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Canada

2019

Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)

Figures and Tables

To promote and protect the health of Canadians through leadership, partnership, innovation and action in public health, Public Health Agency of Canada

Working towards the preservation of effective antimicrobials for humans and animals, Canadian Integrated Program for Antimicrobial Resistance Surveillance

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Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) 2019

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Contributors to CIPARS

CIPARS Team

Program coordinators in 2019

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Surveillance component leads

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- Retail Meat Surveillance: Brent Avery
- Abattoir Surveillance: Anne Deckert
- Farm Surveillance: Agnes Agunos, Anne Deckert, Sheryl Gow, and David Léger
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Provincial public health laboratories

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

- British Columbia Public Health Microbiology and Reference Laboratory, Provincial Health Services Authority, British Columbia (Linda Hoang)
- Provincial Laboratory for Public Health, Alberta (Marie Louie)
- Saskatchewan Laboratory and Disease Control Services (Greg Horsman)
- Cadham Provincial Laboratory, Manitoba (John Wylie)
- Public Health Ontario Laboratory, Public Health Ontario (Vanessa Allen)
- Laboratoire de santé publique du Québec de l'Institut national de santé publique du Québec (Sadjia Bekal)
- New Brunswick Enteric Reference Centre (Sameh El Bailey)
- Microbiology Laboratory, Queen Elizabeth II Health Sciences Centre, Nova Scotia (David Haldane)
- Laboratory Services, Queen Elizabeth Hospital, Prince Edward Island (Greg German)
- Newfoundland Public Health Laboratory (George Zahariadis)

Provincial animal health laboratories

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

- Animal Health Centre, British Columbia Ministry of Agriculture (Erin Zabek)
- Prairie Diagnostic Services, Saskatoon (Kathy Dielschneider and Musangu Ngeleka)
- Veterinary Services Branch Laboratory, Manitoba (Neil Pople)
- The Animal Health Laboratory, University of Guelph, Ontario (Durda Slavic)
- IDEXX Laboratories, Ontario (Hani Dick)
- Laboratoire d'épidémiosurveillance animale du Québec (Julie-Hélène Fairbrother)
- Provincial Veterinary Laboratory, Department of Agriculture, Fisheries, and Aquaculture, New Brunswick (Jim Goltz)
- Veterinary Pathology Laboratory, Nova Scotia (Catherine Graham)
- Diagnostic Services, Atlantic Veterinary College, Prince Edward Island (Jan Giles)
- Animal Health Laboratory, Department of Fisheries, Forestry and Agrifoods, Newfoundland and Labrador (Laura Rogers)
- Department of Fisheries and Agriculture (Jeannie Tucker)

Surveillance components

Retail meat surveillance

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

- Centre for Coastal Health (Carl Ribble and Stefan Iwasawa)
- Agriculture and Agri-Food Canada (Mueen Aslam, Tineke Jones, Cara Service, and Tim McAllister)

We also thank the following health unit managers, public health inspectors, and environmental health officers: Bob Bell, Tanya Musgrave, Torsten Schulz, and Lee Siewerda.

Abattoir surveillance

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

Farm surveillance

We are grateful for the support of the Canadian Poultry Research Council, the Ontario Ministry of Agriculture, Food and Rural Affairs, and the Saskatchewan Ministry of Agriculture, as well as the sentinel veterinarians and the producers who participated in Farm Surveillance by providing data and enabling collection of samples for bacterial culture.

We would like to acknowledge the following organizations for their contribution to the CIPARS Farm Surveillance components:

- Alberta Chicken Producers
- Alberta CAP (Canadian Agricultural Partnership) Funding
- Alberta Beef Producers
- Alberta Cattle Feeders Association
- Bayer Animal Health
- Beef Cattle Research Council/Canadian Cattleman's
- Beef Farmers of Ontario
- British Columbia Chicken Marketing Board
- British Columbia Turkey Farmers
- Canadian Hatcheries Federation
- Canadian Pork Council and Provincial Pork Boards
- Canadian Poultry and Egg Processors Council
- Chicken Farmers of Canada
- Chicken Farmers of Ontario
- CIPARS Farm Broiler Chicken Industry Antimicrobial Use/Resistance Working Group
- CIPARS Farm Feedlot Cattle Expert Group and Advisory Committee
- CIPARS Farm Swine Advisory Committees
- Les Éleveurs de volailles du Québec
- McDonald's
- Ontario CAP Funding
- Prairie Diagnostic Services, Saskatoon
- Saskatchewan Cattle Feeders Association
- Turkey Farmers of Ontario
- Turkey Farmers of Canada
- Vetoquinol

Quantities of antimicrobials distributed for sale in animals

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Health Canada data validation and communication

- Xian-Zhi Li, Annika Flint, Megan Rose-Martel, Valentine Usongo, Mark Reist, Holly Hutchings, Naida Hyndman, and Tushar Shakya

Veterinary Antimicrobial Sales Reporting (VASR) database operations in Canadian Network for Public Health Intelligence (CNPHI)

- The CNPHI team

Integrated AMU information

- Data on antimicrobials used as pesticides on food crops: Brian Belliveau
- Data on antimicrobials dispensed by community pharmacies or purchased by hospitals for use in people: Glenys Smith and Jayson Shurgold
- Data on CIPARS farm-use: Agnes Agunos, David Léger, Sheryl Gow, and Anne Deckert
- Data on aquaculture: John Martell and Ed Porter

Additional thanks for Veterinary Antimicrobial Sales Reporting (VASR)

A very sincere appreciation to input and help along the way from David Léger and Brent Avery for the development of VASR. We appreciate the advice and support of Mary-Jane Ireland, Steven Sternthal, and Stephen Parker. We would also like to thank the data providers, for both their data and for their feedback about improving the VASR system.

Other participants

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

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

We would also like to thank the following individuals and organizations for their contribution to CIPARS in 2019:

Public Health Agency of Canada

Ashleigh Andrysiak, Louise Bellai, Mark Blenkinsop, Ann-Marie Cochrane, George Golding, Saarah Hussain, Dolly Kambo, Nicol Janecko, Stefanie Kadykalo, Ora Kendall, Lisa Landry, Julie Légaré, Sarah Martz, Ryan McKarron, Ali Moterassed, Manuel Navas, Linda Nedd-Gbedemah, Derek Ozunk, Allison Roberts, Mythri Viswanathan, Rama Viswanathan, Victoria Weaver, and Irene Yong.

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Canadian Food Inspection Agency

Daniel Leclair, Debbie Roffe, and Marina Steele

Canadian Meat Council

Independent Contractors

John Ranson and Ron Templeman

Stephanie Brault

Grace Kuiper

Dana Ramsay

What's new for CIPARS in 2019

Antimicrobial use

- In 2019, sales data collected from Veterinary Antimicrobial Sales Report (VASR), a collaborative initiative between Public Health Agency of Canada and Health Canada, were included in this report. Regulatory changes to the Food and Drug Regulations for annual sales reporting came into force in 2017 to increase oversight of antimicrobials available for use in animals, to support antimicrobial resistance (AMR) surveillance and antimicrobial stewardship. These changes require manufacturers, importers, and compounders to report annual sales of medically important antimicrobials intended for use in animals (those important to human medicine). To implement the regulatory reporting requirements, Health Canada and the Public Health Agency of Canada developed the Veterinary Antimicrobial Sales Reporting (VASR) system. The VASR system collects data on volumes of antimicrobials and total quantity sold or compounded by animal species, and by province/territory. The reporting year reflects data collected for the period of January 1 to December 31. Additionally, CIPARS is working on revising the population denominators used to contextualize the sales data.
- In 2019, the methodology for estimating the quantity of antimicrobials administered via water for farm animals was revised (not based on water consumed and inclusion rate per liter) and followed the OIE protocol. The total milligrams of active ingredient was estimated based on the number of packages multiplied by the pack content and the strength (e.g., grams of antimicrobial per unit or percentage of active ingredient) of the product.
- The first year of antimicrobial use data for Canadian feedlot beef cattle was collected in 2019. Data to be released in future reports.

