhimurium	11 (6.1)	1	1	1	8			2	9	8					9	2		7			9
Brandenburg	10 (5.5)	8	2																		2
Give	10 (5.5)	8	1		1				1	2	1	1	1	1	1			1			1
London	9 (5.0)	9																			
Berta	6 (3.3)	2	4																		4
Schwarzengrund	6 (3.3)	5	1												1	1					
4,5,12:i:-	5 (2.8)	2			3			2	3	3					3						3
Uganda	4 (2.2)	4																			
Less common serovars	24 (13.3)	18	1	4	1			3	3	1					3	1	1	1			6
Total	**181 (100)**	**83**	**29**	**38**	**31**		**3**	**13**	**60**	**39**	**5**	**5**	**5**	**5**	**66**	**12**	**1**	**21**			**88**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
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 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	171	28	30	80	33		5	29	69	66	3	2	3	2	67	19	1	28		1	127

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

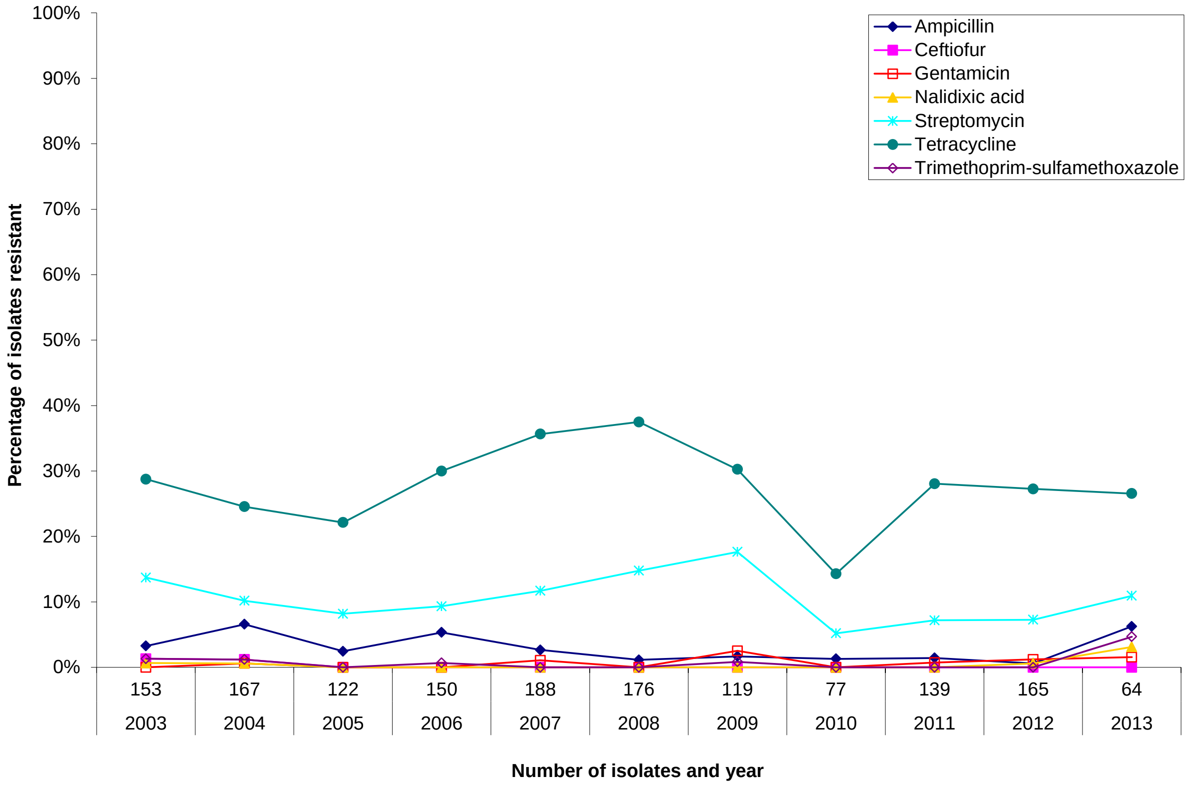
Table 33. Number of antimicrobial classes in resistance patterns of *Campylobacter* from pigs

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
Campybacter coli	248 (97.6)	35	63	71	79			100	110	122	122		33	33	196
Campylobacter spp.	4 (1.6)	1	1	2					1					3	1
Campylobacter jejuni	2 (0.8)		1	1					1	1	1				2
Total	**254 (100)**	**36**	**65**	**74**	**79**			**100**	**112**	**123**	**123**		**33**	**36**	**199**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
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

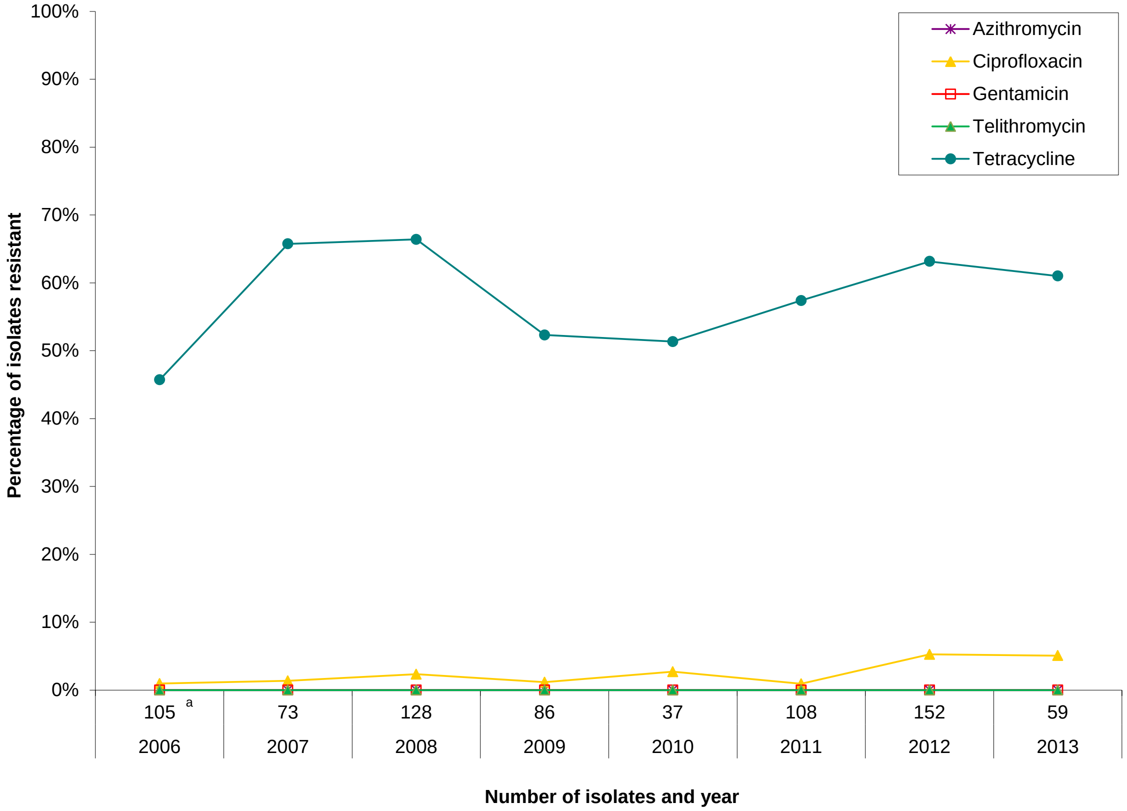
Figure 15. Temporal variations in resistance of *Escherichia coli* isolates from beef cattle



Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of isolates	153	167	122	150	188	176	119	77	139	165	64
Antimicrobial											
Ampicillin	**3%**	7%	2%	5%	3%	1%	2%	1%	1%	**1%**	**6%**
Ceftiofur	**1%**	1%	0%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Gentamicin	**0%**	1%	0%	0%	1%	0%	3%	0%	1%	**1%**	**2%**
Nalidixic acid	**1%**	1%	0%	0%	0%	0%	0%	0%	0%	**1%**	**3%**
Streptomycin	**14%**	10%	8%	9%	12%	15%	18%	5%	7%	**7%**	**11%**
Tetracycline	**29%**	25%	22%	30%	36%	38%	30%	14%	28%	**27%**	**27%**
Trimethoprim-sulfamethoxazole	**1%**	1%	0%	1%	0%	0%	1%	0%	0%	**0%**	**5%**

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

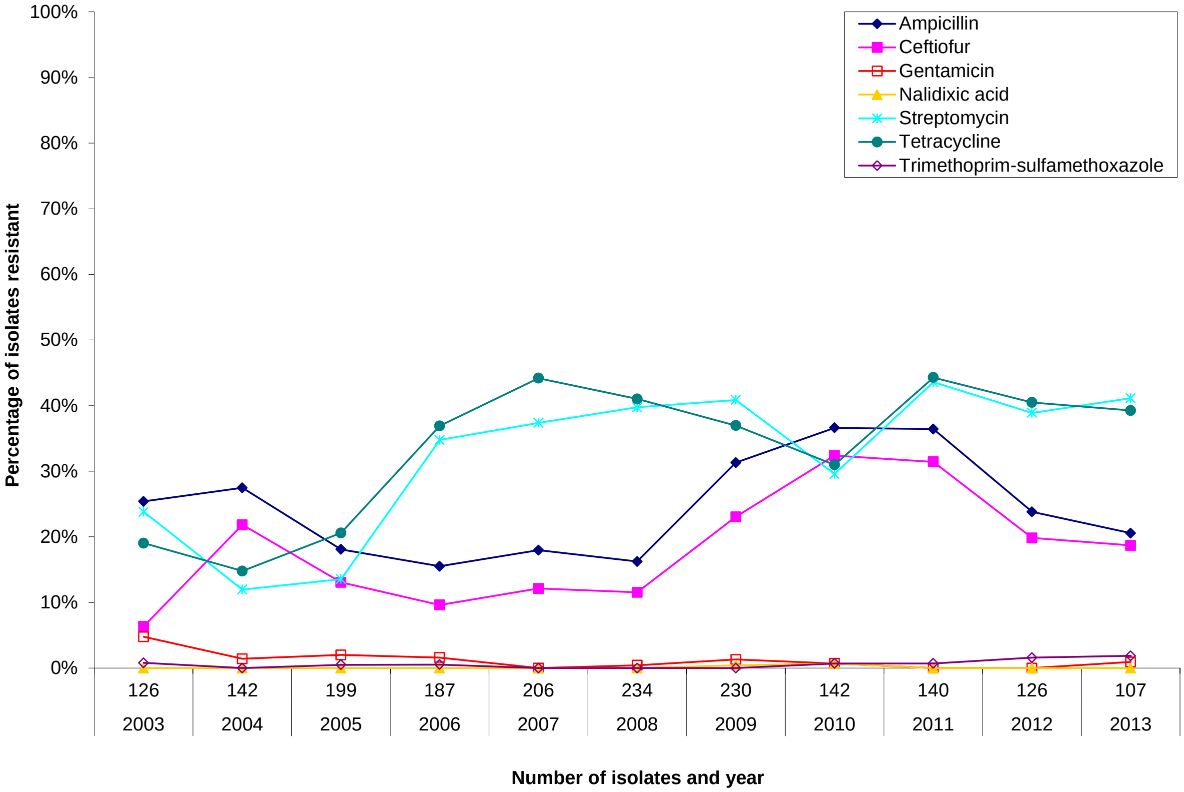


Year Number of isolates	2006 105[a]	2007 73	2008 128	2009 86	2010 37	2011 108	2012 152	2013 59
Antimicrobial								
Azithromycin	**0%**	0%	0%	0%	0%	0%	**0%**	**0%**
Ciprofloxacin	**1%**	1%	2%	1%	3%	1%	**5%**	**5%**
Gentamicin	**0%**	0%	0%	0%	0%	0%	**0%**	**0%**
Telithromycin	**0%**	0%	0%	0%	0%	0%	**0%**	**0%**
Tetracycline	**46%**	66%	66%	52%	51%	57%	**63%**	**61%**

[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

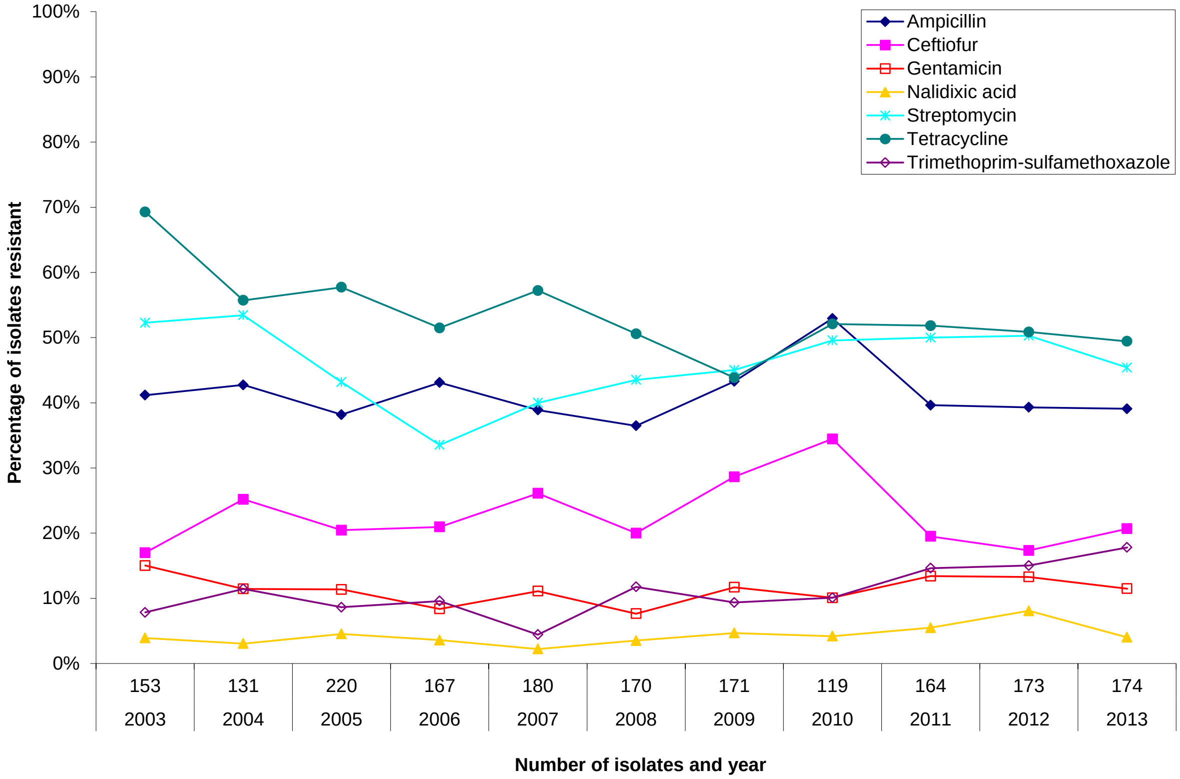


Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of isolates	126	142	199	187	206	234	230	142	140	126	107
Antimicrobial											
Ampicillin	**25%**	**27%**	18%	**16%**	18%	16%	31%	37%	36%	**24%**	**21%**
Ceftiofur	**6%**	**22%**	13%	**10%**	12%	12%	23%	32%	31%	**20%**	**19%**
Gentamicin	**5%**	1%	2%	2%	0%	0%	1%	1%	0%	**0%**	**1%**
Nalidixic acid	**0%**	0%	0%	0%	0%	0%	0%	1%	0%	**0%**	**0%**
Streptomycin	**24%**	12%	14%	35%	37%	40%	41%	30%	44%	**39%**	**41%**
Tetracycline	**19%**	15%	21%	37%	44%	41%	37%	31%	44%	**40%**	**39%**
Trimethoprim-sulfamethoxazole	**1%**	0%	1%	1%	0%	0%	0%	1%	1%	**2%**	**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 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

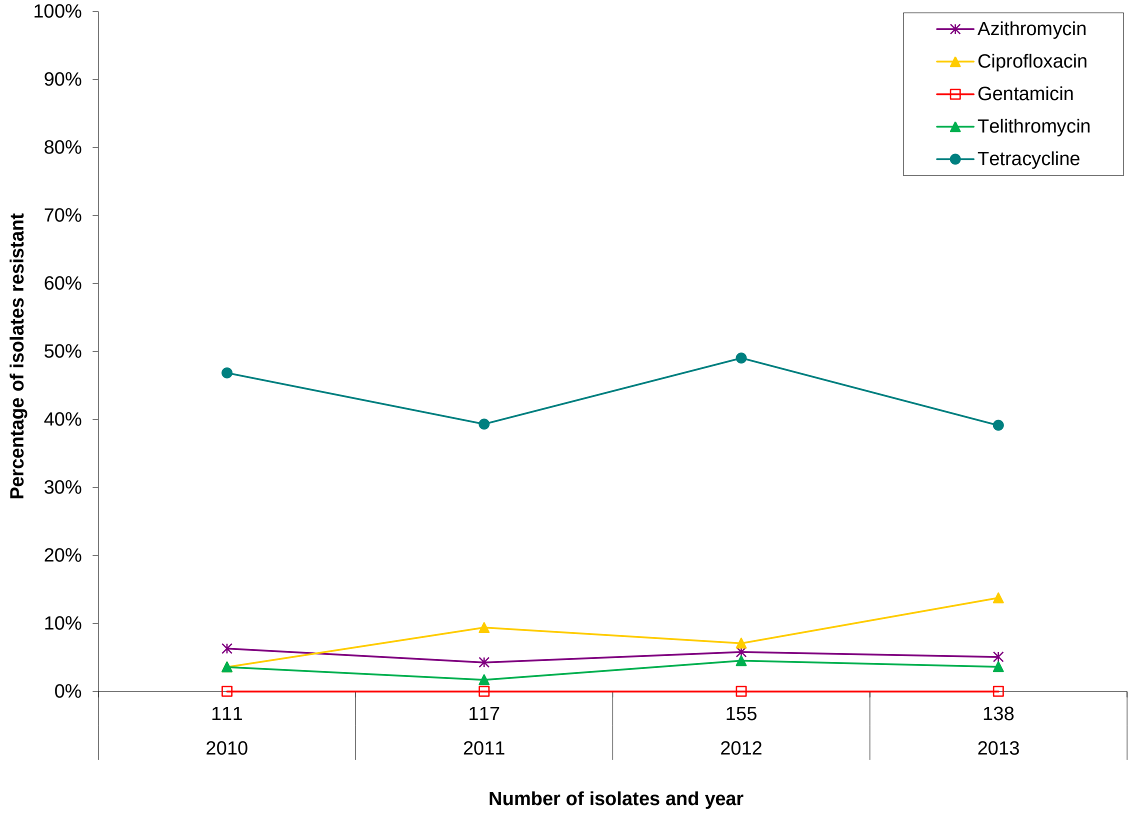


Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of isolates	153	131	220	167	180	170	171	119	164	173	174
Antimicrobial											
Ampicillin	**41%**	**43%**	38%	**43%**	39%	36%	43%	53%	40%	**39%**	**39%**
Ceftiofur	**17%**	**25%**	20%	**21%**	26%	20%	29%	34%	20%	**17%**	**21%**
Gentamicin	**15%**	11%	11%	8%	11%	8%	12%	10%	13%	**13%**	**11%**
Nalidixic acid	**4%**	3%	5%	4%	2%	4%	5%	4%	5%	**8%**	**4%**
Streptomycin	**52%**	53%	43%	34%	40%	44%	45%	50%	50%	**50%**	**45%**
Tetracycline	**69%**	56%	58%	51%	57%	51%	44%	52%	52%	**51%**	**49%**
Trimethoprim-sulfamethoxazole	**8%**	11%	9%	10%	4%	12%	9%	10%	15%	**15%**	**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.

