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Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)

PRELIMINARY RESULTS

2009

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Preamble

The Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) is pleased to present preliminary antimicrobial resistance (AMR) findings and bacterial recovery rates for the 2009 calendar year. This preliminary results document contains data from the following surveillance components:

- *Surveillance of Human Clinical Isolates*
- *Farm Surveillance*
- *Abattoir Surveillance*
- *Retail Meat Surveillance*
- *Surveillance of Animal Clinical Isolates*

What's New in 2009 CIPARS Surveillance

Changes to CIPARS Analyses and Reporting

- New tables have been added to this report for each surveillance component (with the exception of data from *Escherichia coli*), which show the number of isolates resistant to different antimicrobial classes and the number of antimicrobial classes in the resistance patterns.
- Unlike previous years, antimicrobial resistance in *Salmonella* Newport isolates is not highlighted in the human section of the preliminary report because most 2009 isolates were susceptible to all antimicrobials tested.

Changes in Methods

- The *Enterococcus* CMV3AGPF plate replaced the CMV2AGPF plate. This new plate does not include flavomycin (Category IV) and the range of dilutions tested was increased for daptomycin, vancomycin, erythromycin, penicillin, quinupristin-dalfopristin and tetracycline. More details will be presented in the 2009 CIPARS Annual Report.
- The new resistance breakpoint for ceftriaxone (M100-S20, Clinical and Laboratory Standards Institute) was applied to the interpretation of 2009 *Salmonella* and *E. coli* data. The breakpoint was 64 µg/mL and is now 4 µg/mL.

Important Notes

- Antimicrobials were categorized on the basis of importance in human medicine (Veterinary Drugs Directorate, Health Canada;[1] categories revised in April 2009). Antimicrobials are generally listed first according to this classification and then alphabetically. The antimicrobial abbreviations are located in the appendix A on page 55.

[1] http://www.hc-sc.gc.ca/dhp-mps/consultation/vet/consultations/amr_ram_hum-med-rev-eng.php

- 2009 data for this report were extracted from the central data repository as of April 7th, 2010. Additional isolates may be included in the full 2009 report.

About CIPARS Surveillance Components

Surveillance of Human Clinical Isolates

The objectives of the *Surveillance of Human Clinical Isolates* component are to provide a representative and methodologically unified approach to monitor temporal trends in the development of AMR in *Salmonella* isolated from humans at the provincial level.

Hospital-based or private clinical laboratories usually culture human *Salmonella* isolates in Canada. Although reporting is mandatory through laboratory notification of reportable diseases to the National Notifiable Disease Reporting System, forwarding of *Salmonella* cultures to the Provincial Public Health Laboratories (PPHLs) laboratories is voluntary and passive. A high proportion (84% in 2001)[2] of *Salmonella* isolates is forwarded to the PPHLs but this proportion may vary among laboratories.

To ensure a statistically valid sampling plan, all human *Salmonella* isolates (outbreak-associated and non-outbreak-associated) received by PPHLs[3] in Saskatchewan, Manitoba, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador were forwarded to the National Microbiology Laboratory (NML). The PPHLs in more populated provinces (British Columbia, Alberta, Ontario, and Québec) forwarded only the isolates received from the 1st to the 15th of each month. However, all human isolates of *S*. Newport and *S.* Typhi were forwarded to the NML because of concerns regarding multidrug resistance and clinical importance respectively. The Territories did not forward any human *Salmonella* isolates to CIPARS, directly or through PPHLs. Currently, an agreement has not been set up between CIPARS and the Territories.

Farm Surveillance (pigs)

The objectives of the *Farm Surveillance* component are to provide data on antimicrobial use and resistance, monitor temporal trends in the development of AMR, investigate associations between antimicrobial use and resistance in isolates from grower-finisher pigs, and provide data for human-health risk assessments.

This initiative is based on a sentinel farm framework that provides herd-level data on antimicrobial use and fecal samples for bacterial isolation and antimicrobial susceptibility testing. It is administered and coordinated by the Laboratory for Foodborne Zoonoses (LFZ). This surveillance component focuses on grower-finisher pigs.

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

In 2009, the bacteria of interest in pigs were *Salmonella*, generic *Escherichia coli*, and *Enterococcus* recovered from composite fecal samples taken at the grower-finisher units. Nationally, 19 veterinarians and 91 sentinel grower-finisher sites were enrolled. In each of the participating provinces, the number of CIPARS sentinel sites was proportional to the national total of grower-finisher units, other than in Alberta where additional herds were enrolled with provincial support.

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

[3] The Yukon, Northwest Territories, and Nunavut, which do not have a PPHL counterpart, also forward isolates to one of the PPHLs.

Abattoir Surveillance (beef cattle, chickens, and pigs)

The objective of the *Abattoir Surveillance* component is to provide nationally representative, annual AMR data for bacteria isolated from animals entering the food chain, and to monitor temporal trends in the prevalence of AMR in these bacteria. Initially, this component targeted generic *Escherichia coli* and *Salmonella* from beef cattle, pigs, and broiler chickens. In 2003, the component was refined to discontinue *Salmonella* isolation from beef cattle because of the low prevalence of *Salmonella* in that population. An additional change was the inclusion of *Campylobacter* surveillance in beef cattle in late 2005.

In the *Abattoir Surveillance* component, the unit of concern (i.e. the subject of interest) is the bacterial isolate. The bacteria of interest were sampled from the caecal contents (not carcasses) of slaughtered food animals to avoid misinterpretation related to cross-contamination and to better reflect AMR in bacteria that originated on the farm.

Over 90% of all food-producing animals in Canada are slaughtered in federally inspected abattoirs annually. Forty-four federally inspected slaughter plants (6 beef cattle plants[4], 24 poultry plants, and 13 swine plants) from across Canada participated in 2009. The sampling method was designed with the goal that, across Canada, 150 isolates of each targeted bacterial would be recovered from each species over a 12-month period to avoid any potential seasonal bias in bacteria prevalence and antimicrobial susceptibility. The exception was *Campylobacte*r isolated from beef cattle, for which it was estimated that 100 isolates would be recovered over the same period.

Retail Meat Surveillance (beef, chicken, and pork)

The objectives of the *Retail Meat Surveillance* component are to provide data on antimicrobial AMR and to monitor temporal variations in select bacteria found in raw meat at the provincial level. Retail surveillance provides a measure of human exposure to antimicrobial-resistant bacteria through the consumption of undercooked meat. Retail food represents a logical sampling point for surveillance of AMR because it is the endpoint of food animal production and thus is indicative of human exposure. The scope of the surveillance framework can be modified (e.g. food commodities, bacteria, or regions) as necessary and functions as a research platform for investigation of specific questions regarding AMR in the agri-food sector.

As with *Abattoir Surveillance,* the unit of concern in *Retail Meat Surveillance* was the bacterial isolate cultured from one of the commodities of interest. In this situation, the commodities were raw meat products commonly consumed by Canadians, which originated from the 3 animal species sampled in the *Abattoir Surveillance* component. These raw meat products consisted of poultry (chicken legs or wings [skin on]), pork (chops), and beef (ground beef).

Bacteria of interest in chicken were *Campylobacter*, *Salmonella*, *Enterococcus*, and generic *E. coli*. In beef and pork, only *E. coli* was cultured and then tested for antimicrobial susceptibility given the low prevalence of *Campylobacter* and *Salmonella* in these commodities at the retail level as determined during the early phases of the program. *Salmonella* was isolated from pork but only to provide recovery estimates for this commodity for other Public Health Agency of Canada (PHAC) programs. These strains were submitted to antimicrobial susceptibility testing but results are not presented on an annual basis.

The sampling protocol was designed to evaluate AMR in the bacterial of interest and primarily involved continuous weekly submission of samples of retail meat from randomly selected geographic areas (i.e. census divisions defined by Statistics Canada), weighted by population, in each participating province. In 2009, retail meat samples were collected in British Columbia, Saskatchewan, Ontario, Québec, and in the Maritimes (New Brunswick, Nova Scotia and Prince Edward Island).

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[4] May include a very small number of samples from dairy cattle, as a small number of plants slaughter both commodities, however veal is excluded.

Prevalence estimates were used to determine the numbers of samples to be collected, which were based on an expected yield of 100 isolates per commodity per province per year plus 20% to account for lost or damaged samples. Because sampling was less frequent in British Columbia, Saskatchewan, and the Maritime provinces relative to Ontario and Québec, the target of 100 isolates per year may not have always been achieved in those provinces.

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

The objective of the *Surveillance of Animal Clinical Isolates* component is to detect new and/or emerging AMR patterns or new serovar/AMR pattern combinations in *Salmonella.* This component of CIPARS is based on submissions to veterinary diagnostic laboratories where the samples were collected by veterinarians and/or producers. Consequently, sample collection and submission, and *Salmonella* isolation varied among laboratories. *Salmonella* isolates were sent by provincial animal health laboratories from across the country to the *Salmonella* Typing Laboratory at the LFZ, Guelph, Ontario with the exception of Québec where isolates from animal health laboratories were sent to the Réseau des laboratoires de l'Institut national de santé animale, Saint-Hyacinthe for serotyping. Isolates and serotyping results from Québec are then forwarded to the LFZ to perform phagetyping and AMR testing on these isolates. However, unlike the *Surveillance of Human Clinical Isolates* component, all isolates received by provincial animal health laboratories were not necessarily forwarded to the LFZ, with the exception of the provinces of Ontario and Québec. Therefore, coverage may have varied considerably among provinces.

Antimicrobial Resistance in Humans and the Agri-Food Sector

Humans

Salmonella (n = 2,991)

Salmonella Enteritidis

(n = 703)

Table 1. Resistance to antimicrobials in *Salmonella* Enteritidis isolates from humans, by province; *Surveillance of Human Clinical Isolates*, 2009.

	Antimicrobial	Number (%) of isolates resistant										Canada[a]
		BC n = 118	AB n = 75	SK n = 48	MB n = 52	ON n = 245	QC n = 107	NB n = 21	NS n = 27	PEI n = 3	NL n = 7	%
I	Amoxicillin-clavulanic acid	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	Ceftiofur	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	Ceftriaxone	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	Ciprofloxacin	0 (0)	0 (0)	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<1
II	Amikacin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	Ampicillin	2 (2)	1 (1)	0 (0)	1 (2)	6 (2)	3 (3)	0 (0)	0 (0)	0 (0)	0 (0)	2
	Cefoxitin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	Gentamicin	0 (0)	1 (1)	0 (0)	1 (2)	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	<1
	Kanamycin	1 (1)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<1
	Nalidixic acid	11 (9)	7 (9)	4 (8)	7 (13)	29 (12)	9 (8)	3 (14)	5 (19)	0 (0)	0 (0)	10
	Streptomycin	5 (4)	5 (7)	3 (6)	2 (4)	4 (2)	1 (1)	0 (0)	1 (4)	0 (0)	0 (0)	3
	Trimethoprim-sulfamethoxazole	0 (0)	0 (0)	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<1
III	Chloramphenicol	0 (0)	0 (0)	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<1
	Sulfisoxazole	2 (2)	1 (1)	0 (0)	1 (2)	3 (1)	4 (4)	0 (0)	0 (0)	0 (0)	0 (0)	2
	Tetracycline	3 (3)	1 (1)	0 (0)	1 (2)	2 (1)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	1
IV												

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

[a] Estimated percentage for Canada corrected for non-proportional submission protocols among provinces (see Appendix A.2 in the 2007 CIPARS Annual Report).

The abbreviations for the provinces are located in the Appendix on page 55.

Salmonella Heidelberg

(n = 276)

Table 2. Resistance to antimicrobials in *Salmonella* Heidelberg isolates from humans, by province; *Surveillance of Human Clinical Isolates*, 2009.

	Antimicrobial	Number (%) of isolates resistant										Canada[a]
		BC n = 14	AB n = 30	SK n = 10	MB n = 27	ON n = 79	QC n = 75	NB n = 22	NS n = 12	PEI n = 2	NL n = 5	%
I	Amoxicillin-clavulanic acid	0 (0)	3 (10)	2 (20)	2 (7)	12 (15)	7 (9)	4 (18)	6 (50)	0 (0)	0 (0)	12
	Ceftiofur	0 (0)	5 (17)	2 (20)	2 (7)	12 (15)	7 (9)	4 (18)	6 (50)	0 (0)	0 (0)	13
	Ceftriaxone	0 (0)	4 (13)	2 (20)	2 (7)	12 (15)	7 (9)	4 (18)	6 (50)	0 (0)	0 (0)	13
	Ciprofloxacin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
II	Amikacin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	Ampicillin	2 (14)	15 (50)	4 (40)	3 (11)	30 (38)	25 (33)	4 (18)	8 (67)	0 (0)	0 (0)	34
	Cefoxitin	0 (0)	3 (10)	2 (20)	2 (7)	12 (15)	7 (9)	4 (18)	6 (50)	0 (0)	0 (0)	12
	Gentamicin	0 (0)	0 (0)	0 (0)	0 (0)	2 (3)	4 (5)	0 (0)	0 (0)	0 (0)	0 (0)	3
	Kanamycin	1 (7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<1
	Nalidixic acid	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<1
	Streptomycin	0 (0)	2 (7)	0 (0)	2 (7)	3 (4)	5 (7)	0 (0)	0 (0)	0 (0)	1 (20)	5
	Trimethoprim-sulfamethoxazole	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (3)	0 (0)	0 (0)	0 (0)	1 (20)	1
III	Chloramphenicol	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	Sulfisoxazole	0 (0)	2 (7)	0 (0)	0 (0)	2 (3)	6 (8)	0 (0)	0 (0)	0 (0)	1 (20)	4
	Tetracycline	1 (7)	3 (10)	0 (0)	0 (0)	2 (3)	2 (3)	0 (0)	0 (0)	0 (0)	1 (20)	4
IV												

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

[a] Estimated percentage for Canada corrected for non-proportional submission protocols among provinces (see Appendix A.2 in the 2007 CIPARS Annual Report).

Salmonella Paratyphi A and Paratyphi B

(n = 36)

Table 3. Resistance to antimicrobials in *Salmonella* Paratyphi A and Paratyphi B isolates from humans by province; *Surveillance of Human Clinical Isolates*, 2009.

	Antimicrobial	Number (%) of isolates resistant										Canada[a]
		BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL	
		n = 14	n = 4	n = 2	n = 0	n = 10	n = 5	n = 0	n = 1	n = 0	n = 0	%
I	Amoxicillin-clavulanic acid	0 (0)	0 (0)	0 (0)		0 (0)	0 (0)		0 (0)			0
	Ceftiofur	0 (0)	0 (0)	0 (0)		0 (0)	0 (0)		0 (0)			0
	Ceftriaxone	0 (0)	0 (0)	0 (0)		0 (0)	0 (0)		0 (0)			0
	Ciprofloxacin	0 (0)	0 (0)	0 (0)		0 (0)	0 (0)		0 (0)			0
II	Amikacin	0 (0)	0 (0)	0 (0)		0 (0)	0 (0)		0 (0)			0
	Ampicillin	0 (0)	0 (0)	0 (0)		0 (0)	2 (40)		0 (0)			6
	Cefoxitin	0 (0)	0 (0)	0 (0)		0 (0)	0 (0)		0 (0)			0
	Gentamicin	0 (0)	0 (0)	0 (0)		0 (0)	0 (0)		0 (0)			0
	Kanamycin	0 (0)	0 (0)	0 (0)		0 (0)	0 (0)		0 (0)			0
	Nalidixic acid	14 (100)	2 (50)	1 (50)		10 (100)	1 (20)		0 (0)			80
	Streptomycin	0 (0)	0 (0)	0 (0)		0 (0)	1 (20)		0 (0)			3
	Trimethoprim-sulfamethoxazole	0 (0)	0 (0)	0 (0)		0 (0)	0 (0)		0 (0)			0
III	Chloramphenicol	0 (0)	0 (0)	0 (0)		0 (0)	1 (20)		0 (0)			3
	Sulfisoxazole	0 (0)	0 (0)	0 (0)		0 (0)	1 (20)		0 (0)			3
	Tetracycline	0 (0)	0 (0)	0 (0)		0 (0)	1 (20)		0 (0)			3
IV												

Roman numerals I to IV indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.
Salmonella Paratyphi B does not include *S*. Paratyphi B var. L (+) tartrate+, formely called *S*. Paratyphi var. Java. The biotype of *S*. Paratyphi B here included is tartrate negative and associated with more severe, typhoid-like fever. *Salmonella* Paratyphi B var. L (+) tartrate+ is commonly associated with gastro-enteritidis and is included under “Other serovars”.
[a] Estimated percentage for Canada corrected for non-proportional submission protocols among provinces (see Appendix A.2 in the 2007 CIPARS Annual Report).

Salmonella Typhi

(n=117)

Table 4. Resistance to antimicrobials in *Salmonella* Typhi isolates from humans by province; *Surveillance of Human Clinical Isolates*, 2009.

	Antimicrobial	Number (%) of isolates resistant										Canada
		BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL	
		n = 31	n = 12	n = 1	n = 3	n = 59	n = 11	n = 0	n = 0	n = 0	n = 0	%
I	Amoxicillin-clavulanic acid	1 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)					<1
	Ceftiofur	1 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)					<1
	Ceftriaxone	1 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)					<1
	Ciprofloxacin	1 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)					<1
II	Amikacin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)					0
	Ampicillin	2 (6)	8 (67)	0 (0)	0 (0)	9 (15)	2 (18)					18
	Cefoxitin	1 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)					<1
	Gentamicin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)					0
	Kanamycin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)					0
	Nalidixic acid	26 (84)	11 (92)	1 (100)	3 (100)	42 (71)	5 (45)					75
	Streptomycin	1 (3)	7 (58)	0 (0)	0 (0)	8 (14)	2 (18)					16
	Trimethoprim-sulfamethoxazole	1 (3)	7 (58)	0 (0)	0 (0)	9 (15)	2 (18)					17
III	Chloramphenicol	1 (3)	7 (58)	0 (0)	0 (0)	9 (15)	2 (18)					17
	Sulfisoxazole	1 (3)	8 (67)	0 (0)	0 (0)	10 (17)	2 (18)					18
	Tetracycline	0 (0)	3 (25)	0 (0)	0 (0)	3 (5)	1 (9)					6
IV												

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

Salmonella Typhimurium

(n = 269)

Table 5. Resistance to antimicrobials in *Salmonella* Typhimurium isolates from humans by province; *Surveillance of Human Clinical Isolates*, 2009.

	Antimicrobial	Number (%) of isolates resistant										Canada[a]
		BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL	
		n = 19	n = 36	n = 17	n = 12	n = 117	n = 41	n = 7	n = 12	n = 4	n = 4	%
I	Amoxicillin-clavulanic acid	2 (11)	1 (3)	0 (0)	0 (0)	3 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2
	Ceftiofur	2 (11)	1 (3)	0 (0)	0 (0)	3 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2
	Ceftriaxone	2 (11)	1 (3)	0 (0)	0 (0)	3 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2
	Ciprofloxacin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
II	Amikacin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	Ampicillin	7 (37)	9 (25)	2 (12)	5 (42)	22 (19)	8 (20)	0 (0)	3 (25)	0 (0)	0 (0)	21
	Cefoxitin	2 (11)	1 (3)	0 (0)	0 (0)	3 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2
	Gentamicin	0 (0)	1 (3)	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<1
	Kanamycin	1 (5)	4 (11)	1 (6)	3 (25)	4 (3)	2 (5)	0 (0)	0 (0)	0 (0)	0 (0)	5
	Nalidixic acid	3 (16)	2 (6)	0 (0)	0 (0)	3 (3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3
	Streptomycin	6 (32)	13 (36)	2 (12)	4 (33)	21 (18)	9 (22)	1 (14)	3 (25)	0 (0)	0 (0)	22
	Trimethoprim-sulfamethoxazole	1 (5)	0 (0)	0 (0)	0 (0)	2 (2)	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	2
III	Chloramphenicol	5 (26)	8 (22)	1 (6)	3 (25)	17 (15)	8 (20)	0 (0)	2 (17)	0 (0)	0 (0)	17
	Sulfisoxazole	6 (32)	13 (36)	3 (18)	5 (42)	23 (20)	10 (24)	1 (14)	3 (25)	0 (0)	0 (0)	24
	Tetracycline	6 (32)	9 (25)	3 (18)	5 (42)	26 (22)	10 (24)	1 (14)	3 (25)	0 (0)	0 (0)	24
IV												

Roman numerals I to IV indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.
[a] Estimated percentage for Canada corrected for non-proportional submission protocols among provinces (see Appendix A.2 in the 2007 CIPARS Annual Report).

Salmonella "Other Serovars"

(n = 890)

Table 6. Resistance to antimicrobials in *Salmonella* "Other Serovars" isolates from humans by province; *Surveillance of Human Clinical Isolates*, 2009.

	Antimicrobial	Number (%) of isolates resistant										Canada[a]
		BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL	
		n = 119	n = 146	n = 60	n = 88	n = 285	n = 135	n = 27	n = 22	n = 3	n = 5	%
I	Amoxicillin-clavulanic acid	5 (4)	7 (5)	4 (7)	5 (6)	5 (2)	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)	3
	Ceftiofur	5 (4)	7 (5)	4 (7)	5 (6)	6 (2)	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)	3
	Ceftriaxone	5 (4)	7 (5)	4 (7)	5 (6)	6 (2)	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)	3
	Ciprofloxacin	0 (0)	1 (1)	1 (2)	0 (0)	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<1
II	Amikacin	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0
	Ampicillin	11 (9)	12 (8)	7 (12)	10 (11)	12 (4)	5 (4)	2 (7)	1 (5)	0 (0)	0 (0)	6
	Cefoxitin	5 (4)	7 (5)	4 (7)	5 (6)	5 (2)	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)	3
	Gentamicin	3 (3)	2 (1)	1 (2)	3 (3)	3 (1)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	1
	Kanamycin	1 (1)	4 (3)	0 (0)	1 (1)	2 (1)	0 (0)	1 (4)	0 (0)	0 (0)	0 (0)	1
	Nalidixic acid	2 (2)	14 (10)	2 (3)	2 (2)	11 (4)	4 (3)	0 (0)	1 (5)	0 (0)	0 (0)	4
	Streptomycin	9 (8)	10 (7)	7 (12)	7 (8)	28 (10)	12 (9)	3 (11)	3 (14)	0 (0)	0 (0)	9
	Trimethoprim-sulfamethoxazole	5 (4)	8 (5)	0 (0)	1 (1)	4 (1)	4 (3)	1 (4)	0 (0)	0 (0)	0 (0)	3
III	Chloramphenicol	8 (7)	5 (3)	0 (0)	0 (0)	5 (2)	2 (1)	1 (4)	0 (0)	0 (0)	0 (0)	3
	Sulfisoxazole	11 (9)	14 (10)	9 (15)	6 (7)	14 (5)	8 (6)	2 (7)	1 (5)	0 (0)	0 (0)	7
	Tetracycline	15 (13)	30 (21)	12 (20)	12 (14)	39 (14)	14 (10)	4 (15)	5 (23)	0 (0)	0 (0)	15
IV												

Roman numerals I to IV indicate the ranking of antimicrobials based on importance in human medicine as outlined by the Veterinary Drugs Directorate.
a Estimated percentage for Canada corrected for non-proportional submission protocols among provinces (see Appendix A.2 in the 2007 CIPARS Annual Report).

Table 7. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from humans, by province and serovar; *Surveillance of Human Clinical Isolates*, 2009.