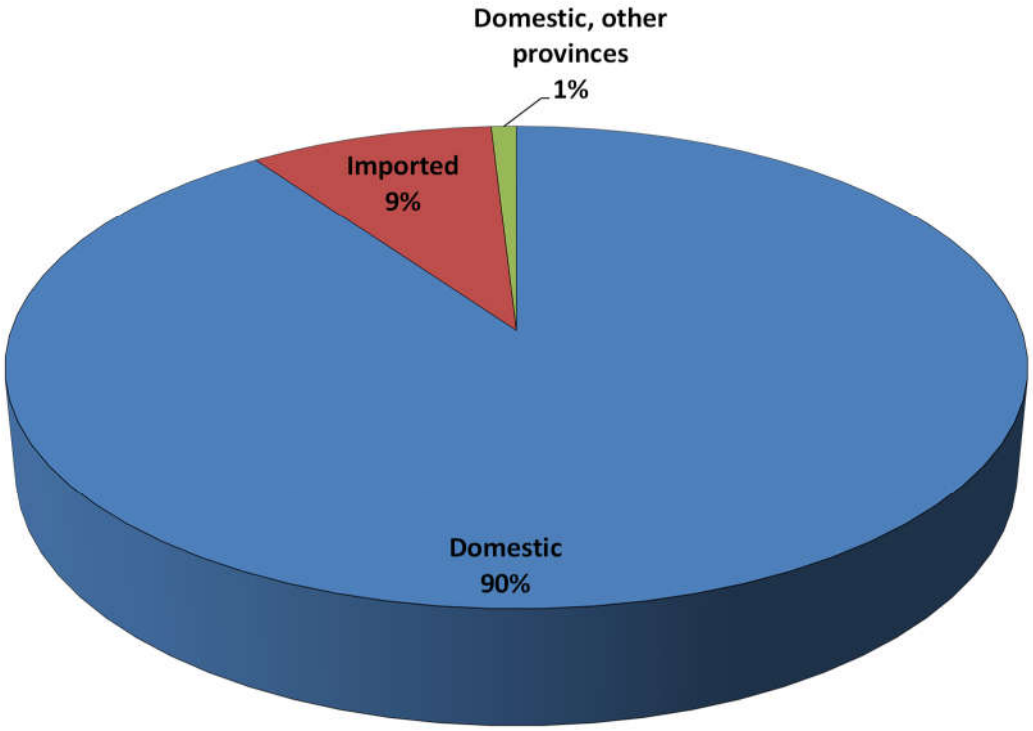
Antimicrobial resistance

- In 2019, thanks to external funding, sampling was conducted in the 3 major feedlot cattle producing provinces of Alberta, Saskatchewan, and Ontario.
- In 2019, telithromycin resistance was no longer reported in *Campylobacter* temporal figures and multiclass resistance tables.
- Only a partial year of retail sampling was conducted in Ontario and the Prairies, and no sampling occurred in the Atlantic region; therefore no temporal retail meat data from these regions are presented in 2019.

Chapter 1 Animal health status and farm information

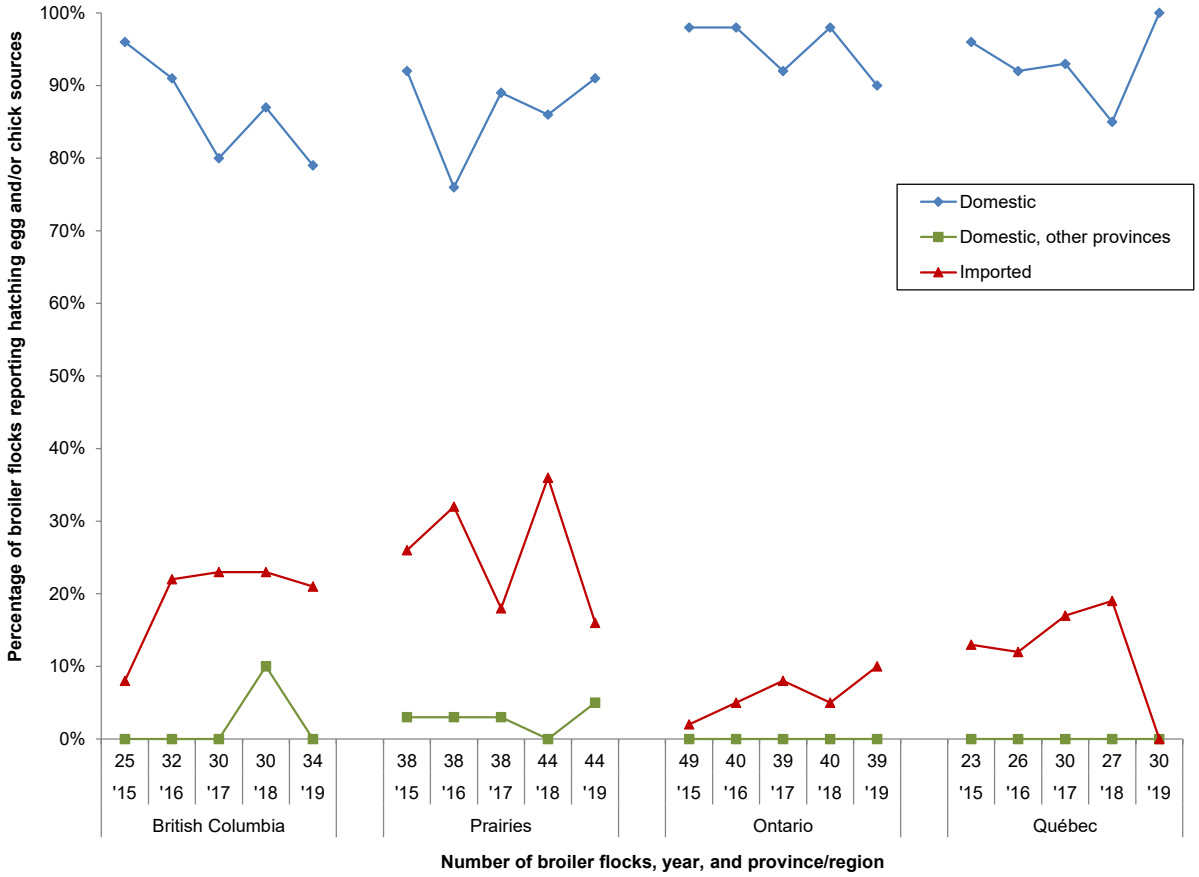
Broiler chickens

Figure 1. 1 Relative distribution of chick sources, 2019



Domestic = hatched within the province where the birds were raised.
Domestic, other provinces = hatched in a different province from where the birds were raised.
Imported = hatching eggs and/or chicks were sourced by the importing hatchery from the United States or other countries.

Figure 1. 2 Sources of hatching eggs and/or chicks placed in the barn sampled, by province/region, 2015 to 2019



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks	25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Hatching egg and/or chick sources																				
Domestic	96%	91%	80%	87%	79%	92%	76%	89%	86%	91%	98%	98%	92%	98%	90%	96%	92%	93%	85%	100%
Domestic, other provinces	0%	0%	0%	10%	0%	3%	3%	3%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Imported	8%	22%	23%	23%	21%	26%	32%	18%	36%	16%	2%	5%	8%	5%	10%	13%	12%	17%	19%	0%