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.

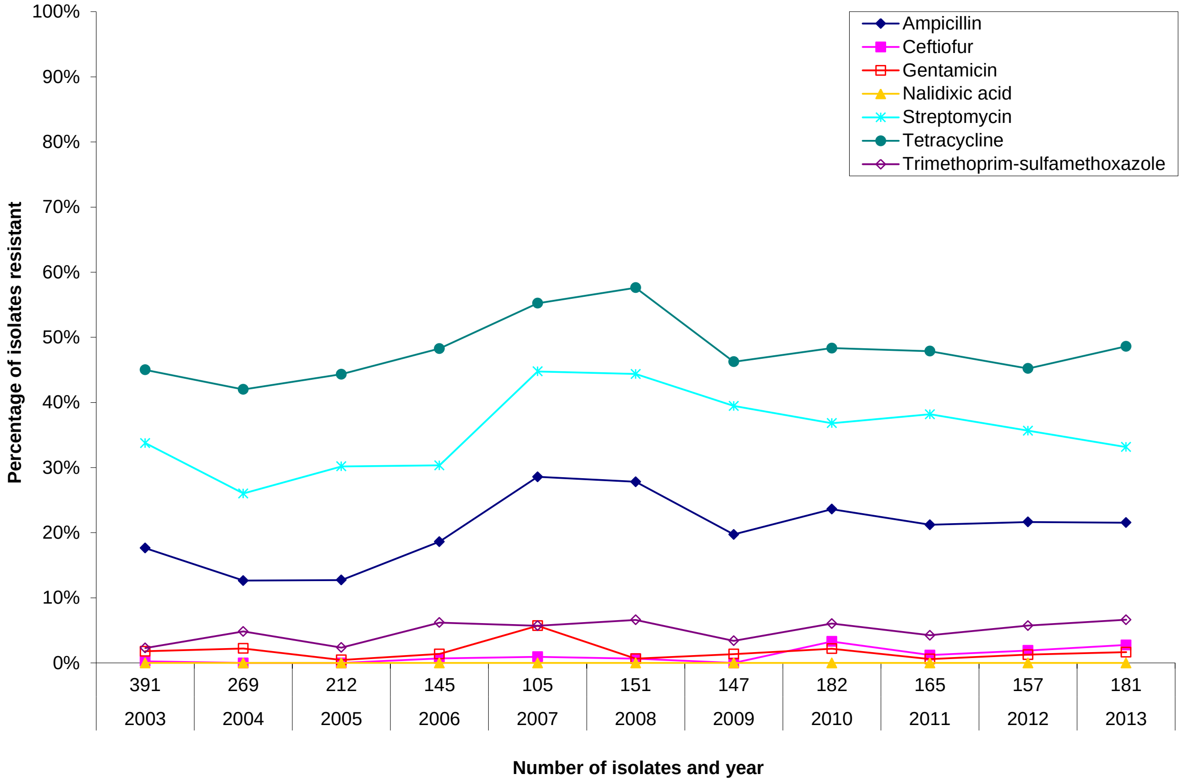
Figure 19. Temporal variations in resistance of *Campylobacter* isolates from chickens



Year Number of isolates	2010 111	2011 117	2012 155	2013 138
Antimicrobial				
Azithromycin	**6%**	4%	**6%**	**5%**
Ciprofloxacin	**4%**	9%	**7%**	**14%**
Gentamicin	**0%**	0%	**0%**	**0%**
Telithromycin	**4%**	2%	**5%**	**4%**
Tetracycline	**47%**	39%	**49%**	**39%**

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.

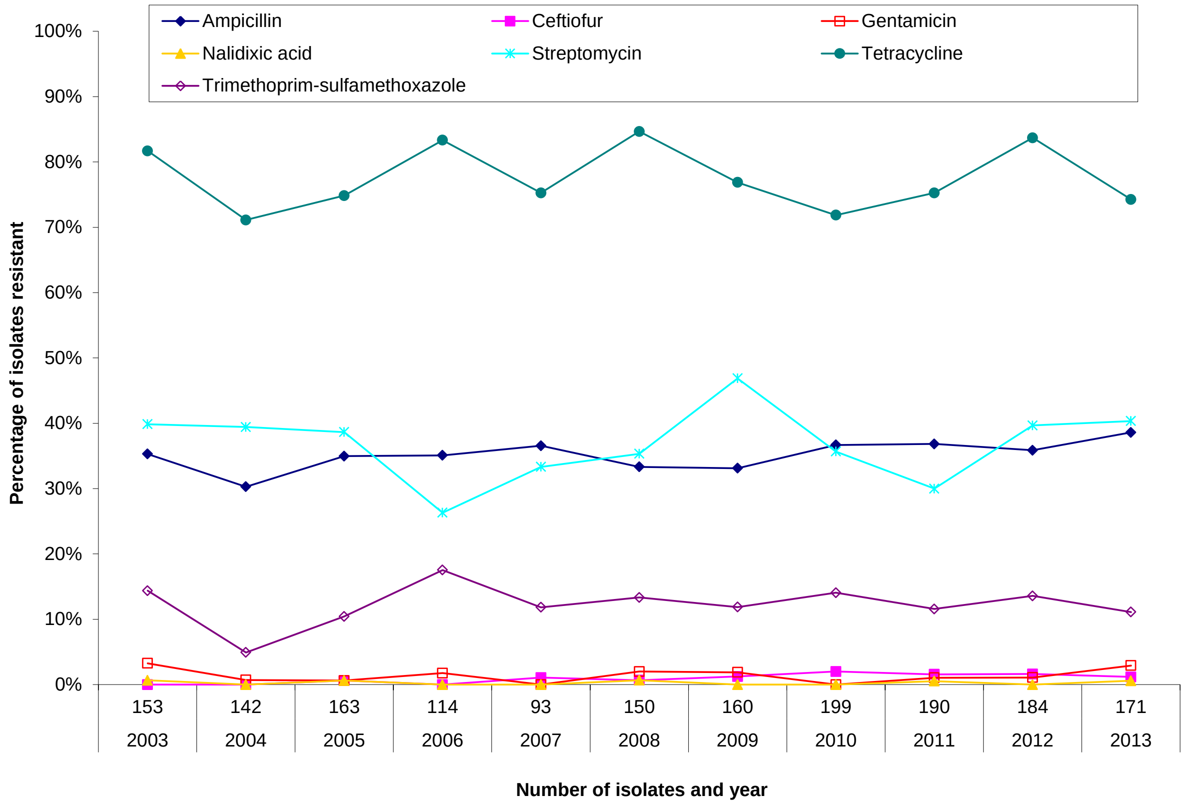
Figure 20. Temporal variations in resistance of *Salmonella* isolates from pigs



Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of isolates	391	269	212	145	105	151	147	182	165	157	181
Antimicrobial											
Ampicillin	**18%**	13%	13%	19%	29%	28%	20%	24%	21%	**22%**	**22%**
Ceftiofur	**0%**	0%	0%	1%	1%	1%	0%	3%	1%	**2%**	**3%**
Gentamicin	**2%**	2%	0%	1%	6%	1%	1%	2%	1%	**1%**	**2%**
Nalidixic acid	**0%**	0%	0%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Streptomycin	**34%**	26%	30%	30%	45%	44%	39%	37%	38%	**36%**	**33%**
Tetracycline	**45%**	42%	44%	48%	55%	58%	46%	48%	48%	**45%**	**49%**
Trimethoprim-sulfamethoxazole	**2%**	5%	2%	6%	6%	7%	3%	6%	4%	**6%**	**7%**

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



Year Number of isolates	2003 153	2004 142	2005 163	2006 114	2007 93	2008 150	2009 160	2010 199	2011 190	2012 184	2013 171
Antimicrobial											
Ampicillin	**35%**	30%	35%	35%	37%	33%	33%	37%	37%	**36%**	**39%**
Ceftiofur	**0%**	0%	1%	0%	1%	1%	1%	2%	2%	**2%**	**1%**
Gentamicin	**3%**	1%	1%	2%	0%	2%	2%	0%	1%	**1%**	**3%**
Nalidixic acid	**1%**	0%	1%	0%	0%	1%	0%	0%	1%	**0%**	**1%**
Streptomycin	**40%**	39%	39%	26%	33%	35%	47%	36%	30%	**40%**	**40%**
Tetracycline	**82%**	71%	75%	83%	75%	85%	77%	72%	75%	**84%**	**74%**
Trimethoprim-sulfamethoxazole	**14%**	5%	10%	18%	12%	13%	12%	14%	12%	**14%**	**11%**

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

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

	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	64	4	8	0.0							1.6	21.9	60.9	15.6						
	Ceftiofur	64	0.50	0.50	0.0				4.7	34.4	59.4	1.6									
	Ceftriaxone	64	≤ 0.25	≤ 0.25	0.0					100.0											
	Ciprofloxacin	64	≤ 0.015	≤ 0.015	0.0	96.9				3.1											
II	Ampicillin	64	2	4	6.3							7.8	45.3	40.6				6.3			
	Azithromycin	64	4	4	0.0								17.2	76.6	6.3						
	Cefoxitin	64	4	8	0.0							4.7	12.5	67.2	14.1	1.6					
	Gentamicin	64	0.50	1	1.6					1.6	60.9	35.9					1.6				
	Kanamycin	64	≤ 8	≤ 8	0.0										100.0						
	Nalidixic acid	64	2	4	3.1							9.4	70.3	15.6	1.6			3.1			
	Streptomycin	64	≤ 32	64	10.9												89.1	6.3	4.7		
	Trimethoprim-sulfamethoxazole	64	≤ 0.12	≤ 0.12	4.7				90.6	4.7					4.7						
III	Chloramphenicol	64	8	8	6.3								4.7	21.9	64.1	3.1		6.3			
	Sulfisoxazole	64	≤ 16	> 256	15.6											70.3	14.1				15.6
	Tetracycline	64	≤ 4	> 32	26.6									68.8	4.7	3.1	3.1	20.3			
IV																					

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

	Antimicrobial	Species	n	Percentiles MIC 50	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*	9	0.125	64	11.1				66.7	22.2								11.1	
	Ciprofloxacin	*Campylobacter jejuni*	50	0.125	0.25	4.0			18.0	64.0	14.0					4.0				
	Telithromycin	*Campylobacter coli*	9	4	4	0.0								33.3	66.7					
	Telithromycin	*Campylobacter jejuni*	50	1	2	0.0					2.0	28.0	54.0	14.0		2.0				
II	Azithromycin	*Campylobacter coli*	9	0.125	0.25	0.0				88.9	11.1									
	Azithromycin	*Campylobacter jejuni*	50	0.032	0.064	0.0	2.0	60.0	30.0	8.0										
	Clindamycin	*Campylobacter coli*	9	1	1	0.0					11.1	22.2	66.7							
	Clindamycin	*Campylobacter jejuni*	50	0.125	0.25	0.0			6.0	68.0	26.0									
	Erythromycin	*Campylobacter coli*	9	2	2	0.0							22.2	77.8						
	Erythromycin	*Campylobacter jejuni*	50	0.5	0.5	0.0				2.0	42.0	48.0	8.0							
	Gentamicin	*Campylobacter coli*	9	1	1	0.0						22.2	77.8							
	Gentamicin	*Campylobacter jejuni*	50	1	1	0.0						16.0	78.0	6.0						
	Nalidixic acid	*Campylobacter coli*	9	16	> 64	11.1										33.3	55.6			11.1
	Nalidixic acid	*Campylobacter jejuni*	50	≤ 4	8	4.0									74.0	22.0				4.0
III	Florfenicol	*Campylobacter coli*	9	2	2	0.0							22.2	77.8						
	Florfenicol	*Campylobacter jejuni*	50	1	2	0.0						6.0	84.0	10.0						
	Tetracycline	*Campylobacter coli*	9	> 64	> 64	77.8						11.1	11.1							77.8
	Tetracycline	*Campylobacter jejuni*	50	32	> 64	58.0				22.0	12.0	6.0	2.0				4.0	6.0	26.0	22.0
IV																				

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

	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	107	≤ 1	> 32	18.7							77.6	1.9			1.9	0.9	17.8			
I	Ceftiofur	107	1	> 8	18.7					0.9	29.0	48.6	2.8			18.7					
I	Ceftriaxone	107	≤ 0.25	16	18.7					81.3						13.1	4.7	0.9			
I	Ciprofloxacin	107	≤ 0.015	≤ 0.015	0.0	90.7	7.5	1.9													
II	Ampicillin	107	≤ 1	> 32	20.6							72.9	4.7	1.9				20.6			
II	Azithromycin	107	4	8	0.0							0.9	14.0	65.4	19.6						
II	Cefoxitin	107	2	32	18.7						0.9	18.7	45.8	15.9			15.9	2.8			
II	Gentamicin	107	0.50	1	0.9					17.8	72.0	9.3				0.9					
II	Kanamycin	107	≤ 8	≤ 8	0.0										100.0						
II	Nalidixic acid	107	4	4	0.0							1.9	45.8	49.5	2.8						
II	Streptomycin	107	≤ 32	> 64	41.1												58.9	12.1	29.0		
II	Trimethoprim-sulfamethoxazole	107	≤ 0.12	≤ 0.12	1.9				91.6	5.6	0.9				1.9						
III	Chloramphenicol	107	8	8	0.0								4.7	37.4	57.0	0.9					
III	Sulfisoxazole	107	32	> 256	14.0											14.0	49.5	21.5	0.9		14.0
III	Tetracycline	107	≤ 4	> 32	39.3									60.7				39.3			
IV																					

Distribution (%) of MICs (µg/mL)

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

	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	174	4	32	20.1								12.6	43.1	21.8	2.3	12.6	7.5			
I	Ceftiofur	174	0.50	> 8	20.7				0.6	21.8	50.0	6.3	0.6		9.8	10.9					
I	Ceftriaxone	174	≤ 0.25	16	20.7					76.4	0.6	2.3			4.6	12.1	2.9	1.1			
I	Ciprofloxacin	174	≤ 0.015	≤ 0.015	0.0	92.5	3.4			4.0											
II	Ampicillin	174	4	> 32	39.1							5.2	25.9	28.7	1.1			39.1			
II	Azithromycin	174	4	8	0.0							1.1	22.4	60.9	15.5						
II	Cefoxitin	174	4	> 32	20.1								5.2	51.1	21.8	1.7	3.4	16.7			
II	Gentamicin	174	0.50	16	11.5					4.0	48.3	33.9	0.6	0.6	1.1	2.3	9.2				
II	Kanamycin	174	≤ 8	> 64	16.7										81.6	1.7			16.7		
II	Nalidixic acid	174	2	4	4.0						0.6	11.5	72.4	11.5				4.0			
II	Streptomycin	174	≤ 32	> 64	45.4												54.6	13.8	31.6		
II	Trimethoprim-sulfamethoxazole	174	≤ 0.12	> 4	17.8				70.1	10.3	1.7				17.8						
III	Chloramphenicol	174	8	8	2.9								2.9	36.2	54.6	3.4		2.9			
III	Sulfisoxazole	174	32	> 256	44.8											44.8	9.8			0.6	44.8
III	Tetracycline	174	≤ 4	> 32	49.4									50.6			7.5	42.0			
IV																					

Distribution (%) of MICs (µg/mL)

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

	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*	12	0.125	0.5	8.3			25.0	41.7	16.7	8.3					8.3			
I	Ciprofloxacin	*Campylobacter jejuni*	123	0.125	8	13.0			16.3	54.5	15.4	0.8				4.1	8.9			
I	Ciprofloxacin	*Campylobacter* spp.	3	4	4	66.7			33.3						66.7					
I	Telithromycin	*Campylobacter coli*	12	1	16	16.7					41.7	8.3	8.3	25.0			16.7			
I	Telithromycin	*Campylobacter jejuni*	123	0.5	2	2.4					8.9	48.8	29.3	9.8		0.8	2.4			
I	Telithromycin	*Campylobacter* spp.	3	4	4	0.0						33.3			66.7					
II	Azithromycin	*Campylobacter coli*	12	0.125	> 64	16.7		8.3	41.7	33.3										16.7
II	Azithromycin	*Campylobacter jejuni*	123	0.064	0.125	3.3	1.6	38.2	37.4	18.7	0.8									3.3
II	Azithromycin	*Campylobacter* spp.	3	0.25	> 64	33.3				33.3	33.3									33.3
II	Clindamycin	*Campylobacter coli*	12	0.25	8	16.7				50.0	16.7	16.7				8.3	8.3			
II	Clindamycin	*Campylobacter jejuni*	123	0.125	0.25	1.6			13.8	52.8	26.8	3.3			1.6	1.6				
II	Clindamycin	*Campylobacter* spp.	3	0.25	16	33.3				33.3	33.3						33.3			
II	Erythromycin	*Campylobacter coli*	12	0.5	> 64	16.7					41.7	25.0	16.7							16.7
II	Erythromycin	*Campylobacter jejuni*	123	0.25	1	3.3				2.4	49.6	36.6	8.1							3.3
II	Erythromycin	*Campylobacter* spp.	3	4	> 64	33.3						33.3			33.3					33.3
II	Gentamicin	*Campylobacter coli*	12	0.5	1	0.0					8.3	50.0	41.7							
II	Gentamicin	*Campylobacter jejuni*	123	1	1	0.0				1.6	0.8	40.7	56.9							
II	Gentamicin	*Campylobacter* spp.	3	2	2	0.0						33.3		66.7						
II	Nalidixic acid	*Campylobacter coli*	12	≤ 4	16	8.3									58.3	25.0	8.3			8.3
II	Nalidixic acid	*Campylobacter jejuni*	123	≤ 4	> 64	13.0									56.9	30.1			0.8	12.2
II	Nalidixic acid	*Campylobacter* spp.	3	> 64	> 64	100.0													33.3	66.7
III	Florfenicol	*Campylobacter coli*	12	1	2	0.0						8.3	75.0	16.7						
III	Florfenicol	*Campylobacter jejuni*	123	1	1	0.0						4.9	86.2	8.9						
III	Florfenicol	*Campylobacter* spp.	3	1	2	0.0						33.3	33.3	33.3						
III	Tetracycline	*Campylobacter coli*	12	0.5	> 64	33.3					33.3	25.0	8.3							33.3
III	Tetracycline	*Campylobacter jejuni*	123	0.25	> 64	39.8				22.0	28.5	4.1	2.4	0.8	2.4		0.8	3.3	14.6	21.1
III	Tetracycline	*Campylobacter* spp.	3	0.25	32	33.3					66.7							33.3		
IV																				

Distribution (%) of MICs (µg/mL)