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 pathways inhibitors		Phenicols	Quinolones		Tetracyclines
		0	1	2-3	4-5	6	AMK	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	CHL	CIP	NAL	TET
British Columbia																					
Enteritidis	118 (37.5)	100	14	4					1	5	2					2				11	3
Typhi	31 (9.8)	4	26		1					1	2	1	1	1	1	1	1	1	1	26	
Typhimurium	19 (6)	7	5	2	5				1	6	7	2	2	2	2	6	1	5		3	6
Heidelberg	14 (4.4)	12	1	1					1		2										1
Newport	14 (4.4)	13			1					1	1	1	1	1	1	1		1			1
Paratyphi A	14 (4.4)		14																	14	
I 4,[5],12:i:-	11 (3.5)	4	3	2	1	1		1		2	4	2	2	2	2	4	1	2		1	5
Stanley	7 (2.2)	5			2			1	1	2	2	1	1	1	1	2	1	2			2
Less common serovars	87 (27.6)	79	2	3	2	1		1		4	4	1	1	1	1	4	3	3		1	7
Total	**315 (100)**	**224**	**65**	**12**	**12**	**2**		**3**	**4**	**21**	**24**	**8**	**8**	**8**	**8**	**20**	**7**	**14**	**1**	**56**	**25**
Alberta																					
Enteritidis	75 (24.8)	64	10		1			1	1	5	1					1				7	1
Typhimurium	36 (11.9)	18	4	6	8			1	4	13	9	1	1	1	1	13		8		2	9
Heidelberg	30 (9.9)	15	8	7						2	15	3	4	3	5	2					3
I 4,[5],12:i:-	16 (5.3)	4	12								2	2	2	2	2						10
Saintpaul	12 (4)	10	2																		2
Typhi	12 (4)	1	3		6	2				7	8					8	7	7		11	3
Infantis	11 (3.6)	7	1	2		1		1	1		2	1	1	1	1	3	1	1		3	3
Less common serovars	111 (36.6)	86	10	9	6			1	3	10	8	4	4	4	4	11	7	4	1	13	15
Total	**303 (100)**	**205**	**50**	**24**	**21**	**3**		**4**	**9**	**37**	**45**	**11**	**12**	**11**	**13**	**38**	**15**	**20**	**1**	**36**	**46**
Saskatchewan																					
Enteritidis	48 (34.8)	41	7							3										4	
I 4,[5],12:i:-	17 (12.3)	6	8	1	2					3	7	4	4	4	4	3				1	6
Typhimurium	17 (12.3)	14		1	2				1	2	2					3		1			3
Heidelberg	10 (7.2)	6	4								4	2	2	2	2						
Agona	7 (5.1)	3		4						2						4					4
Infantis	6 (4.3)	6																			
Newport	4 (2.9)	4																			
Oranienburg	3 (2.2)	3																			
Less common serovars	26 (18.8)	22	2	1	1			1		2						2			1	3	2
Total	**138 (100)**	**105**	**21**	**7**	**5**			**1**	**1**	**12**	**13**	**6**	**6**	**6**	**6**	**12**		**1**	**1**	**8**	**15**
Manitoba																					
Enteritidis	52 (28.6)	43	8			1		1		2	1					1		1	1	7	1
I 4,[5],12:i:-	40 (22)	28	11	1				1		1	6	4	4	4	4	1					6
Heidelberg	27 (14.8)	23	3	1						2	3	2	2	2	2						
Typhimurium	12 (6.6)	7			5				3	4	5					5		3			5
Newport	8 (4.4)	8																			
Montevideo	4 (2.2)	4																			
Oranienburg	4 (2.2)	4																			
Saintpaul	4 (2.2)	3			1					1	1					1				1	1
Less common serovars	31 (17)	22	4	4	1			2	1	5	3	1	1	1	1	4	1			4	5
Total	**182 (100)**	**142**	**26**	**6**	**7**	**1**		**4**	**4**	**15**	**19**	**7**	**7**	**7**	**7**	**12**	**1**	**4**	**1**	**12**	**18**
Ontario																					
Enteritidis	245 (30.9)	211	28	4	2					4	6					3	1			29	2
Typhimurium	116 (14.6)	88	4	4	19	1		1	4	21	22	3	3	3	3	23	2	17		3	26
Heidelberg	79 (9.9)	46	29	4				2		3	30	12	12	12	12	2				1	2
Typhi	59 (7.4)	17	32	2	5	3				8	9					10	9	9		42	3
Newport	38 (4.8)	37		1						1											1
I 4,[5],12:i:-	24 (3)	19	4	1						1	2	1	1	1	1						3
Hadar	20 (2.5)	1	5	14						14											19
Saintpaul	20 (2.5)	19		1				1		1						1					
Less common serovars	193 (24.3)	160	15	10	7	1		2	2	11	10	4	5	4	5	13	4	5	2	21	16
Total	**794 (100)**	**598**	**117**	**41**	**33**	**5**		**6**	**6**	**64**	**79**	**20**	**21**	**20**	**21**	**52**	**16**	**31**	**2**	**96**	**72**
Québec																					
Enteritidis	107 (28.6)	96	7	3	1			1		1	3					4				9	1
Heidelberg	75 (20.1)	45	24	6				4		5	25	7	7	7	7	6	2				2
Typhimurium	41 (11)	31		2	8				2	9	8					10	1	8			10
Javiana	27 (7.2)	27																			
Thompson	13 (3.5)	13																			
Newport	11 (2.9)	11																			
Typhi	11 (2.9)	6	3		1	1				2	2					2	2	2		5	1
I 4,[5],12:i:-	8 (2.1)	5	1	1	1			1		2	2	1	1	1	1	2					1
Less common serovars	81 (21.7)	60	9	8	4					11	5	1	1	1	1	7	4	3		5	14
Total	**374 (100)**	**294**	**44**	**20**	**15**	**1**		**6**	**2**	**30**	**45**	**9**	**9**	**9**	**9**	**31**	**9**	**13**		**19**	**29**

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

Table 8 Error! Reference source not found. **(continued). Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from humans, by province and serovar; *Surveillance of Human Clinical Isolates*, 2009.**

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 pathways inhibitors		Phenicols	Quinolones		Tetracyclines
		0	1	2-3	4-5	6	AMK	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	CHL	CIP	NAL	TET
New Brunswick																					
Heidelberg	22 (28.6)	18	4								4	4	4	4	4						
Enteritidis	21 (27.3)	18	3																	3	
Typhimurium	7 (9.1)	6		1						1						1					1
Carrau	4 (5.2)	3	1								1										
I 4,[5],12:i:-	3 (3.9)	2			1				1	1	1					1		1			1
Poona	3 (3.9)	3																			
Hadar	2 (2.6)			2						2											2
Javiana	2 (2.6)	2																			
Less common serovars	13 (16.9)	12		1												1	1				1
Total	**77 (100)**	**64**	**8**	**4**	**1**				**1**	**4**	**6**	**4**	**4**	**4**	**4**	**3**	**1**	**1**		**3**	**5**
Nova Scotia																					
Enteritidis	27 (36.5)	21	6							1										5	
Heidelberg	12 (16.2)	4	8								8	6	6	6	6						
Typhimurium	12 (16.2)	8	1	1	2					3	3					3		2			3
Hadar	3 (4.1)		1	2						2											3
Carrau	2 (2.7)	2																			
I 4,[5],12:i:-	2 (2.7)	1	1																		1
Newport	2 (2.7)	2																			
Saintpaul	2 (2.7)	1	1													1					
Less common serovars	12 (16.2)	10	1	1						1	1									1	1
Total	**74 (100)**	**49**	**19**	**4**	**2**					**7**	**12**	**6**	**6**	**6**	**6**	**4**		**2**		**6**	**8**
Prince Edward Island																					
Typhimurium	4 (33.3)	4																			
Enteritidis	3 (25)	3																			
Heidelberg	2 (16.7)	2																			
Carrau	1 (8.3)	1																			
Muenchen	1 (8.3)	1																			
Thompson	1 (8.3)	1																			
Total	**12 (100)**	**12**																			
Newfoundland and Labrador																					
Enteritidis	7 (33.3)	7																			
Heidelberg	5 (23.8)	4		1						1						1	1				1
Typhimurium	4 (19)	4																			
Braenderup	1 (4.8)	1																			
Mbandaka	1 (4.8)	1																			
Nessziona	1 (4.8)	1																			
Poona	1 (4.8)	1																			
Rissen	1 (4.8)	1																			
Total	**21 (100)**	**20**		**1**						**1**						**1**	**1**				**1**

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

Figure 1. Temporal variation in resistance to selected antimicrobials in human isolates of *Salmonella* serovars Enteritidis, Heidelberg, and Paratyphi A and B; *Surveillance of Human Clinical Isolates*, 2003–2009.

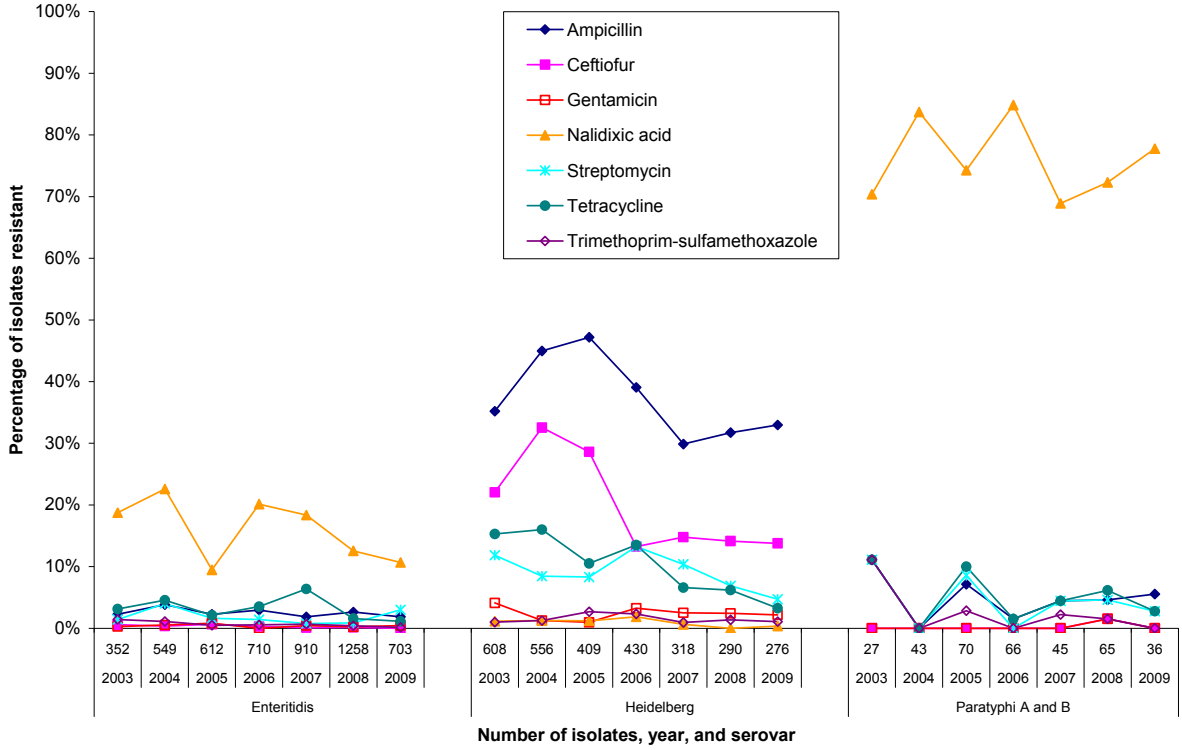
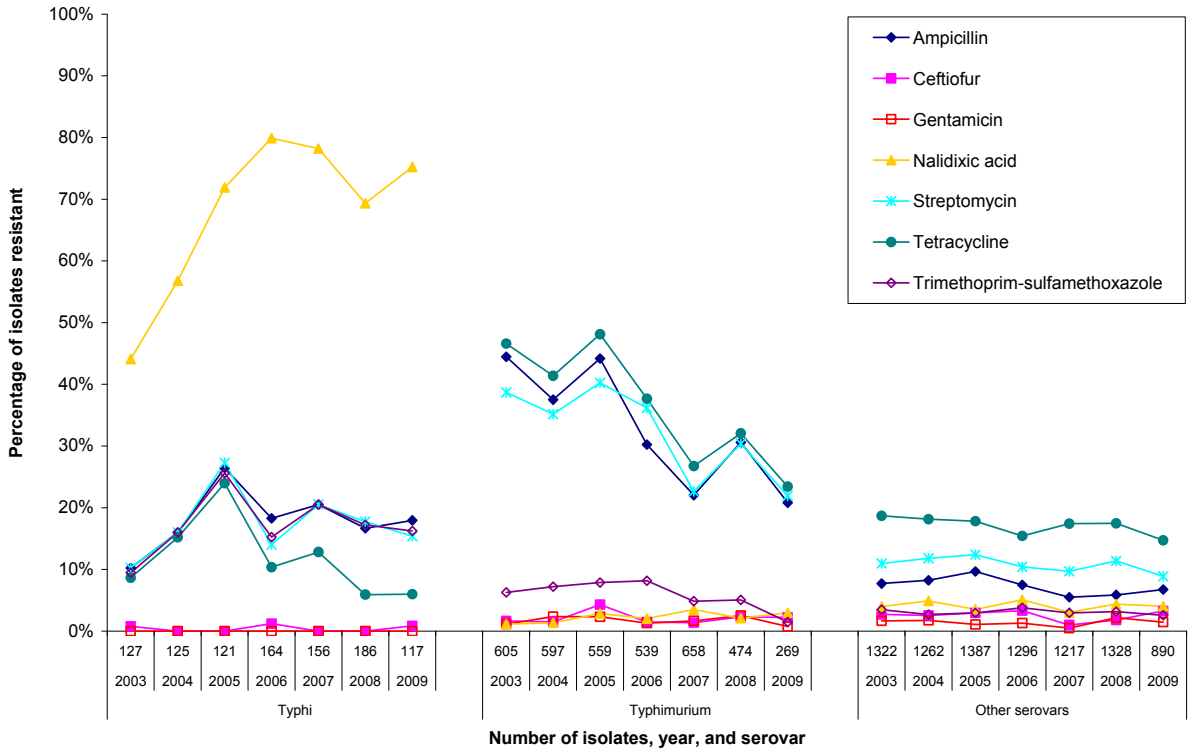


Figure 2. Temporal variation in resistance to selected antimicrobials in human isolates of *Salmonella* serovars Typhi, Typhimurium, and "Other Serovars"; *Surveillance of Human Clinical Isolates*, 2003–2009.



Beef Cattle

Salmonella

Surveillance of Animal Clinical Isolates

(n = 122)

Figure 3. Resistance to antimicrobials in *Salmonella* isolates from cattle; *Surveillance of Animal Clinical Isolates*, 2009.

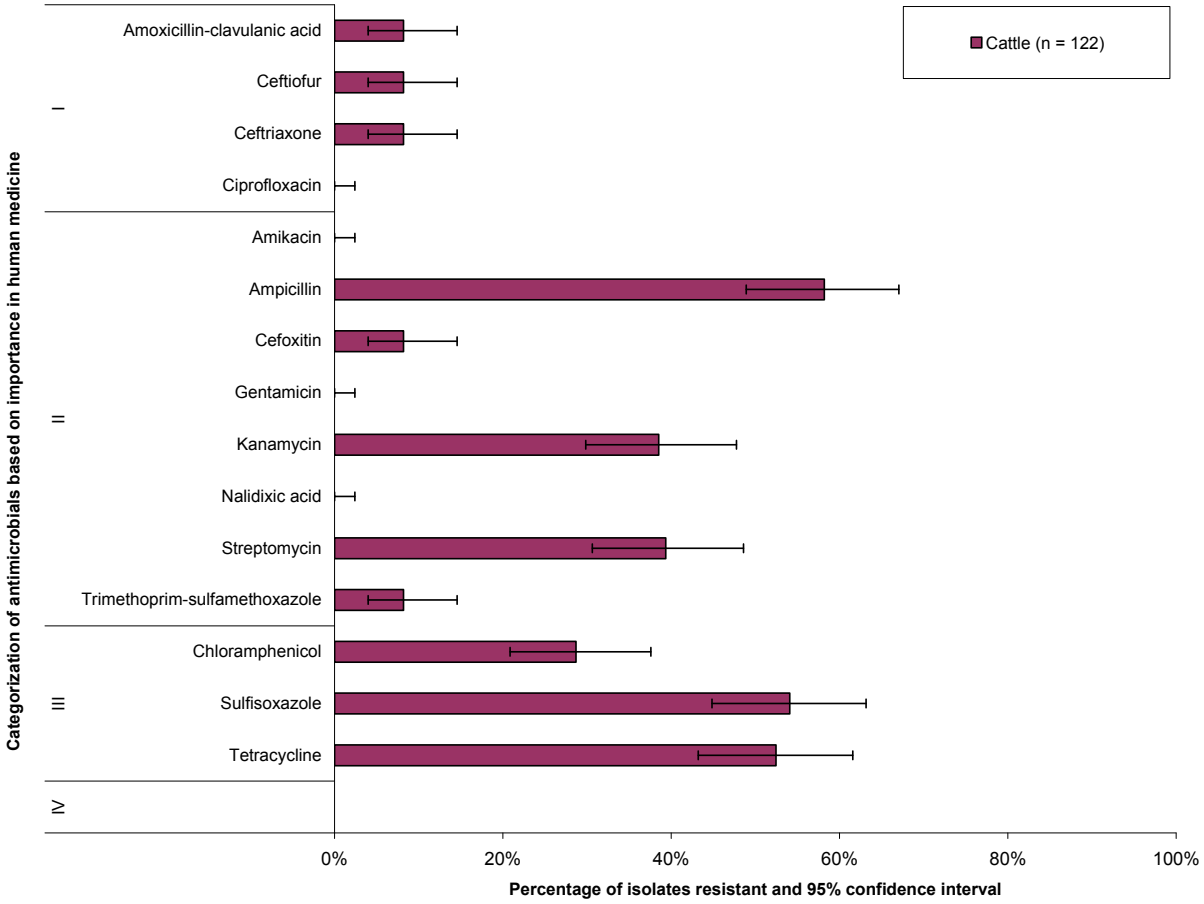


Table 8. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from cattle, by serovar; *Surveillance of Animal Clinical Isolates*, 2009.

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 pathways inhibitors		Phenicols	Quinolones		Tetracyclines
		0	1	2-3	4-5	6	AMK	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	CHL	CIP	NAL	TET
Typhimurium var. 5-	47 (38.8)	1	7		39				30	28	46	7	7	7	7	39	1	16			39
Typhimurium	31 (25.6)	10		2	19				15	18	20	1	1	1	1	20	7	18			21
Heidelberg	7 (5.8)	4	1	2							3					2	2				
I 6,14,18:-:-	5 (4.1)	5																			
Kentucky	4 (3.3)	4																			
Cerro	3 (2.5)	3																			
Oranienburg	3 (2.5)	3																			
Less common serovars	21 (17.4)	15	2	3	1				2	2	2	2	2	2	2	5		1			4
Total	**121 (100)**	**45**	**10**	**7**	**59**				**47**	**48**	**71**	**10**	**10**	**10**	**10**	**66**	**10**	**35**			**64**

Serovars represented by less than 2% of isolates were classified as “Less common serovars”.
Serovar identity was not available for 1 isolate.
Red, blue and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

Escherichia coli

Abattoir Surveillance

(n = 119)

Figure 4. Resistance to antimicrobials in *Escherichia coli* isolates from beef cattle; *Abattoir Surveillance*, 2009.

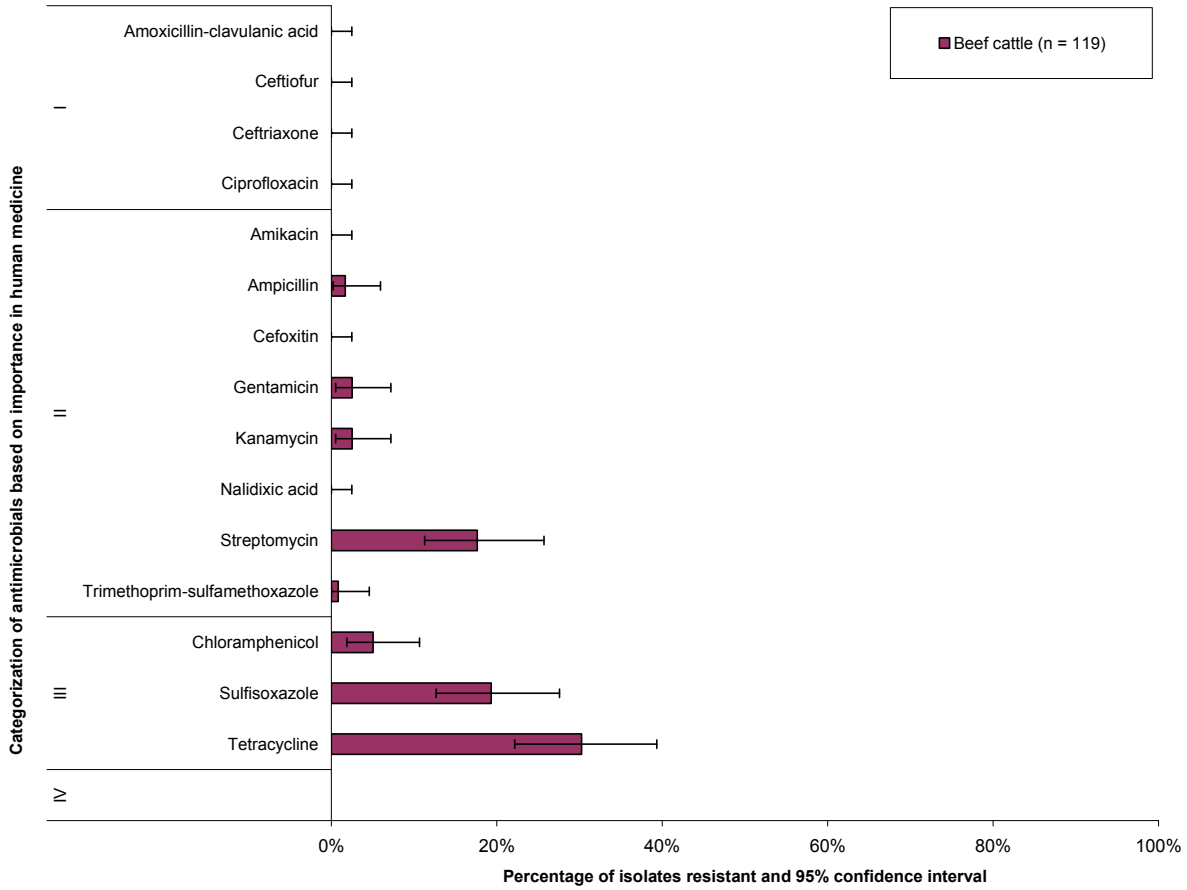
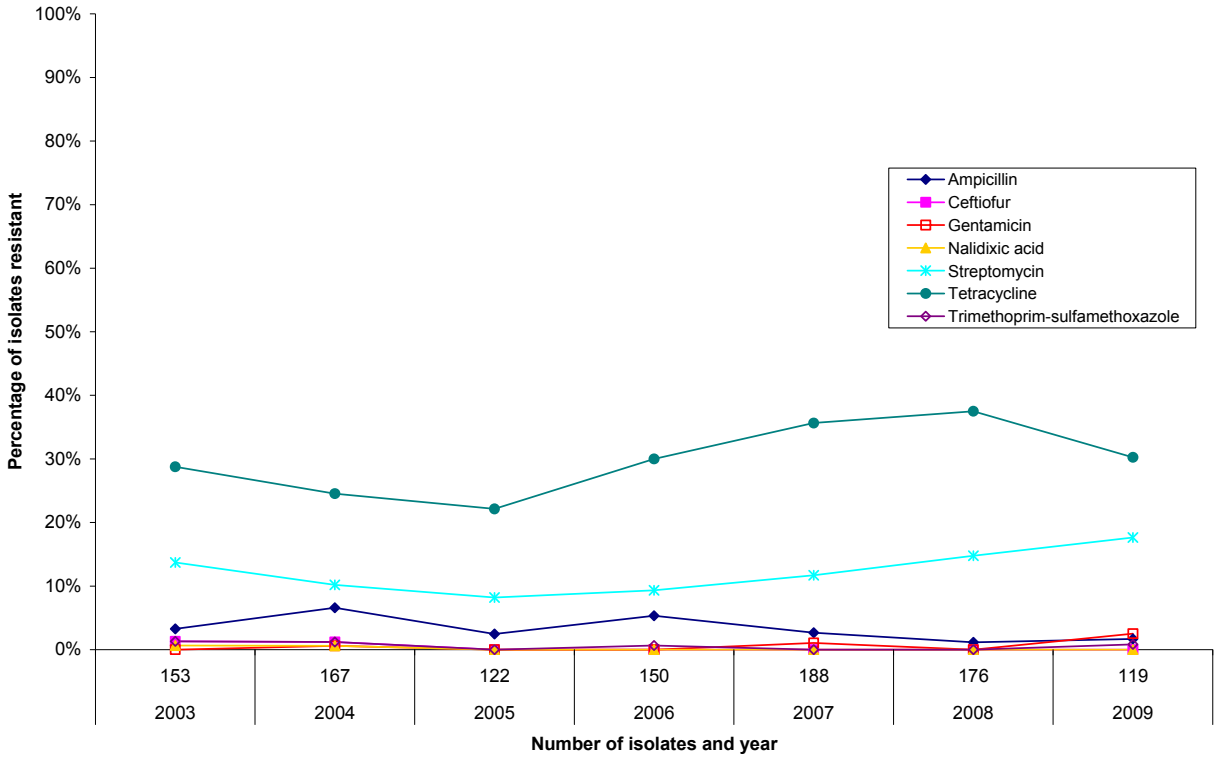


Figure 5. Temporal variation in resistance to selected antimicrobials in *Escherichia coli* isolates from beef cattle; *Abattoir Surveillance*, 2003–2009.