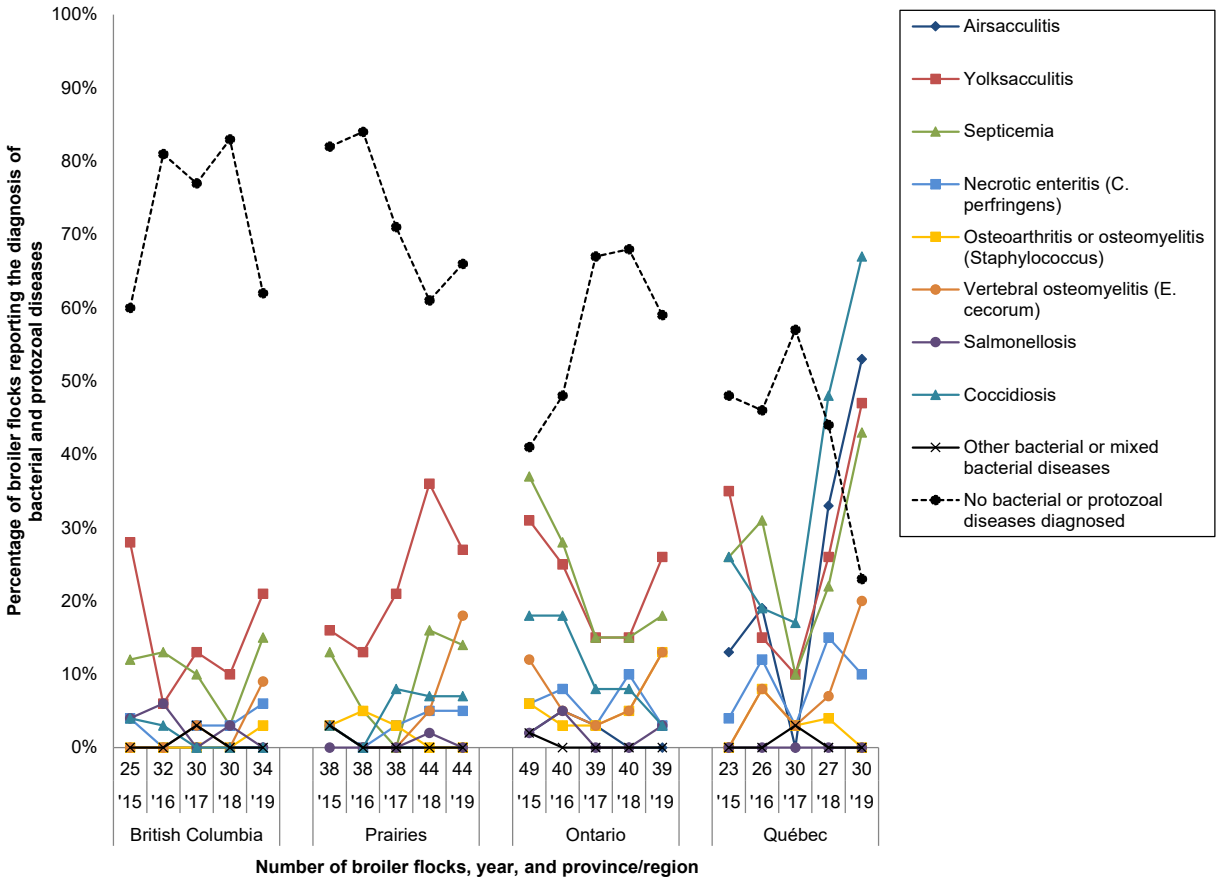
Domestic = hatched from hatcheries located in the province where the birds were raised.

Domestic, other provinces = hatched from hatcheries located in provinces other than the province where the birds were raised.

Imported = hatching eggs and/or chicks were sourced by importing hatchery from the United States or other countries.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Figure 1. 3 Percentage of broiler flocks reporting the diagnosis of bacterial and protozoal diseases, by province/region, 2015 to 2019

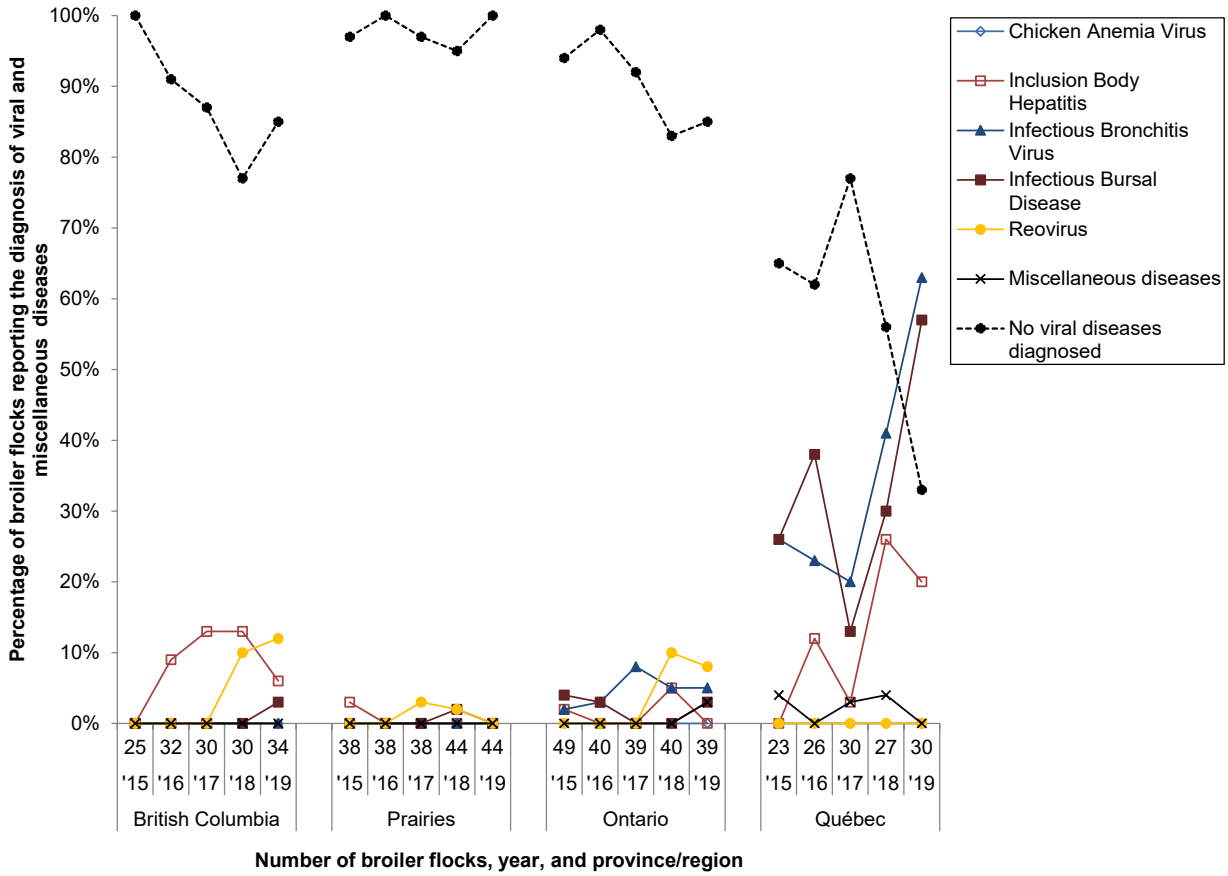


Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks	25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Diseases																				
Airsacculitis	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	2%	5%	3%	0%	0%	13%	19%	0%	33%	53%
Yolksacculitis	28%	6%	13%	10%	21%	16%	13%	21%	36%	27%	31%	25%	15%	15%	26%	35%	15%	10%	26%	47%
Septicemia	12%	13%	10%	3%	15%	13%	5%	0%	16%	14%	37%	28%	15%	15%	18%	26%	31%	10%	22%	43%
Necrotic enteritis (*C. perfringens*)	4%	0%	3%	3%	6%	3%	0%	3%	5%	5%	6%	8%	3%	10%	3%	4%	12%	3%	15%	10%
Osteoarthritis or osteomyelitis (*Staphylococcus*)	0%	0%	0%	0%	3%	3%	5%	3%	0%	0%	6%	3%	3%	5%	13%	0%	8%	3%	4%	0%
Vertebral osteomyelitis (*E. cecorum*)	0%	0%	3%	0%	9%	3%	0%	0%	5%	18%	12%	5%	3%	5%	13%	0%	8%	3%	7%	20%
Salmonellosis	4%	6%	0%	3%	0%	0%	0%	0%	2%	0%	2%	5%	0%	0%	3%	0%	0%	0%	0%	0%
Coccidiosis	4%	3%	0%	0%	0%	3%	0%	8%	7%	7%	18%	18%	8%	8%	3%	26%	19%	17%	48%	67%
Other bacterial or mixed bacterial infections	0%	0%	3%	0%	0%	3%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	3%	0%	0%
No bacterial or protozoal diseases diagnosed	60%	81%	77%	83%	62%	82%	84%	71%	61%	66%	41%	48%	67%	68%	59%	48%	46%	57%	44%	23%

Health status was considered to be positive if the questionnaire response was “Confirmed positive” or “Likely positive”. Health status was considered to be negative if the questionnaire response was "Confirmed negative" or "Likely negative". No diseases diagnosed pertains to flocks reporting "Likely Negative" in all bacterial and protozoal diseases listed on the questionnaire.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Figure 1. 4 Percentage of broiler flocks reporting the diagnosis of viral and miscellaneous diseases, by province/region, 2015 to 2019