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	181	≤ 1	16	2.8							72.9	6.1	2.8	6.1	9.4	1.1	1.7			
I	Ceftiofur	181	1	2	2.8					1.1	24.3	64.1	7.7			2.8					
I	Ceftriaxone	181	≤ 0.25	≤ 0.25	2.8					96.7	0.6					1.1	0.6	1.1			
I	Ciprofloxacin	181	≤ 0.015	0.03	0.0	87.3	10.5	2.2													
II	Ampicillin	181	≤ 1	> 32	21.5							69.6	6.6	1.7		0.6		21.5			
II	Azithromycin	181	4	8	0.6						0.6	0.6	7.7	69.6	18.2	2.8	0.6				
II	Cefoxitin	181	2	8	2.8						0.6	12.7	44.2	31.5	7.7	0.6	0.6	2.2			
II	Gentamicin	181	0.50	1	1.7					19.9	68.5	9.9				1.7					
II	Kanamycin	181	≤ 8	≤ 8	7.2										92.8				7.2		
II	Nalidixic acid	181	4	4	0.0							0.6	40.9	54.1	4.4						
II	Streptomycin	181	≤ 32	> 64	33.1												66.9	5.5	27.6		
II	Trimethoprim-sulfamethoxazole	181	≤ 0.12	0.25	6.6				74.6	16.0	2.8				6.6						
III	Chloramphenicol	181	8	> 32	11.6								1.1	22.1	61.3	3.9	0.6	11.0			
III	Sulfisoxazole	181	64	> 256	36.5											11.0	32.0	20.4			36.5
III	Tetracycline	181	≤ 4	> 32	48.6									51.4			4.4	44.2			
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	171	4	8	1.8							1.8	15.8	39.8	37.4	3.5	0.6	1.2			
I	Ceftiofur	171	0.50	0.50	1.2				1.8	34.5	59.1	2.9	0.6		0.6	0.6					
I	Ceftriaxone	171	≤ 0.25	≤ 0.25	1.2					98.2		0.6				0.6	0.6				
I	Ciprofloxacin	171	≤ 0.015	≤ 0.015	0.0	96.5	0.6	0.6	1.2	0.6	0.6										
II	Ampicillin	171	4	> 32	38.6							4.1	28.1	26.9	1.2	1.2		38.6			
II	Azithromycin	171	4	8	0.6							1.8	17.0	70.2	10.5		0.6				
II	Cefoxitin	171	4	8	1.8							0.6	13.5	63.7	18.7	1.8		1.8			
II	Gentamicin	171	0.50	1	2.9					7.0	59.6	30.4				0.6	2.3				
II	Kanamycin	171	≤ 8	> 64	17.0										82.5	0.6		1.2	15.8		
II	Nalidixic acid	171	2	4	0.6							11.1	74.3	12.9	0.6	0.6		0.6			
II	Streptomycin	171	≤ 32	> 64	40.4												59.6	16.4	24.0		
II	Trimethoprim-sulfamethoxazole	171	≤ 0.12	> 4	11.1				70.2	16.4	1.2	0.6	0.6		11.1						
III	Chloramphenicol	171	8	32	16.4								1.8	29.8	50.3	1.8	6.4	9.9			
III	Sulfisoxazole	171	≤ 16	> 256	39.2											53.2	7.0	0.6			39.2
III	Tetracycline	171	> 32	> 32	74.3									24.0	1.8	0.6	6.4	67.3			
IV																					

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

	Antimicrobial	Species	n	Percentiles MIC 50	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*	248	0.125	16	13.3		0.4	9.3	44.4	30.2	2.4				**2.4**	**9.7**	**1.2**		
	Ciprofloxacin	*Campylobacter jejuni*	2	0.125	0.125	0.0				100.0										
	Ciprofloxacin	*Campylobacter* spp.	4	0.25	0.25	0.0			25.0	25.0	50.0									
	Telithromycin	*Campylobacter coli*	248	4	16	40.3					5.7	3.6	11.7	26.6	5.2	6.9	**40.3**			
	Telithromycin	*Campylobacter jejuni*	2	8	8	0.0						50.0				50.0				
	Telithromycin	*Campylobacter* spp.	4	1	2	0.0					25.0		50.0	25.0						
II	Azithromycin	*Campylobacter coli*	248	0.5	> 64	49.2		0.4	19.8	25.0	4.4	0.8	0.4						**0.4**	**48.8**
	Azithromycin	*Campylobacter jejuni*	2	> 64	> 64	50.0		50.0												**50.0**
	Azithromycin	*Campylobacter* spp.	4	0.125	0.5	0.0			50.0	25.0		25.0								
	Clindamycin	*Campylobacter coli*	248	4	16	44.4				4.4	9.3	10.5	3.6	7.7	20.2	**23.4**	**14.5**	**6.5**		
	Clindamycin	*Campylobacter jejuni*	2	8	8	50.0				50.0						**50.0**				
	Clindamycin	*Campylobacter* spp.	4	0.5	> 16	25.0				25.0	25.0	25.0						**25.0**		
	Erythromycin	*Campylobacter coli*	248	4	> 64	49.2					6.1	8.5	27.0	7.7	1.2	0.4		**2.0**	**1.2**	**46.0**
	Erythromycin	*Campylobacter jejuni*	2	> 64	> 64	50.0					50.0									**50.0**
	Erythromycin	*Campylobacter* spp.	4	1	2	0.0					25.0	25.0	25.0	25.0						
	Gentamicin	*Campylobacter coli*	248	1	1	0.0						3.2	89.1	7.3	0.4					
	Gentamicin	*Campylobacter jejuni*	2	1	1	0.0						50.0	50.0							
	Gentamicin	*Campylobacter* spp.	4	1	1	0.0					50.0		50.0							
	Nalidixic acid	*Campylobacter coli*	248	8	> 64	13.3									24.6	55.2	6.9		**1.6**	**11.7**
	Nalidixic acid	*Campylobacter jejuni*	2	≤ 4	≤ 4	0.0									100.0					
	Nalidixic acid	*Campylobacter* spp.	4	> 64	> 64	75.0									25.0				**25.0**	**50.0**
III	Florfenicol	*Campylobacter coli*	248	1	2	0.0						17.3	62.1	19.4	1.2					
	Florfenicol	*Campylobacter jejuni*	2	1	1	0.0							100.0							
	Florfenicol	*Campylobacter* spp.	4	1	1	0.0						25.0	75.0							
	Tetracycline	*Campylobacter coli*	248	> 64	> 64	79.0				0.4	6.1	5.2	2.8	3.6	0.4	2.4	**7.7**	**8.1**	**13.3**	**50.0**
	Tetracycline	*Campylobacter jejuni*	2	64	64	100.0													**100.0**	
	Tetracycline	*Campylobacter* spp.	4	8	16	25.0					25.0					50.0	**25.0**			
IV																				

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

RECOVERY RESULTS

Table 42. *Abattoir surveillance* recovery rates

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		
	2013	**100%**[b]	59/59			**92%**[b]	54/59		
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		
	2013	**99%**	171/172	**16%**	105/672	**21%**	137/662		
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		
	2013	**99%**	166/168	**52%**	171/330	**76%**	237/314		

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 and 2013, the number of samples received from abattoir beef cattle was much lower than anticipated due to substantial 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

GROW-FINISHER PIGS

SALMONELLA (n = 99)

No significant temporal variations were detected in the percentages of *Salmonella* isolates with resistance to the selected antimicrobials between 2013 and 2012 or between 2013 and 2006 (Figure 22).

Although it was not statistically significant, there was an increase in ampicillin resistance from 25% to 40% between 2012 and 2013 (Figure 22). Historically, over the last 7 years, ampicillin resistance has been equal to 35% or less (Figure 22).

No isolates had resistance to greater than 5 classes of antimicrobials (Table 43). Three isolates had resistance to 10 antimicrobials and 5 antimicrobial classes (Table 43). This included 1 Typhimurium var. 5- with an ACKSSuT-A2C-CRO pattern, 1 Mbandaka and 1 Livingston both with the ACSSuT-A2C-CRO-SXT pattern.

ESCHERICHIA COLI (n = 1,573)[14]

Resistance to ampicillin was significantly lower in 2013 (31%) than in 2006 (35%) (Figure 23). Resistance to streptomycin was also significantly lower in 2013 (34%) than in 2006 (37%), or in 2012 (44%) (Figure 23).The percentage of isolates with resistance to ceftiofur was significantly lower in 2013 (1%) than in 2012 (2%) (Figure 23).

No isolates had resistance to greater than 6 classes of antimicrobials (Table 44). Four isolates had resistance to 12 antimicrobials and 6 antimicrobial classes (Table 44). The pattern detected in all 4 of these isolates was A2C-AMP-AZM-CHL-CRO-KAN-SSS-STR-SXT-TET.

[14] Up to 3 generic *E. coli* isolates per positive sample were kept for analysis. The expected number of total isolates was 1,602 (534 x 3) but only 1,573 isolates were collected for antimicrobials susceptibility testing leaving a difference of 29 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.

BROILER CHICKENS

Farm Surveillance in broiler chickens was implemented in April 2013, thus the temporal figures presented in other surveillance components (or *Farm Surveillance* in pigs) are not yet available. The figures included in this section present adjusted prevalence rates of resistance (with lower and upper confidence intervals). The data were adjusted for clustering to account for multiple samples collected per farm. Chick placement (chick pads or environmental swabs) and pre-harvest results are both presented.

SALMONELLA (n = 280)

Chick placement (n = 51)

Across all provinces sampled, the top 3 *Salmonella* serovars were Kentucky, Enteritidis, and Senftenberg (Table 45). Only 1 Heidelberg isolate was isolated (Québec). Provincial differences in serovar distribution were noted with Enteritidis being the most common serovar in British Columbia (71%, 12/17 isolates) and Kentucky in the rest of the provinces sampled: Alberta (50%, 5/10), Ontario (93%, 12/13), and Québec (73%, 8/11) (Table 45). Differences in serovar distribution were also observed in isolates from the 2 types of samples (Table 46). Kentucky was the most common serovar from any sample type, chick pads (57%, 24/42 isolates), environmental swabs (44%, 4/9) (Table 46). Ninety-three percent (14/15) of the Enteritidis were isolated from chick pad samples but all the isolates, including 1 from the environment were susceptible to all antimicrobial tested (Table 46).

No ciprofloxacin and nalidixic acid resistance were observed in any serovar (Figure 24). Provincial differences in the proportion of ceftiofur resistant isolates were noted: British Columbia (18%), Alberta (35%), Ontario (58%), and Québec (0%) (Figure 24). Although not statistically significant, the proportion of resistance to Category I and II β-lactam antimicrobials, except cefoxitin, was slightly higher in environmental isolates (33%) compared to chick pads isolates (26%) (Figure 25). Since the total number of isolates was small, caution in interpreting these results is recommended.

No isolate was resistant to 6 or 7 classes of antimicrobials. Only 1 isolate was resistant to 4 or 5 antimicrobial classes and 19 isolates were resistant to 2 or 3 antimicrobial classes (Table 45 and Table 46). The patterns containing the highest number of antimicrobials were A2C-AMP-CRO-STR-TET and A2C-AMP-CRO. The A2C-AMP-CRO-STR-TET pattern was also the most common in chick placement isolates (n = 7), followed by STR-TET (n = 6).

Pre-harvest (n = 229)

Across all provinces sampled, the top 3 *Salmonella* serovars were Kentucky, Enteritidis, and Heidelberg (Table 49). No Enteritidis isolate was recovered in Québec (Table 49). Provincial differences in serovar distribution were observed at pre-harvest, with Enteritidis being the most common serovar in British Columbia (46%, 31/68) and Kentucky in all other provinces sampled: Alberta (29%, 7/24), Ontario (54%, 35/65), and Québec (50%, 36/72) (Table 49). These results were similar to chick placement (Table 45).

All of the Enteritidis isolates were also susceptible to all antimicrobials tested.

No ciprofloxacin resistance was observed in any serovar (Table 49). Nalidixic acid resistance was observed in 4 Kentucky isolates (4%, 4/89) from British Columbia (Table 49). Across all provinces sampled, ceftiofur resistance was 22% and provincial differences were also observed: British Columbia (18%), Alberta (32%), Ontario (43%), and Québec (4%) (Figure 28). Overall, 23% of isolates exhibited resistance to most of the β-lactams (ampicillin, amoxicillin-clavulanic acid, ceftiofur, and ceftriaxone) but a lower proportion (18%) of isolates were resistant to cefoxitin (Table 49). Number of antimicrobial classes in resistance patterns of *Salmonella* from chickens on farm at pre-harvest is also presented in Table 49. No isolate was resistant to 6 or 7 antimicrobial classes (Table 49). Six isolates were resistant to 4 or 5 classes of antimicrobials and 84 isolates were resistant to 2 or 3 classes of antimicrobials (Table 49). The patterns containing the highest number of antimicrobials were A2C-ACSSuT-CRO and A2C-AMP-CRO-STR-TET. The STR-TET was the most common pattern (n = 40), followed by A2C-AMP-CRO-STR-TET (n=21) and A2C-AMP-CRO (n = 13).

ESCHERICHIA COLI (n = 576)

Chick placement (n = 191)

Overall, generic *E. coli* [15] was recovered in 81% of the samples (Table 60). Nalidixic acid resistance was observed in 4% (adjusted prevalence) of chick pads isolates and 2% of environmental isolates (Figure 27).
Provincial differences in the proportion of ceftiofur resistant isolates were observed: British Columbia (67%), Alberta (68%), Ontario (17%) and Québec (21%) (Figure 26). Sample type differences in the proportion of ceftiofur resistance was also noted: chick pads (44%) and environmental (25%) (Figure 27).
No isolate was resistant to 6 or 7 antimicrobial classes (Table 47 and Table 48). Fifty isolates were resistant to 4 or 5 antimicrobial classes and 67 isolates were resistant to 2 or 3 antimicrobial classes (Table 47 and Table 48). The patterns presenting the highest number of antimicrobials were A2C-AMP and A2C-ACSSUT-CRO-GEN-SXT. The A2C-AMP pattern was the most commun pattern observed.

Pre-harvest (n = 385)

Only 1 chicken *E. coli* isolate, recovered from Ontario was resistant to ciprofloxacin (Table 50). Resistance to azithromycin was detected in 1 isolate from Ontario and 1 isolate from Québec (Table 50). As in placement, resistance to nalidixic acid was noted in 4% of samples: British Columbia (10%), Alberta (8%), Ontario (2%), and Québec (1%) (Figure 29). Across all provinces, resistance to ceftiofur was 30% and provincial differences were also observed: British Columbia (61%), Alberta (42%), Ontario (13%), and Québec (17%) (Figure 29). As in *Salmonella*, the proportion of *E. coli* resistant to β-lactam antimicrobials varied depending on the antimicrobial (ampicillin: 61%, amoxicillin-clavulanic acid: 32%, ceftriaxone, cefoxitin: 32%, and ceftiofur: 30%) (Table 50).

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[15] Consisted of normal avian gut, environmental commensals, and avian pathogenic *E. coli* responsible for yolksacculitis and septicemic diseases. As in other components, isolates were not further characterized.

No isolate was resistant to 6 or 7 antimicrobial classes (Table 50). Ninety isolates were resistant to 4 or 5 antimicrobial classes and 161 isolates were resistant to 2 or 3 antimicrobial classes (Table 50). As in placement, the patterns presenting the highest number of antimicrobials were A2C-ACSSUT-CRO-GEN-SXT and A2C-AMP. The latter pattern (n = 34) was the most common one.

CAMPYLOBACTER (n = 81)

Chick placement

Campylobacter isolation was not done from the chick placement samples because of well documented challenges in recovering the organism from the chicks or newly cleaned barn environment.

Pre-harvest (n = 81)

Overall resistance to ciprofloxacin was 16% and resistant isolates were largely from these 2 provinces: British Columbia (30%), Ontario (20%) (Figure 30). Ciprofloxacine resistance was observed in only 1 isolate in Québec and no ciprofloxacine resistance was noted in Alberta (Figure 30). No azithromycin and telithromycin resistance were observed (Figure 30). No isolates were resistant to 4 or 7 antimicrobial classes (Table 51). Sixteen isolates were resistant to 2 or 3 antimicrobial classes and 35 isolates were resistant to 1 antimicrobial class (Table 51). The pattern presenting the highest number of antimicrobials was CIP-NAL-TET (n = 16).

MULTICLASS RESISTANCE

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

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
National																					
Typhimurium var. 5-	25 (25.3)		7	1	17			1	17	18	2	2	2	2	17	2		16			25
Derby	19 (19.2)	2	1	14	2				16	2					16						16
Infantis	10 (10.1)	9	1																		1
4,5,12:i:-	9 (9.1)				9			6	9	9					9	1	1				9
Brandenburg	8 (8.1)	5			3					3					3			3			3
California	6 (6.1)	4	1	1			2	2	2						1						1
Schwarzengrund	4 (4.0)	4																			
4,12:-:-	3 (3.0)	3																			
4,12:i:-	3 (3.0)		2		1				1	1					1						3
Livingstone	3 (3.0)			2	1				3	1	1	1	1	1	3	1		1			3
Ohio	2 (2.0)	1			1			1	1	1		1		1	1	1					1
Less common serovars	7 (7.1)	3	1	1	2		1		2	3	2	2	2	2	4	3		2			2
Total	**99 (100)**	**31**	**13**	**19**	**36**		**3**	**10**	**51**	**38**	**5**	**6**	**5**	**6**	**55**	**8**	**1**	**22**			**64**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.

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

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	1,573	260	322	703	284	4	16	197	535	489	22	21	18	18	714	210	14	319		5	1186

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.

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

Table 45. Number of antimicrobial classes in resistance patterns of *Salmonella* from chicks and barn environment at chick placement, by province

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	12 (70.6)	12																			
Kentucky	3 (17.6)			3					3	3	3	3	3	3							3
4,5,12:i:-	1 (5.9)	1																			
Tennessee	1 (5.9)				1				1						1			1			1
Total	**17 (100)**	**13**		**3**	**1**				**4**	**3**	**3**	**3**	**3**	**3**	**1**			**1**			**4**
Alberta																					
Kentucky	5 (50.0)			5					5	5	5	5	2	5							5
Enteritidis	3 (30.0)	3																			
Senftenberg	2 (20.0)	2																			
Total	**10 (100)**	**5**		**5**					**5**	**5**	**5**	**5**	**2**	**5**							**5**
Ontario																					
Kentucky	12 (93.3)	6	2	4					4	6	6	6	4	6							4
Senftenberg	1 (7.7)			1			1	1	1						1						1
Total	**13 (100)**	**6**	**2**	**5**			**1**	**1**	**5**	**6**	**6**	**6**	**4**	**6**	**1**						**5**
Québec																					
Kentucky	8 (72.7)		2	6					6												8
Give	2 (18.2)	2																			
Heidelberg	1 (9.1)	1																			
Total	**11 (100)**	**3**	**2**	**6**					**6**												**8**
National																					
Kentucky	28 (54.9)	6	4	18					18	14	14	14	9	14							20
Enteritidis	15 (29.4)	15																			
Senftenberg	3 (5.9)	2		1			1	1	1						1						1
Give	2 (3.9)	2																			
Heidelberg	1 (2.0)	1																			
4,5,12:i:-	1 (2.0)	1																			
Tennessee	1 (2.0)				1				1						1			1			1
Total	**51 (100)**	**27**	**4**	**19**	**1**		**1**	**1**	**20**	**14**	**14**	**14**	**9**	**14**	**2**			**1**			**22**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.

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 46. Number of antimicrobial classes in resistance patterns of *Salmonella* from chicks and barn environment at chick placement

Sample Type / 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
Chick pads																					
Kentucky	24 (57.1)	6	3	15					15	11	11	11	8	11							17
Enteritidis	14 (33.3)	14																			
Give	2 (4.8)	2																			
4,5,12:i:-	1 (2.4)	1																			
Senftenberg	1 (2.4)			1			1	1	1						1						1
Total	**42 (100)**	**23**	**3**	**16**			**1**	**1**	**16**	**11**	**11**	**11**	**8**	**11**	**1**						**18**
Environmental																					
Kentucky	4 (44.4)		1	3					3	3	3	3	1	3							3
Senftenberg	2 (22.2)	2																			
Enteritidis	1 (11.1)	1																			
Heidelberg	1 (11.1)	1																			
Tennessee	1 (11.1)				1				1						1			1			1
Total	**9 (100)**	**4**	**1**	**3**	**1**				**4**	**3**	**3**	**3**	**1**	**3**	**1**			**1**			**4**
All sample types																					
Kentucky	28 (54.9)	6	4	18					18	14	14	14	9	14							20
Enteritidis	15 (29.4)	15																			
Senftenberg	3 (5.9)	2		1			1	1	1						1						1
Give	2 (3.9)	2																			
Heidelberg	1 (2.0)	1																			
4,5,12:i:-	1 (2.0)	1																			
Tennessee	1 (2.0)				1				1						1			1			1
Total	**51 (100)**	**27**	**4**	**19**	**1**		**1**	**1**	**20**	**14**	**14**	**14**	**9**	**14**	**2**			**1**			**22**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.