Retail Meat Surveillance

(n = 647)

Figure 6. Resistance to antimicrobials in *Escherichia coli* isolates from beef; *Retail Meat Surveillance*, 2009.

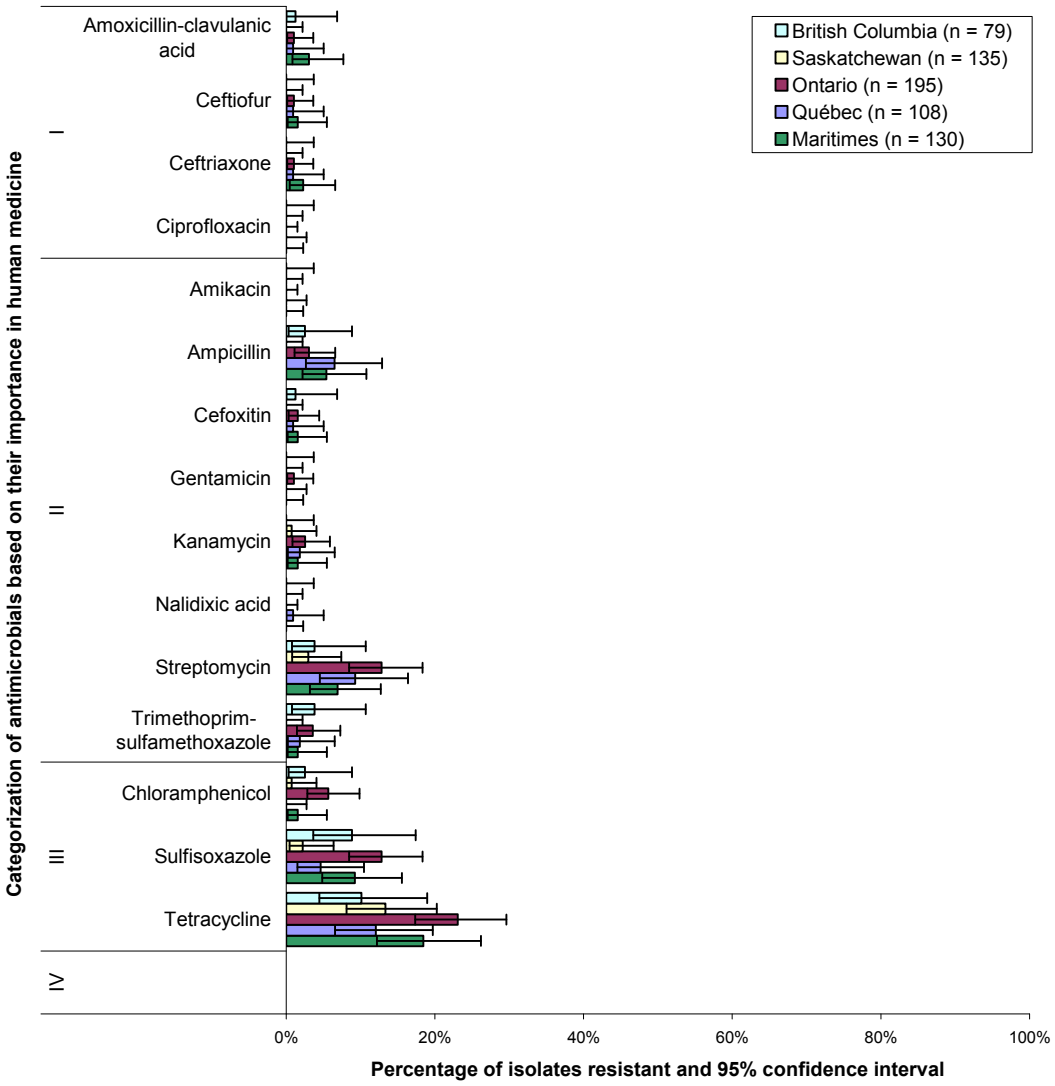
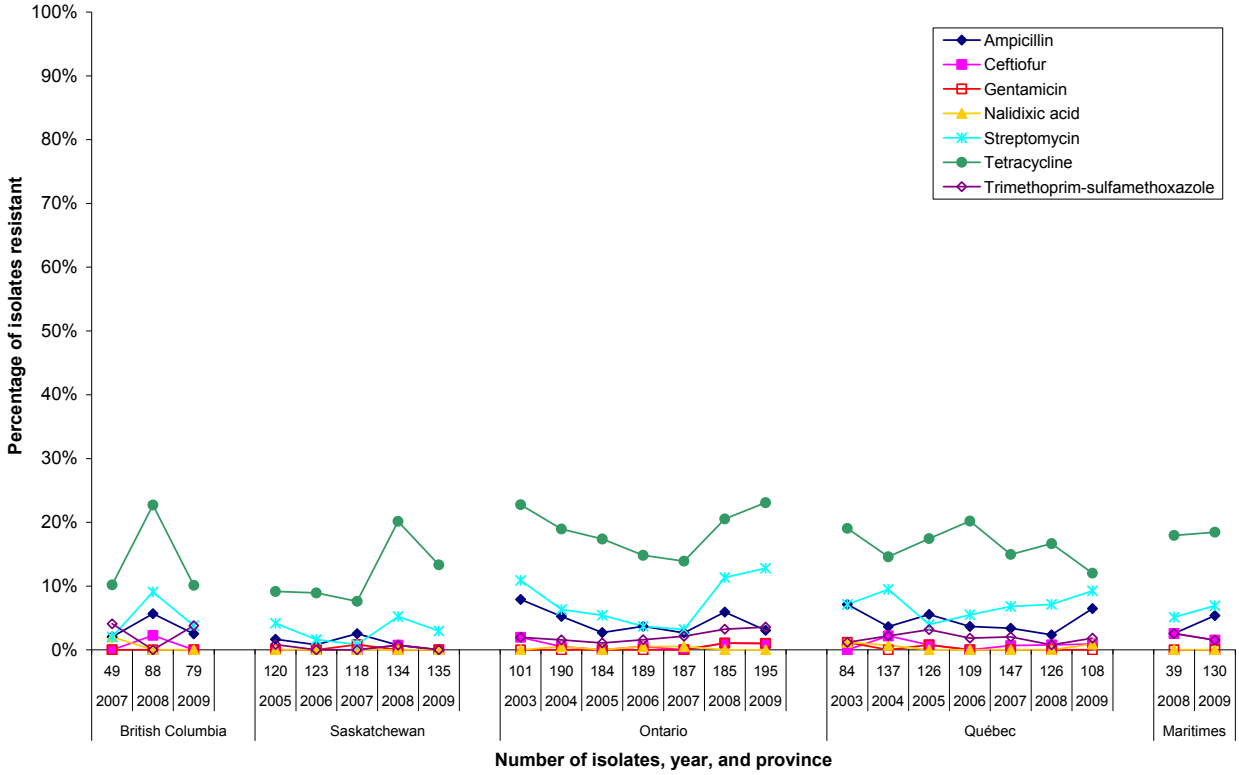


Figure 7. Temporal variation in resistance to selected antimicrobials in *Escherichia coli* isolates from beef; *Retail Meat Surveillance*, 2003–2009.

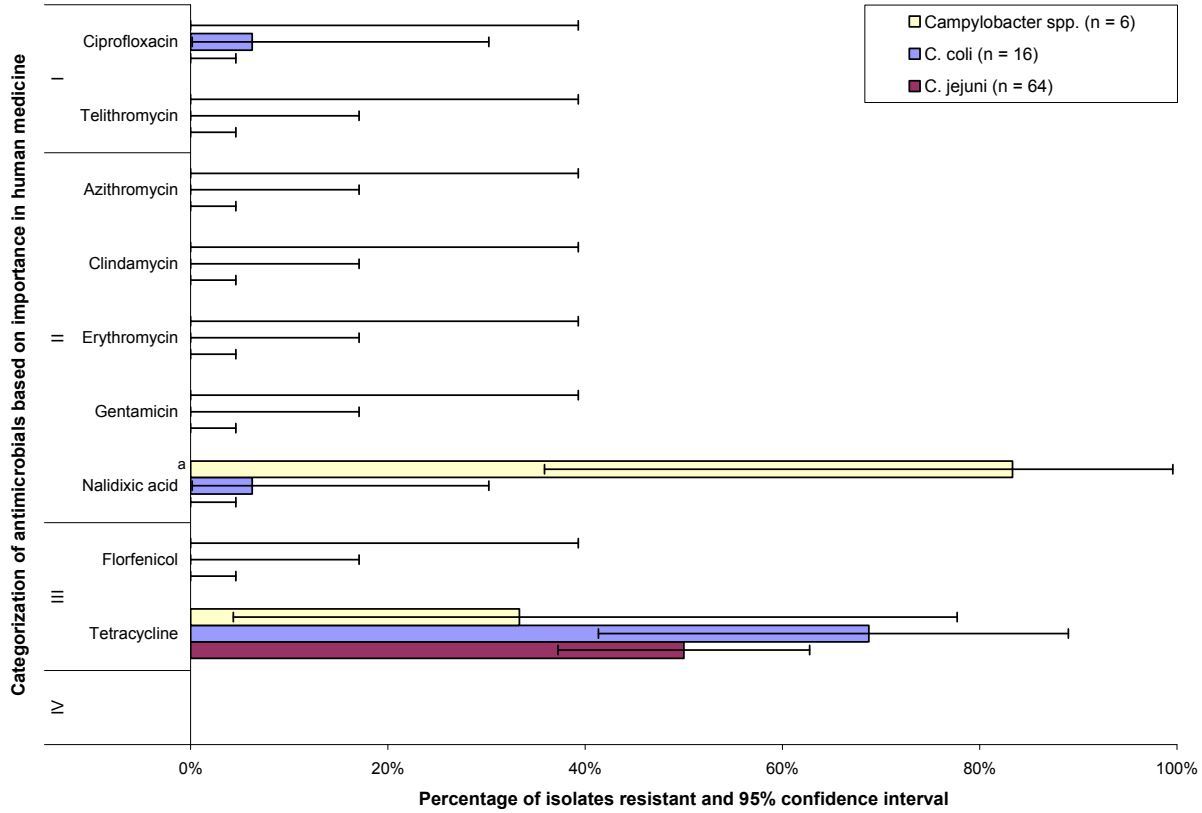


Campylobacter

Abattoir Surveillance

(n = 86; *C. jejuni* – n = 64; *C. coli* – n = 16; *Campylobacter* spp. – n = 6)

Figure 8. Resistance to antimicrobials in *Campylobacter* isolates from beef cattle; *Abattoir Surveillance*, 2009.



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

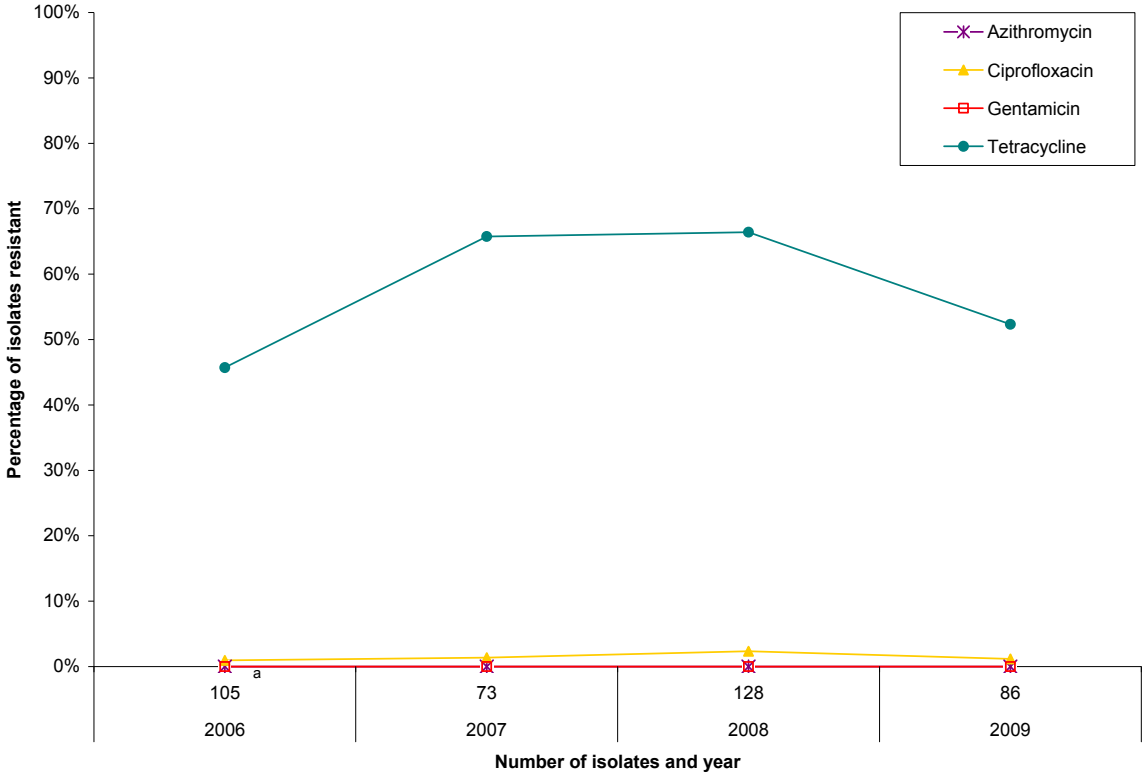
Table 9. Number of antimicrobial classes in resistance patterns of *Campylobacter* isolates from beef cattle, by *Campylobacter* species; *Abattoir Surveillance*, 2009.

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
C. jejuni	64 (74.4)	32	32												32
C. coli	16 (18.6)	4	12										1	1	11
Campylobacter spp.[a]	6 (7)	1	3	2										5	2
Total	86 (100)	37	47	2									1	6	45

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

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

Figure 9. Temporal variation in resistance to selected antimicrobials in *Campylobacter* isolates from beef cattle; *Abattoir Surveillance*, 2006–2009.



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

Chickens

Salmonella

Abattoir Surveillance

(n = 230)

Figure 10. Resistance to antimicrobials in *Salmonella* isolates from chickens; *Abattoir Surveillance*, 2009.

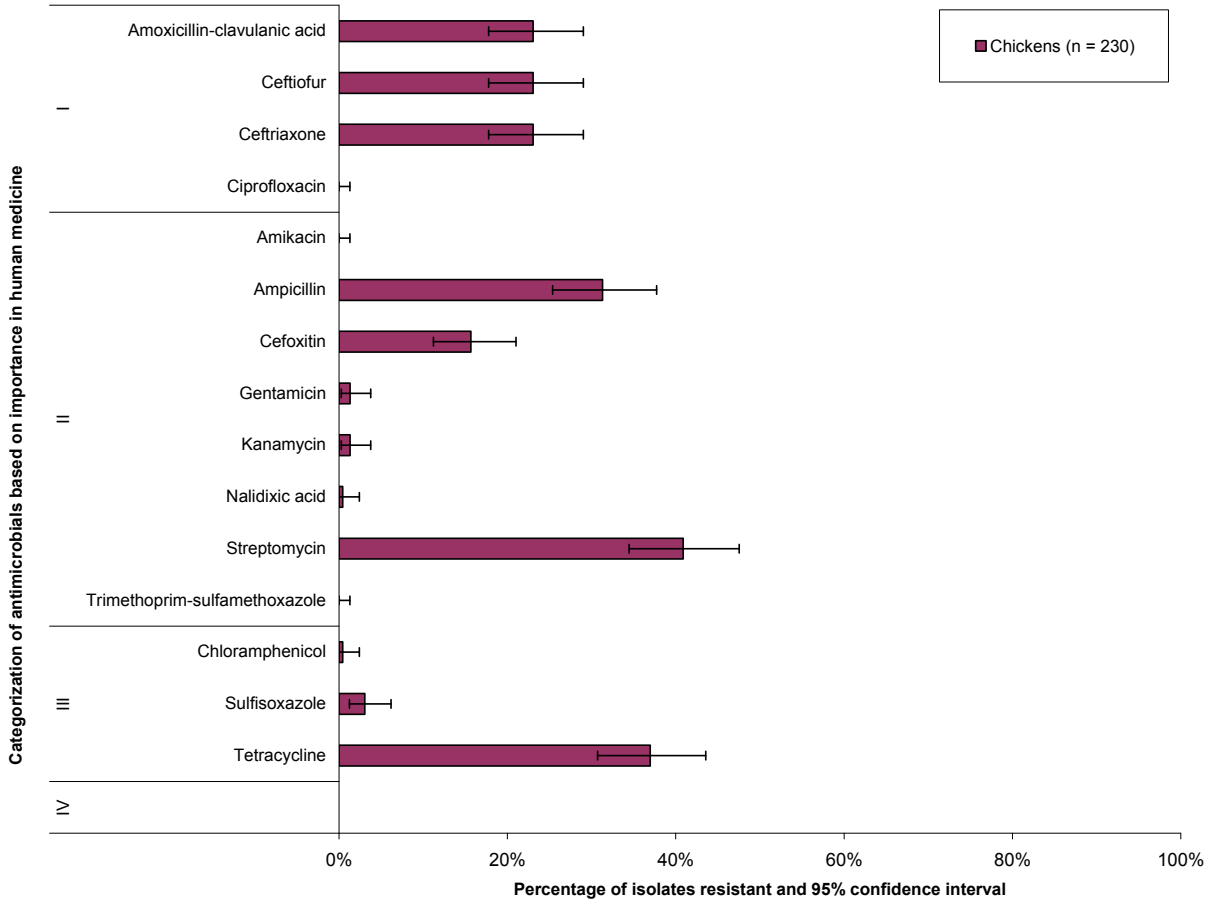
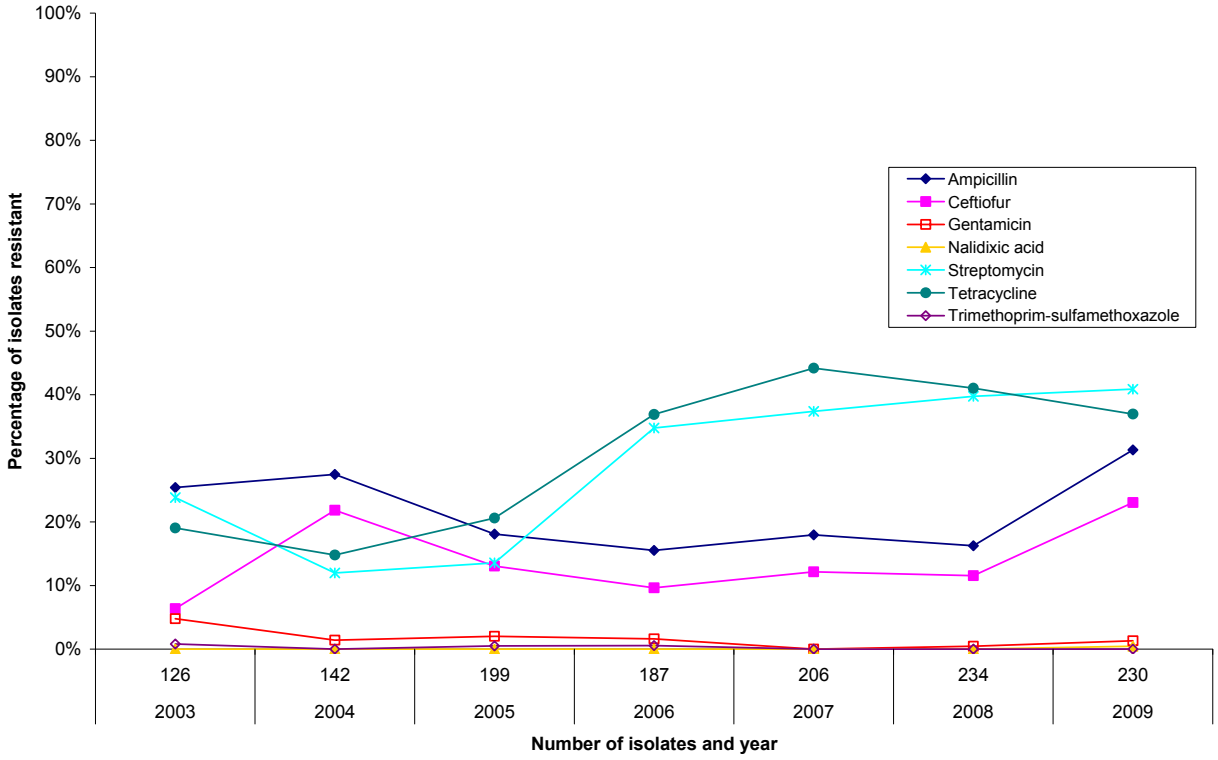


Table 10. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from chickens, by serovar; *Abattoir Surveillance,* 2009.

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 pathways inhibitors		Phenicols	Quinolones		Tetracyclines
		0	1	2-3	4-5	6	AMK	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	CHL	CIP	NAL	TET
Kentucky	95 (41.3)	16	9	69	1					70	41	40	40	24	40					1	71
Heidelberg	50 (21.7)	23	18	9				2		8	27	10	10	9	10	2					
Enteritidis	44 (19.1)	43	1							1											
Hadar	9 (3.9)	2	1	6						7											6
Typhimurium	6 (2.6)	5			1					1	1					1		1			1
Less common serovars	26 (11.3)	17	1	8				1	3	7	3	3	3	3	3	4					7
Total	**230 (100)**	**106**	**30**	**92**	**2**			**3**	**3**	**94**	**72**	**53**	**53**	**36**	**53**	**7**		**1**		**1**	**85**

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

Figure 11. Temporal variation in resistance to selected antimicrobials in *Salmonella* isolates from chickens; *Abattoir Surveillance*, 2003–2009.