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks	25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Diseases																				
Chicken Anemia Virus	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Inclusion Body Hepatitis	0%	9%	13%	13%	6%	3%	0%	0%	0%	0%	2%	0%	0%	5%	0%	0%	12%	3%	26%	20%
Infectious Bronchitis Virus	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	3%	8%	5%	5%	26%	23%	20%	41%	63%
Infectious Bursal Disease	0%	0%	0%	0%	3%	0%	0%	0%	2%	0%	4%	3%	0%	0%	3%	26%	38%	13%	30%	57%
Reovirus	0%	0%	0%	10%	12%	0%	0%	3%	2%	0%	0%	0%	0%	10%	8%	0%	0%	0%	0%	0%
Miscellaneous diseases	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	4%	0%	3%	4%	0%
No viral diseases diagnosed	100%	91%	87%	77%	85%	97%	100%	97%	95%	100%	94%	98%	92%	83%	85%	65%	62%	77%	56%	33%

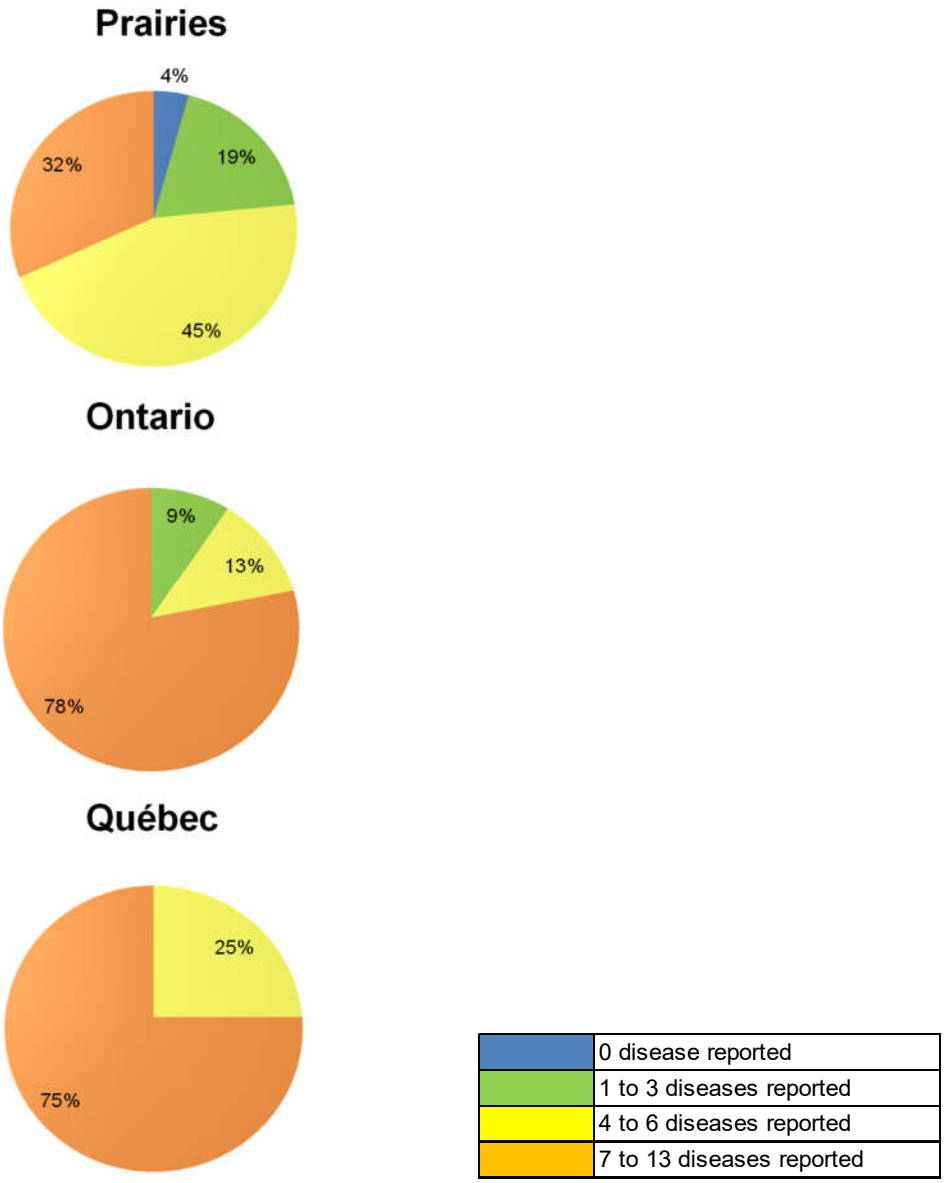
Health status was considered to be positive if the questionnaire response was "Confirmed positive" or "Likely positive". Health status was considered to be negative if the questionnaire response for any of the viral diseases was "Confirmed negative" or "Likely negative". No diseases diagnosed pertains to flocks reporting "Likely Negative" in all the viral diseases listed on the questionnaire.

In 2019, ascites was reported (metabolic noninfectious disease).

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Grower-finisher pigs

Figure 1. 5 Number of infectious diseases reported by grower-finisher pig herds (n = 107), by province/region, 2019



Number of diseases is tabulated based on the 13 diseases listed on the questionnaire.

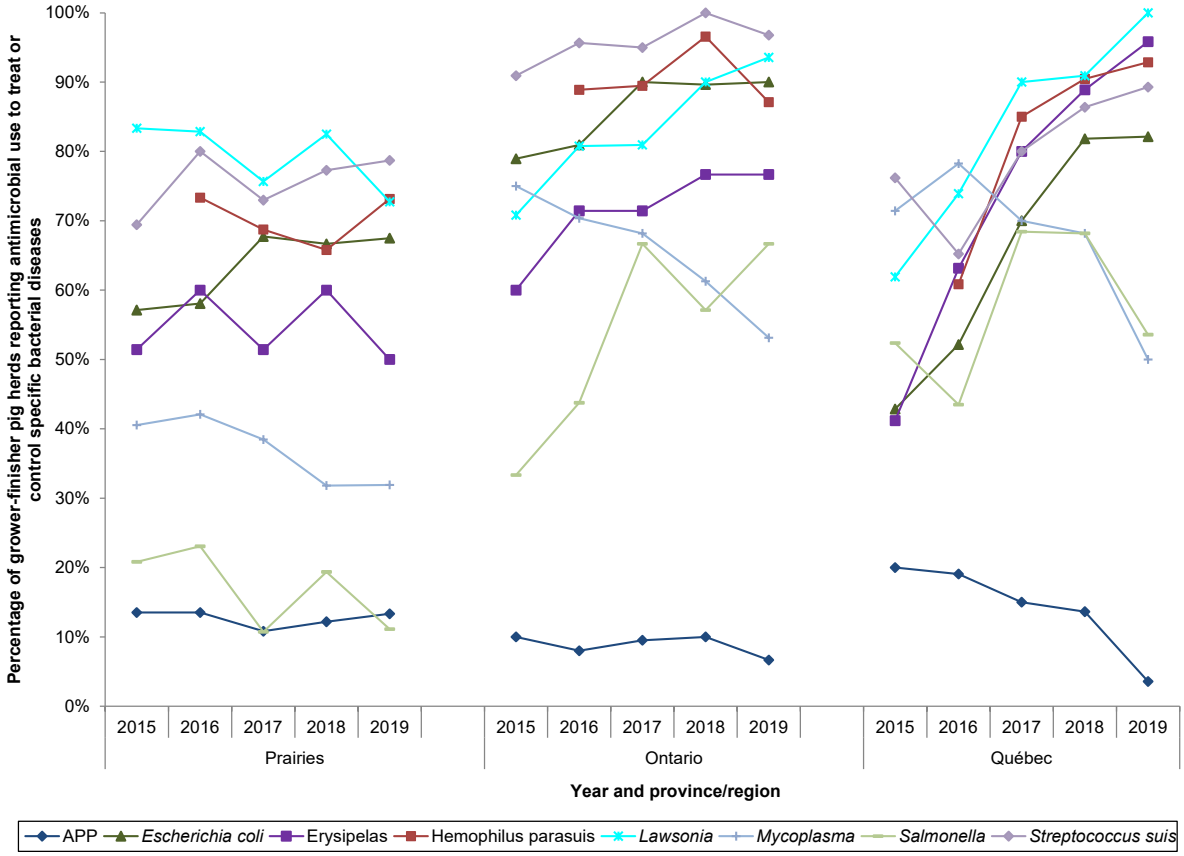
All farms in Ontario reported at least 1 disease on the questionnaire.

Health status was considered to be positive if the questionnaire response was "Confirmed positive" or "Likely positive". Health status was considered to be negative if the questionnaire response was "Confirmed negative" or "Likely negative".