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

Table 47. Number of antimicrobial classes in resistance patterns of *Escherichia coli* from chicks and barn environment at chick placement, by province

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	43 (22.5)	9	14	10	10		6	2	9	33	24	29	24	29	16	3		1		1	19
Alberta	31 (16.2)	1	9	11	10		12	4	10	25	21	21	21	21	12	2		2		2	19
Ontario	64 (33.5)	13	13	25	13		16	1	18	32	11	12	11	11	23	10		5		1	39
Québec	53 (27.7)	9	6	21	17		23	4	28	24	12	11	12	11	32	10		6		2	35
National	**191 (100)**	**32**	**42**	**67**	**50**		**57**	**11**	**65**	**114**	**68**	**73**	**68**	**72**	**83**	**25**		**14**		**6**	**112**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.

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

Table 48. Number of antimicrobial classes in resistance patterns of *Escherichia coli* from chicks and barn environment at chick placement

Sample type	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
Chick pads	129 (67.5)	17	29	45	38		45	8	45	83	52	56	52	56	58	18		10		5	79
Environmental	62 (32.5)	15	13	22	12		12	3	20	31	16	17	16	16	25	7		4		1	33
Total	**191 (100)**	**32**	**42**	**67**	**50**		**57**	**11**	**65**	**114**	**68**	**73**	**68**	**72**	**83**	**25**		**14**		**6**	**112**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

Table 49. Number of antimicrobial classes in resistance patterns of *Salmonella* from chickens on farm at pre-harvest

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	31 (45.6)	31																			
Cubana	13 (19.1)	13																			
Kentucky	11 (16.2)			7	4				11	11	11	11	10	11						4	11
4,5,12:i:-	7 (10.3)	4	3							3	3	3	3	3							
Liverpool	3 (4.4)	3																			
Infantis	2 (2.9)	2																			
Braenderup	1 (1.5)	1																			
Total	**68 (100)**	**54**	**3**	**7**	**4**				**11**	**14**	**14**	**14**	**13**	**14**						**4**	**11**
Alberta																					
Kentucky	7 (29.2)			7					7	7	7	7	7	7							7
Schwarzengrund	4 (16.7)	4																			
Cubana	3 (12.5)	3																			
Infantis	3 (12.5)	2	1							1	1	1	1	1							
Enteritidis	2 (8.3)	2																			
4,5,12:i:-	2 (8.3)			1	1				2	2					2						1
Hadar	1 (4.2)			1					1												1
Anatum	1 (4.2)			1					1						1						
Mbandaka var. 14+	1 (4.2)	1																			
Total	**24 (100**	**12**	**1**	**10**	**1**				**11**	**10**	**8**	**8**	**8**	**8**	**3**						**9**
Ontario																					
Kentucky	35 (53.8)	10	9	16					16	22	22	22	12	22							16
Heidelberg	21 (32.3)	15		6					4	3	3	3	3	3	3	3		3			2
Enteritidis	2 (3.1)	2																			
Hadar	2 (3.1)			2					2												2
Less common serovars	5 (7.7)	1	1	2	1				3	4	3	3	3	3	2			1			2
Total	**65 (100)**	**28**	**10**	**26**	**1**				**25**	**29**	**28**	**28**	**18**	**28**	**5**	**3**		**4**			**22**
Québec																					
Kentucky	36 (50.0)		2	34			1		34	1	1	1	1	1	1						36
Ohio	7 (9.7)	7																			
Give	6 (8.3)	6																			
Heidelberg	5 (6.9)	2	2	1					1	1	1	1	1	1	2	2					
Litchfield	4 (5.6)	4																			
Schwarzengrund	4 (5.6)	1		3					1						3						3
8,20:-:z6	2 (2.8)		1	1					1												2
Infantis	2 (2.8)	2																			
Less common serovars	6 (8.3)	3	1	2					1	1	1	1	1	1	1	1					2
Total	**72 (100)**	**25**	**6**	**41**			**1**		**38**	**3**	**3**	**3**	**3**	**3**	**7**	**3**					**43**
National																					
Kentucky	89 (38.9)	10	11	64	4		1		68	41	41	41	30	41	1					4	70
Enteritidis	35 (15.3)	35																			
Heidelberg	26 (11.4)	17	2	7					5	4	4	4	4	4	5	5		3			2
Cubana	16 (7.0)	16																			
4,5,12:i:-	9 (3.9)	4	3	1	1				2	5	3	3	3	3	2						1
Infantis	8 (3.5)	6	2							2	2	2	2	2							
Schwarzengrund	8 (3.5)	5		3					1						3						3
Ohio	7 (3.1)	7																			
Give	6 (2.6)	6																			
Less common serovars	25 (10.9)	13	2	9	1				9	4	3	3	3	3	4	1		1			9
Total	**229 (100)**	**119**	**20**	**84**	**6**		**1**		**85**	**56**	**53**	**53**	**42**	**53**	**15**	**6**		**4**		**4**	**85**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
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 *Escherichia coli* from chickens on farm at pre-harvest

Province / 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	94 (24.4)	8	30	33	23		8	9	36	83	57	59	57	57	27	5		1		9	38
Alberta	60 (15.6)	14	6	24	16		6	13	31	41	29	28	28	25	17	4		4		5	32
Ontario	120 (31.2)	29	28	41	22		12	10	44	59	18	17	18	16	49	28	1	8	1	2	55
Quebec	111 (28.8)	6	13	63	29		25	12	72	53	21	19	20	19	84	45	1	17		1	67
National	385 (100)	57	77	161	90		51	44	183	236	125	123	123	117	177	82	2	30	1	17	192

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

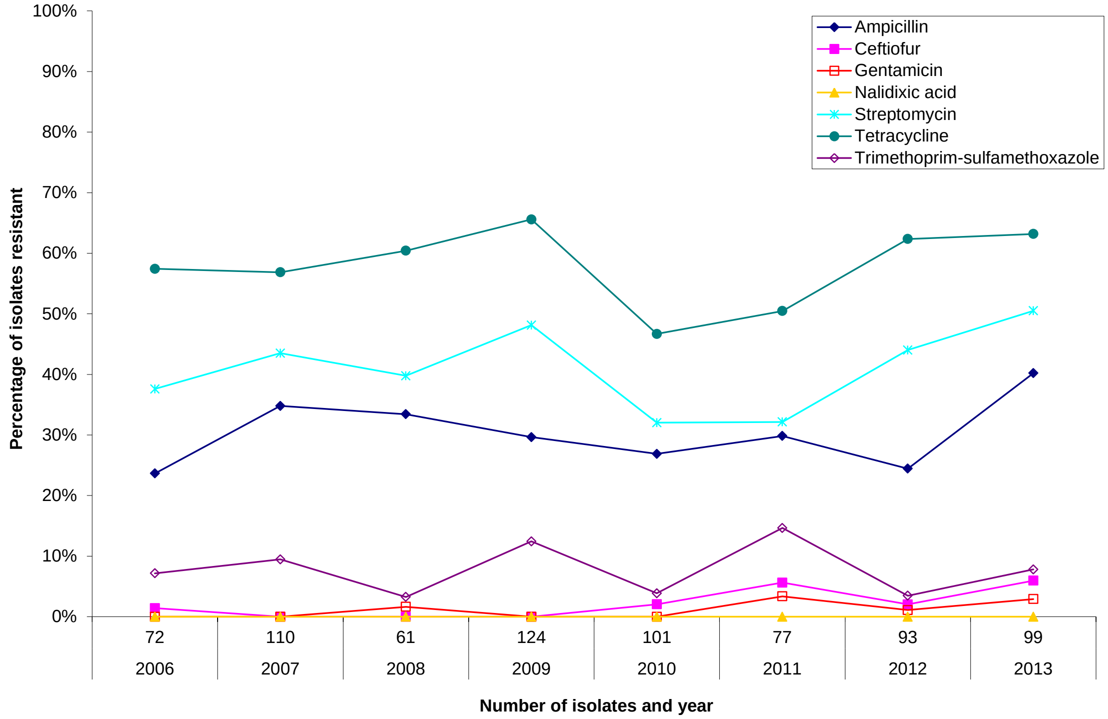
Table 51. Number of antimicrobial classes in resistance patterns of *Campylobacter* from chicken on farm at pre-harvest

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 coli	0 (0)														
Campylobacter jejuni	27 (100)	11	5	11									11	11	16
Total	**27 (100)**	**11**	**5**	**11**									**11**	**11**	**16**
Alberta															
Campylobacter coli	0 (0)														
Campylobacter jejuni	15 (100)	6	9												9
Total	**15 (100)**	**6**	**9**												**9**
Ontario															
Campylobacter coli	1(5.0)	1													
Campylobacter jejuni	19 (95.0)	8	7	4									4	4	11
Total	**20 (100)**	**9**	**7**	**4**									**4**	**4**	**11**
Québec															
Campylobacter coli	4 (21.1)		3	1									1	1	4
Campylobacter jejuni	15 (78.9)	4	11												11
Total	**19 (100)**	**4**	**14**	**1**									**1**	**1**	**15**
National															
Campylobacter coli	5 (6.2)	1	3	1									1	1	4
Campylobacter jejuni	76(93.8)	29	32	15									15	15	47
Total	**81 (100)**	**30**	**35**	**16**									**16**	**16**	**51**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
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

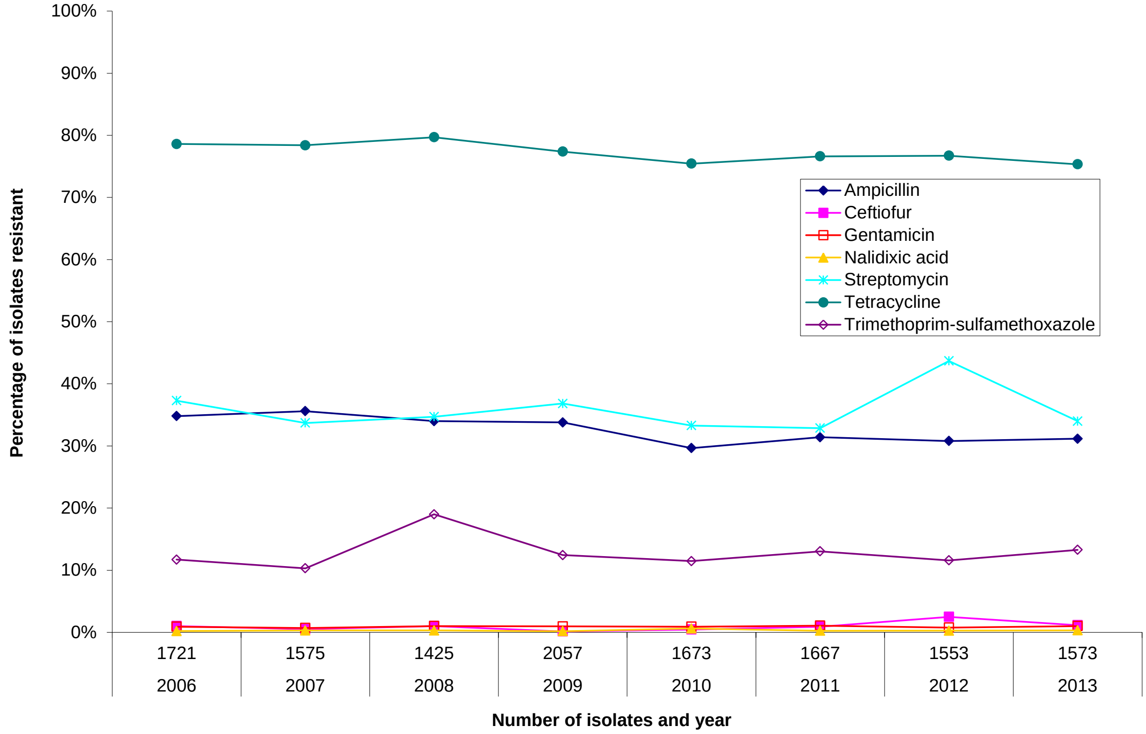
Figure 22. Temporal variations in resistance of *Salmonella* isolates from pigs



Year Number of isolates	2006 72	2007 110	2008 61	2009 124	2010 101	2011 77	2012 93	2013 99
Antimicrobial								
Ampicillin	**24%**	35%	33%	30%	27%	30%	**25%**	**40%**
Ceftiofur	**1%**	0%	0%	0%	2%	6%	**2%**	**6%**
Gentamicin	**0%**	0%	2%	0%	0%	3%	**1%**	**3%**
Nalidixic acid	**0%**	0%	0%	0%	0%	0%	**0%**	**0%**
Streptomycin	**38%**	44%	40%	48%	32%	32%	**46%**	**50%**
Tetracycline	**57%**	57%	60%	66%	47%	50%	**61%**	**63%**
Trimethoprim-sulfamethoxazole	**7%**	9%	3%	12%	4%	15%	**4%**	**8%**

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

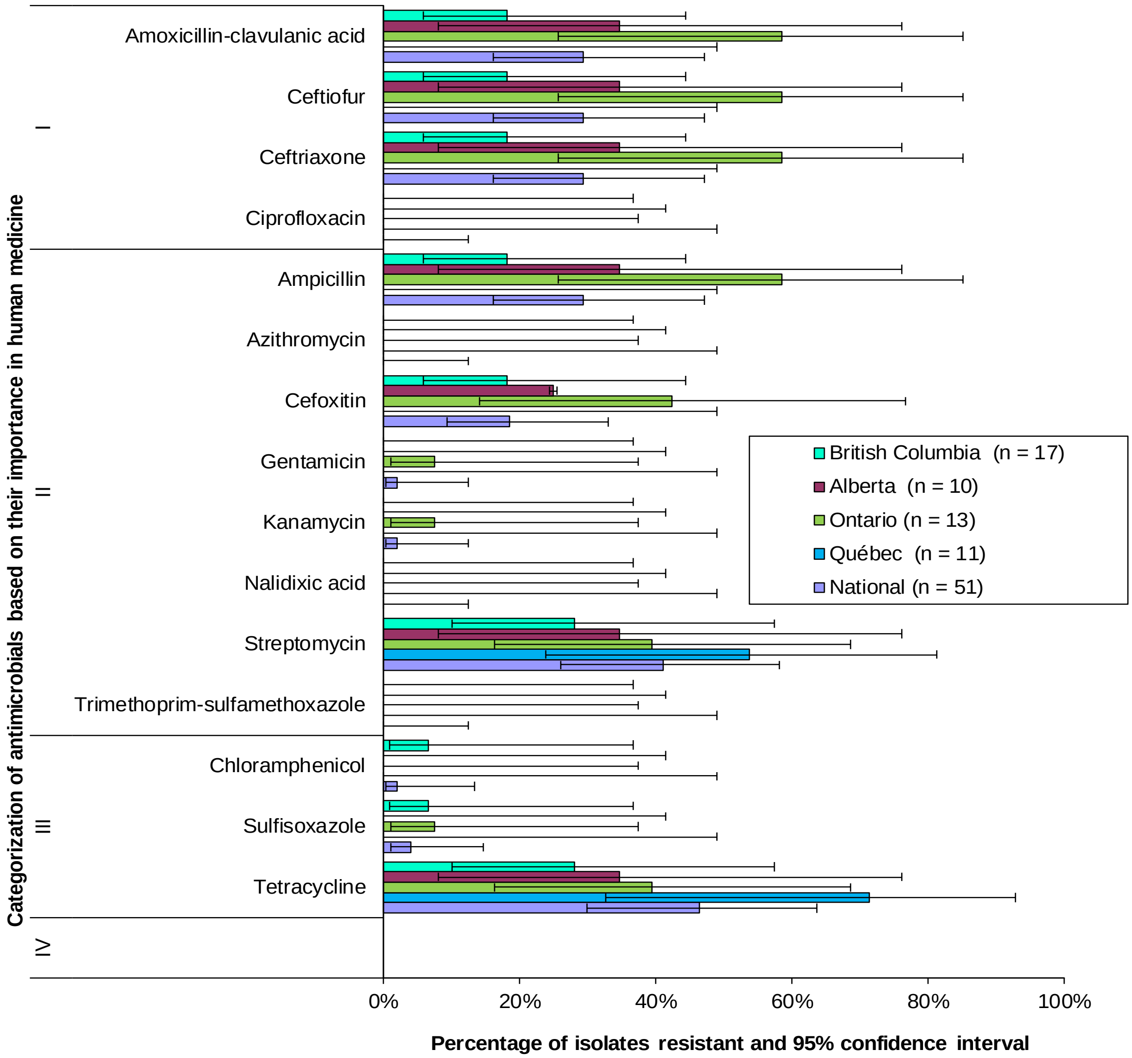


Year	2006	2007	2008	2009	2010	2011	2012	2013
Number of isolates	1,721	1,575	1,425	2,057	1,673	1,667	1,553	1,573
Antimicrobial								
Ampicillin	**35%**	36%	34%	34%	30%	31%	**31%**	**31%**
Ceftiofur	**1%**	1%	1%	0%	0%	1%	**2%**	**1%**
Gentamicin	**1%**	1%	1%	1%	1%	1%	**1%**	**1%**
Nalidixic acid	**0%**	0%	0%	0%	0%	0%	**0%**	**0%**
Streptomycin	**37%**	34%	35%	37%	33%	33%	**44%**	**34%**
Tetracycline	**79%**	78%	80%	77%	75%	77%	**77%**	**75%**
Trimethoprim-sulfamethoxazole	**12%**	11%	19%	12%	11%	13%	**12%**	**13%**

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.