Retail Meat Surveillance

(n = 457)

Figure 12. Resistance to antimicrobials in *Salmonella* isolates from chicken; *Retail Meat Surveillance*, 2009.

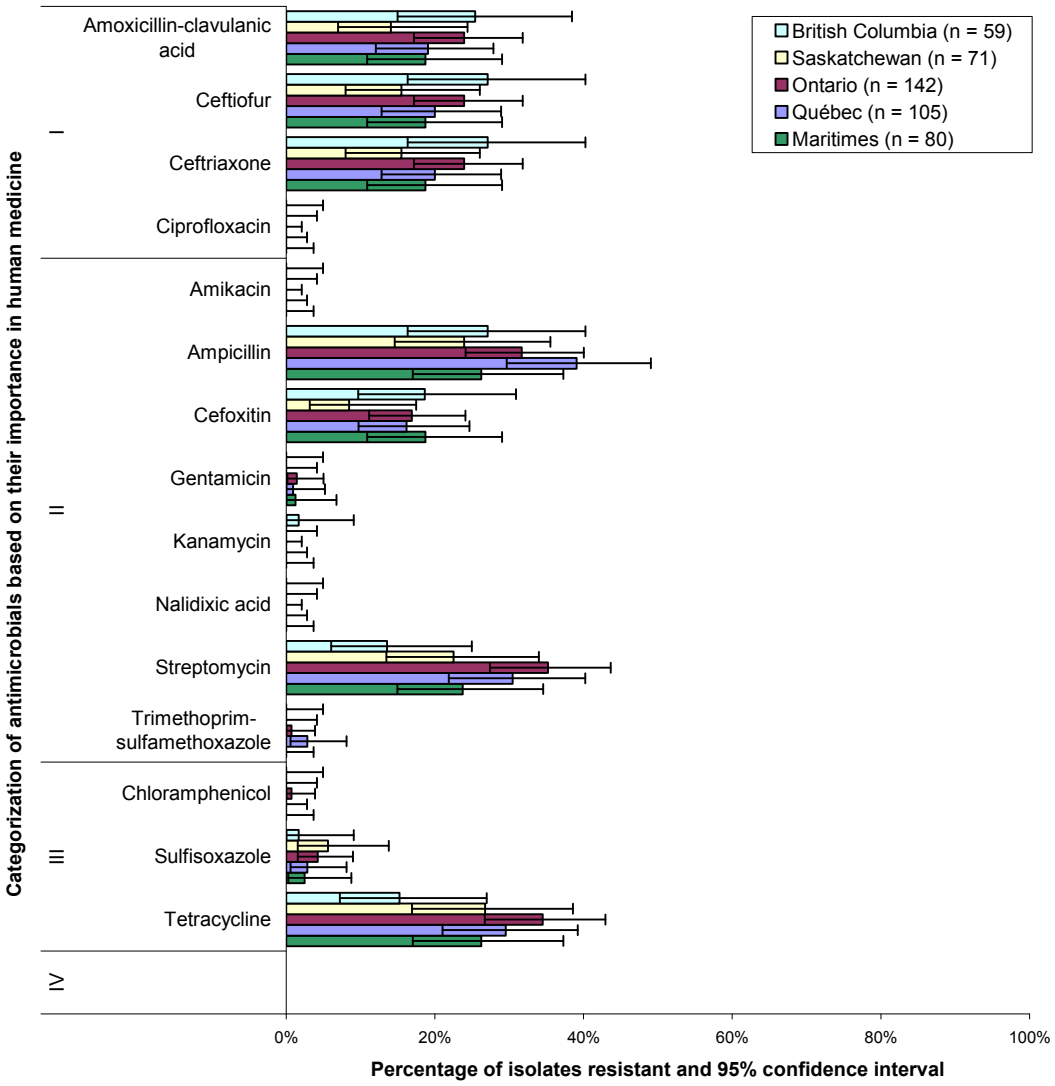
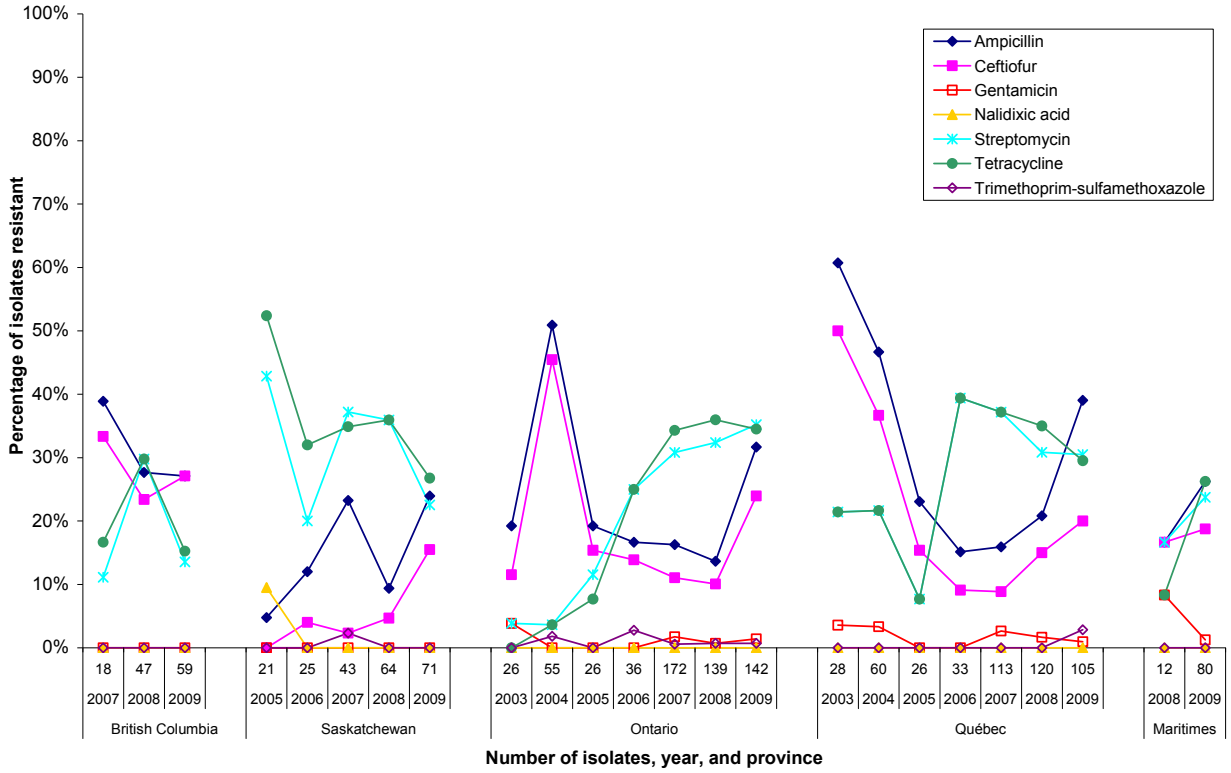


Table 11. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from chicken, by serovar; *Retail Meat Surveillance*, 2009.

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 pathways inhibitors		Phenicols	Quinolones		Tetracyclines
		0	1	2-3	4-5	6	AMK	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	CHL	CIP	NAL	TET
British Columbia																					
Enteritidis	30 (50.8)	30																			
Kentucky	10 (16.9)		4	6						6	8	7	8	3	8						7
Hadar	8 (13.6)	6	1	1						1	1	1	1	1	1						1
Heidelberg	6 (10.2)		6								6	6	6	6	6						
Worthington	2 (3.4)	1		1					1	1						1					1
Less common serovars	3 (5.1)	2	1								1	1	1	1	1						
Total	**59 (100)**	**39**	**12**	**8**					**1**	**8**	**16**	**15**	**16**	**11**	**16**	**1**					**9**
Saskatchewan																					
Enteritidis	23 (32.4)	23																			
Heidelberg	14 (19.7)	5	7	2							9	2	3	2	3						2
Kentucky	10 (14.1)			10						10	6	6	6	2	6						10
Schwarzengrund	4 (5.6)	1		3						3						3					3
Typhimurium	4 (5.6)	4																			
I 4,[5],12:i:-	3 (4.2)	3																			
Infantis	3 (4.2)	2	1								1	1	1	1	1						
Agona	2 (2.8)	1	1																		1
Montevideo	2 (2.8)	2																			
Less common serovars	6 (8.5)	2	1	3						3	1	1	1	1	1	1					3
Total	**71 (100)**	**43**	**10**	**18**						**16**	**17**	**10**	**11**	**6**	**11**	**4**					**19**
Ontario																					
Kentucky	51 (35.9)	11	4	36						37	14	14	14	5	14						37
Heidelberg	44 (31)	21	20	3						2	22	13	13	13	13	1	1				1
Enteritidis	19 (13.4)	19																			
Hadar	8 (5.6)	2		6				1		6	1	1	1	1	1	1					6
Schwarzengrund	5 (3.5)	3	2								2	2	2	2	2						
Typhimurium	4 (2.8)	2		1	1			1		2	1					2		1			1
Thompson	3 (2.1)	2		1						1	1					1					
Less common serovars	8 (5.6)	2	3	3						2	4	4	4	3	4	1					4
Total	**142 (100)**	**62**	**29**	**50**	**1**			**2**		**50**	**45**	**34**	**34**	**24**	**34**	**6**	**1**	**1**			**49**
Québec																					
Heidelberg	49 (46.7)	19	25	4	1					4	29	9	10	10	10	2	3				2
Kentucky	24 (22.9)	2		22						22	8	8	8	4	8						22
Enteritidis	14 (13.3)	14																			
I 8,20:i:-	3 (2.9)		1	2						2	1	1	1	1	1						3
Infantis	3 (2.9)	1	2								2	2	2	2	2						
Thompson	3 (2.9)	3																			
Less common serovars	9 (8.6)	4	1	4				1		4	1					1					4
Total	**105 (100)**	**43**	**29**	**32**	**1**			**1**		**32**	**41**	**20**	**21**	**17**	**21**	**3**	**3**				**31**
Maritimes																					
Heidelberg	35 (43.8)	23	10	1	1					2	12	6	6	6	6	1					1
Kentucky	21 (26.3)	5	4	12						13	5	5	5	5	5						14
Enteritidis	8 (10)	8																			
Hadar	5 (6.3)		2	3						3											5
Albany	2 (2.5)		2								2	2	2	2	2						
Infantis	2 (2.5)	2																			
Kiambu	2 (2.5)	1		1				1		1	1	1	1	1	1	1					
Less common serovars	5 (6.3)	3	2								1	1	1	1	1						1
Total	**80 (100)**	**42**	**20**	**17**	**1**			**1**		**19**	**21**	**15**	**15**	**15**	**15**	**2**					**21**

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

Figure 13. Temporal variation in resistance to selected antimicrobials in *Salmonella* isolates from chicken; *Retail Meat Surveillance*, 2003–2009.



Surveillance of Animal Clinical Isolates

(n = 253)

Figure 14. Resistance to antimicrobials in *Salmonella* isolates from chickens; *Surveillance of Animal Clinical Isolates*, 2009.

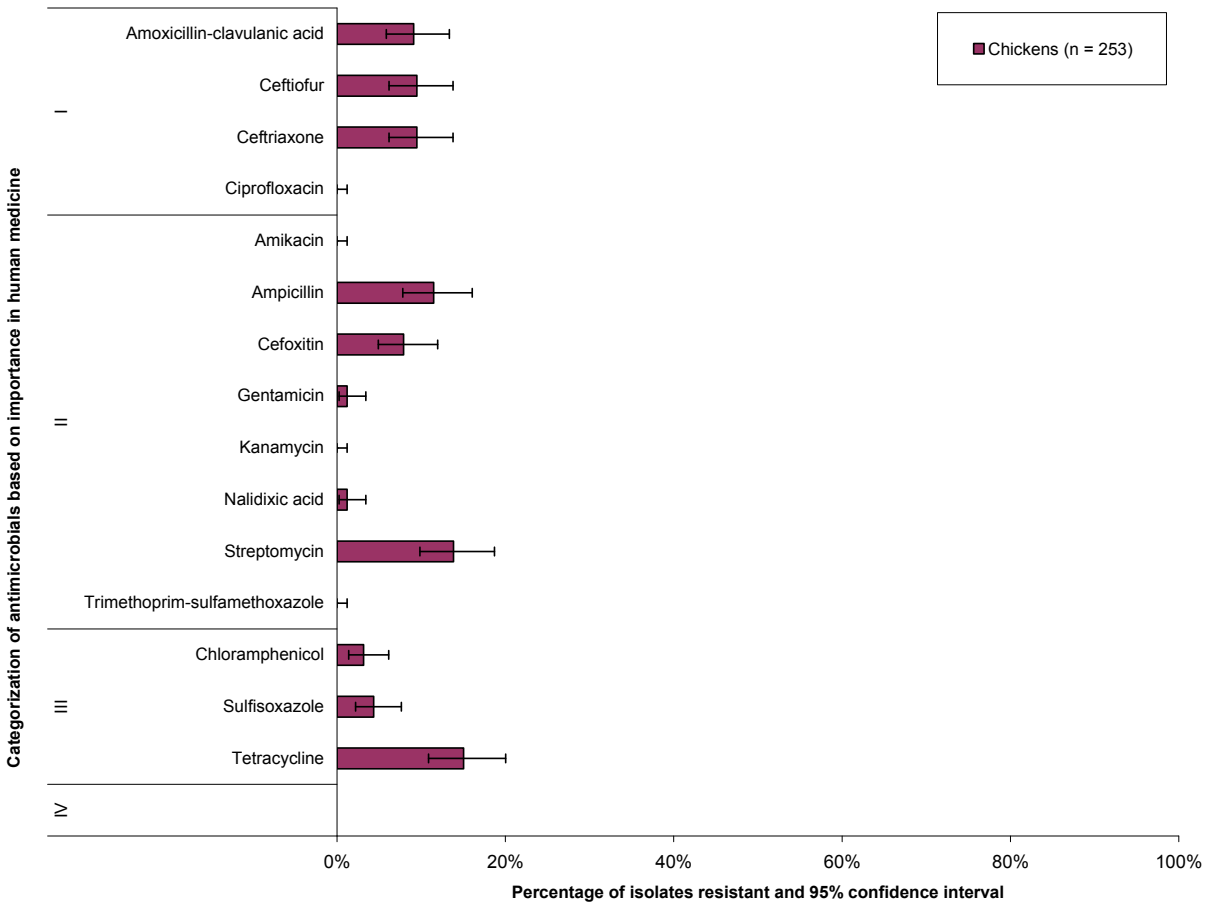


Table 12. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from chickens, by serovar; *Surveillance of Animal Clinical Isolates*, 2009.

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 pathways inhibitors		Phenicols	Quinolones		Tetracyclines
		0	1	2-3	4-5	6	AMK	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	CHL	CIP	NAL	TET
Enteritidis	129 (51.4)	127			2			1		2	2	2	2		2	2		2			2
Heidelberg	39 (15.5)	33	4	1	1			1		1	6	4	5	3	5	1		1			2
Kentucky	31 (12.4)	5	1	23	2					24	8	7	7	7	7					3	24
Typhimurium	14 (5.6)	10	1		3					3	4	1	1	1	1	3		3			3
I Rough:g,m:-	7 (2.8)	7																			
Less common serovars	31 (12.4)	16	9	4	2			1		5	9	9	9	9	9	5		2			7
Total	**251 (100)**	**198**	**15**	**28**	**10**		**3**			**35**	**29**	**23**	**24**	**20**	**24**	**11**		**8**		**3**	**38**

Serovars represented by less than 2% of isolates were classified as “Less common serovars”.
Serovar identity was not available for 2 isolates.
Red, blue and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

Escherichia coli

Abattoir Surveillance

(n = 171)

Figure 15. Resistance to antimicrobials in *Escherichia coli* isolates from chickens; *Abattoir Surveillance*, 2009.

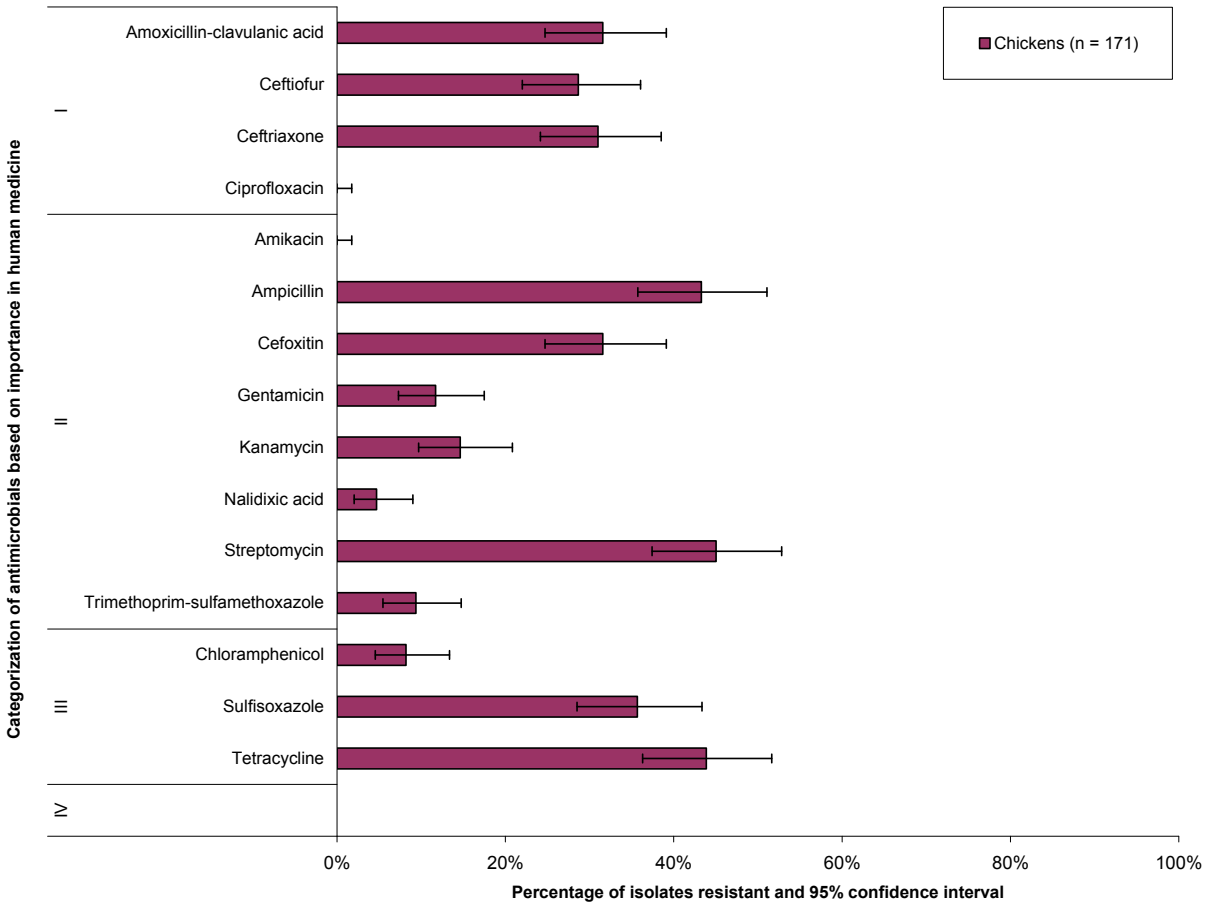
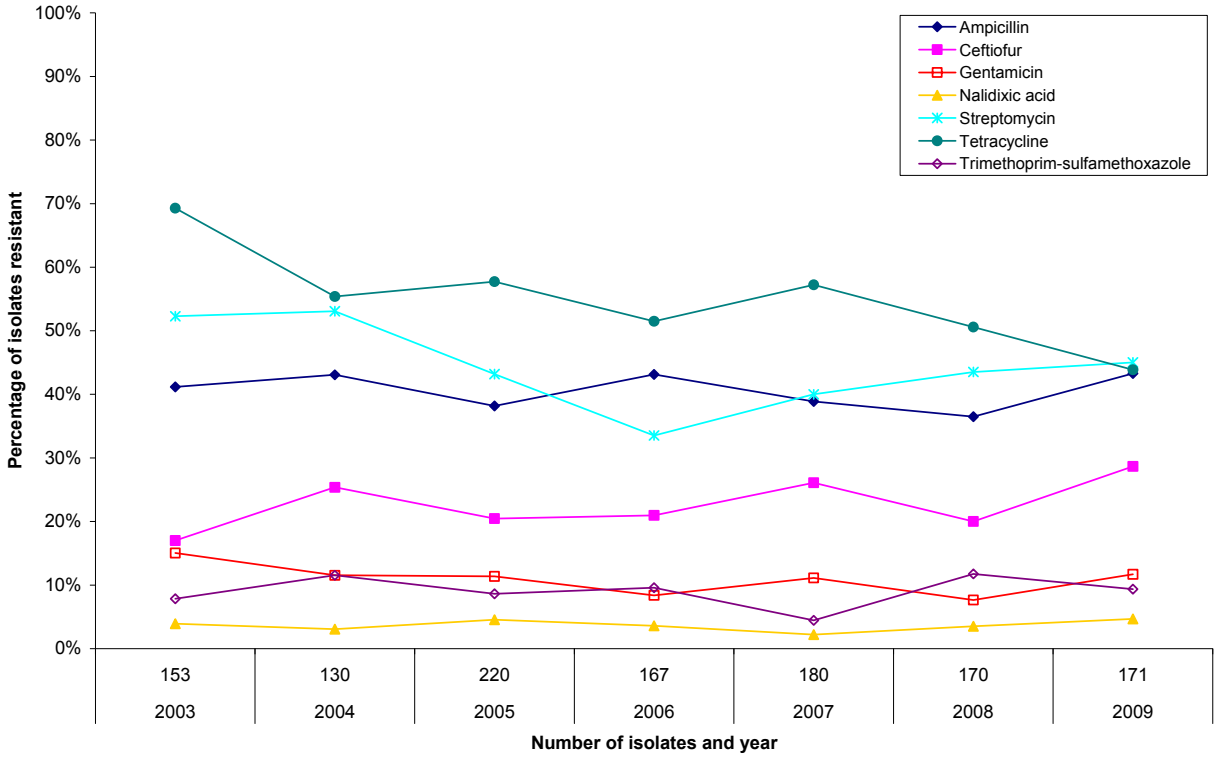


Figure 16. Temporal variation in resistance to selected antimicrobials in *Escherichia coli* isolates from chickens; *Abattoir Surveillance*, 2003–2009.



Retail Meat Surveillance

(n = 619)

Figure 17. Resistance to antimicrobials in *Escherichia coli* isolates from chicken; *Retail Meat Surveillance*, 2009.