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 1. 6 Reported health status for diseases of grower-finisher pig herds, by province/region, 2015 to 2019

a) Bacterial diseases



Province/region	Prairies					Ontario					Québec				
Year	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Disease/bacteria															
APP	14%	14%	11%	12%	13%	10%	8%	10%	10%	7%	20%	19%	15%	14%	4%
Escherichia coli	57%	58%	68%	67%	68%	79%	81%	90%	90%	90%	43%	52%	70%	82%	82%
Erysipelas	51%	60%	51%	60%	50%	60%	71%	71%	77%	77%	41%	63%	80%	89%	96%
Hemophilus parasuis	NA	73%	69%	66%	73%	NA	89%	89%	97%	87%	NA	61%	85%	90%	93%
Lawsonia	83%	83%	76%	83%	73%	71%	81%	81%	90%	94%	62%	74%	90%	91%	100%
Mycoplasma	41%	42%	38%	32%	32%	75%	70%	68%	61%	53%	71%	78%	70%	68%	50%
Salmonella	21%	23%	11%	19%	11%	33%	44%	67%	57%	67%	52%	43%	68%	68%	54%
Streptococcus suis	69%	80%	73%	77%	79%	91%	96%	95%	100%	97%	76%	65%	80%	86%	89%

APP = *Actinobacillus pleuropneumoniae*.

Hemophilus parasuis, added to the questionnaire in 2016. NA = not available.

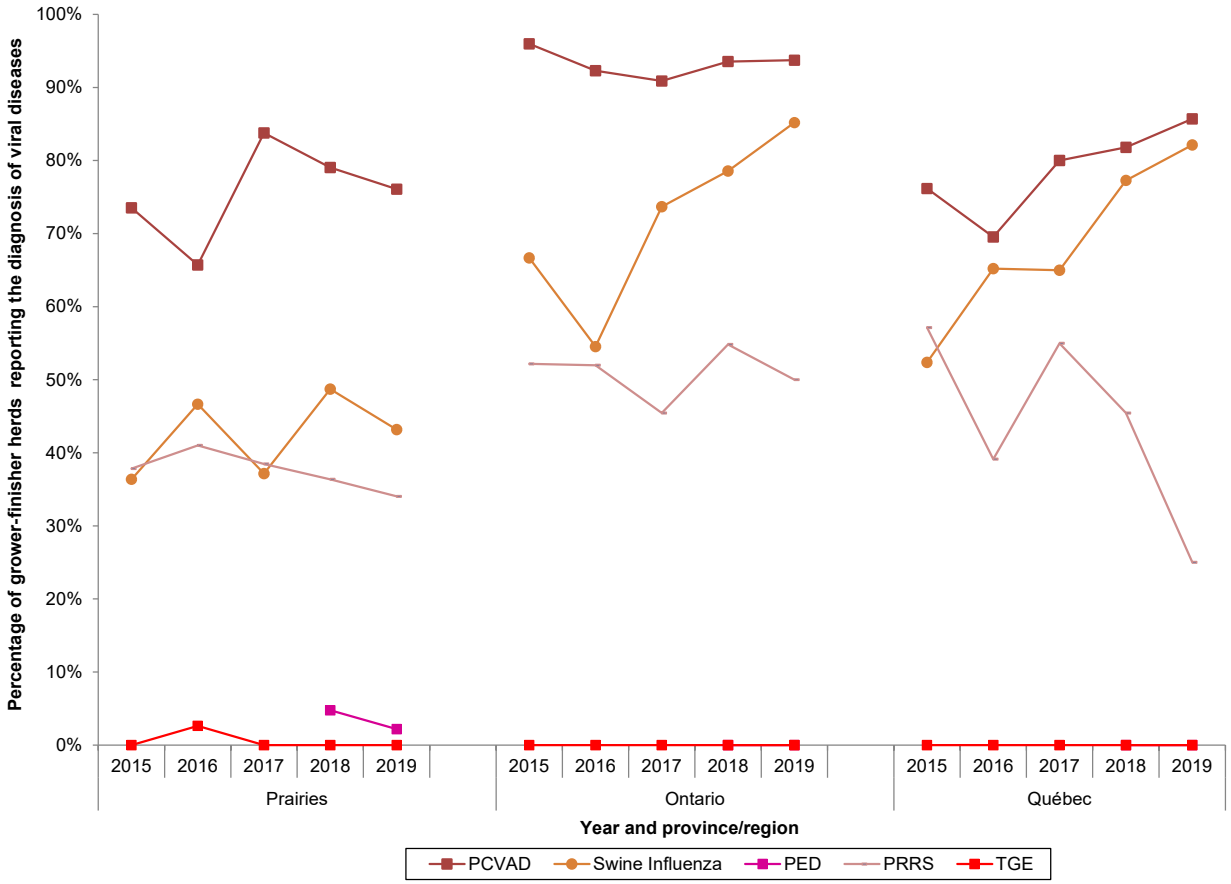
Health status was considered to be positive if the questionnaire response was "Confirmed positive" or "Likely positive". Health status was considered to be negative if the questionnaire response was "Confirmed negative" or "Likely negative".

Health status of nurseries and sow herds supplying CIPARS grower-finisher pig herds is available upon request.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 1. 6 Reported health status for diseases of grower-finisher pig herds, by province/region, 2015 to 2019 (continued)

b) Viral diseases



Province/region	Prairies					Ontario					Québec				
Year	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Disease/virus															
PCVAD	74%	66%	84%	79%	76%	96%	92%	91%	94%	94%	76%	70%	80%	82%	86%
Swine Influenza	36%	47%	37%	49%	43%	67%	55%	74%	79%	85%	52%	65%	65%	77%	82%
PED	NA	0%	0%	5%	2%	NA	0%	0%	0%	0%	NA	0%	0%	0%	0%
PRRS	38%	41%	38%	36%	34%	52%	52%	45%	55%	50%	57%	39%	55%	45%	25%
TGE	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

PCVAD = Porcine Circovirus Associated Disease.

PED = Porcine Epidemic Diarrhea, added to the questionnaire in 2016. NA = not available.

PRRS = Porcine Reproductive and Respiratory Syndrome.

TGE = Transmissible Gastroenteritis.

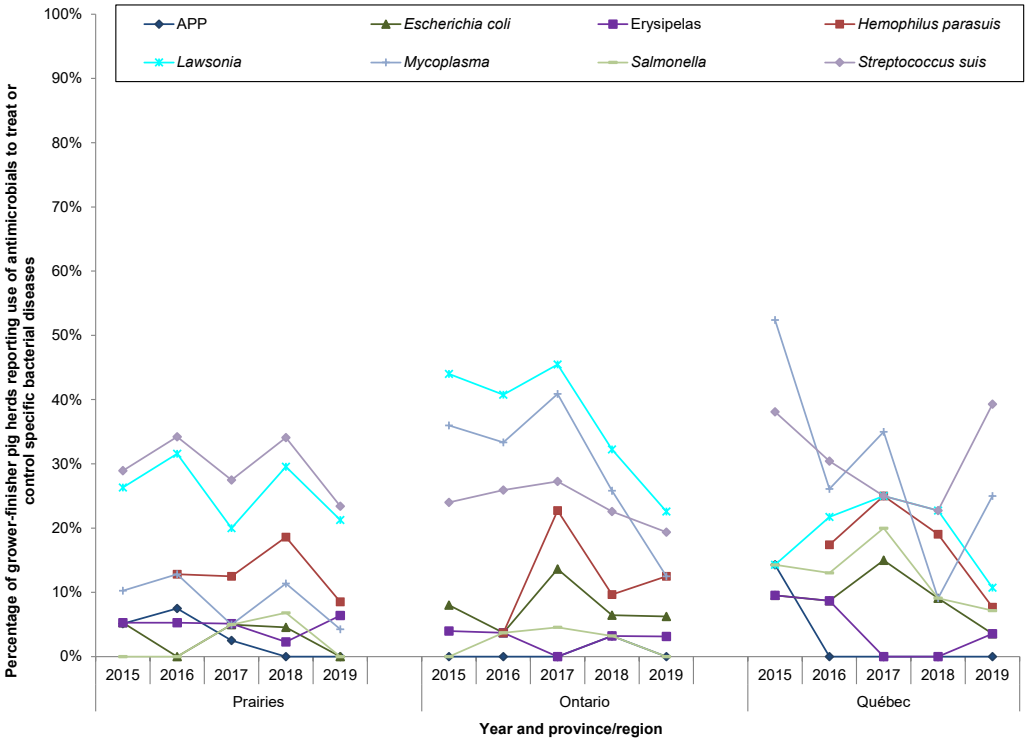
Health status was considered to be positive if the questionnaire response was "Confirmed positive" or "Likely positive". Health status was considered to be negative if the questionnaire response was "Confirmed negative" or "Likely negative".