ANTIMICROBIAL RESISTANCE SUMMARY

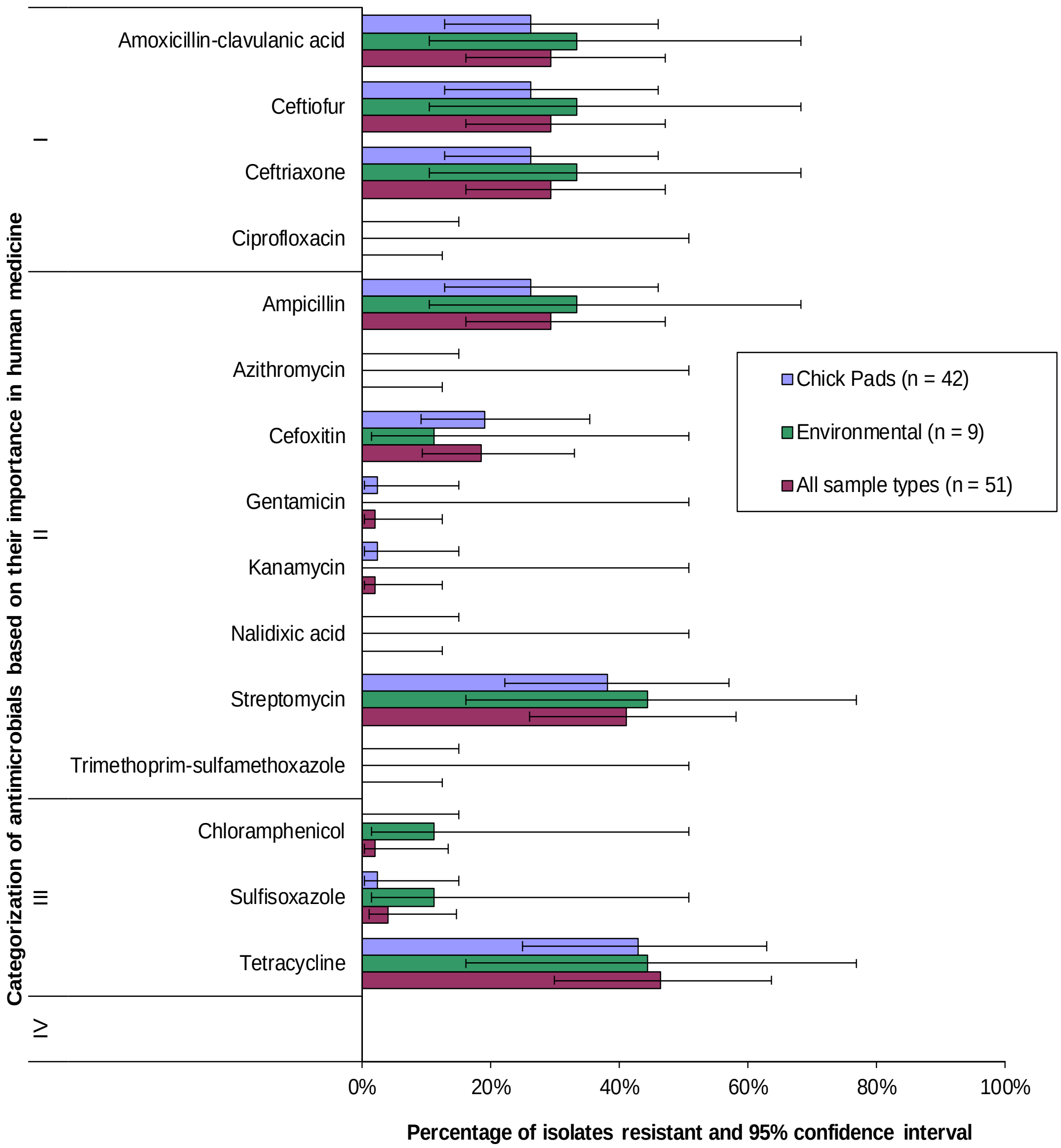
Figure 24. Resistance of *Salmonella* isolates from chickens at chick placement, by province



Province/region Number of isolates	British Columbia 17	Alberta 10	Ontario 13	Québec 11	National 51
Antimicrobial					
Ampicillin	18%	35%	58%	0%	29%
Ceftiofur	18%	35%	58%	0%	29%
Gentamicin	0%	0%	8%	0%	2%
Nalidixic acid	0%	0%	0%	0%	0%
Streptomycin	28%	35%	39%	54%	41%
Tetracycline	28%	35%	39%	71%	46%
Trimethoprim-sulfamethoxazole	0%	0%	0%	0%	0%

This figure summarizes the proportion (%, adjusted to account for multiple samples per flock) of isolates resistant to a specific antimicrobial at chick placement by province/region for the 2013 sampling year.

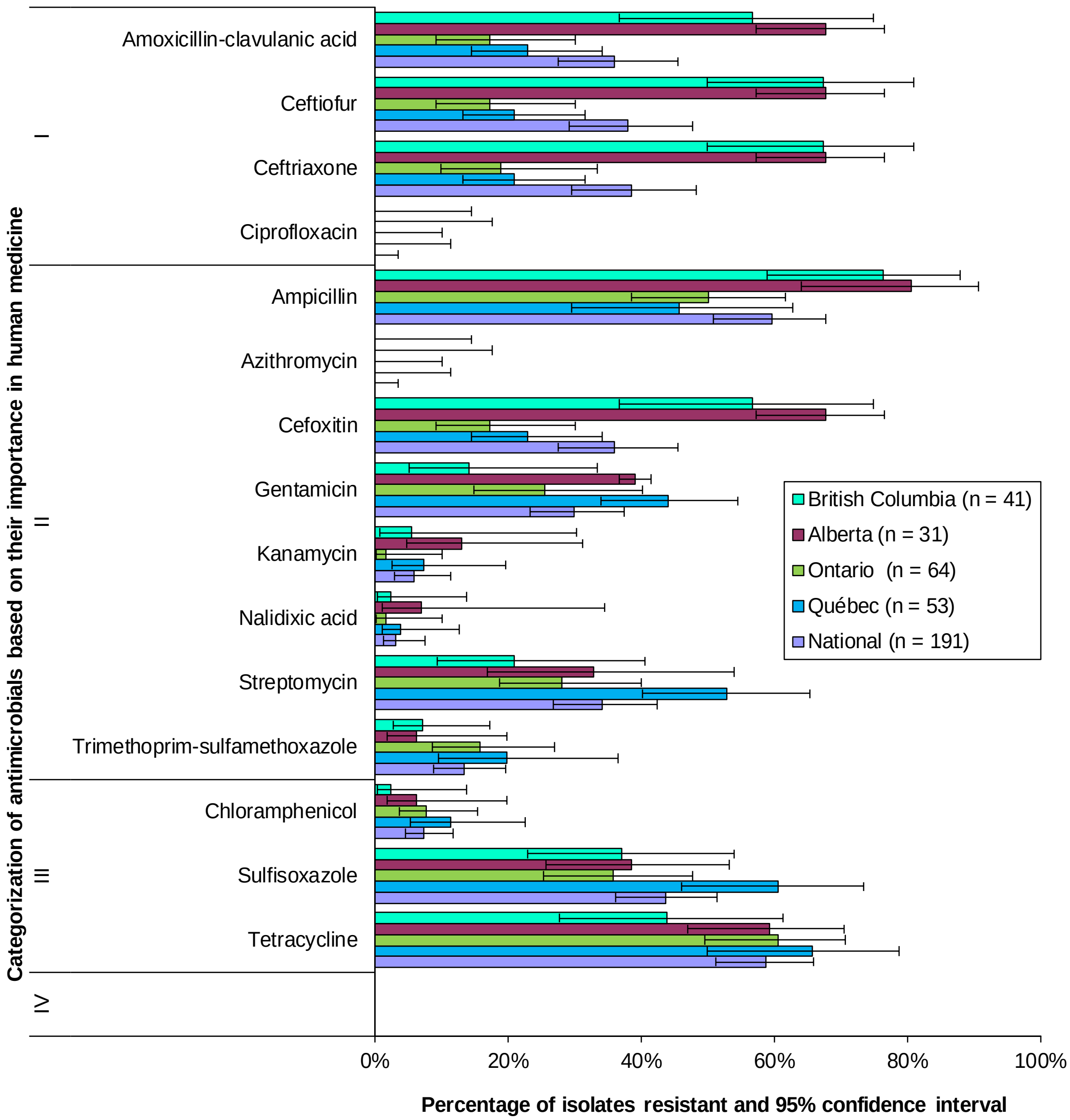
Figure 25. Resistance of *Salmonella* isolates from chicks and barn environment at chick placement



Sample type Number of isolates	Chick pads 42	Environmental 9	All sample types 51
Antimicrobial			
Ampicillin	26%	33%	29%
Ceftiofur	26%	33%	29%
Gentamicin	2%	0%	2%
Nalidixic acid	0%	0%	0%
Streptomycin	38%	44%	41%
Tetracycline	43%	44%	46%
Trimethoprim-sulfamethoxazole	0%	0%	0%

This figure summarizes the proportion (%, adjusted to account for multiple samples per flock) of isolates resistant to a specific antimicrobial at chick placement by sample type for the 2013 sampling year.

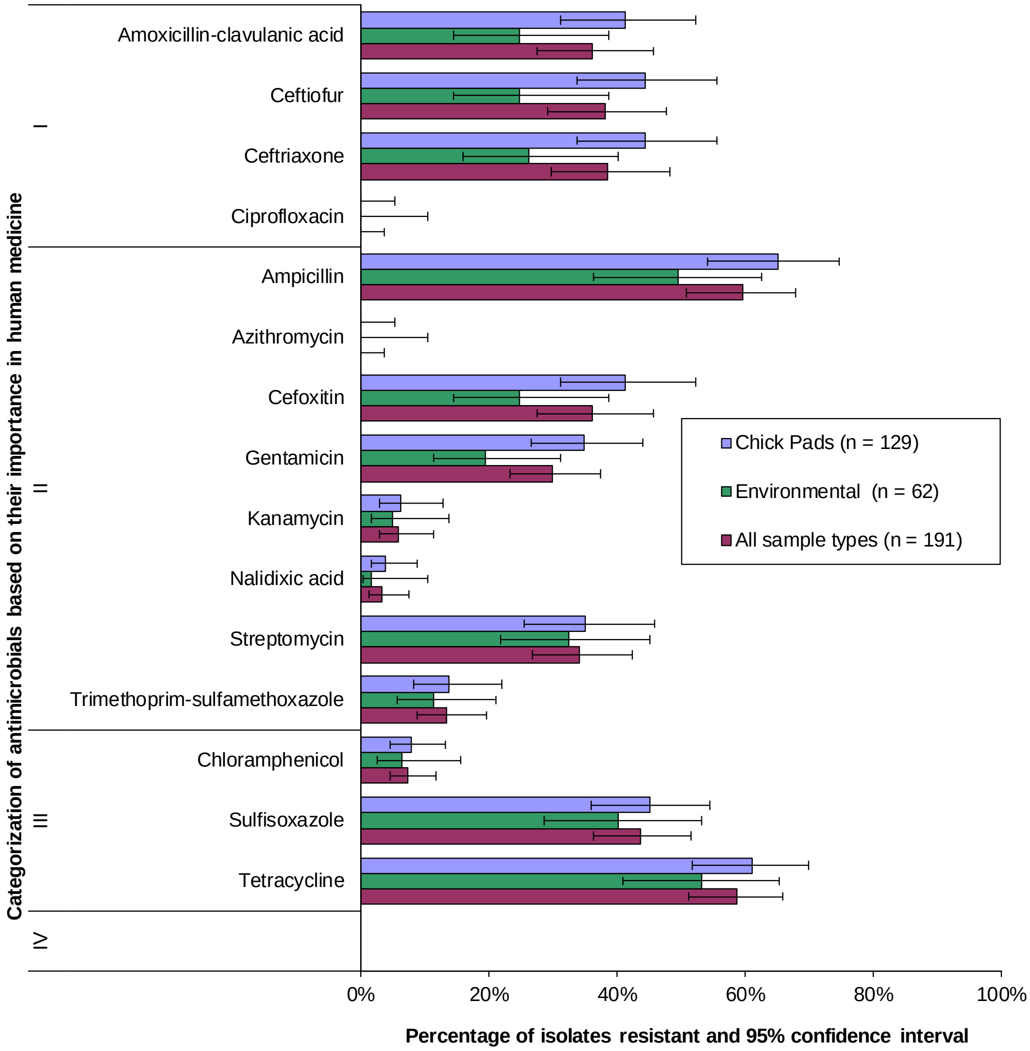
Figure 26. Resistance of *Escherichia coli* isolates from chick at placement, by province



Province/region Number of isolates	British Columbia 43	Alberta 31	Ontario 64	Québec 53	National 191
Antimicrobial					
Ampicillin	75%	81%	50%	46%	60%
Ceftiofur	67%	68%	17%	21%	38%
Gentamicin	14%	39%	25%	44%	30%
Nalidixic acid	2%	7%	2%	4%	3%
Streptomycin	21%	33%	28%	53%	34%
Tetracycline	44%	59%	61%	66%	59%
Trimethoprim-sulfamethoxazole	7%	6%	16%	20%	13%

The figure above summarizes the proportion (%, adjusted to account for multiple samples per flock) of isolates resistant to a specific antimicrobial at chick placement by province/region for the 2013 sampling year.

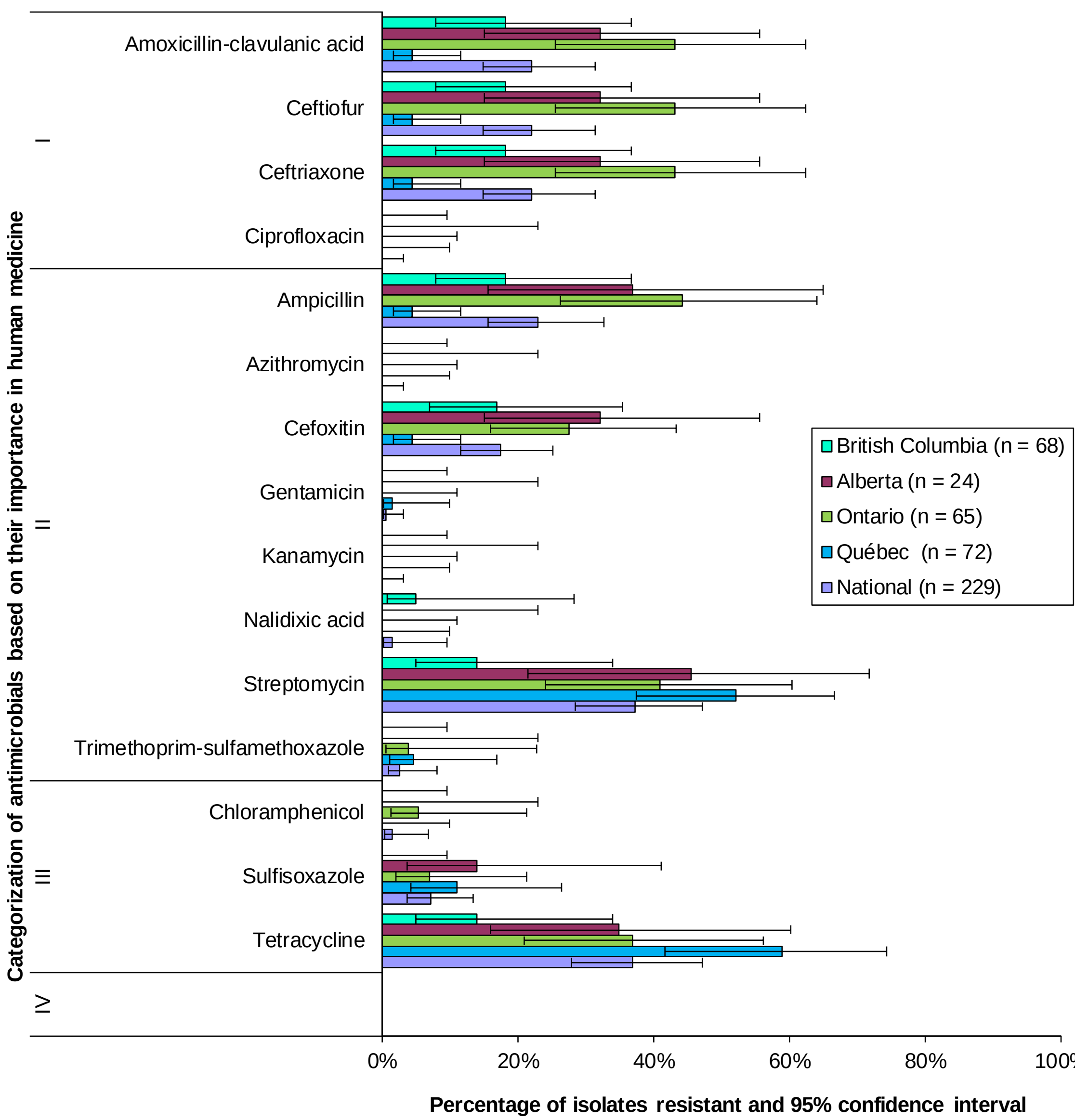
Figure 27. Resistance of *Escherichia coli* isolates from chickens at chick placement



Sample type Number of isolates	Chick pads 129	Environmental 62	All sample types 191
Antimicrobial			
Ampicillin	65%	49%	60%
Ceftiofur	44%	25%	38%
Gentamicin	35%	19%	30%
Nalidixic acid	4%	2%	3%
Streptomycin	35%	32%	34%
Tetracycline	61%	53%	59%
Trimethoprim-sulfamethoxazole	14%	11%	13%

The figure above summarizes the proportion (%, adjusted to account for multiple samples per flock) of isolates resistant to a specific antimicrobial at chick placement by sample type for the 2013 sampling year.

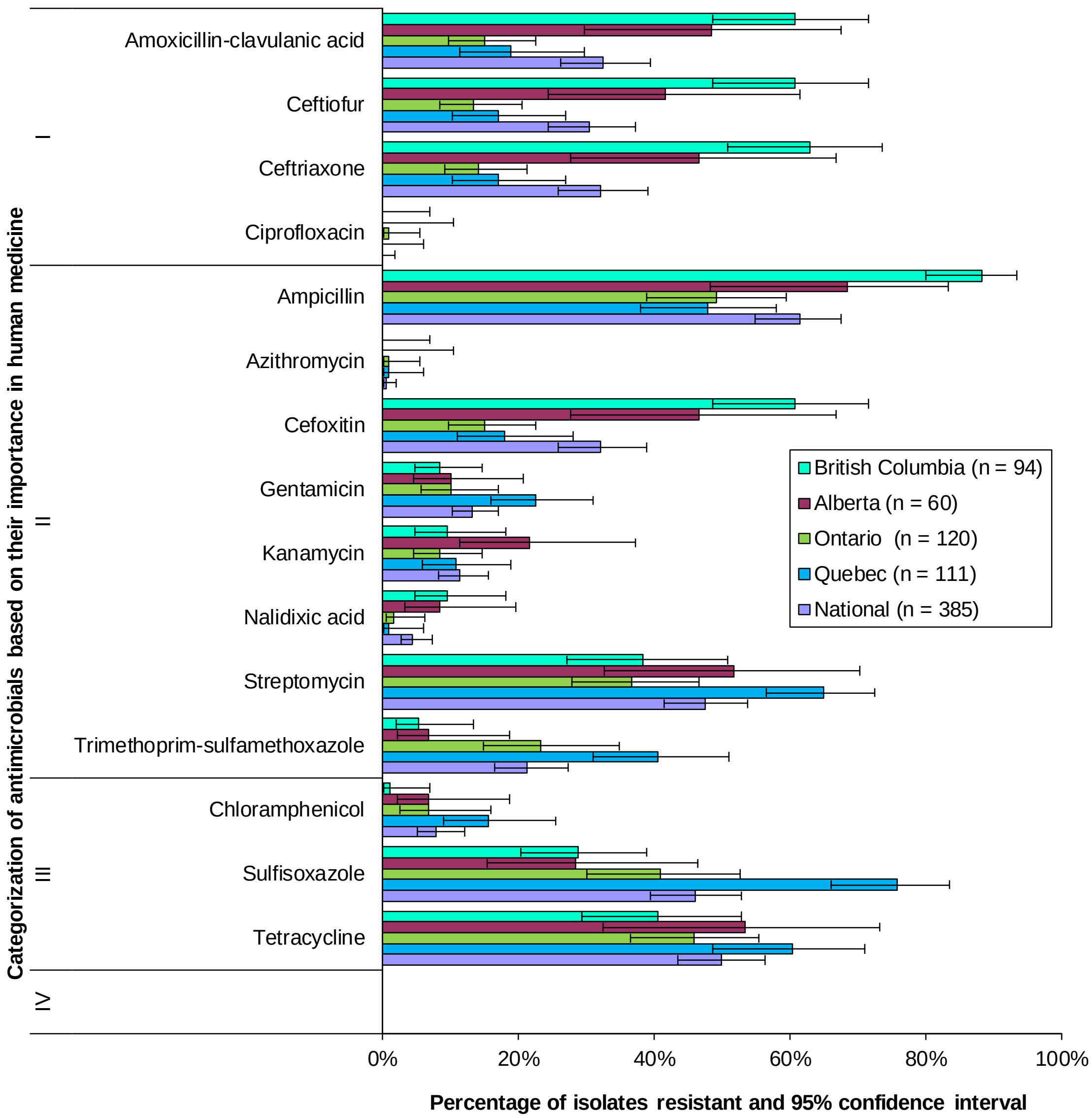
Figure 28. Resistance of *Salmonella* isolates from chickens at pre-harvest



Province/region Number of isolates	British Columbia 68	Alberta 24	Ontario 65	Québec 72	National 229
Antimicrobial					
Ampicillin	18%	37%	44%	4%	23%
Ceftiofur	18%	32%	43%	4%	22%
Gentamicin	0%	0%	0%	1%	< 1%
Nalidixic acid	6%	0%	0%	0%	1%
Streptomycin	14%	45%	41%	52%	37%
Tetracycline	14%	35%	37%	59%	37%
Trimethoprim-sulfamethoxazole	0%	0%	4%	5%	3%

This figure summarizes the proportion (%, adjusted to account for multiple samples per flock) of isolates resistant to a specific antimicrobial at the national level and by province/region for the 2013 sampling year.