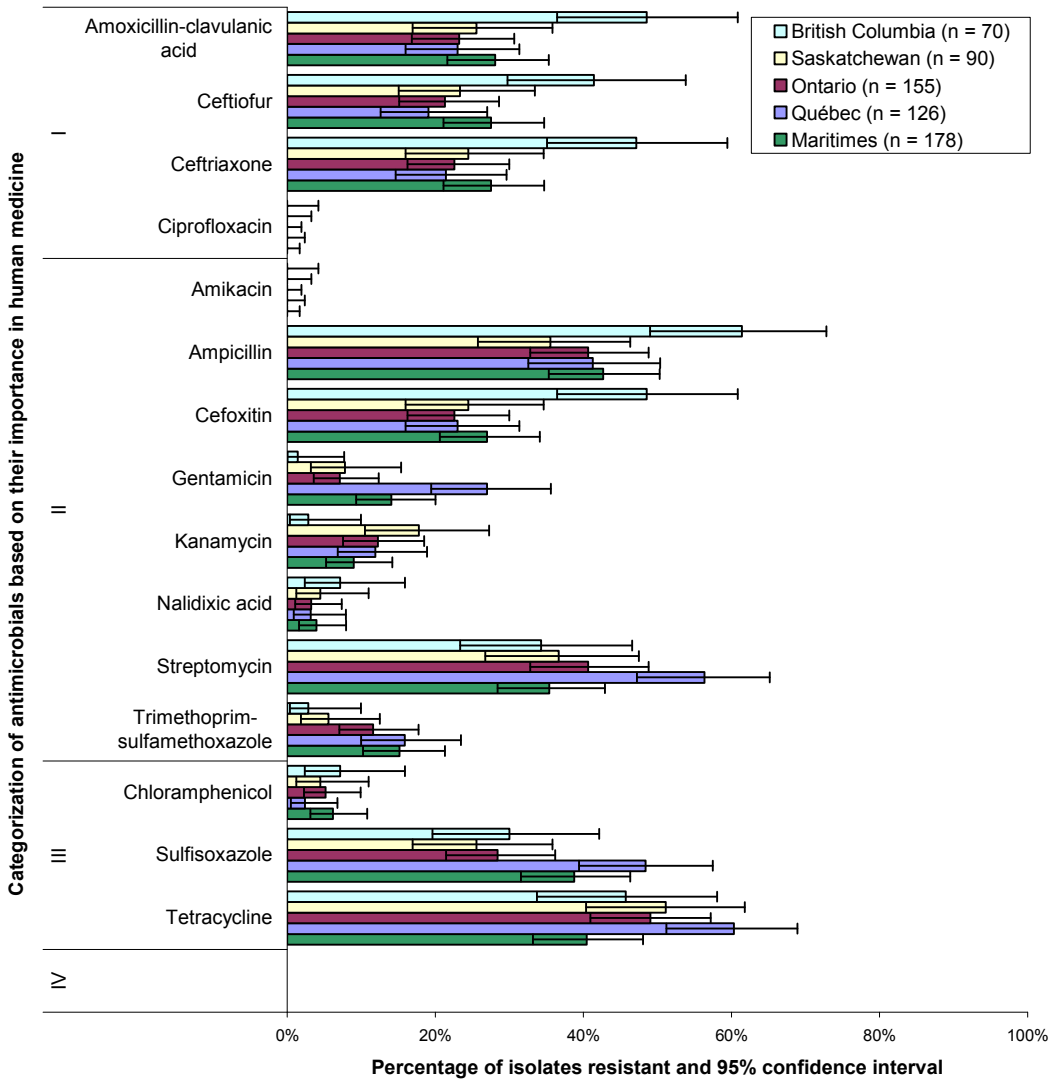
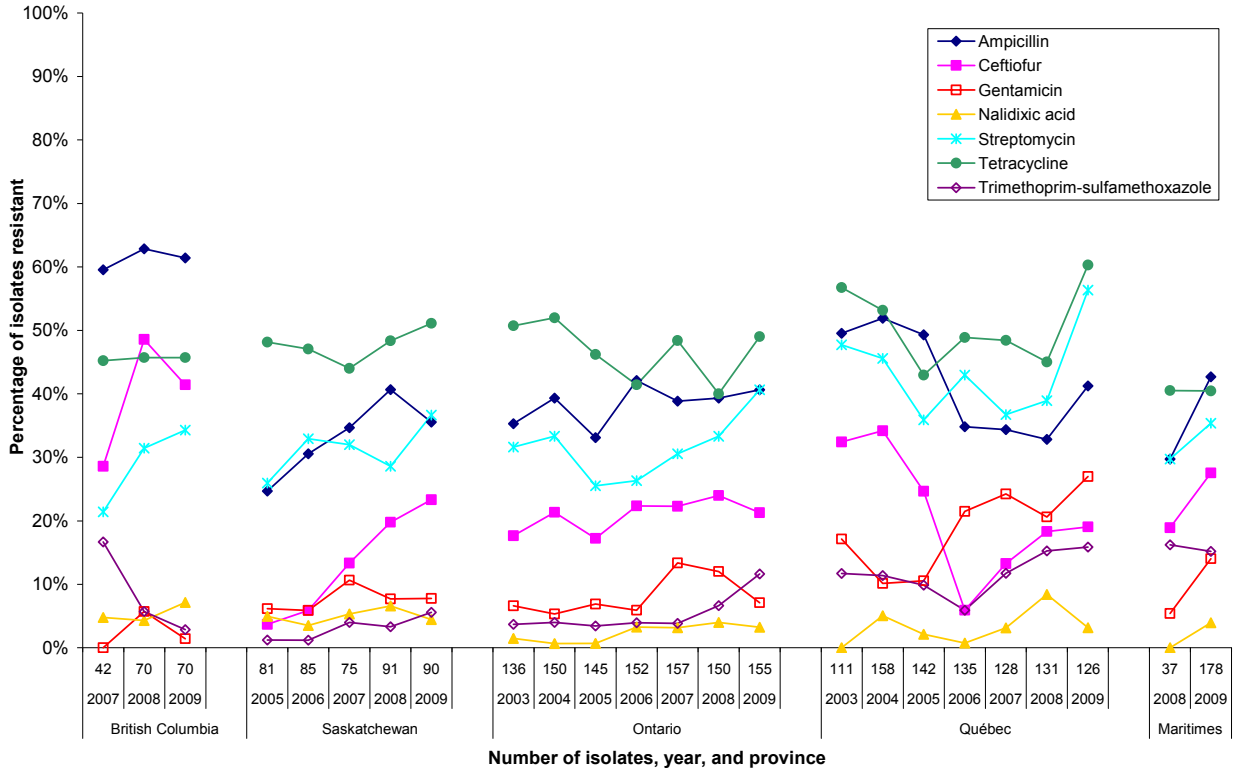


Figure 18. Temporal variation in resistance to selected antimicrobials in *Escherichia coli* isolates from chicken; *Retail Meat Surveillance*, 2003–2009.



Campylobacter

Retail Meat Surveillance

(n = 325)

Figure 19. Resistance to antimicrobials in *Campylobacter* isolates from chicken; *Retail Meat Surveillance*, 2009.

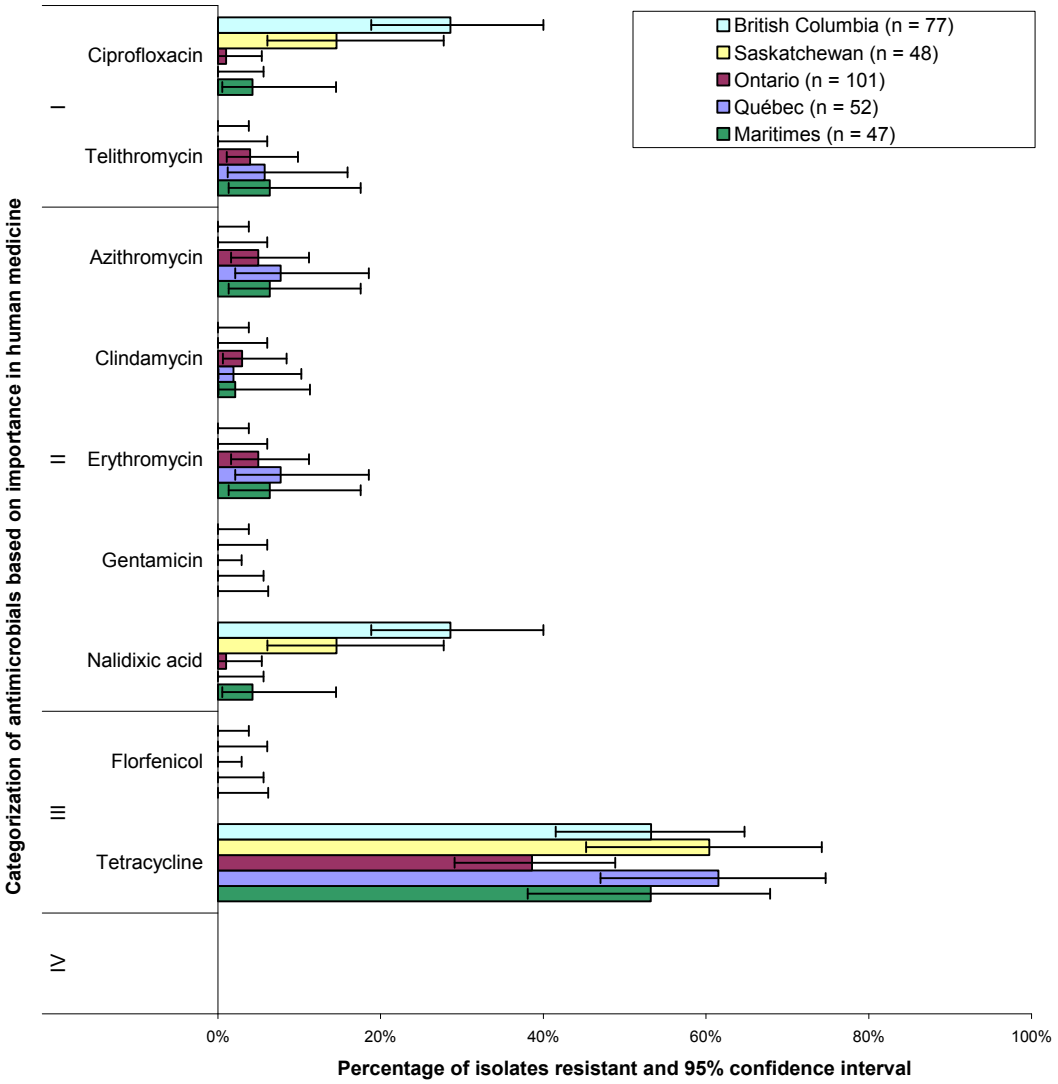
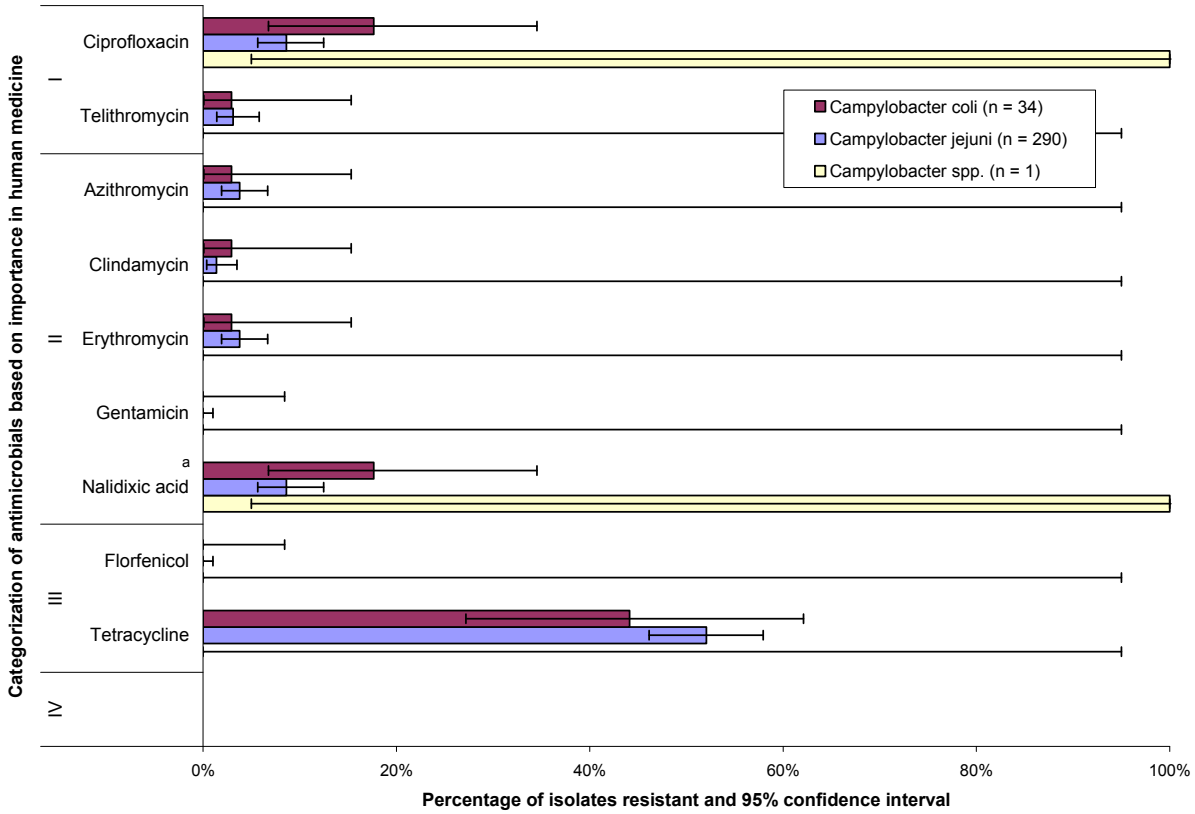


Figure 20. Resistance to antimicrobials in *Campylobacter* isolates from chicken, by *Campylobacter* species; *Retail Meat Surveillance*, 2009.



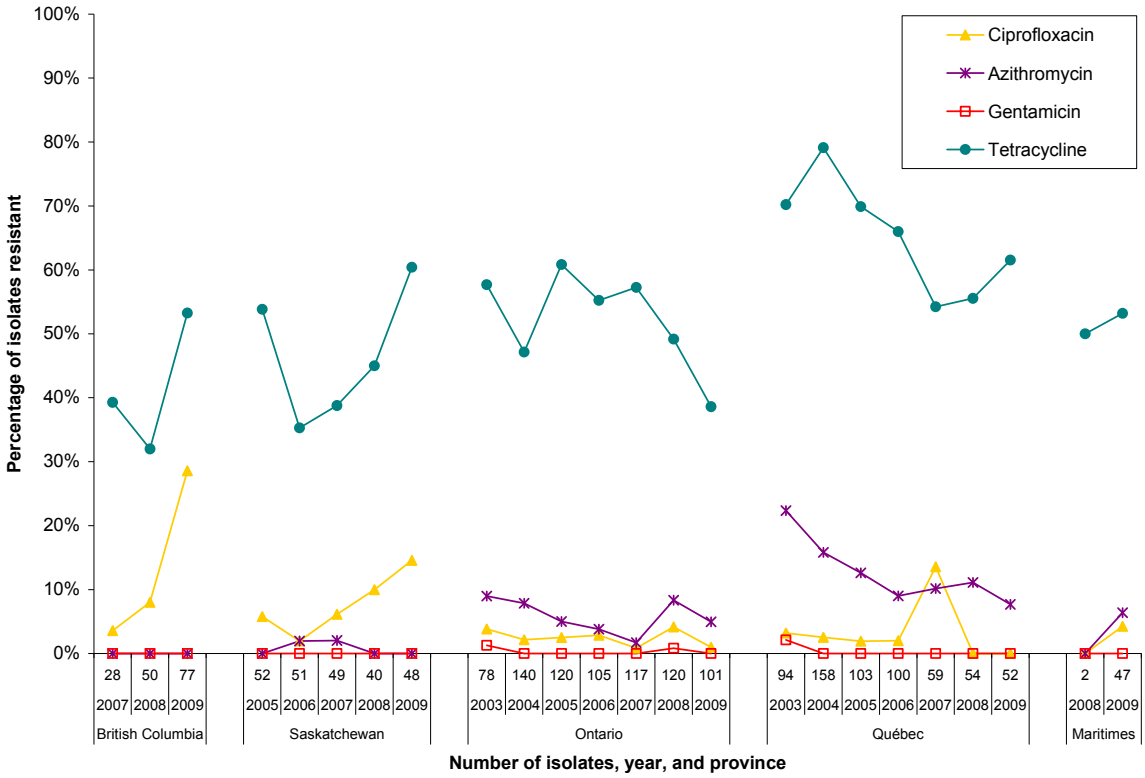
[a] *Campylobacter* spp. includes unidentified species, some of which may be intrinsically resistant to nalidixic acid.

Table 13. Number of antimicrobial classes in resistance patterns of *Campylobacter* isolates from chicken, by species; *Retail Meat Surveillance*, 2009.

Province / 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															
C. jejuni	65 (84.4)	21	31	13									18	18	39
C. coli	11 (14.3)	6	5										3	3	2
Campylobacter spp.	1 (1.3)		1										1	1	
Total	**77 (100)**	**27**	**37**	**13**									**22**	**22**	**41**
Saskatchewan															
C. jejuni	41 (85.4)	16	20	5									6	6	24
C. coli	7 (14.6)	1	6										1	1	5
Total	**48 (100)**	**17**	**26**	**5**									**7**	**7**	**29**
Ontario															
C. jejuni	94 (93.1)	54	36	4				3	2	4	4		1	1	36
C. coli	7 (6.9)	3	3	1				1	1	1	1				3
Total	**101 (100)**	**57**	**39**	**5**				**4**	**3**	**5**	**5**		**1**	**1**	**39**
Québec															
C. jejuni	48 (92.3)	17	27	4				3	1	4	4				30
C. coli	4 (7.7)	2	2												2
Total	**52 (100)**	**19**	**29**	**4**				**3**	**1**	**4**	**4**				**32**
Maritimes															
C. jejuni	42 (89.4)	20	19	2	1			3	1	3	3				22
C. coli	5 (10.6)	2	1	2									2	2	3
Total	**47 (100)**	**22**	**20**	**4**	**1**			**3**	**1**	**3**	**3**		**2**	**2**	**25**

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

Figure 21. Temporal variation in resistance to selected antimicrobials in *Campylobacter* isolates from chicken; *Retail Meat Surveillance*, 2003–2009.



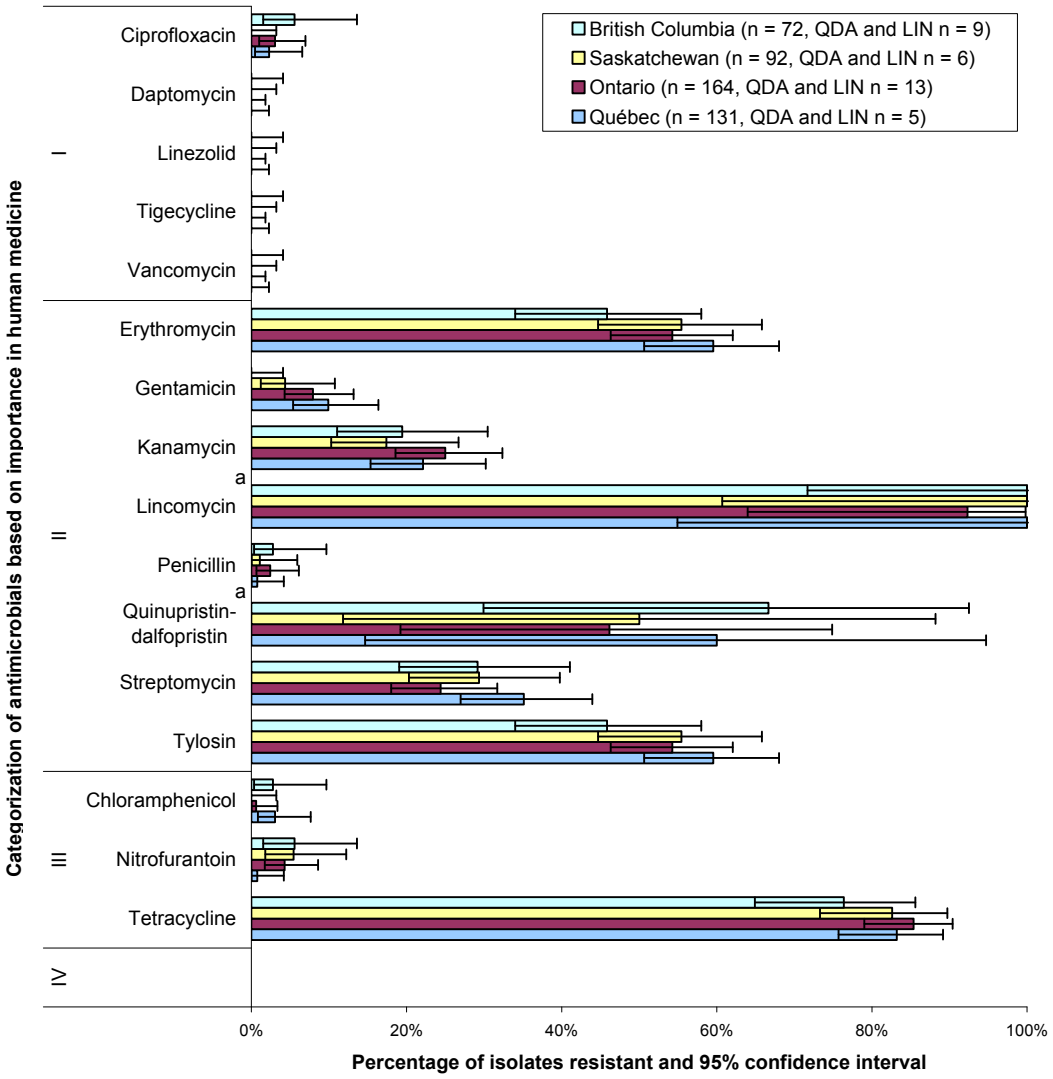
Ciprofloxacin has replaced nalidixic acid in the *Campylobacter* temporal graphs because resistance to nalidixic acid is close or identical to ciprofloxacin resistance. Unlike resistance to nalidixic acid, ciprofloxacin resistance does not pose the problem associated with intrinsic resistance in certain *Campylobacter* spp.

Enterococcus

Retail Meat Surveillance

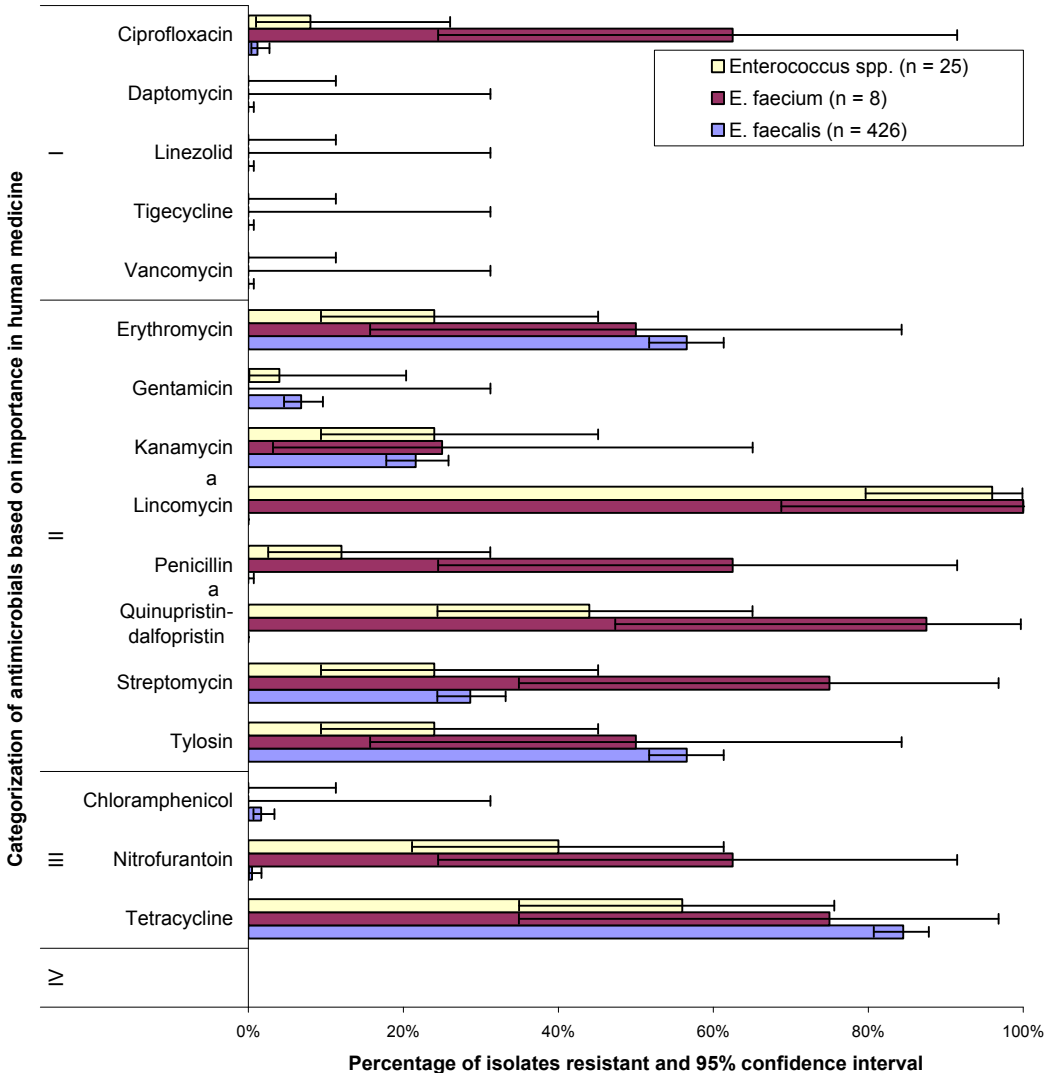
(n = 459)

Figure 22. Resistance to antimicrobials in *Enterococcus* isolates from chicken, by province; *Retail Meat Surveillance*, 2009.