Health status of nurseries and sow herds supplying CIPARS grower-finisher herds is available upon request.

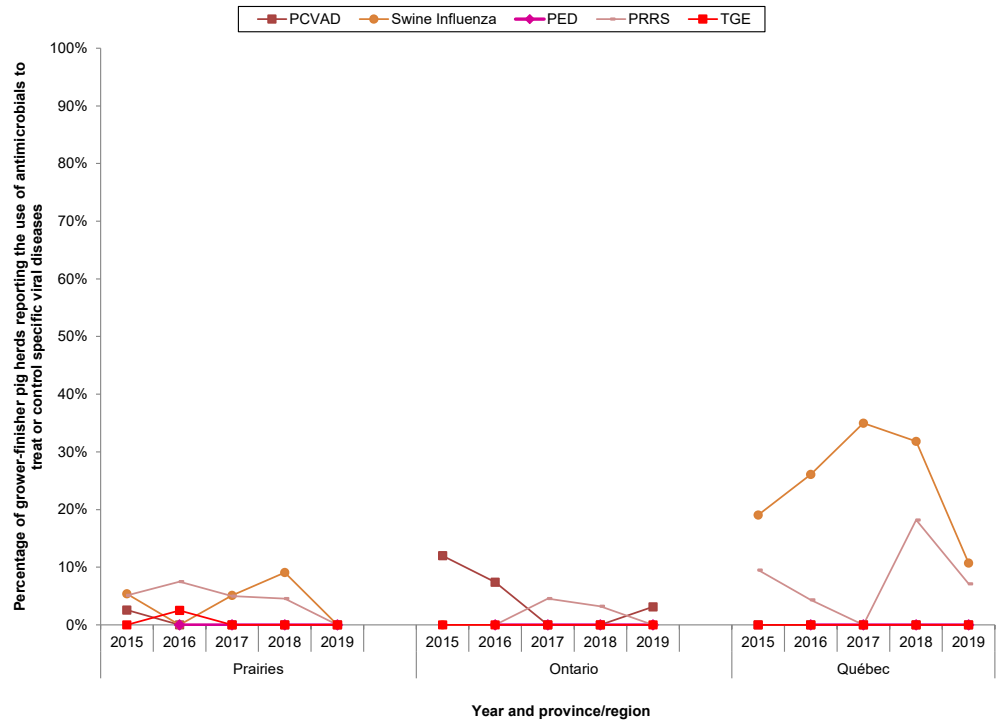
The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 1. 7 Reported antimicrobial use for specific diseases in grower-finisher pig herds, by province/region, 2015 to 2019

a) Bacterial diseases



b) Viral diseases



See corresponding footnotes on next page.

Figure 1. 7 Reported antimicrobial use for specific diseases in grower-finisher pig herds, by province/region, 2015 to 2019 (continued)

APP = *Actinobacillus pleuropneumoniae.*

Hemophilus parasuis, added to the questionnaire in 2016.

PCVAD = Porcine Circovirus Associated Disease.

PED = Porcine Epidemic Diarrhea, added to the questionnaire in 2016.

PRRS = Porcine Reproductive and Respiratory Syndrome.

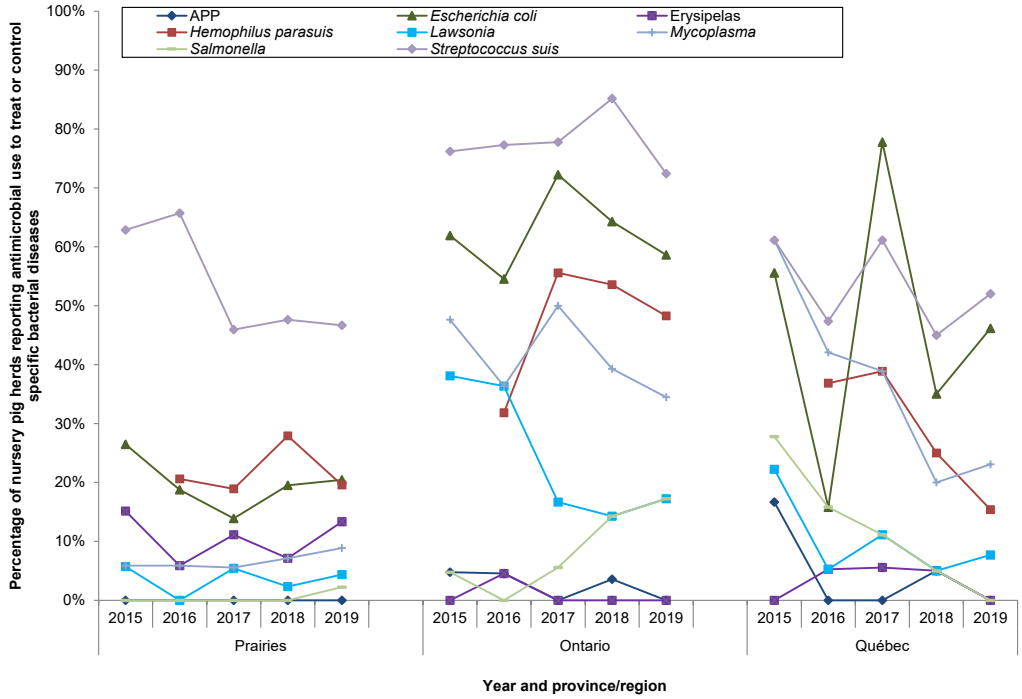
TGE = Transmissible Gastroenteritis.

Health status was considered to be positive if the questionnaire response was "Confirmed positive" or "Likely positive". Health status was considered to be negative if the questionnaire response was "Confirmed negative" or "Likely negative".

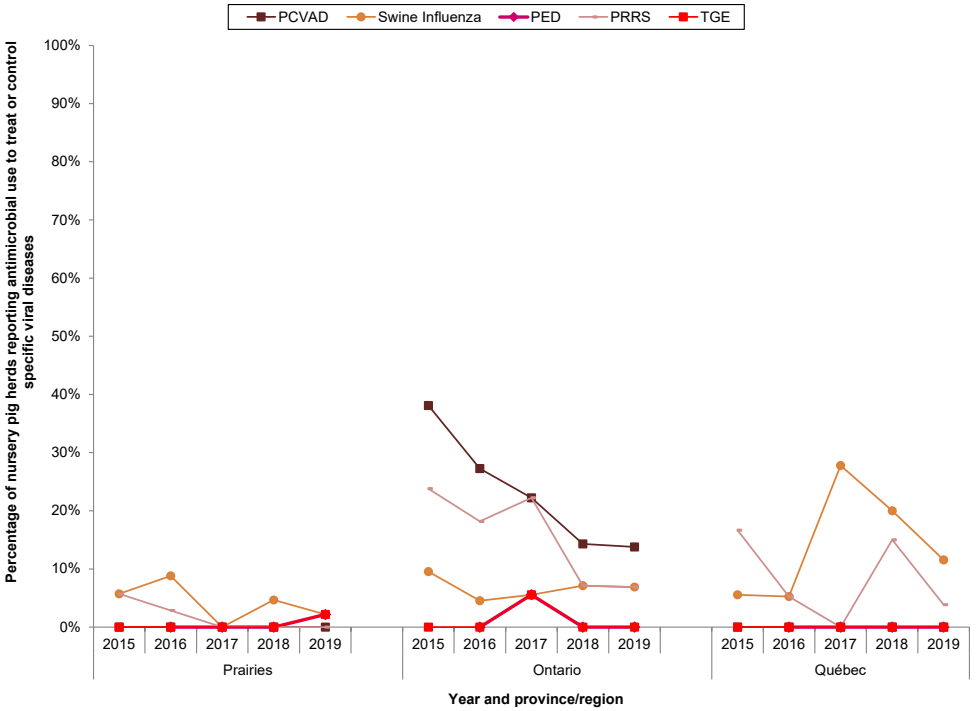
The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 1. 8 Reported antimicrobial use for specific diseases in nurseries supplying grower-finisher herds, by province/region, 2015 to 2019

a) Bacterial diseases



b) Viral diseases



See corresponding footnotes on next page.