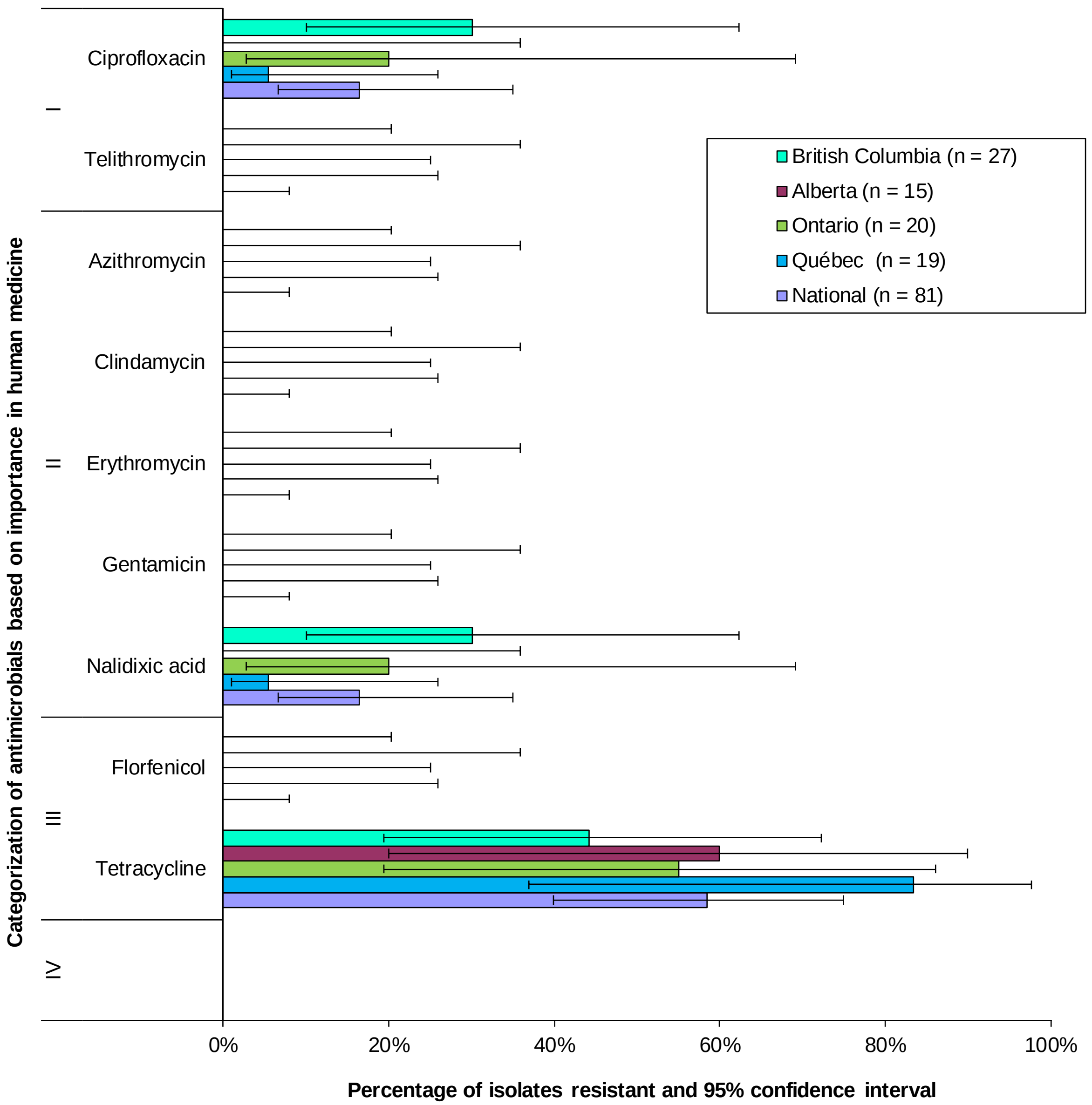
Figure 29. Resistance of *Escherichia coli* isolates from chickens at pre-harvest



Province/region Number of isolates	British Columbia 94	Alberta 60	Ontario 120	Québec 111	National 385
Antimicrobial					
Ampicillin	88%	68%	49%	48%	61%
Ceftiofur	61%	42%	13%	17%	30%
Gentamicin	8%	10%	10%	23%	13%
Nalidixic acid	10%	8%	2%	1%	4%
Streptomycin	38%	52%	37%	65%	48%
Tetracycline	40%	53%	46%	60%	50%
Trimethoprim-sulfamethoxazole	5%	7%	23%	41%	21%

The figure above summarizes the proportion (%, adjusted to account for multiple samples per flock) of isolates resistant to a specific antimicrobial by province/region for the 2013 sampling year.

Figure 30. Resistance of *Campylobacter* isolates from chickens at pre-harvest



Province/region Number of isolates	British Columbia 27	Alberta 15	Ontario 20	Québec 19	National 81
Antimicrobial					
Azithromycin	0%	0%	0%	0%	0%
Ciprofloxacin	30%	0%	20%	5%	16%
Gentamicin	0%	0%	0%	0%	0%
Telithromycin	0%	0%	0%	0%	0%
Tetracycline	44%	60%	55%	83%	59%

The figure above summarizes the proportion (%, adjusted to account for multiple samples per flock) of isolates resistant to a specific antimicrobial by province/region for the 2013 sampling year.

MINIMUM INHIBITORY CONCENTRATIONS

Table 52. 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	99	≤ 1	16	5.1							59.6	2.0	7.1	21.2	5.1		5.1			
I	Ceftiofur	99	1	1	6.1						11.1	80.8	2.0			6.1					
I	Ceftriaxone	99	≤ 0.25	≤ 0.25	6.1					93.9				1.0	1.0	3.0	1.0				
I	Ciprofloxacin	99	≤ 0.015	0.03	0.0	84.8	14.1	1.0													
II	Ampicillin	99	1	> 32	38.4							53.5	8.1					38.4			
II	Azithromycin	99	4	8	1.0							1.0	8.1	66.7	23.2		1.0				
II	Cefoxitin	99	2	8	5.1							7.1	52.5	27.3	7.1	1.0	2.0	3.0			
II	Gentamicin	99	0.5	1	3.0					13.1	64.6	19.2				3.0					
II	Kanamycin	99	≤ 8	> 64	10.1										89.9				10.1		
II	Nalidixic acid	99	4	4	0.0								29.3	64.6	5.1	1.0					
II	Streptomycin	99	64	> 64	51.5												48.5	8.1	43.4		
II	Trimethoprim-sulfamethoxazole	99	≤ 0.12	0.5	8.1				69.7	18.2	4.0				8.1						
III	Chloramphenicol	99	8	> 32	22.2									15.2	59.6	3.0		22.2			
III	Sulfisoxazole	99	> 256	> 256	55.6											9.1	24.2	11.1			55.6
III	Tetracycline	99	> 32	> 32	64.6									35.4		2.0	12.1	50.5			
IV																					

Percent of isolates resistant are not adjusted for clustering.

Table 53. Distribution of minimum inhibitory concentrations among *Escherichia coli* 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	1,573	4	8	1.4							1.7	20.5	44.8	29.6	2.0	0.4	1.0			
I	Ceftiofur	1,573	0.5	0.5	1.1				2.2	40.6	54.8	1.0	0.1	0.2	0.3	0.8					
I	Ceftriaxone	1,573	≤ 0.25	≤ 0.25	1.3					98.3	0.1	0.2		0.1	0.3	0.8	0.1	0.1			
I	Ciprofloxacin	1,573	≤ 0.015	≤ 0.015	0.0	98.0	1.6	0.3		0.1											
II	Ampicillin	1,573	2	> 32	31.1							6.0	34.6	25.8	1.7	0.8	0.3	30.8			
II	Azithromycin	1,573	4	8	0.9						0.1	1.0	16.7	69.2	11.8	0.3	0.9				
II	Cefoxitin	1,573	4	8	1.1						0.1	0.3	19.8	63.1	14.6	1.0	0.3	0.8			
II	Gentamicin	1,573	0.5	1	1.0					4.4	65.5	27.0	1.5		0.6	0.4	0.6				
II	Kanamycin	1,573	≤ 8	>64	12.5										87.3	0.1		0.4	12.1		
II	Nalidixic acid	1,573	2	4	0.3						0.3	13.9	74.5	10.9	0.1		0.2	0.1			
II	Streptomycin	1,573	≤ 32	> 64	34.0												66.0	14.8	19.2		
II	Trimethoprim-sulfamethoxazole	1,573	≤ 0.12	>4	13.4				70.9	12.8	2.2	0.7			13.4						
III	Chloramphenicol	1,573	8	32	20.3								2.2	31.8	42.7	3.1	11.0	9.3			
III	Sulfisoxazole	1,573	16	> 256	45.4											50.4	4.1	0.1			45.4
III	Tetracycline	1,573	> 32	> 32	75.4									24.3	0.3	0.3	5.5	69.6			
IV																					

Percent of isolates resistant are not adjusted for clustering.

Table 54. Distribution of minimum inhibitory concentrations among *Salmonella* from chick at placement

	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	17	≤ 1	> 32	17.6							82.4						17.6			
		Alberta	10	≤ 1	> 32	50.0							50.0					10.0	40.0			
		Ontario	13	≤ 1	> 32	46.2							53.8					15.4	30.8			
		Québec	11	≤ 1	≤ 1	0.0							100.0									
	Ceftiofur	British Columbia	17	1	> 8	17.6							82.4				17.6					
		Alberta	10	1	> 8	50.0						10.0	40.0			10.0	40.0					
		Ontario	13	1	> 8	46.2						46.2	7.7			7.7	38.5					
I		Québec	11	0.5	1	0.0						63.6	36.4									
	Ceftriaxone	British Columbia	17	≤ 0.25	16	17.6					82.4						11.8	5.9				
		Alberta	10	≤ 0.25	16	50.0					50.0					30.0	20.0					
		Ontario	13	≤ 0.25	16	46.2					53.8				7.7	15.4	23.1					
		Québec	11	≤ 0.25	≤ 0.25	0.0					100.0											
	Ciprofloxacin	British Columbia	17	≤ 0.015	0.03	0.0	64.7	35.3														
		Alberta	10	≤ 0.015	≤ 0.015	0.0	100.0															
		Ontario	13	≤ 0.015	≤ 0.015	0.0	100.0															
		Québec	11	≤ 0.015	≤ 0.015	0.0	100.0															
	Ampicillin	British Columbia	17	≤ 1	> 32	17.6							76.5	5.9					17.6			
		Alberta	10	≤ 1	> 32	50.0							50.0						50.0			
		Ontario	13	≤ 1	> 32	46.2							53.8						46.2			
		Québec	11	≤ 1	≤ 1	0.0							100.0									
	Azithromycin	British Columbia	17	4	8	0.0								5.9	76.5	17.6						
		Alberta	10	4	4	0.0								40.0	60.0							
		Ontario	13	4	4	0.0								46.2	53.8							
		Québec	11	4	4	0.0								18.2	72.7	9.1						
	Cefoxitin	British Columbia	17	2	32	17.6								76.5	5.9			17.6				
		Alberta	10	4	32	20.0								40.0	10.0		30.0	20.0				
		Ontario	13	4	32	30.8							15.4	30.8	7.7		15.4	30.8				
		Québec	11	2	2	0.0							36.4	63.6								
	Gentamicin	British Columbia	17	0.5	1	0.0					41.2	41.2	17.6									
		Alberta	10	0.5	0.5	0.0					20.0	80.0										
		Ontario	13	≤ 0.25	0.5	7.7					61.5	30.8						7.7				
		Québec	11	0.5	1	0.0					45.5	27.3	27.3									
II	Kanamycin	British Columbia	17	≤ 8	≤ 8	0.0										100.0						
		Alberta	10	≤ 8	≤ 8	0.0										100.0						
		Ontario	13	≤ 8	≤ 8	7.7										92.3				7.7		
		Québec	11	≤ 8	≤ 8	0.0										100.0						
	Nalidixic acid	British Columbia	17	4	8	0.0								41.2	47.1	11.8						
		Alberta	10	4	4	0.0								40.0	60.0							
		Ontario	13	2	4	0.0								61.5	38.5							
		Québec	11	2	4	0.0								63.6	36.4							
	Streptomycin	British Columbia	17	32	> 64	23.5												76.5	5.9	17.6		
		Alberta	10	32	64	50.0												50.0	40.0	10.0		
		Ontario	13	32	> 64	38.5												61.5	15.4	23.1		
		Québec	11	64	> 64	54.5												45.5	36.4	18.2		
	Trimethoprim-sulfamethoxazole	British Columbia	17	≤ 0.12	≤ 0.12	0.0				94.1	5.9											
		Alberta	10	≤ 0.12	≤ 0.12	0.0				100.0												
		Ontario	13	≤ 0.12	≤ 0.12	0.0				100.0												
		Québec	11	≤ 0.12	≤ 0.12	0.0				100.0												
	Chloramphenicol	British Columbia	17	8	8	5.9									23.5	70.6			5.9			
		Alberta	10	4	8	0.0								10.0	70.0	20.0						
		Ontario	13	4	4	0.0									100.0							
		Québec	11	4	8	0.0									72.7	27.3						
	Sulfisoxazole	British Columbia	17	32	64	5.9												52.9	41.2			5.9
III		Alberta	10	≤ 16	32	0.0											50.0	50.0				
		Ontario	13	32	32	7.7											7.7	84.6				7.7
		Québec	11	32	32	0.0											27.3	72.7				
	Tetracycline	British Columbia	17	4	> 32	23.5									76.5				23.5			
		Alberta	10	4	> 32	50.0									50.0				50.0			
		Ontario	13	4	> 32	38.5									61.5				38.5			
		Québec	11	> 32	> 32	72.7									27.3				72.7			
IV																						

Table 55. Distribution of minimum inhibitory concentrations among *Escherichia coli* from chicks and barn environment at placement

	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	43	32	> 32	55.8								2.3	23.3	18.6		9.3	46.5			
		Alberta	31	32	> 32	67.7								6.5	16.1	6.5	3.2	48.4	19.4			
		Ontario	64	8	> 32	17.2								4.7	42.2	34.4	1.6	1.6	15.6			
		Québec	53	8	> 32	22.6							5.7	3.8	37.7	18.9	11.3	3.8	18.9			
	Ceftiofur	British Columbia	43	8	> 8	67.4				2.3	2.3	25.6	2.3			18.6	48.8					
		Alberta	31	8	> 8	67.7				3.2	16.1	12.9				29.0	38.7					
		Ontario	64	0.5	8	17.2					12.5	68.8	1.6			7.8	9.4					
I		Québec	53	0.5	8	20.8				1.9	22.6	49.1	5.7			15.1	5.7					
	Ceftriaxone	British Columbia	43	16	32	67.4					27.9	2.3	2.3			9.3	39.5	14.0	4.7			
		Alberta	31	16	16	67.7					32.3					6.5	54.8	6.5				
		Ontario	64	≤ 0.25	16	18.8					81.3				1.6	4.7	10.9	1.6				
		Québec	53	≤ 0.25	8	20.8					77.4		1.9			11.3	9.4					
	Ciprofloxacin	British Columbia	43	≤ 0.015	≤ 0.015	0.0	95.3	2.3			2.3											
		Alberta	31	≤ 0.015	≤ 0.015	0.0	93.5				6.5											
		Ontario	64	≤ 0.015	≤ 0.015	0.0	95.3	3.1			1.6											
		Québec	53	≤ 0.015	≤ 0.015	0.0	94.3	1.9			3.8											
	Ampicillin	British Columbia	43	> 32	> 32	76.7								4.7	18.6				76.7			
		Alberta	31	> 32	> 32	80.6							3.2	16.1					80.6			
		Ontario	64	4	> 32	50.0								23.4	26.6				50.0			
		Québec	53	4	> 32	45.3							1.9	24.5	24.5	3.8			45.3			
	Azithromycin	British Columbia	43	4	4	0.0								20.9	74.4	2.3	2.3					
		Alberta	31	4	4	0.0								12.9	77.4	9.7						
		Ontario	64	4	4	0.0								7.8	87.5	4.7						
		Québec	53	4	8	0.0							1.9	7.5	77.4	13.2						
	Cefoxitin	British Columbia	43	> 32	> 32	55.8								4.7	37.2	2.3		4.7	51.2			
		Alberta	31	> 32	> 32	67.7								3.2	19.4	9.7		12.9	54.8			
		Ontario	64	4	> 32	17.2								9.4	50.0	23.4		1.6	15.6			
		Québec	53	4	> 32	22.6							1.9	9.4	50.9	15.1		5.7	17.0			
	Gentamicin	British Columbia	43	0.5	> 16	14.0						55.8	27.9	2.3			2.3	11.6				
		Alberta	31	1	> 16	38.7					3.2	25.8	29.0			3.2	6.5	32.3				
		Ontario	64	1	> 16	25.0						48.4	26.6				7.8	17.2				
		Québec	53	2	> 16	43.4					1.9	22.6	24.5	5.7	1.9		17.0	26.4				
II	Kanamycin	British Columbia	43	≤ 8	≤ 8	4.7										90.7	4.7			4.7		
		Alberta	31	≤ 8	> 64	12.9										80.6	6.5			12.9		
		Ontario	64	≤ 8	≤ 8	1.6										92.2	6.3			1.6		
		Québec	53	≤ 8	16	7.5										84.9	7.5			7.5		
	Nalidixic acid	British Columbia	43	2	4	2.3							11.6	72.1	14.0				2.3			
		Alberta	31	2	4	6.5								83.9	9.7				6.5			
		Ontario	64	2	4	1.6							1.6	79.7	17.2				1.6			
		Québec	53	2	4	3.8							7.5	77.4	11.3				3.8			
	Streptomycin	British Columbia	43	≤ 32	64	20.9												79.1	11.6	9.3		
		Alberta	31	≤ 32	> 64	32.3												67.7	16.1	16.1		
		Ontario	64	≤ 32	> 64	28.1												71.9	10.9	17.2		
		Québec	53	64	> 64	52.8												47.2	18.9	34.0		
	Trimethoprim-sulfamethoxazole	British Columbia	43	≤ 0.12	0.25	7.0				69.8	20.9	2.3				7.0						
		Alberta	31	≤ 0.12	0.5	6.5				74.2	12.9	3.2	3.2			6.5						
		Ontario	64	≤ 0.12	> 4	15.6				71.9	10.9		1.6			15.6						
		Québec	53	0.25	> 4	18.9				47.2	24.5	9.4				18.9						
	Chloramphenicol	British Columbia	43	4	8	2.3									65.1	30.2	2.3		2.3			
		Alberta	31	4	8	6.5									67.7	25.8			6.5			
		Ontario	64	8	8	7.8								1.6	43.8	46.9			7.8			
		Québec	53	4	32	11.3									52.8	32.1	3.8	1.9	9.4			
	Sulfisoxazole	British Columbia	43	32	> 256	37.2											46.5	16.3				37.2
III		Alberta	31	≤ 16	> 256	38.7											51.6	6.5	3.2			38.7
		Ontario	64	≤ 16	> 256	35.9											51.6	10.9			1.6	35.9
		Québec	53	> 256	> 256	60.4											39.6					60.4
	Tetracycline	British Columbia	43	≤ 4	> 32	44.2									55.8			7.0	37.2			
		Alberta	31	> 32	> 32	61.3									35.5	3.2			61.3			
		Ontario	64	> 32	> 32	60.9									39.1			6.3	54.7			
		Québec	53	> 32	> 32	66.0									34.0			13.2	52.8			
IV																						