[a] Resistance to quinupristin-dalfopristin (QDA) and lincomycin (LIN) is not reported for *E. faecalis* because *E. faecalis* is intrinsically resistant to these antimicrobials.
Due to quality control and other laboratory-based issues, results of *Enterococcus* isolates from the Maritimes are not presented in 2009 (n=89).

Figure 23. Resistance to antimicrobials in *Enterococcus* isolates from chicken, by *Enterococcus* species; *Retail Meat Surveillance*, 2009.



[a] Resistance to quinupristin-dalfopristin and lincomycin is not reported for *E. faecalis* because *E. faecalis* is intrinsically resistant to these antimicrobials.

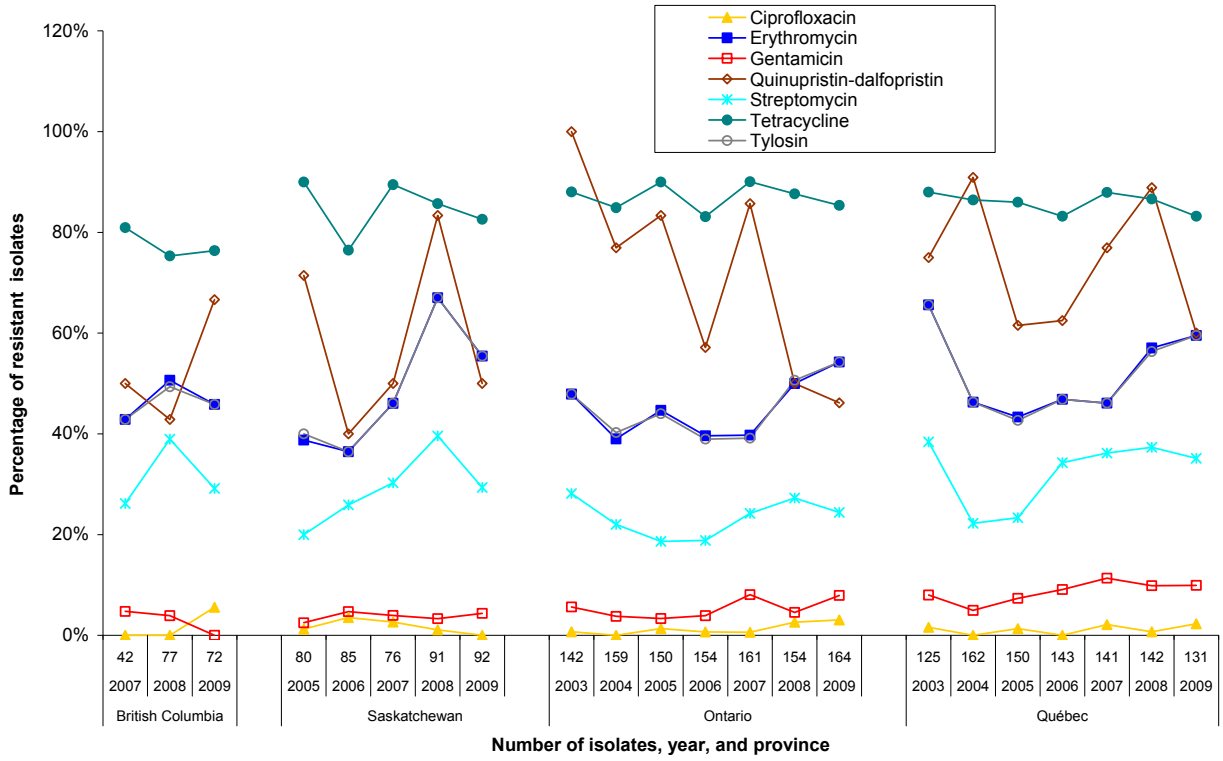
Table 14. Number of antimicrobial classes in resistance patterns of *Enterococcus* isolates from chicken, by species; *Retail Meat Surveillance*, 2009.

Province / 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			Glycopeptides	Glycylcyclines	Lincosamides	Lipopeptides	Macrolides		Nitrofurans	Oxazolidinones	Penicillins	Phenicols	Quinolones	Streptogramins	Tetracyclines
		0	1	2–5	6–9	10–13[a]	GEN	KAN	STR	VAN	TIG	LIN	DAP	ERY	TYL	NIT	LNZ	PEN	CHL	CIP	QDA	TET
British Columbia																						
E. faecalis	63 (87.5)	10	21	32				12	17					31	31				2	2		50
Enterococcus spp.	7 (9.7)			7				1	2			7		1	1	3					4	3
E. faecium	2 (2.8)				2			1	2			2		1	1	1		2		2	2	2
Total	**72 (100)**	**10**	**21**	**39**	**2**			**14**	**21**			**9**		**33**	**33**	**4**		**2**	**2**	**4**	**6**	**55**
Saskatchewan																						
E. faecalis	86 (93.5)	8	30	48			4	16	27					51	51							72
Enterococcus spp.	5 (5.4)			5								5				4		1			2	3
E. faecium	1 (1.1)			1								1				1					1	1
Total	**92 (100)**	**8**	**30**	**54**			**4**	**16**	**27**			**6**		**51**	**51**	**5**		**1**			**3**	**76**
Ontario																						
E. faecalis	151 (92.1)	15	50	86			12	36	34					82	82	2			1	1		131
Enterococcus spp.	9 (5.5)		2	5	2		1	4	3			8		4	4	2		1		2	3	6
E. faecium	4 (2.4)		1		3			1	3			4		3	3	3		3		2	3	3
Total	**164 (100)**	**15**	**53**	**91**	**5**		**13**	**41**	**40**			**12**		**89**	**89**	**7**		**4**	**1**	**5**	**6**	**140**
Québec																						
E. faecalis	126 (96.2)	10	38	78			13	28	44					77	77				4	2		107
Enterococcus spp.	4 (3.1)		1	3				1	1			4		1	1	1		1			2	2
E. faecium	1 (0.8)			1					1			1								1	1	
Total	**131 (100)**	**10**	**39**	**82**			**13**	**29**	**46**			**5**		**78**	**78**	**1**		**1**	**4**	**3**	**3**	**109**

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

[a] Because *E. faecalis* is intrinsically resistant to lincomycin and quinupristine-dalfopristine the range is 10-11.

Figure 24. Temporal variation in resistance to selected antimicrobials in *Enterococcus* isolates from chicken; *Retail Meat Surveillance*, 2003–2009.



Due to quality control and other laboratory-based issues, results of *Enterococcus* isolates from the Maritimes are not presented in 2009 (n=89).

Pigs

Salmonella

Farm Surveillance

(n =124)

Figure 25. Resistance to antimicrobials in *Salmonella* isolates from pigs; *Farm Surveillance*, 2009.

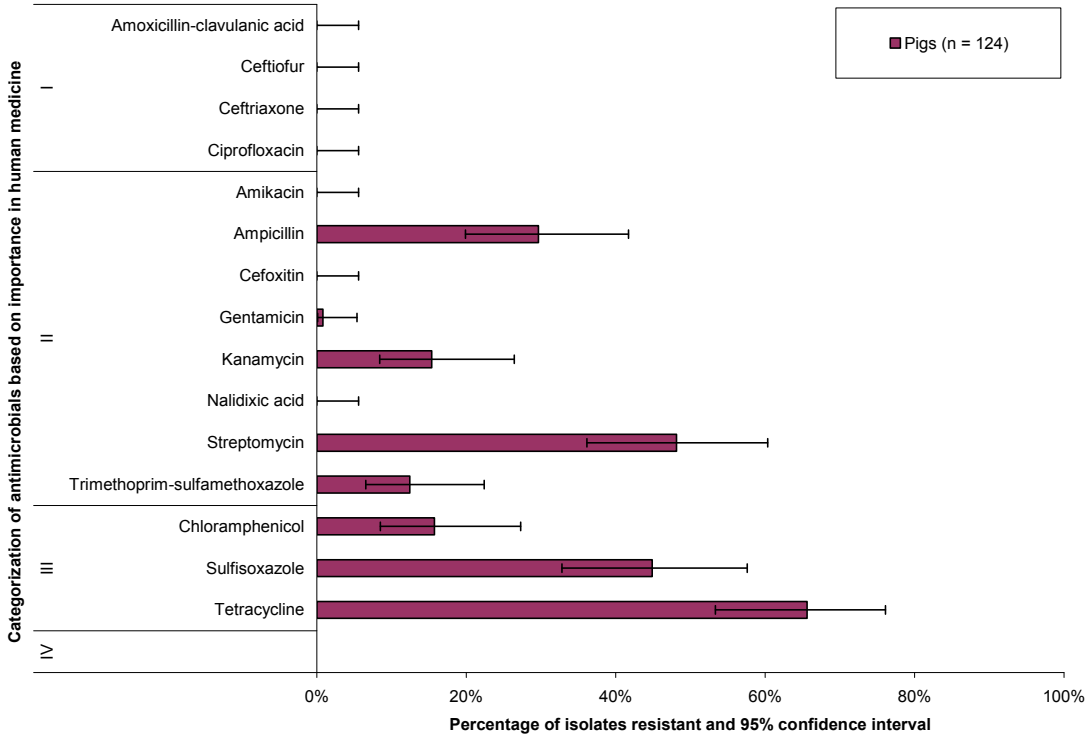
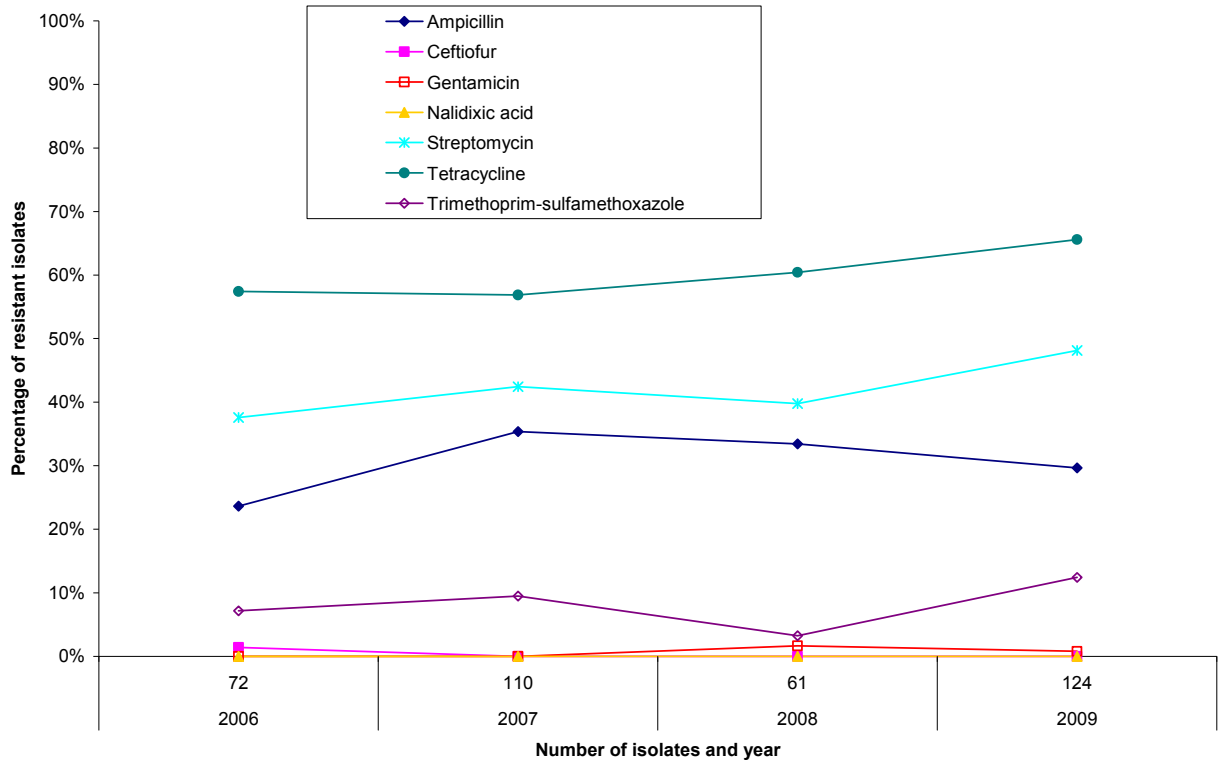


Table 15. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from pigs, by serovar; *Farm Surveillance*, 2009.

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 pathways inhibitors		Phenicols	Quinolones	Tetracyclines
		0	1	2-3	4-5	6	AMK	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	CHL	CIP	NAL	TET
Typhimurium var. 5-	28 (22.6)		2	15	11				11	13	15					12	4	7			28
Derby	25(20.2)	6	1	17	1					18	1					18	1				19
Typhimurium	13(10.5)	1		3	9				12	12	9					12	6	7			11
Brandenburg	12(9.7)	2	8	2							2										10
Infantis	7(5.6)	7																			
Senftenberg	5(4.0)	5																			
I 4,12:i:-	4(3.2)			1	3					3	4					3	1				4
Schwarzengrund	4(3.2)	1		3						3						3					3
Bovismorbificans	3(2.4)	1	2								2										
I 4,12:-:e,n,z15	3(2.4)	3																			
Cerro	2(1.6)	2																			
London	2(1.6)	2																			
Rissen	2(1.6)	1		1						1						1					1
Less common serovars	14(11.3)	5	4	2	3			1	3	5	3					4	3	1			8
Total	**124(100)**	**36**	**17**	**44**	**27**			**1**	**26**	**55**	**36**					**53**	**15**	**15**			**84**

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

Figure 26. Temporal variation in resistance to selected antimicrobials in *Salmonella* isolates from pigs; *Farm Surveillance*, 2006–2009.



Abattoir Surveillance

(n = 147)

Figure 27. Resistance to antimicrobials in *Salmonella* isolates from pigs; *Abattoir Surveillance*, 2009.

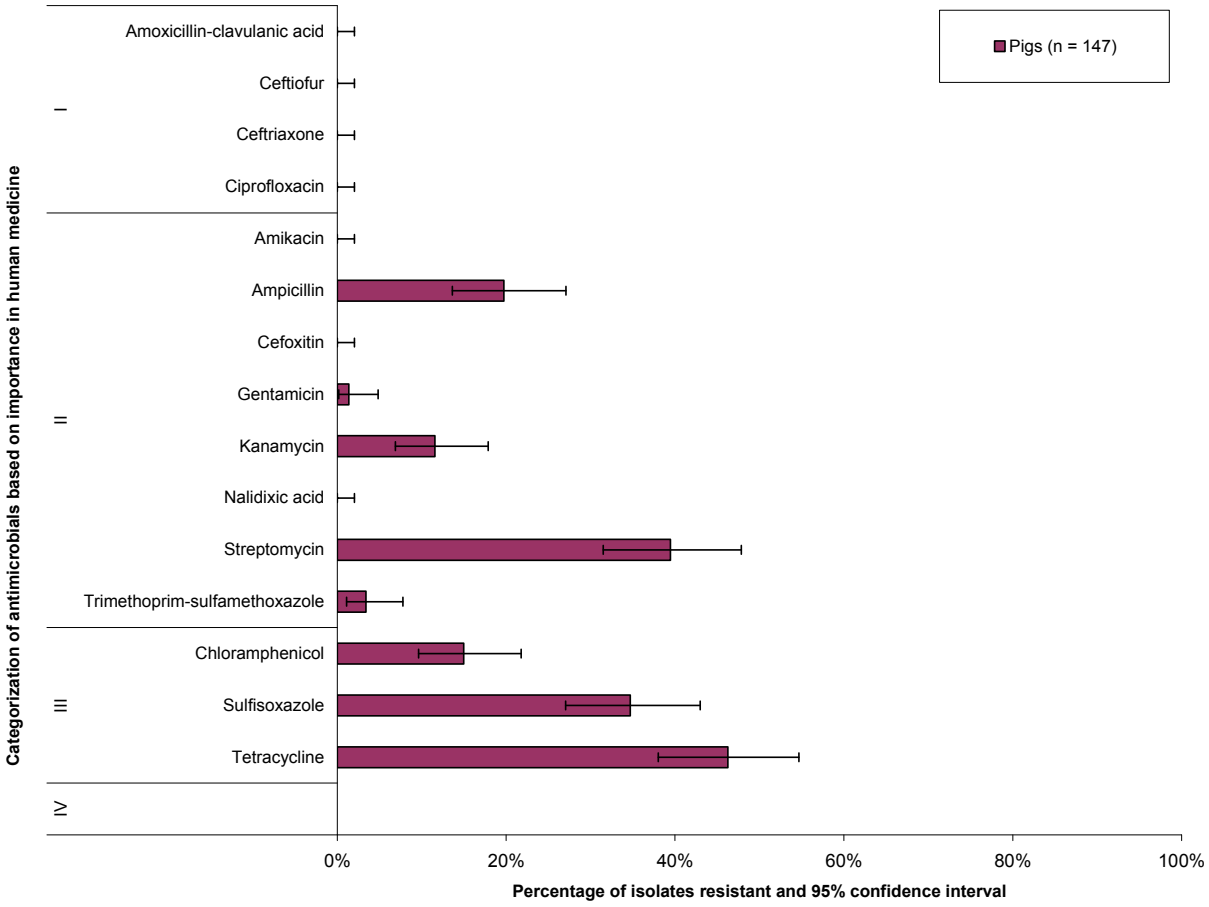
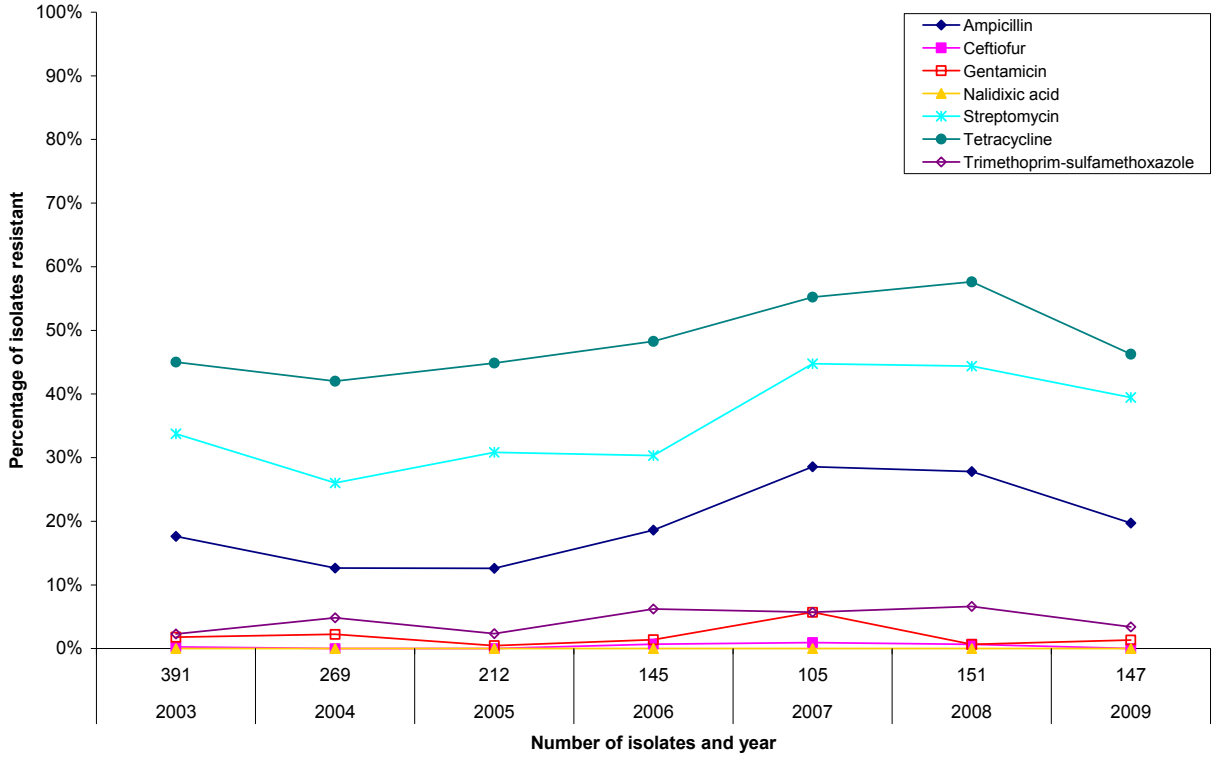


Table 16. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from pigs, by serovar; *Abattoir Surveillance*, 2009.

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 pathways inhibitors		Phenicols	Quinolones		Tetracyclines
		0	1	2-3	4-5	6	AMK	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	CHL	CIP	NAL	TET
Derby	26 (17.7)	6	2	18						17						18	1	1			17
Typhimurium var. 5-	20 (13.6)	6	2		12				6	12	12					12		11			14
Brandenburg	13 (8.8)	8	3	2					1	2	1										4
Infantis	11 (7.5)	11																			
Typhimurium	11 (7.5)			5	6				4	9	10					7	2	5			10
Worthington	8 (5.4)	3	5																		5
Schwarzengrund	5 (3.4)	4		1						1						1		1			
Anatum	4 (2.7)	2	1		1				1		1					1	1				2
Enteritidis	4 (2.7)	4																			
Give	4 (2.7)	3		1						1	1										
Hadar	3 (2)			3						3											3
Havana	3 (2)	3																			
Krefeld	3 (2)				3				3	3	3					3		2			3
Mbandaka	3 (2)			3				1	1	3						3					3
Less common serovars	29 (19.7)	22		5	2			1	1	7	1					6	1	2			7
Total	**147 (100)**	**72**	**13**	**38**	**24**			**2**	**17**	**58**	**29**					**51**	**5**	**22**			**68**

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

Figure 28. Temporal variation in resistance to selected antimicrobials in *Salmonella* isolates from pigs; *Abattoir Surveillance*, 2003–2009.



Surveillance of Animal Clinical Isolates

(n = 198)

Figure 29. Resistance to antimicrobials in *Salmonella* isolates from pigs; *Surveillance of Animal Clinical Isolates*, 2009.