Figure 1. 8 Reported antimicrobial use for specific diseases in nurseries supplying grower-finisher herds, by province/region, 2015 to 2019 (continued)

APP = *Actinobacillus pleuropneumoniae*.

Hemophilus parasuis, added to the questionnaire in 2016.

PCVAD = Porcine Circovirus Associated Disease.

PED = Porcine Epidemic Diarrhea, added to the questionnaire in 2016.

PRRS = Porcine Reproductive and Respiratory Syndrome.

TGE = Transmissible Gastroenteritis.

Not all questionnaires were completed for all diseases listed.

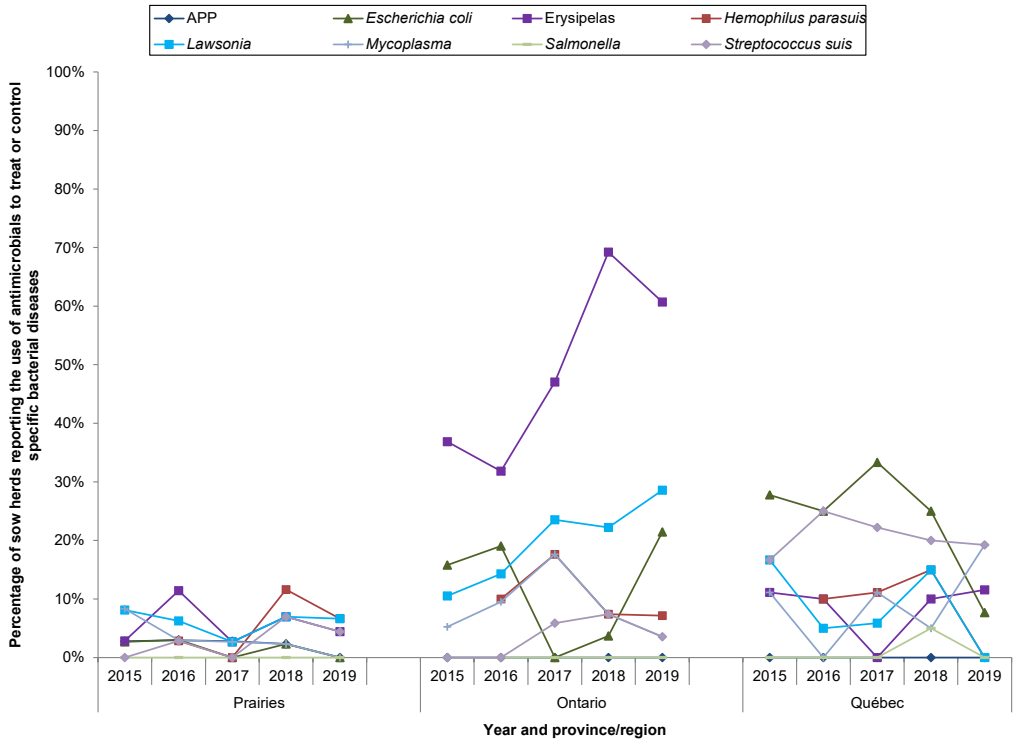
Health status was considered to be positive if the questionnaire response was "Confirmed positive" or "Likely positive". Health status was considered to be negative if the questionnaire response was "Confirmed negative" or "Likely negative".

There are 3 primary stages of pig production: suckling pigs (pre-weaning, in sow herds), nursery pigs (weaning to 25 kg), and grower-finisher pigs (25 kg to market weight). Data on antimicrobial use in suckling and nursery pigs is required to understand total antimicrobial exposure.

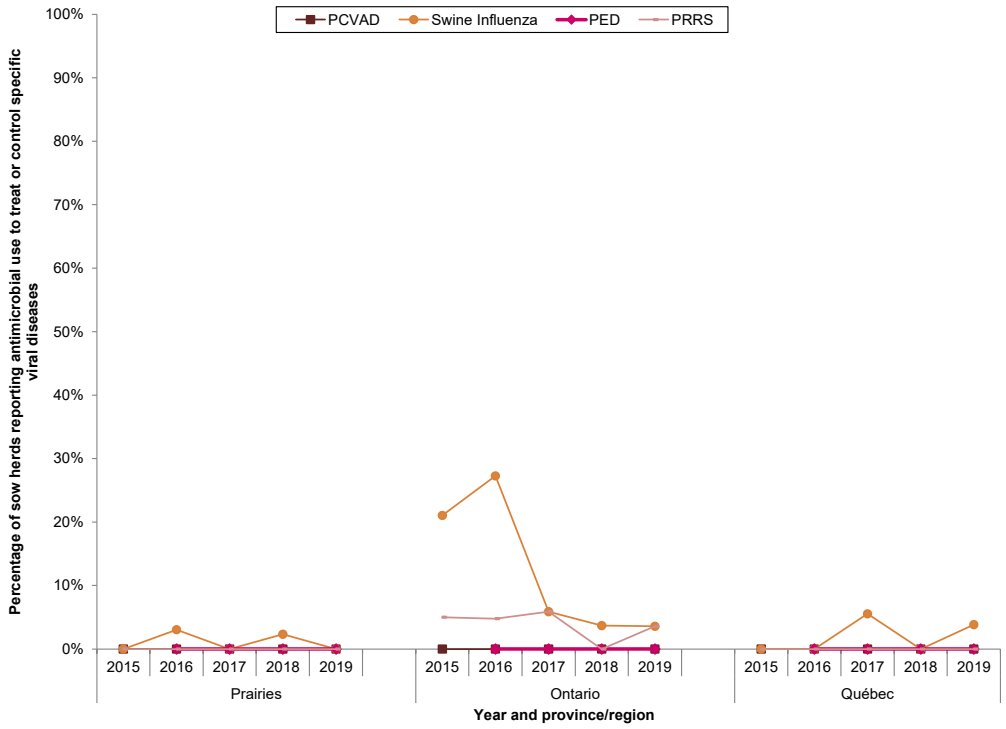
The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 1. 9 Reported antimicrobial use for specific diseases in sow herds supplying grower-finisher pig herds, by province/region, 2015 to 2019

a) Bacterial diseases



b) Viral diseases



See corresponding footnotes on next page.

Figure 1. 9 Reported antimicrobial use for specific diseases in sow herds supplying grower-finisher pig herds, by province/region, 2015 to 2019 (continued)

APP = *Actinobacillus pleuropneumoniae.*

Hemophilus parasuis, added to the questionnaire in 2016.

PCVAD = Porcine Circovirus Associated Disease.

PED = Porcine Epidemic Diarrhea, added to the questionnaire in 2016.

PRRS = Porcine Reproductive and Respiratory Syndrome.

Transmissible Gastroenteritis (TGE) was not included in the sow herd survey.

Not all questionnaires were completed for all diseases listed.

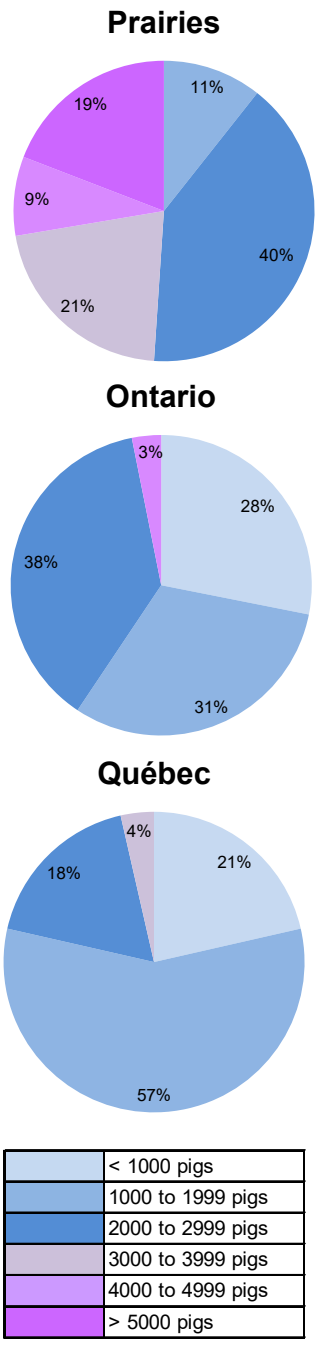
Health status was considered to be positive if the questionnaire response was "Confirmed positive" or "Likely positive". Health status was considered to be negative if the questionnaire response was "Confirmed negative" or "Likely negative".