Table 56. Distribution of minimum inhibitory concentrations among *Salmonella* from chicken at pre-harvest

	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	68	≤ 1	> 32	20.6							79.4					2.9	17.6			
		Alberta	24	≤ 1	> 32	33.3							58.3		8.3			8.3	25.0			
		Ontario	65	≤ 1	> 32	43.1							55.4			1.5		7.7	35.4			
		Québec	72	≤ 1	1	4.2							93.1	2.8				1.4	2.8			
	Ceftiofur	British Columbia	68	1	16	20.6						7.4	69.1	2.9			20.6					
		Alberta	24	1	> 8	33.3						16.7	50.0				33.3					
		Ontario	65	1	> 8	43.1					1.5	27.7	27.7			10.8	32.3					
		Québec	72	0.5	1	4.2					2.8	58.3	34.7				4.2					
	Ceftriaxone	British Columbia	68	≤ 0.25	16	20.6					79.4					1.5	17.6	1.5				
		Alberta	24	≤ 0.25	16	33.3					66.7						29.2	4.2				
		Ontario	65	≤ 0.25	16	43.1					56.9				1.5	20.0	20.0		1.5			
		Québec	72	≤ 0.25	≤ 0.25	4.2					95.8							4.2				
	Ciprofloxacin	British Columbia	68	≤ 0.015	0.03	0.0	79.4	14.7			5.9											
		Alberta	24	≤ 0.015	≤ 0.015	0.0	100.0															
		Ontario	65	≤ 0.015	≤ 0.015	0.0	96.9	3.1														
		Québec	72	≤ 0.015	≤ 0.015	0.0	95.8	4.2														
II	Ampicillin	British Columbia	68	≤ 1	> 32	20.6							76.5	2.9					20.6			
		Alberta	24	≤ 1	> 32	41.7							58.3						41.7			
		Ontario	65	≤ 1	> 32	44.6							52.3	3.1					44.6			
		Québec	72	≤ 1	1	4.2							91.7	4.2					4.2			
	Azithromycin	British Columbia	68	4	8	0.0								4.4	77.9	17.6						
		Alberta	24	4	8	0.0								12.5	70.8	16.7						
		Ontario	65	4	8	0.0							3.1	16.9	67.7	12.3						
		Québec	72	4	4	0.0							1.4	13.9	77.8	6.9						
	Cefoxitin	British Columbia	68	2	32	19.1							8.8	61.8	7.4	1.5	1.5	13.2	5.9			
		Alberta	24	4	32	33.3							8.3	37.5	20.8			29.2	4.2			
		Ontario	65	2	32	27.7							29.2	24.6	3.1		15.4	24.6	3.1			
		Québec	72	2	4	4.2						2.8	29.2	51.4	12.5				4.2			
	Gentamicin	British Columbia	68	0.5	0.5	0.0					32.4	58.8	7.4	1.5								
		Alberta	24	0.5	1	0.0					25.0	54.2	20.8									
		Ontario	65	0.5	0.5	0.0					30.8	64.6	4.6									
		Québec	72	0.5	1	1.4					20.8	65.3	12.5					1.4				
	Kanamycin	British Columbia	68	≤ 8	≤ 8	0.0										100.0						
		Alberta	24	≤ 8	≤ 8	0.0										100.0						
		Ontario	65	≤ 8	≤ 8	0.0										100.0						
		Québec	72	≤ 8	≤ 8	0.0										100.0						
	Nalidixic acid	British Columbia	68	4	8	5.9								44.1	44.1	5.9			5.9			
		Alberta	24	2	4	0.0								54.2	45.8							
		Ontario	65	2	4	0.0								53.8	46.2							
		Québec	72	2	4	0.0							1.4	55.6	41.7	1.4						
	Streptomycin	British Columbia	68	≤ 32	64	16.2												83.8	11.8	4.4		
		Alberta	24	32	64	45.8												54.2	20.8	25.0		
		Ontario	65	32	> 64	38.5												61.5	23.1	15.4		
		Québec	72	64	> 64	52.8												47.2	29.2	23.6		
	Trimethoprim-sulfamethoxazole	British Columbia	68	≤ 0.12	0.25	0.0				100.0												
		Alberta	24	≤ 0.12	≤ 0.12	0.0				100.0												
		Ontario	65	≤ 0.12	≤ 0.12	4.6				93.8	1.5					4.6						
		Québec	72	≤ 0.12	≤ 0.12	4.2				95.8						4.2						
III	Chloramphenicol	British Columbia	68	32	64	0.0								1.5	23.5	73.5	1.5					
		Alberta	24	4	8	0.0								4.2	45.8	50.0						
		Ontario	65	4	8	6.2								7.7	49.2	35.4	1.5		6.2			
		Québec	72	4	8	0.0								2.8	58.3	38.9						
	Sulfisoxazole	British Columbia	68	≤ 16	64	0.0											13.2	58.8	27.9			
		Alberta	24	32	> 256	12.5											4.2	75.0	8.3			12.5
		Ontario	65	32	64	7.7											15.4	64.6	12.3			7.7
		Québec	72	32	64	9.7											25.0	54.2	11.1			9.7
	Tetracycline	British Columbia	68	≤ 4	> 32	16.2									83.8				16.2			
		Alberta	24	≤ 4	> 32	37.5									62.5				37.5			
		Ontario	65	≤ 4	> 32	33.8									66.2				33.8			
		Québec	72	> 32	> 32	59.7									40.3				59.7			
IV																						

Table 57. Distribution of minimum inhibitory concentrations among *Escherichia coli* from chickens at pre-harvest

	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	94	32	> 32	60.6								1.1	12.8	22.3	3.2	27.7	33.0			
		Alberta	60	8	> 32	48.3								6.7	26.7	16.7	1.7	31.7	16.7			
		Ontario	120	8	32	15.0								13.3	30.0	37.5	4.2	9.2	5.8			
		Québec	111	8	> 32	18.9								9.0	36.0	32.4	3.6	8.1	10.8			
	Ceftiofur	British Columbia	94	8	>8	60.6					3.2	20.2	3.2	10.6	2.1	24.5	36.2					
		Alberta	60	1	>8	41.7					25.0	23.3	5.0		5.0	21.7	20.0					
		Ontario	120	0.5	8	13.3					27.5	54.2	3.3	0.8	0.8	5.8	7.5					
I		Québec	111	0.5	8	17.1					18.0	61.3	2.7	0.9		8.1	9.0					
	Ceftriaxone	British Columbia	94	8	32	62.8					23.4	1.1	6.4	6.4	2.1	16.0	33.0	7.4	2.1	2.1		
		Alberta	60	≤ 0.25	32	46.7					51.7		1.7			10.0	23.3	13.3				
		Ontario	120	≤ 0.25	8	14.2					85.0		0.8		0.8	4.2	8.3	0.8				
		Québec	111	≤ 0.25	16	17.1					80.2	0.9	1.8			1.8	10.8	4.5				
	Ciprofloxacin	British Columbia	94	≤ 0.015	0.06	0.0	86.2	3.2	2.1		6.4	2.1										
		Alberta	60	≤ 0.015	0.03	0.0	88.3	1.7		3.3	5.0	1.7										
		Ontario	120	≤ 0.015	≤ 0.015	0.8	94.2	3.3	0.8		0.8			0.8								
		Québec	111	≤ 0.015	≤ 0.015	0.0	94.6	4.5		0.9												
	Ampicillin	British Columbia	94	> 32	> 32	88.3								6.4	4.3	1.1			88.3			
		Alberta	60	> 32	> 32	68.3							3.3	11.7	16.7				68.3			
		Ontario	120	8	> 32	49.2							5.8	22.5	20.8	1.7			49.2			
		Québec	111	4	> 32	47.7							3.6	24.3	23.4	0.9			47.7			
	Azithromycin	British Columbia	94	4	8	0.0							1.1	18.1	66.0	14.9						
		Alberta	60	4	4	0.0								16.7	80.0	3.3						
		Ontario	120	4	8	0.8							0.8	12.5	70.0	15.8		0.8				
		Québec	111	4	8	0.9							0.9	21.6	54.1	21.6	0.9	0.9				
	Cefoxitin	British Columbia	94	> 32	> 32	60.6								1.1	22.3	16.0		8.5	52.1			
		Alberta	60	8	> 32	46.7								11.7	30.0	11.7		3.3	43.3			
		Ontario	120	4	> 32	15.0								11.7	55.0	16.7	1.7	1.7	13.3			
		Québec	111	4	> 32	18.0								6.3	44.1	28.8	2.7		18.0			
	Gentamicin	British Columbia	94	0.5	8	8.5					6.4	51.1	22.3	4.3	2.1	5.3	2.1	6.4				
		Alberta	60	0.5	2	10.0					6.7	45.0	33.3	5.0			3.3	6.7				
		Ontario	120	0.5	8	10.0					5.8	52.5	30.0	0.8		0.8	2.5	7.5				
		Québec	111	1	> 16	22.5					0.9	47.7	25.2	2.7		0.9	4.5	18.0				
II	Kanamycin	British Columbia	94	≤ 8	16	9.6										87.2	3.2			9.6		
		Alberta	60	≤ 8	> 64	21.7										76.7	1.7			21.7		
		Ontario	120	≤ 8	16	8.3										89.2	2.5		0.8	7.5		
		Québec	111	≤ 8	> 64	10.8										82.0	3.6	3.6		10.8		
	Nalidixic acid	British Columbia	94	2	16	9.6							11.7	64.9	12.8		1.1	1.1	8.5			
		Alberta	60	2	4	8.3							15.0	66.7	8.3	1.7		1.7	6.7			
		Ontario	120	2	4	1.7							10.0	69.2	19.2				1.7			
		Québec	111	2	4	0.9							4.5	75.7	18.9			0.9				
	Streptomycin	British Columbia	94	≤ 32	> 64	38.3												61.7	11.7	26.6		
		Alberta	60	64	> 64	51.7												48.3	23.3	28.3		
		Ontario	120	≤ 32	> 64	36.7												63.3	11.7	25.0		
		Québec	111	64	> 64	64.9												35.1	21.6	43.2		
	Trimethoprim-sulfamethoxazole	British Columbia	94	≤ 0.12	0.25	5.3				77.7	14.9	2.1				5.3						
		Alberta	60	≤ 0.12	0.5	6.7				80.0	6.7	3.3	1.7	1.7		6.7						
		Ontario	120	≤ 0.12	> 4	23.3				63.3	5.8	5.0	0.8	1.7		23.3						
		Québec	111	0.5	> 4	40.5				32.4	17.1	6.3	2.7	0.9		40.5						
	Chloramphenicol	British Columbia	94	8	8	1.1								3.2	40.4	54.3	1.1		1.1			
		Alberta	60	8	8	6.7									40.0	53.3			6.7			
		Ontario	120	8	8	6.7								0.8	45.8	45.0	1.7	2.5	4.2			
		Québec	111	8	> 32	15.3								2.7	30.6	38.7	12.6	3.6	11.7			
	Sulfisoxazole	British Columbia	94	≤ 16	> 256	28.7											54.3	17.0				28.7
III		Alberta	60	≤ 16	> 256	28.3											61.7	8.3	1.7			28.3
		Ontario	120	≤ 16	> 256	40.8											52.5	5.0	1.7			40.8
		Québec	111	> 256	> 256	75.7											16.2	7.2		0.9		75.7
	Tetracycline	British Columbia	94	4	> 32	40.4									59.6				40.4			
		Alberta	60	32	> 32	53.3									45.0	1.7		3.3	50.0			
		Ontario	120	≤ 4	> 32	45.8									54.2			2.5	43.3			
		Québec	111	> 32	> 32	60.4									39.6			3.6	56.8			
IV																						

Table 58. Distribution of minimum inhibitory concentrations among *Campylobacter* from chicken on farm at pre-harvest

	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	0	0	0	0.0														
	Ciprofloxacin	*Campylobacter coli*	Alberta	0	0	0	0.0														
	Ciprofloxacin	*Campylobacter coli*	Ontario	1	0.12	0.12	0.0				100.0										
	Ciprofloxacin	*Campylobacter coli*	Québec	4	0.25	16	25.0					75.0						25.0			
	Ciprofloxacin	*Campylobacter jejuni*	British Columbia	27	0.12	16	40.7			7.4	48.1	3.7						40.7			
	Ciprofloxacin	*Campylobacter jejuni*	Alberta	15	0.12	0.12	0.0			6.7	93.3										
	Ciprofloxacin	*Campylobacter jejuni*	Ontario	19	0.12	16	21.1			15.8	42.1	21.1						21.1			
I	Ciprofloxacin	*Campylobacter jejuni*	Québec	15	0.12	0.12	0.0			6.7	93.3										
	Telithromycin	*Campylobacter coli*	British Columbia	0	0	0	0.0														
	Telithromycin	*Campylobacter coli*	Alberta	0	0	0	0.0														
	Telithromycin	*Campylobacter coli*	Ontario	1	0.25	0.25	0.0					100.0									
	Telithromycin	*Campylobacter coli*	Québec	4	2	4	0.0								75.0	25.0					
	Telithromycin	*Campylobacter jejuni*	British Columbia	27	0.5	1	0.0						59.3	40.7							
	Telithromycin	*Campylobacter jejuni*	Alberta	15	0.5	2	0.0						53.3	33.3	13.3						
	Telithromycin	*Campylobacter jejuni*	Ontario	19	1	2	0.0					5.3	26.3	47.4	21.1						
	Telithromycin	*Campylobacter jejuni*	Québec	15	1	1	0.0						33.3	66.7							
	Azithromycin	*Campylobacter coli*	British Columbia	0	0	0	0.0														
	Azithromycin	*Campylobacter coli*	Alberta	0	0	0	0.0														
	Azithromycin	*Campylobacter coli*	Ontario	1	0.03	0.03	0.0		100.0												
	Azithromycin	*Campylobacter coli*	Québec	4	0.12	0.12	0.0				100.0										
	Azithromycin	*Campylobacter jejuni*	British Columbia	27	0.03	0.06	0.0		55.6	44.4											
	Azithromycin	*Campylobacter jejuni*	Alberta	15	0.06	0.12	0.0		20.0	66.7	13.3										
	Azithromycin	*Campylobacter jejuni*	Ontario	19	0.03	0.06	0.0		63.2	36.8											
	Azithromycin	*Campylobacter jejuni*	Québec	15	0.03	0.06	0.0		60.0	40.0											
	Clindamycin	*Campylobacter coli*	British Columbia	0	0	0	0.0														
	Clindamycin	*Campylobacter coli*	Alberta	0	0	0	0.0														
	Clindamycin	*Campylobacter coli*	Ontario	1	0.25	0.25	0.0					100.0									
II	Clindamycin	*Campylobacter coli*	Québec	4	4	4	0.0						25.0			75.0					
	Clindamycin	*Campylobacter jejuni*	British Columbia	27	0.12	0.25	0.0			7.4	81.5	11.1									
	Clindamycin	*Campylobacter jejuni*	Alberta	15	0.12	0.25	0.0			26.7	60.0	13.3									
	Clindamycin	*Campylobacter jejuni*	Ontario	19	0.12	0.25	0.0			21.1	52.6	26.3									
	Clindamycin	*Campylobacter jejuni*	Québec	15	0.12	0.12	0.0			13.3	80.0	6.7									
	Erythromycin	*Campylobacter coli*	British Columbia	0	0	0	0.0														
	Erythromycin	*Campylobacter coli*	Alberta	0	0	0	0.0														
	Erythromycin	*Campylobacter coli*	Ontario	1	0.25	0.25	0.0					100.0									
	Erythromycin	*Campylobacter coli*	Québec	4	1	2	0.0							75.0	25.0						
	Erythromycin	*Campylobacter jejuni*	British Columbia	27	0.5	0.5	0.0					40.7	55.6	3.7							
	Erythromycin	*Campylobacter jejuni*	Alberta	15	0.5	1	0.0						86.7	13.3							
	Erythromycin	*Campylobacter jejuni*	Ontario	19	0.25	1	0.0					57.9	5.3	36.8							
	Erythromycin	*Campylobacter jejuni*	Québec	15	0.25	0.5	0.0					60.0	40.0								
	Gentamicin	*Campylobacter coli*	British Columbia	0	0	0	0.0														
	Gentamicin	*Campylobacter coli*	Alberta	0	0	0	0.0														
	Gentamicin	*Campylobacter coli*	Ontario	1	0.5	0.5	0.0						100.0								
	Gentamicin	*Campylobacter coli*	Québec	4	1	1	0.0							100.0							
	Gentamicin	*Campylobacter jejuni*	British Columbia	27	0.5	1	0.0						51.9	48.1							
	Gentamicin	*Campylobacter jejuni*	Alberta	15	1	1	0.0						26.7	73.3							
	Gentamicin	*Campylobacter jejuni*	Ontario	19	1	1	0.0						47.4	52.6							
II	Gentamicin	*Campylobacter jejuni*	Québec	15	1	1	0.0						33.3	66.7							
	Nalidixic acid	*Campylobacter coli*	British Columbia	0	0	0	0.0														
	Nalidixic acid	*Campylobacter coli*	Alberta	0	0	0	0.0														
	Nalidixic acid	*Campylobacter coli*	Ontario	1	8	8	0.0										100.0				
	Nalidixic acid	*Campylobacter coli*	Québec	4	8	> 64	25.0										75.0				25.0
	Nalidixic acid	*Campylobacter jejuni*	British Columbia	27	4	> 64	40.7									51.9	7.4				40.7
	Nalidixic acid	*Campylobacter jejuni*	Alberta	15	4	4	0.0									100.0					
	Nalidixic acid	*Campylobacter jejuni*	Ontario	19	4	> 64	21.1									57.9	21.1				21.1
	Nalidixic acid	*Campylobacter jejuni*	Québec	15	4	4	0.0									100.0					
	Florfenicol	*Campylobacter coli*	British Columbia	0	0	0	0.0														
	Florfenicol	*Campylobacter coli*	Alberta	0	0	0	0.0														
	Florfenicol	*Campylobacter coli*	Ontario	1	1	1	0.0							100.0							
	Florfenicol	*Campylobacter coli*	Québec	4	1	2	0.0							75.0	25.0						
	Florfenicol	*Campylobacter jejuni*	British Columbia	27	1	1	0.0						3.7	96.3							
	Florfenicol	*Campylobacter jejuni*	Alberta	15	1	1	0.0							100.0							
	Florfenicol	*Campylobacter jejuni*	Ontario	19	1	1	0.0							100.0							
III	Florfenicol	*Campylobacter jejuni*	Québec	15	1	1	0.0							100.0							
	Tetracycline	*Campylobacter coli*	British Columbia	0	0	0	0.0														
	Tetracycline	*Campylobacter coli*	Alberta	0	0	0	0.0														
	Tetracycline	*Campylobacter coli*	Ontario	1	0.25	0.25	0.0					100.0									
	Tetracycline	*Campylobacter coli*	Québec	4	> 64	> 64	100.0														100.0
	Tetracycline	*Campylobacter jejuni*	British Columbia	27	32	> 64	59.3				3.7	3.7	22.2	11.1				7.4	7.4	40.7	3.7
	Tetracycline	*Campylobacter jejuni*	Alberta	15	> 64	> 64	60.0				33.3	6.7							6.7	20.0	33.3
	Tetracycline	*Campylobacter jejuni*	Ontario	19	64	> 64	57.9				21.1		10.5	10.5					5.3	26.3	26.3
	Tetracycline	*Campylobacter jejuni*	Québec	15	64	> 64	73.3				26.7									40.0	33.3
IV																					

RECOVERY RESULTS

Table 59. *Farm Surveillance* recovery rates in grower-finisher pigs

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				
	2013	**99%**	530/534	**19%**	99/534				

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).