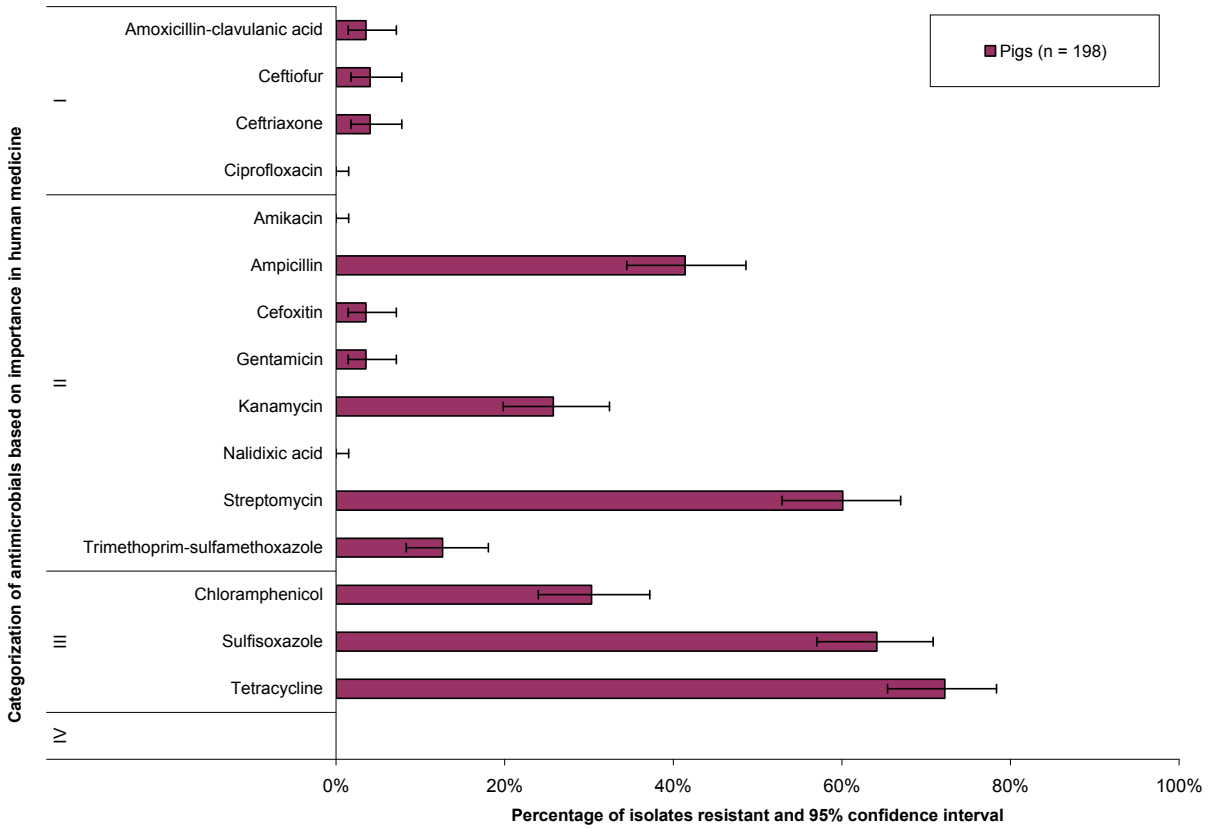


Table 17. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from pigs, by serovar; *Surveillance of Animal Clinical Isolates*, 2009.

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 pathways inhibitors		Phenicols	Quinolones		Tetracyclines
		0	1	2-3	4-5	6	AMK	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	CHL	CIP	NAL	TET
Typhimurium	48 (24.6)	4		8	36			2	20	38	39	2	2	2	2	42	13	30			44
Derby	27 (13.8)	4	2	20	1					21						21		1			23
Typhimurium var. 5-	21 (10.8)	1	1	2	17			1	14	17	18					19	2	12			19
Infantis	12 (6.2)	11	1																		1
Brandenburg	8 (4.1)	4	2	1	1			1	1	2	1		1		1	1	1	1			4
Schwarzengrund	8 (4.1)	3		4	1				1	5	1					5					5
Mbandaka	7 (3.6)	3		3	1			1	1	3	1					3	1				4
I 4,[5],12:i:-	6 (3.1)	1			5				3	5	5					5	2	4			5
Worthington	6 (3.1)	3		3						3						3					3
Bovismorbificans	5 (2.6)		1		4				2	4	5	2	2	2	2	4		2			4
I 4,[5],12:-:-	4 (2.1)		1	2	1					3	1					3		1			4
Less common serovars	43 (22.1)	17	4	12	10			2	8	16	10	3	3	3	3	19	5	8			25
Total	**195 (100)**	**51**	**12**	**55**	**77**			**7**	**50**	**117**	**81**	**7**	**8**	**7**	**8**	**125**	**24**	**59**			**141**

Serovars represented by less than 2% of isolates were classified as “Less common serovars”.
Serovar identity was not available for 3 isolates.
Red, blue and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

Escherichia coli

Farm Surveillance

(n = 1,800)

Figure 30. Resistance to antimicrobials in *Escherichia coli* isolates from pigs; *Farm Surveillance*, 2009.

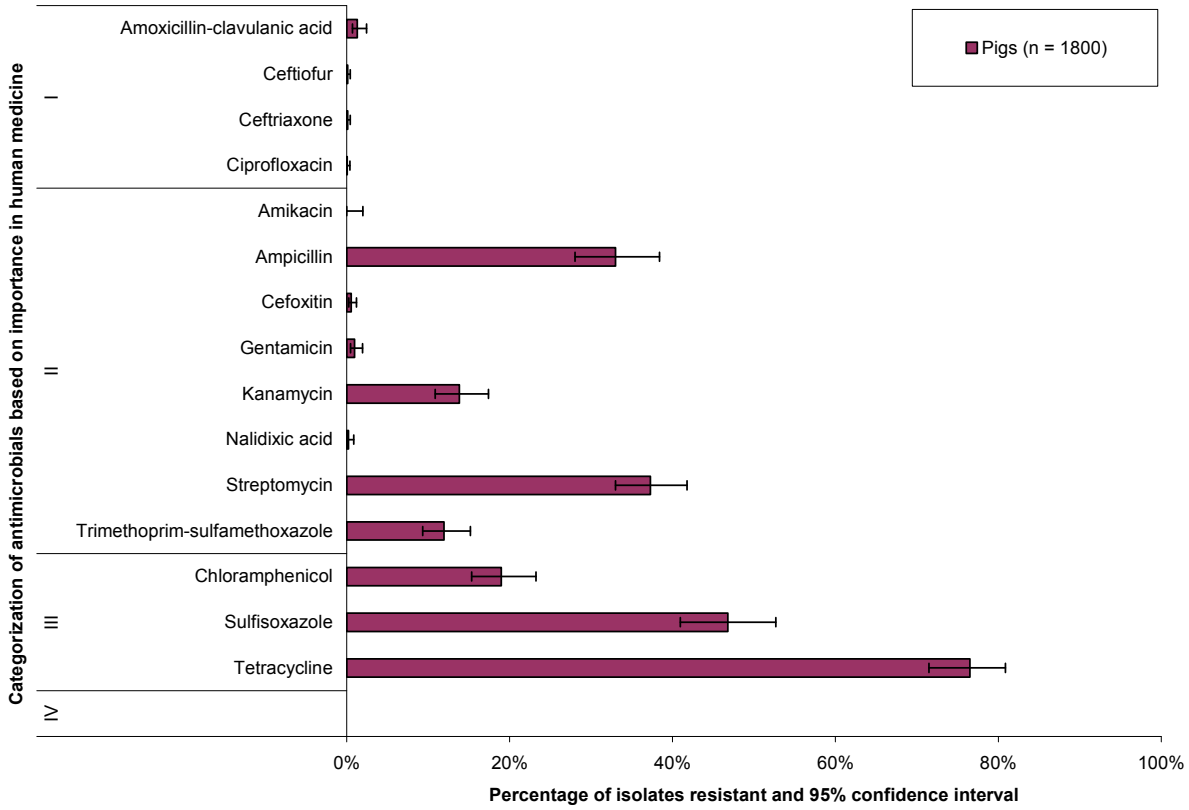
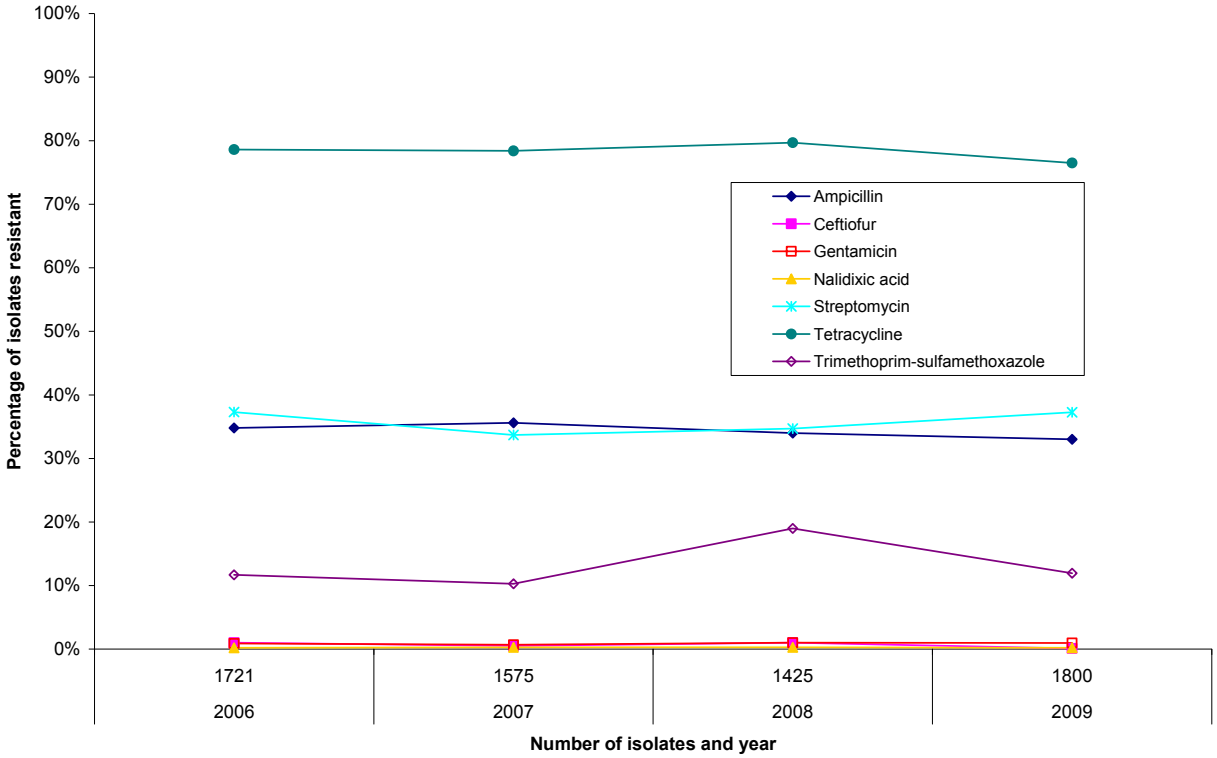


Figure 31. Temporal variation in resistance to selected antimicrobials in *Escherichia coli* isolates from pigs; *Farm Surveillance*, 2006–2009.



Abattoir Surveillance

(n = 160)

Figure 32. Resistance to antimicrobials in *Escherichia coli* isolates from pigs; *Abattoir Surveillance*, 2009.

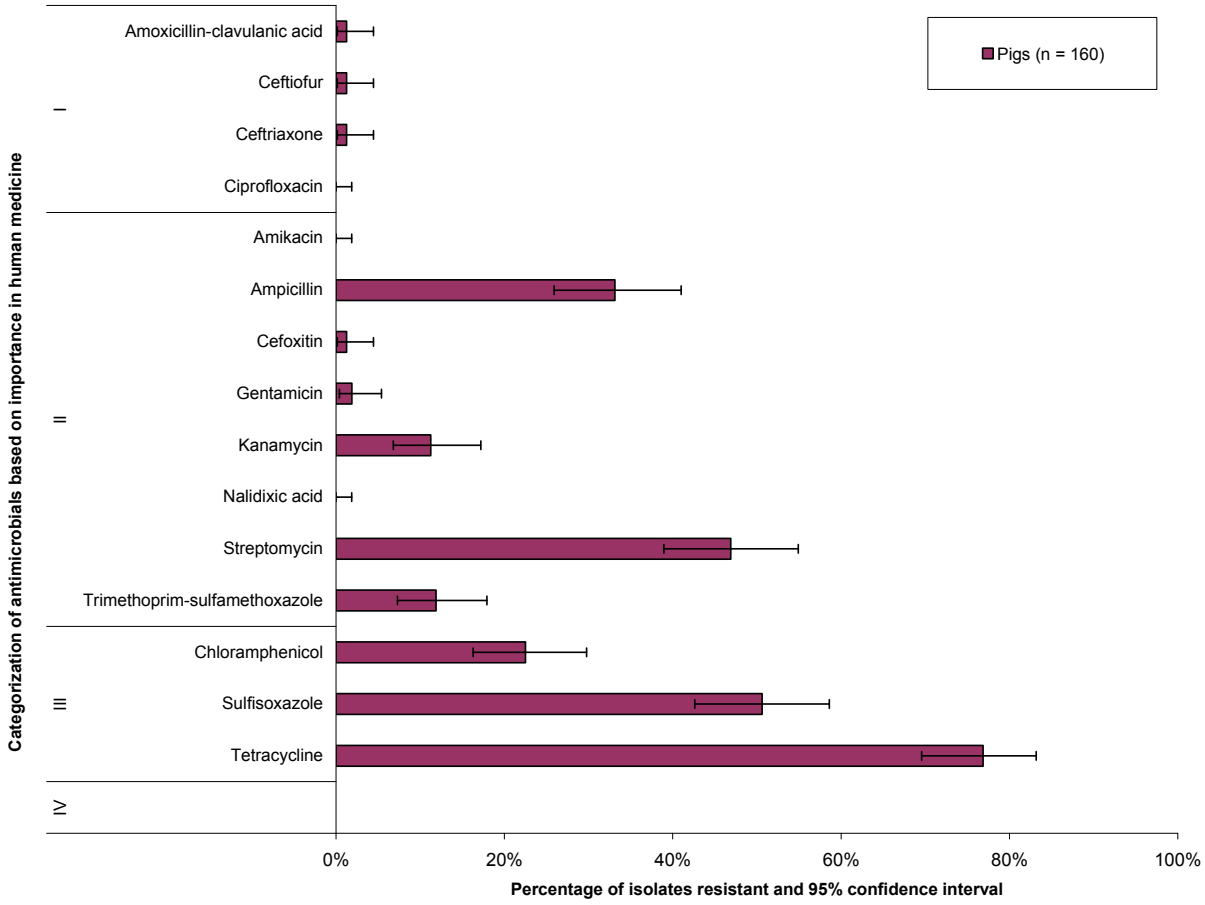
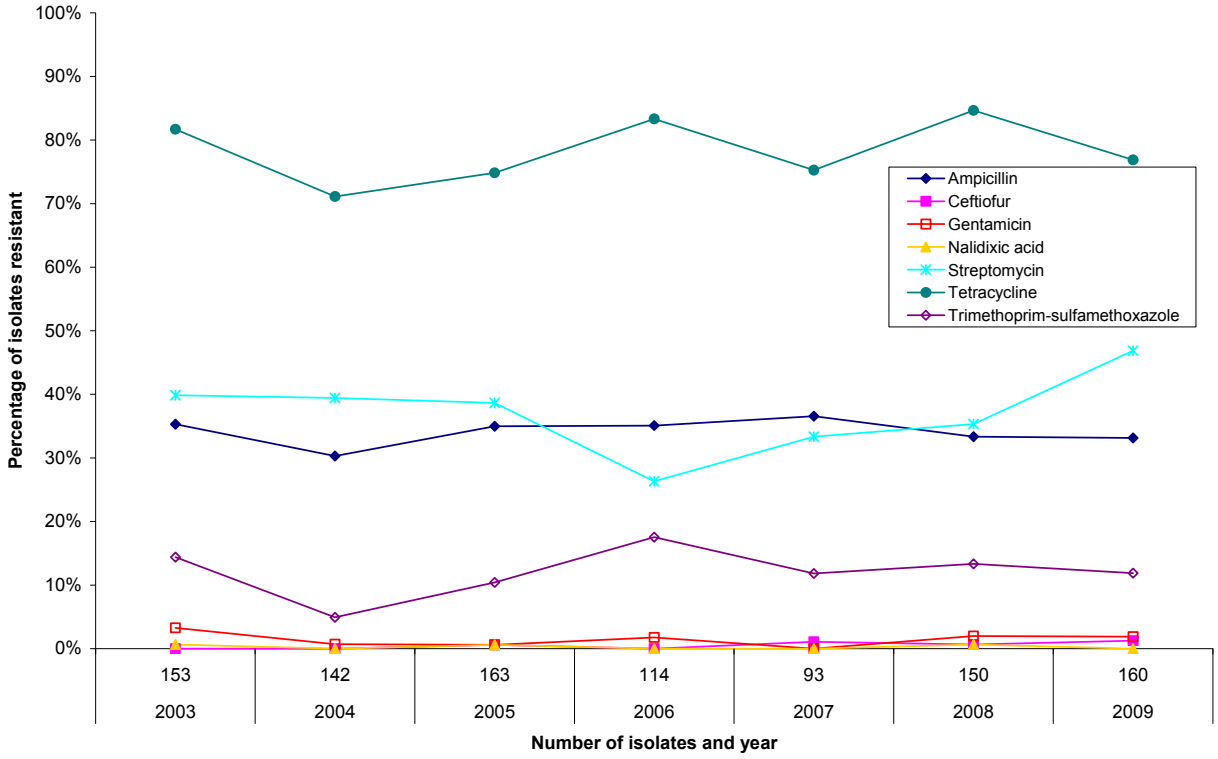


Figure 33. Temporal variation in resistance to selected antimicrobials in *Escherichia coli* isolates from pigs; *Abattoir Surveillance*, 2003–2009.



Retail Meat Surveillance

(n = 322)

Figure 34. Resistance to antimicrobials in *Escherichia coli* isolates from pork, by province; *Retail Meat Surveillance,* 2009.

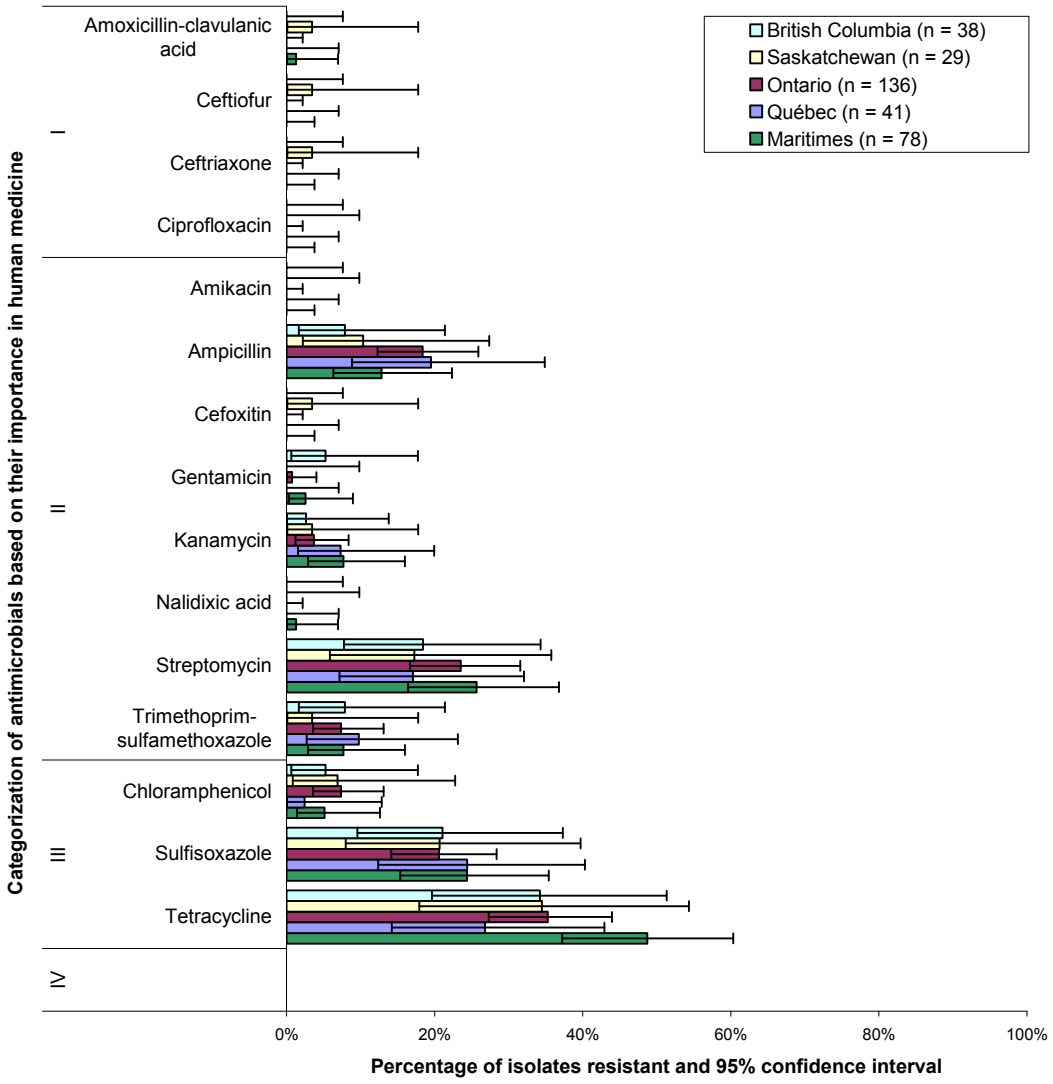
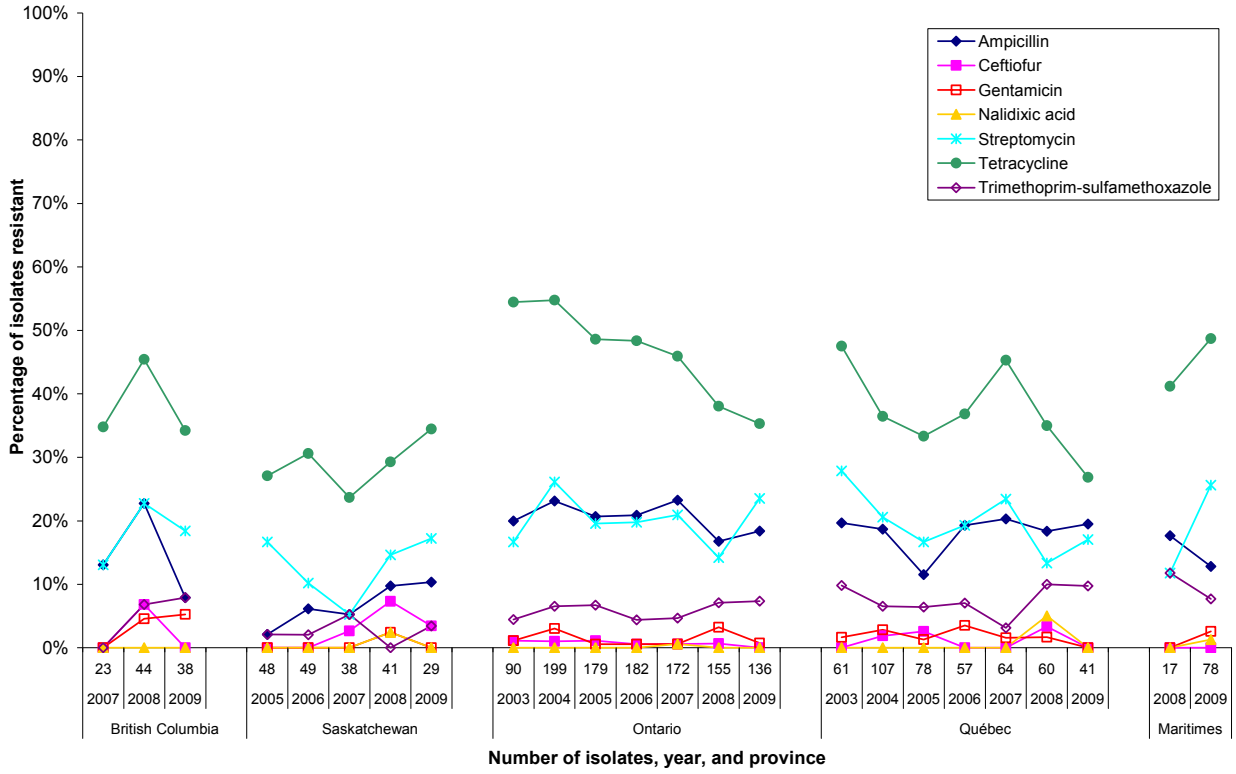


Figure 35. Temporal variation in resistance to selected antimicrobials in *Escherichia coli* isolates from pork; *Retail Meat Surveillance*, 2003–2009.