Table 60. *Farm Surveillance* recovery rates in broiler chickens

CIPARS Component / Animal species	Province / region	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted							
			Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*	
Chickens	British Columbia	2013	**72%**	43/60	**28%**	17/60				
(Placement)	Alberta	2013	**89%**	31/35	**29%**	29/35				
	Ontario	2013	**85%**	64/75	**17%**	13/75				
	Québec	2013	**82%**	53/65	**17%**	11/65				
	National	2013	**81%**	191/235	**22%**	51/235				
Chickens	British Columbia	2013	**98%**	94/96	**71%**	68/96	**28%**	27/96		
(Preharvest)	Alberta	2013	**100%**	60/60	**40%**	24/60	**25%**	15/60		
	Ontario	2013	**100%**	120/120	**54%**	65/120	**17%**	20/120		
	Québec	2013	**99%**	111/112	**64%**	72/112	**17%**	19/112		
	National	2013	**99%**	385/388	**59%**	229/388	**20%**	81/388		

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 = 248)

Typhimurium var. 5- was the most common serovar recovered from cattle (32%, 79/248) (Table 61). Eleven isolates (14%) were resistant to 6 antimicrobial classes; 10 of these were resistant to all classes ex except the macrolides and 1 isolate demonstrated resistance to azithromycin (macrolide) but was not resistant to the quinolones (Table 61).
The second most common serotype observed in cattle was Dublin (23%, 56/248). Thirteen *S.* Dublin isolates (23%) demonstrated resistance to 6 antimicrobial classes (all except the macrolides) (Table 61).

CHICKENS

SALMONELLA (n = 182)

Heidelberg was the most common serovar from chickens (24%, 43/182); just 1 isolate was resistant to more than 1 antimicrobial class (Table 62).
There were 39 isolates of *S.* Enteritidis from chickens and none were resistant to any of the antimicrobials tested (Table 62).
One *S.* Indiana isolate was recovered from chickens and was resistant to 5 antimicrobial classes (ACSSuT pattern) (Table 62).
Sixty-four percent (117/182) of all *Salmonella* isolates from chickens were non-resistant (Table 62).

PIGS

SALMONELLA (n = 296)

Two isolates from pigs (1 *S.* Mbandaka and 1 *S.* Workthington) demonstrated resistance to 6 antimicrobial classes (all except the quinolones); the resistance pattern was ACKSSuT-A2C-AZM-CRO-SXT (Table 63). No quinolone resistance was observed in any clinical isolates from pigs (Table 63).

TURKEYS

SALMONELLA (n = 66)

Three Indiana isolates were resistant to all antimicrobial classes except the quinolones; the resistance pattern was ACKSSuT-A2C-AZM-CRO-GEN-SXT (Table 64).
No resistance to quinolone antimicrobials was observed in any isolates from turkeys in 2013 (Table 64).

HORSES

SALMONELLA (n = 18)

No Heidelberg isolates were reported from horses in 2013 (Table 65).
One Give isolate demonstrated resistance to 4 antimicrobial classes (ACSSuT-A2C-CRO-SXT) and 2 Typhimurium isolates were resistant to tetracycline (Table 65).

MULTICLASS RESISTANCE

Table 61. 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
Typhimurium var. 5-	79 (31.9)				68	11	1	35	69	79	53	53	53	53	79	6	1	61		10	79
Dublin	56 (22.6)	2	3	1	37	13	2	13	48	45	45	44	37	42	54			50		16	51
Typhimurium	32 (12.9)	11		2	19			5	19	19	6	7	7	7	21	5		18			21
Cerro	23 (9.3)	23																			
4,5,12:i:-	7 (2.8)	3			4			1	4	4	1	1	1	1	4	1		1			4
Kentucky	7 (2.8)	7																			
Heidelberg	5 (2.0)	5																			
Infantis	5 (2.0)	5																			
Thompson	5 (2.0)	4		1					1						1						1
Less common serovars	29 (11.7)	23	1	1	4			1	4	5	4	3	5	3	5	2		5			4
Total	**248 (100)**	**83**	**4**	**5**	**132**	**24**	**3**	**55**	**145**	**152**	**109**	**108**	**103**	**106**	**164**	**14**	**1**	**135**		**26**	**160**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
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 62. 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	43 (23.6)	23	19	1			1		1	19	19	19	19	19	1						
Enteritidis	39 (21.4)	39																			
Kentucky	32 (17.6)	8	3	21					21	17	17	17	15	17							21
Typhimurium	22 (12.1)	21	1							1	1	1	1	1							
Senftenberg	6 (3.3)	2		4			4	4	4						4						4
Infantis	4 (2.2)	4																			
Muenchen	4 (2.2)	1		3			2								3						3
Less common serovars	32 (17.6)	19	5	7	1		4	2	10	4	1	2		2	6			1			6
Total	**182 (100)**	**117**	**28**	**36**	**1**		**11**	**6**	**36**	**41**	**38**	**39**	**35**	**39**	**14**			**1**			**34**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.

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 63. 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	83 (28.0)	4	5	11	63		4	22	64	66	2	1	1	1	73	26	4	50			76
Derby	39 (13.2)	12	4	20	3			2	21	3					22	1					25
Typhimurium var. 5-	39 (13.2)	1	4	5	29			6	31	30					31	1		29			36
Infantis	19 (6.4)	16	1	2				1	1							1					3
4,12:i:-	17 (5.7)	1	3		13		2	4	13	13					13	2		7			16
Brandenburg	13 (4.4)	6	4	3				1		2		1		1	1	1					6
4,5,12:i:-	10 (3.4)	1	2	1	6			4	6	6					7			1			9
Mbandaka	10 (3.4)	3		6		1	2	2	7	1	1	1	1	1	6	1	1	1			7
Heidelberg	9 (3.0)			9					9						9						9
Agona	7 (2.4)	4	1	1	1		1	1	2	1					2			1			3
Less common serovars	50 (16.9)	20	6	11	12	1	3	8	19	16	7	7	7	7	24	9	2	9			24
Total	**296 (100)**	**68**	**30**	**69**	**127**	**2**	**12**	**51**	**173**	**138**	**10**	**10**	**9**	**10**	**188**	**42**	**7**	**98**			**214**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.

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 64. 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	8 (12.1)	1		6	1		7	3	4	4	1	1	1	1	4						5
Muenchen	8 (12.1)	1		7			3		2						7						6
Indiana	7 (10.6)	1			3	3	4	2	6	6	6	6	6	6	6	4	3	6			6
Liverpool	7 (10.6)	7																			
Albany	4 (6.1)			4			4	1	3	3	2	3	2	3	2						1
Bredeney	4 (6.1)		3	1			4	2	1	1		1		1							
Montevideo	4 (6.1)			4			3	2	2	4	1	1	1	1							
Senftenberg	4 (6.1)			4			4	4	4	4											
Agona	3 (4.5)	1		2			1		1	1	1	1	1	1	2						1
Schwarzengrund	3 (4.5)			3			1	1	3						3						3
Enteritidis	2 (3.0)	2																			
Hadar	2 (3.0)			2					2												2
Litchfield	2 (3.0)		1	1			1		1	1	1	1	1	1	1						
Less common serovars	8 (12.1)	5	2		1		1		1	3	2	2	2	2	1						1
Total	**66 (100)**	**18**	**6**	**34**	**5**	**3**		**15**	**30**	**27**	**14**	**16**	**14**	**16**	**26**	**4**	**3**	**6**			**25**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.

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 65. 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
Typhimurium	6 (33.3)	4	2																		2
Infantis	4 (22.2)	4																			
Give	2 (11.1)	1			1				1	1	1	1	1	1	1	1		1			1
4,5,12:b:-	2 (11.1)	2																			
Newport	2 (11.1)	2																			
Hartford	1 (5.6)	1																			
4,5,12:i:-	1 (5.6)	1																			
Total	**18 (100)**	**15**	**2**		**1**				**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**		**1**			**3**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.

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

Table 66. Distribution of minimum inhibitory concentrations among *Salmonella* from 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	248	16	> 32	44.0							36.7	1.6	1.2	9.3	7.3	15.7	28.2			
I	Ceftiofur	248	1	> 8	42.7				0.4		17.3	35.5	2.4	1.6	4.0	38.7					
I	Ceftriaxone	248	≤ 0.25	32	43.5					56.0			0.4	4.4	0.4	6.9	25.4	5.6	0.8		
I	Ciprofloxacin	248	≤ 0.015	0.12	0.0	60.5	28.2	0.8	2.4	4.4	3.6										
II	Ampicillin	248	> 32	> 32	61.3							35.1	2.8	0.8				61.3			
II	Azithromycin	248	4	16	0.4							0.8	3.2	62.5	16.9	16.1	0.4				
II	Cefoxitin	248	4	> 32	41.5							10.9	31.0	10.5	5.2	0.8	5.6	35.9			
II	Gentamicin	248	0.50	1	1.2					12.9	69.8	15.7	0.4			0.4	0.8				
II	Kanamycin	248	≤ 8	> 64	22.2										77.8				22.2		
II	Nalidixic acid	248	4	> 32	10.5							0.4	35.1	42.3	11.7			10.5			
II	Streptomycin	248	> 64	> 64	58.5												41.5	5.6	52.8		
II	Trimethoprim-sulfamethoxazole	248	0.25	0.50	5.6				49.6	35.5	5.6	3.6			5.6						
III	Chloramphenicol	248	> 32	> 32	54.4								1.6	16.5	27.0	0.4	0.4	54.0			
III	Sulfisoxazole	248	> 256	> 256	66.1											6.5	21.4	6.0			66.1
III	Tetracycline	248	> 32	> 32	64.5									35.5			4.4	60.1			
IV																					

Table 67. Distribution of minimum inhibitory concentrations among *Salmonella* from chickens

	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	182	≤ 1	> 32	20.9							75.3	2.2		0.5	1.1	1.6	19.2			
I	Ceftiofur	182	1	> 8	21.4				0.5		14.8	62.1	1.1			21.4					
I	Ceftriaxone	182	≤ 0.25	16	21.4					78.6					1.1	16.5	3.3		0.5		
I	Ciprofloxacin	182	≤ 0.015	0.03	0.0	85.7	13.7	0.5													
II	Ampicillin	182	≤ 1	> 32	22.5							70.9	5.5	1.1				22.5			
II	Azithromycin	182	4	8	0.0						0.5		7.1	77.5	14.8						
II	Cefoxitin	182	2	32	19.2							13.7	47.3	15.9	2.2	1.6	17.0	2.2			
II	Gentamicin	182	0.50	1	6.0					23.1	64.8	4.9		0.5	0.5		6.0				
II	Kanamycin	182	≤ 8	≤ 8	3.3										96.7			0.5	2.7		
II	Nalidixic acid	182	4	4	0.0							1.6	39.6	57.1	1.1	0.5					
II	Streptomycin	182	≤ 32	64	19.8												80.2	9.9	9.9		
II	Trimethoprim-sulfamethoxazole	182	≤ 0.12	≤ 0.12	0.0				98.9	1.1											
III	Chloramphenicol	182	8	8	0.5								1.6	29.7	66.5	1.6		0.5			
III	Sulfisoxazole	182	32	64	7.7											10.4	66.5	15.4			7.7
III	Tetracycline	182	≤ 4	> 32	18.7									81.3			0.5	18.1			
IV																					

Table 68. 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	296	2	16	3.4							48.3	5.7	2.0	10.5	30.1	1.4	2.0			
I	Ceftiofur	296	1	1	3.4				0.3		7.1	84.5	4.7		0.3	3.0					
I	Ceftriaxone	296	≤ 0.25	≤ 0.25	3.4					96.6				0.3		0.7	2.0	0.3			
I	Ciprofloxacin	296	≤ 0.015	≤ 0.015	0.0	92.9	5.7	1.4													
II	Ampicillin	296	2	> 32	46.6							46.3	6.8	0.3			0.3	46.3			
II	Azithromycin	296	4	8	2.4								0.7	68.6	26.4	2.0	2.4				
II	Cefoxitin	296	2	4	3.0							4.1	46.3	42.6	4.1		0.7	2.4			
II	Gentamicin	296	0.50	1	4.1					6.1	73.3	14.9	1.0		0.7	2.7	1.4				
II	Kanamycin	296	≤ 8	> 64	17.2										82.8			0.7	16.6		
II	Nalidixic acid	296	4	4	0.0							1.4	45.3	49.3	4.1						
II	Streptomycin	296	64	> 64	58.4												41.6	11.8	46.6		
II	Trimethoprim-sulfamethoxazole	296	≤ 0.12	> 4	14.2				68.9	16.9				0.3	13.9						
III	Chloramphenicol	296	8	> 32	33.1								0.3	6.4	57.8	2.4	0.3	32.8			
III	Sulfisoxazole	296	> 256	> 256	63.5											1.4	20.6	13.9	0.7		63.5
III	Tetracycline	296	> 32	> 32	72.3									27.4	0.3	0.3	12.5	59.5			
IV																					

Table 69. Distribution of minimum inhibitory concentrations among *Salmonella* from turkeys

	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	66	≤ 1	> 32	21.2							56.1	3.0		7.6	12.1		21.2			
I	Ceftiofur	66	1	> 8	24.2						6.1	69.7				24.2					
I	Ceftriaxone	66	≤ 0.25	32	24.2					75.8						6.1	10.6	1.5	6.1		
I	Ciprofloxacin	66	≤ 0.015	≤ 0.015	0.0	97.0	3.0														
II	Ampicillin	66	2	> 32	40.9							50.0	9.1					40.9			
II	Azithromycin	66	4	8	4.5								9.1	75.8	10.6		4.5				
II	Cefoxitin	66	4	> 32	21.2							6.1	34.8	36.4	1.5		9.1	12.1			
II	Gentamicin	66	16	> 16	50.0					7.6	39.4	1.5	1.5			3.0	47.0				
II	Kanamycin	66	≤ 8	> 64	22.7										72.7		4.5	12.1	10.6		
II	Nalidixic acid	66	4	4	0.0								40.9	59.1							
II	Streptomycin	66	≤ 32	> 64	45.5												54.5	18.2	27.3		
II	Trimethoprim-sulfamethoxazole	66	≤ 0.12	≤ 0.12	6.1				92.4	1.5					6.1						
III	Chloramphenicol	66	8	8	9.1									24.2	66.7			9.1			
III	Sulfisoxazole	66	32	> 256	39.4											4.5	47.0	9.1			39.4
III	Tetracycline	66	≤ 4	> 32	37.9									62.1				37.9			
IV																					

Table 70. Distribution of minimum inhibitory concentrations among *Salmonella* from horses

	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	18	≤ 1	≤ 1	5.6							94.4						5.6			
I	Ceftiofur	18	1	1	5.6						44.4	50.0				5.6					
I	Ceftriaxone	18	≤ 0.25	≤ 0.25	5.6					94.4						5.6					
I	Ciprofloxacin	18	≤ 0.015	≤ 0.015	0.0	100.0															
II	Ampicillin	18	≤ 1	≤ 1	5.6							94.4						5.6			
II	Azithromycin	18	4	4	0.0									94.4	5.6						
II	Cefoxitin	18	2	4	5.6							38.9	33.3	22.2			5.6				
II	Gentamicin	18	0.50	0.50	0.0					22.2	72.2	5.6									
II	Kanamycin	18	≤ 8	≤ 8	0.0										100.0						
II	Nalidixic acid	18	4	4	0.0								44.4	55.6							
II	Streptomycin	18	≤ 32	≤ 32	5.6												94.4		5.6		
II	Trimethoprim-sulfamethoxazole	18	≤ 0.12	≤ 0.12	5.6				94.4						5.6						
III	Chloramphenicol	18	8	8	5.6									27.8	66.7			5.6			
III	Sulfisoxazole	18	32	64	5.6											5.6	72.2	16.7			5.6
III	Tetracycline	18	≤ 4	> 32	16.7									83.3				16.7			
IV																					

SURVEILLANCE OF FEED AND FEED INGREDIENTS

KEY FINDINGS

SALMONELLA (n = 32)

One Senftenberg and 1 Mbandaka serovar demonstrated resistance to 3 antimicrobial classes; no resistance to Category I antimicrobials was detected (Table 71). Sixty-nine percent (22/32) of isolates had no information about the intended use of the feed product; 4 isolates (13%) were from feed intended for dairy cattle, 2 (6%) each for beef cattle and fish, and 1 (3%) each for goats and swine. Among the 2 feed isolates that demonstrated resistance, the *S*. Senftenberg isolate was intended for fish and the *S*. Mbandaka 1 was intended for dairy cattle.

MULTICLASS RESISTANCE

Table 71. 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
Senftenberg	5 (15.6)	4		1					1						1						1
Montevideo	4 (12.5)	4																			
Infantis	3 (9.4)	3																			
Johannesburg	2 (6.3)	2																			
Mbandaka	2 (6.3)	1		1					1						1						1
Newport	2 (6.3)	2																			
Soerenga	2 (6.3)	2																			
Agona	1 (3.1)	1																			
Anatum var. 15+	1 (3.1)	1																			
Berta	1 (3.1)	1																			
Cerro	1 (3.1)	1																			
4,5,12:b:-	1 (3.1)	1																			
Ohio var. 14+	1 (3.1)	1																			
Oranienburg	1 (3.1)	1																			
Orion var. 15+ 34+	1 (3.1)	1																			
Schwarzengrund	1 (3.1)	1																			
Tennessee var. 14+	1 (3.1)	1																			
Typhimurium	1 (3.1)	1																			
Urbana	1 (3.1)	1																			
Total	**32 (100)**	**30**		**2**					**2**						**2**						**2**

Antimicrobial abbreviations are defined in the section *How To Read This Chapter*.
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

Table 72. 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	32	≤ 1	≤ 1	0.0							100.0									
	Ceftiofur	32	1	1	0.0						28.1	71.9									
	Ceftriaxone	32	≤ 0.25	≤ 0.25	0.0					100.0											
	Ciprofloxacin	32	≤ 0.015	≤ 0.015	0.0	93.8	6.3														
II	Ampicillin	32	≤ 1	≤ 1	0.0							100.0									
	Azithromycin	32	4	8	0.0								6.3	75.0	18.8						
	Cefoxitin	32	2	4	0.0							12.5	46.9	40.6							
	Gentamicin	32	0.50	0.50	0.0					18.8	71.9	9.4									
	Kanamycin	32	≤ 8	≤ 8	0.0										100.0						
	Nalidixic acid	32	4	4	0.0								40.6	59.4							
	Streptomycin	32	≤ 32	≤ 32	6.3												93.8	6.3			
	Trimethoprim-sulfamethoxazole	32	≤ 0.12	≤ 0.12	0.0				93.8	6.3											
III	Chloramphenicol	32	8	8	0.0									25.0	75.0						
	Sulfisoxazole	32	32	64	6.3											6.3	56.3	28.1	3.1		6.3
	Tetracycline	32	≤ 4	≤ 4	6.3									93.8				6.3			
IV																					