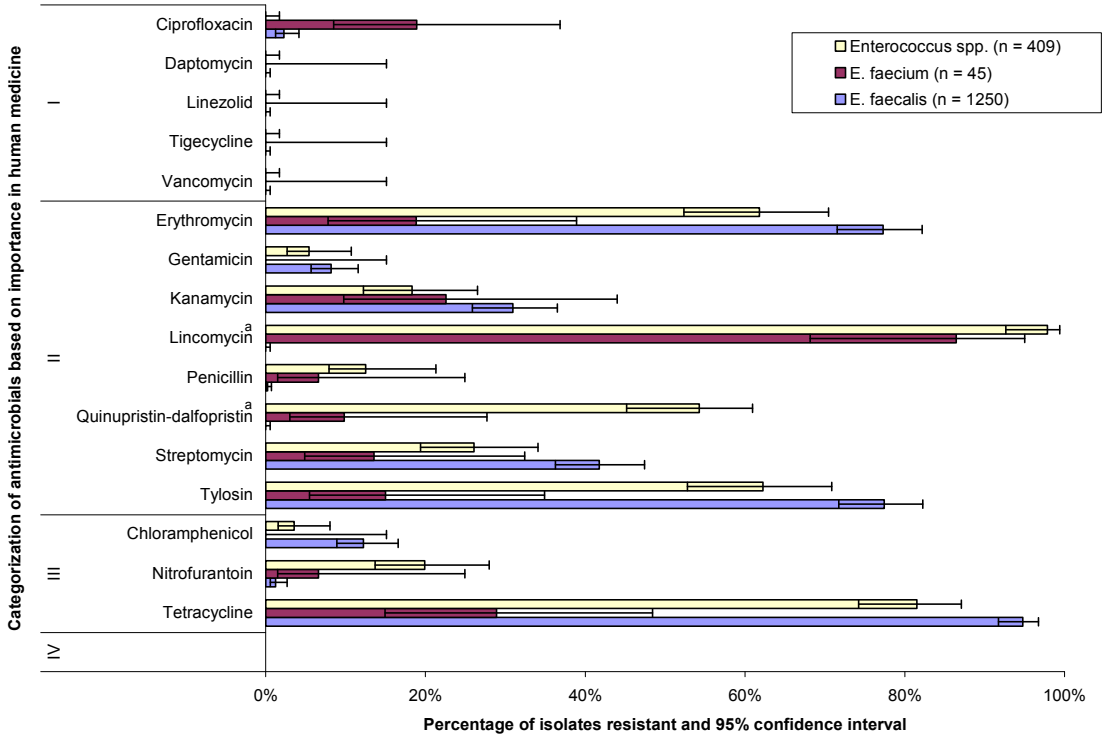


Enterococcus

Farm Surveillance

(n = 1,704)

Figure 36. Resistance to antimicrobials in *Enterococcus* isolates from pigs; *Farm Surveillance*, 2009.



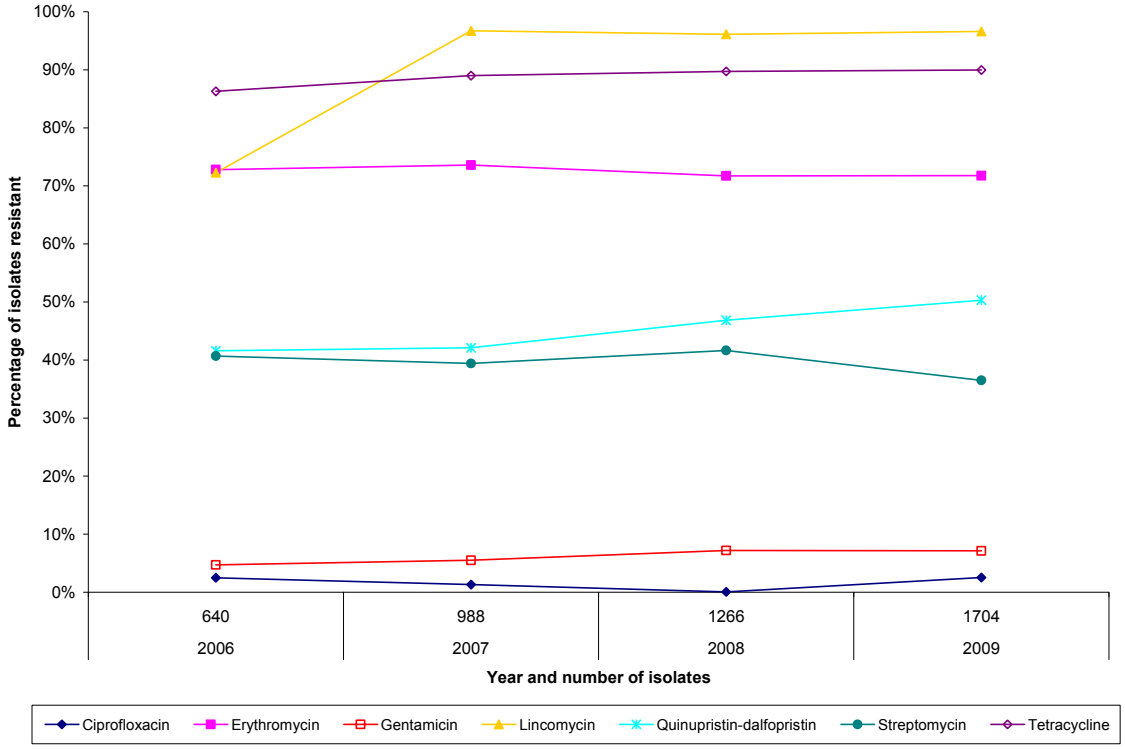
[a] Resistance to quinupristin-dalfopristin and lincomycin is not reported for *E. faecalis* because *E. faecalis* is intrinsically resistant to these antimicrobials.

Table 18. Number of antimicrobial classes in resistance patterns of *Enterococcus* isolates from pigs, by species; *Farm Surveillance*, 2009.

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			Glycopeptides	Glycylcyclines	Lincosamides	Lipopeptides	Macrolides		Nitrofurans	Oxazolidinones	Penicillins	Phenicols	Quinolones	Streptogramins	Tetracyclines
		0	1	2–5	6–9	10–13[a]	GEN	KAN	STR	VAN	TIG	LIN	DAP	ERY	TYL	NIT	LNZ	PEN	CHL	CIP	QDA	TET
E. faecalis	1,250 (73.4)	53	193	1,004			94	384	516					955	957	13		3	144	29		1,186
Enterococcus spp.	409 (24)	4	42	297	66		18	67	100			401		248	251	89		54	13		220	340
E. faecium	45 (2.6)	1	25	16	3			11	7			40		8	7	3		3		8	4	13
Total	1,704 (100)	58	260	1,317	69		112	462	623			441		1,211	1,215	105		60	157	37	224	1,539

Red, blue and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.
[a] Because *E. faecalis* is intrinsically resistant to lincomycin and quinupristine-dalfopristine, the range is 10-11.

Figure 37. Temporal variation in resistance to selected antimicrobials in *Enterococcus* isolates from pigs; *Farm Surveillance*, 2006–2009.



Turkeys

Salmonella

Surveillance of Animal Clinical Isolates

(n = 60)

Figure 38. Resistance to antimicrobials in *Salmonella* isolates from turkeys; *Surveillance of Animal Clinical Isolates*, 2009.

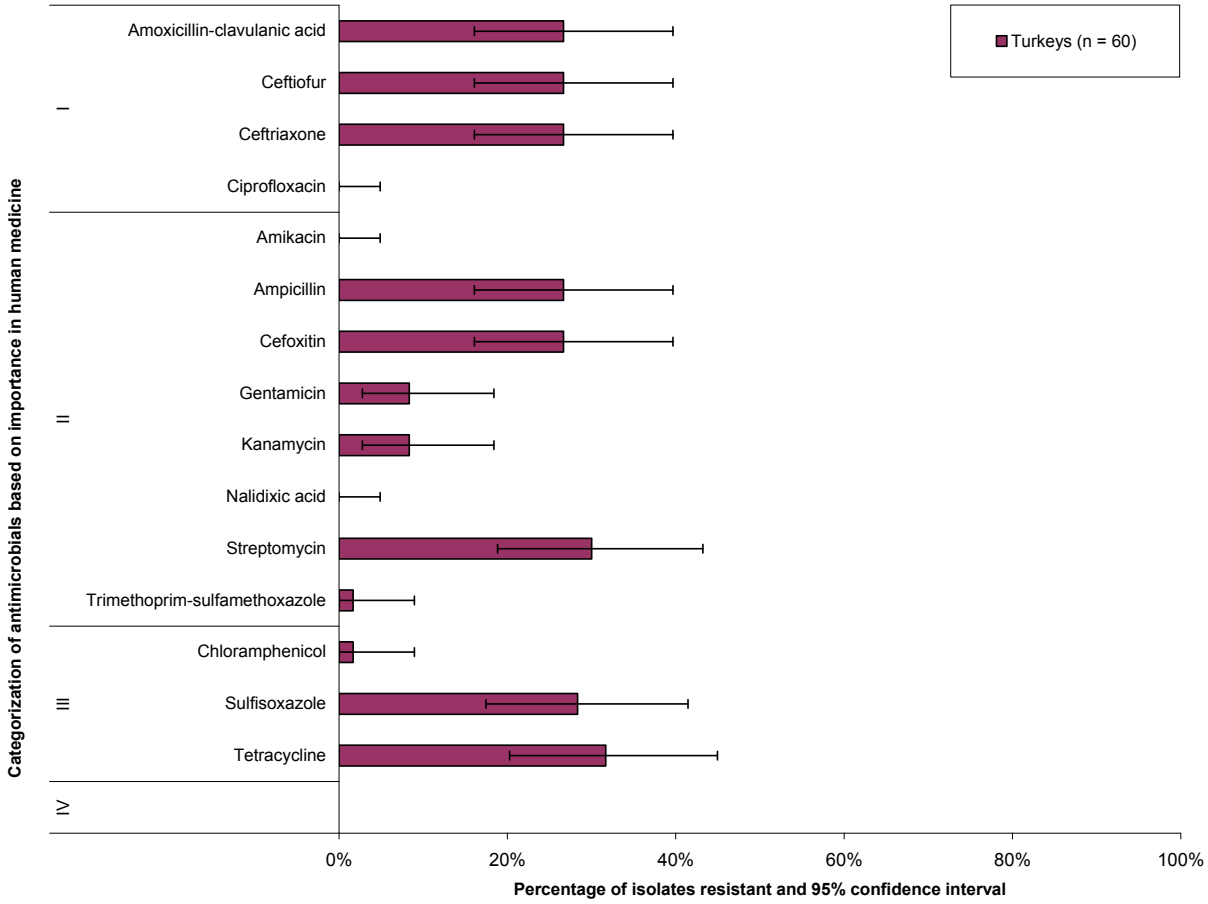


Table 19. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from turkeys, by serovar; *Surveillance of Animal Clinical Isolates*, 2009.

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 pathways inhibitors		Phenicols	Quinolones		Tetracyclines
		0	1	2-3	4-5	6	AMK	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	CHL	CIP	NAL	TET
Schwarzengrund	30 (50)	26		3	1					4	1	1	1	1	1	4					4
Heidelberg	4 (6.7)		3		1			1	1	1	4	4	4	4	4	1					1
Senftenberg	4 (6.7)	1	2	1				1		1	2	2	2	2	2	1					1
Hadar	3 (5)			1	2				1	3	2	2	2	2	2	2					3
Worthington	3 (5)			3					1	3						3					3
Agona	2 (3.3)		1		1					1	2	2	2	2	2	1	1	1			1
Give	2 (3.3)	2																			
I 4,[5],12:-:-	2 (3.3)		1	1							2	2	2	2	2	1					1
Ouakam	2 (3.3)		2					1	1	1											1
Less common serovars	8 (13.3)	2	1	5				2	1	4	3	3	3	3	3	4					4
Total	**60 (100)**	**31**	**10**	**14**	**5**			**5**	**5**	**18**	**16**	**16**	**16**	**16**	**16**	**17**	**1**	**1**			**19**

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

Horses

Salmonella

Surveillance of Animal Clinical Isolates

(n = 23)

Figure 39. Resistance to antimicrobials in *Salmonella* isolates from horses; *Surveillance of Animal Clinical Isolates*, 2009.

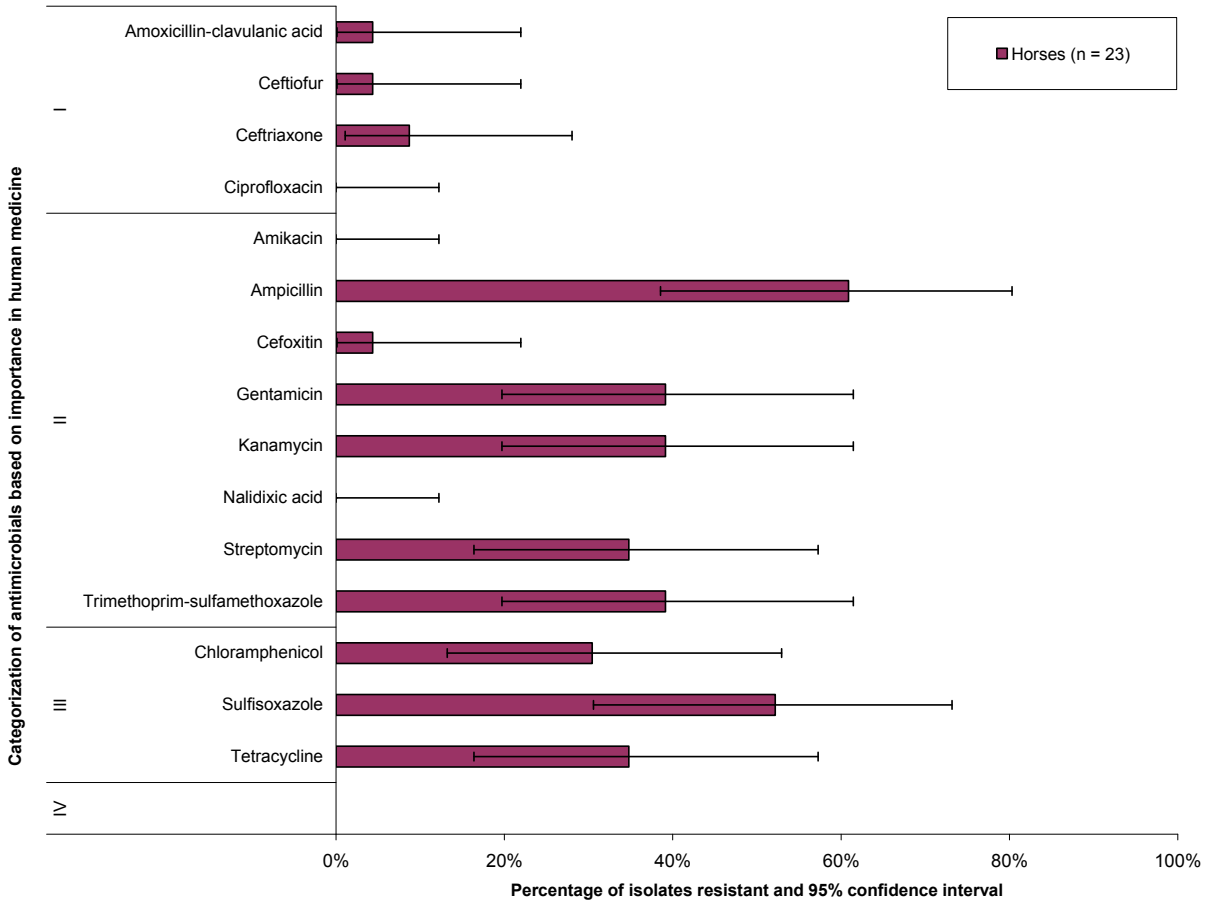


Table 20. Number of antimicrobial classes in resistance patterns of *Salmonella* isolates from horses, by serovar; *Surveillance of Animal Clinical Isolates*, 2009.

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 pathways inhibitors		Phenicols	Quinolones		Tetracyclines
		0	1	2-3	4-5	6	AMK	GEN	KAN	STR	AMP	AMC	CRO	FOX	TIO	SSS	SXT	CHL	CIP	NAL	TET
Heidelberg	9 (40.9)			3	6			9	9	2	9	1	1	1	1	9	9	6			
Hadar	4 (18.2)		1	3						3	3										4
Thompson	2 (9.1)	2																			
Typhimurium	2 (9.1)	1			1					1	1					1		1			1
Daytona	1 (4.5)	1																			
Mbandaka	1 (4.5)			1						1						1					1
Newport	1 (4.5)	1																			
Oranienburg	1 (4.5)	1																			
Orion	1 (4.5)			1						1						1					1
Total	**22 (100)**	**6**	**1**	**8**	**7**			**9**	**9**	**8**	**13**	**1**	**1**	**1**	**1**	**12**	**9**	**7**			**7**

Serovar identity was not available for 1 isolate.
Red, blue and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively

Appendix A

Recovery Rates

Table A.1. Recovery rates and number of isolates submitted for antimicrobial susceptibility testing across the bacterial species, the active surveillance components and the animal species; CIPARS, 2002−2009.

CIPARS Component/ Animal species	Province	Year	Percentage (%) of isolates recovered and number of isolates recovered/number of samples submitted							
			Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*	
Farm Surveillance										
Pigs		2006	**99%**	459/462	**20%**	94/462			**81%**	374/462
		2007	**100%**	612/612	**21%**	136/612			**81%**	495/612
		2008	**99%**	481/486	**13%**	61/486			**92%**	448/486
		2009	**99%**	695/701	**17%**	124/701			**97%**	679/701
Abattoir Surveillance										
Beef cattle		2002	**97%**	76/78	**1%**	3/78				
		2003	**97%**	155/159	**< 1 %**	1/114				
		2004	**98%**	167/170						
		2005	**97%**	122/126			**66%**	23/35		
		2006	**100%**	150/150			**36%**	31/87		
		2007	**99%**	188/190			**39%**	75/190		
		2008	**97%**	176/182			**71%**[b]	129/182		
		2009	**94%**	119/126			**68%**	86/126		
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%**	200/1103				
		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				
Pigs		2002	**97%**	38/39	**27%**	103/385				
		2003	**98%**	153/155	**28%**	395/1393				
		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				
Retail Meat Surveillance										
Beef	British Columbia	2005	**93%**	27/29						
		2007	**79%**	49/62						
		2008	**77%**	88/115						
		2009	**71%**	79/112						
	Saskatchewan	2005	**79%**	120/151						
		2006	**76%**	123/161						
		2007	**78%**	118/151						
		2008	**76%**	134/177						
		2009	**83%**	135/163						
	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						
	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						
	Maritimes	2004	**67%**	16/24						
		2007	**52%**	16/31						
		2008	**70%**	39/56						
		2009	**69%**	132/192						

The number of isolates recovered may differ from the final number of isolates tested for antimicrobial susceptibility. The numbers for 2003 retail for Ontario and Québec for *Salmonella*, *Campylobacter* and *Enterococcus* in the grey areas are from a pilot phase where the sampling strategy was the same as in future years but sample size was lower.

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

Table A.1 (continued). Recovery rates and number of isolates submitted for antimicrobial susceptibility testing across the bacterial species, the active surveillance components and the animal species; CIPARS, 2002−2009.

CIPARS Component/ Animal species	Province	Year	Percentage (%) of isolates recovered and number of isolates recovered/number of samples submitted							
			Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*	
Retail Meat Surveillance										
Chicken	British Columbia	2005	**95%**	19/20	**13%**	5/39	**69%**	27/39	**100%**	20/20
		2007	**98%**	42/43	**22%**[a]	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
	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%**[a]	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
	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%**[a]	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
	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%**[a]	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%**	105/266	**20%**	52/266	**99%**	132/134
	Maritimes	2004	**100%**	13/13	**4%**	1/25	**40%**	10/25	**100%**	13/13
		2007	**91%**	29/32	**22%**[a]	7/32				
		2008	**68%**	38/56	**22%**	12/56				
		2009	**94%**	180/191	**48%**	92/191	**30%**	57/191		
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				
	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				
	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				
	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				
	Maritimes	2004	**58%**	14/24						
		2007	**39%**	13/31	**3%**	1/30				
		2008	**30%**	17/56	**2%**	1/56				
		2009	**41%**	79/192	**3%**	5/190				

The number of isolates recovered may differ from the final number of isolates tested for antimicrobial susceptibility. The numbers for 2003 retail for Ontario and Québec for *Salmonella, Campylobacter* and *Enterococcus* in the grey areas are from a pilot phase where the sampling strategy was the same as in future years but sample size was lower.
Due to quality control and other laboratory-based issues, results of *Enterococcus* isolates from the Maritimes are not presented in 2009 (n=89).
[a] Enhancement to *Salmonella* recovery methods explains higher prevalence in 2007 and after from chicken isolates.

Abbreviations

Antimicrobials

AMC	Amoxicillin-clavulanic acid
AMK	Amikacin
AMP	Ampicillin
AZM	Azithromycin
CHL	Chloramphenicol
CIP	Ciprofloxacin
CLI	Clindamycin
CRO	Ceftriaxone
DAP	Daptomycin
ERY	Erythromycin
FLR	Florfenicol
FOX	Cefoxitin
GEN	Gentamicin
KAN	Kanamycin
LIN	Lincomycin
LNZ	Linezolid
NAL	Nalidixic acid
NIT	Nitrofurantoin
PEN	Penicillin
QDA	Quinupristin-dalfopristin
SSS	Sulfisoxazole
STR	Streptomycin
SXT	Trimethoprim-sulfamethoxazole
TEL	Telithromycin
TET	Tetracycline
TIG	Tigecycline
TIO	Ceftiofur
TYL	Tylosin
VAN	Vancomycin

Canadian provinces

AB	Alberta
BC	British Columbia
MB	Manitoba
NB	New Brunswick
NL	Newfoundland and Labrador
NS	Nova Scotia
NT	Northwest Territories
NU	Nunavut
ON	Ontario
PEI	Prince Edward Island
QC	Québec
SK	Saskatchewan
YT	Yukon Territory