There are 3 primary stages of pig production: suckling pigs (pre-weaning, in sow herds), nursery pigs (weaning to 25 kg), and grower-finisher pigs (25 kg to market weight). Data on antimicrobial use in suckling and nursery pigs is required in order to understand total antimicrobial exposure.

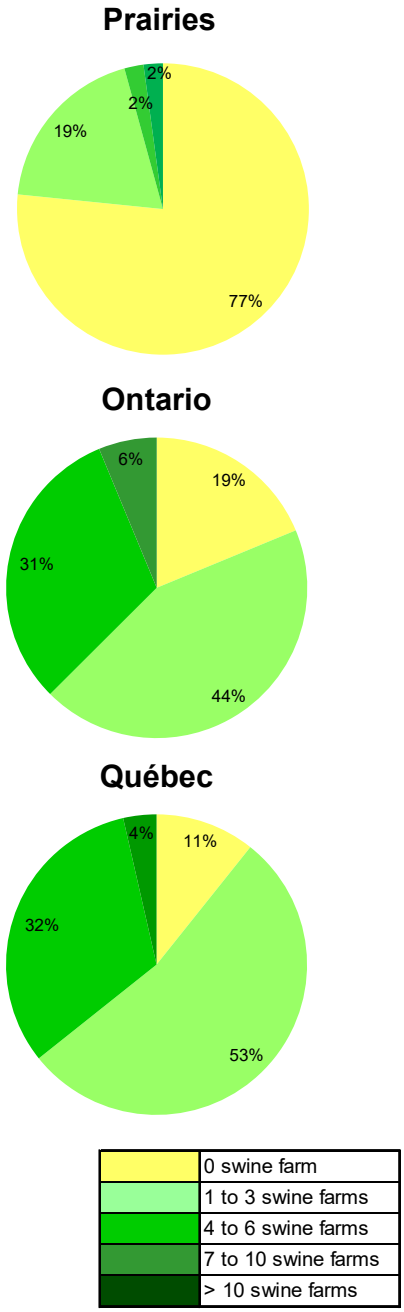
The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 1. 10 Demographics of grower-finisher pig herds, by province/region (n = 107), 2019

a) Barn Capacity



b) Number of swine farms within 2 km



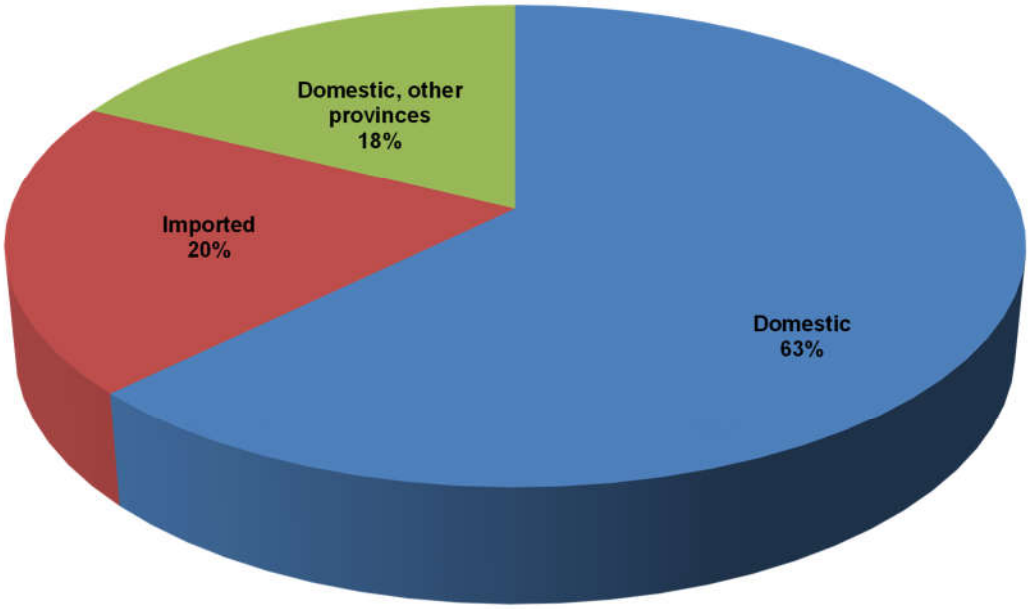
Capacity indicates the maximum number of pigs that the barn is designed to house.

Participating herds may have additional barns that were not sampled for the CIPARS program therefore this barn capacity is not necessarily equivalent to grower-finisher herd size.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Turkeys

Figure 1. 11 Relative distribution of turkey poult sources, 2019

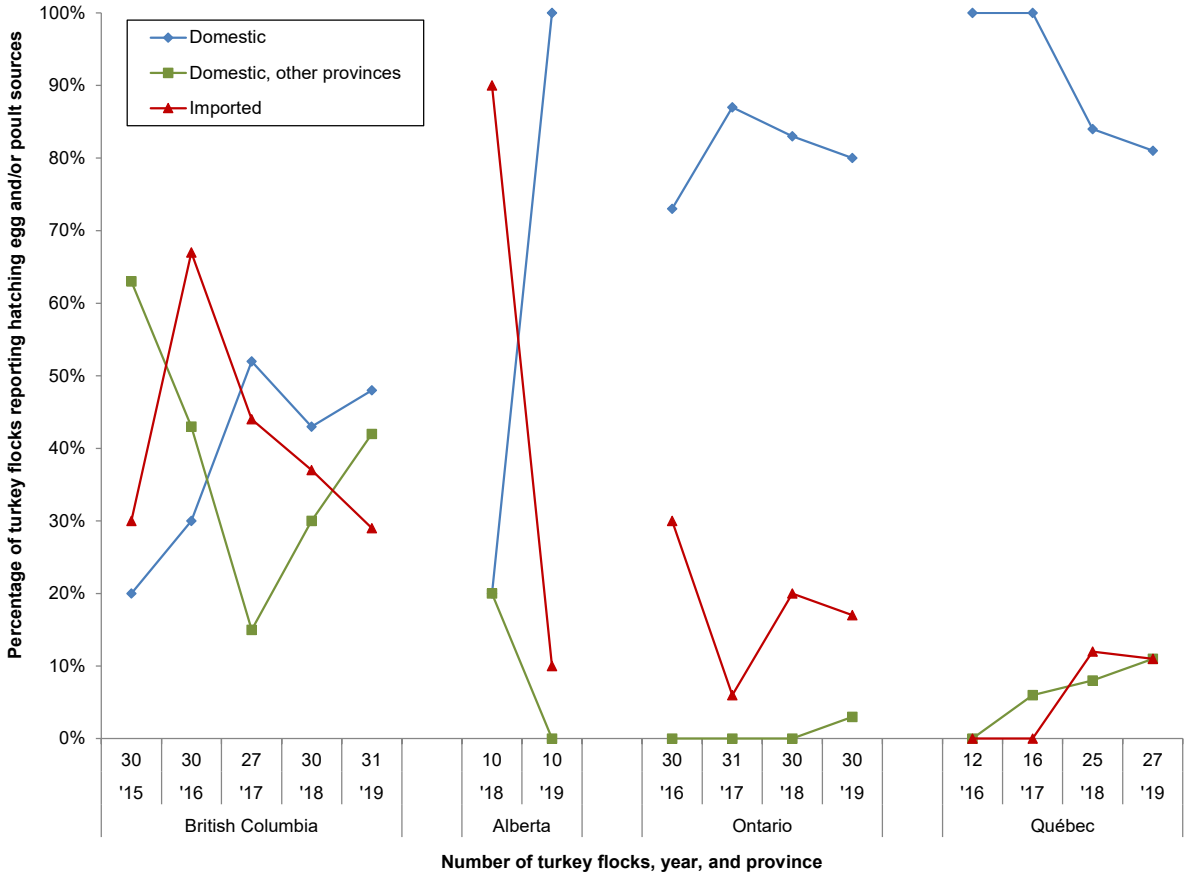


Domestic = hatching eggs originated and/or poults hatched from hatcheries located in the province where the birds were raised.

Domestic, other provinces = hatching eggs originated and/or poults hatched from hatcheries located in provinces other than the province where the birds were raised.

Imported = hatching eggs/poults were sourced by the importing hatchery from the United States or other countries; there were hatching eggs from domestic breeders hatched in United States hatcheries and then delivered/reared in Canadian turkey farms.

Figure 1. 12 Sources of hatching eggs and/or poults placed in the barn sampled, by province, 2015 to 2019



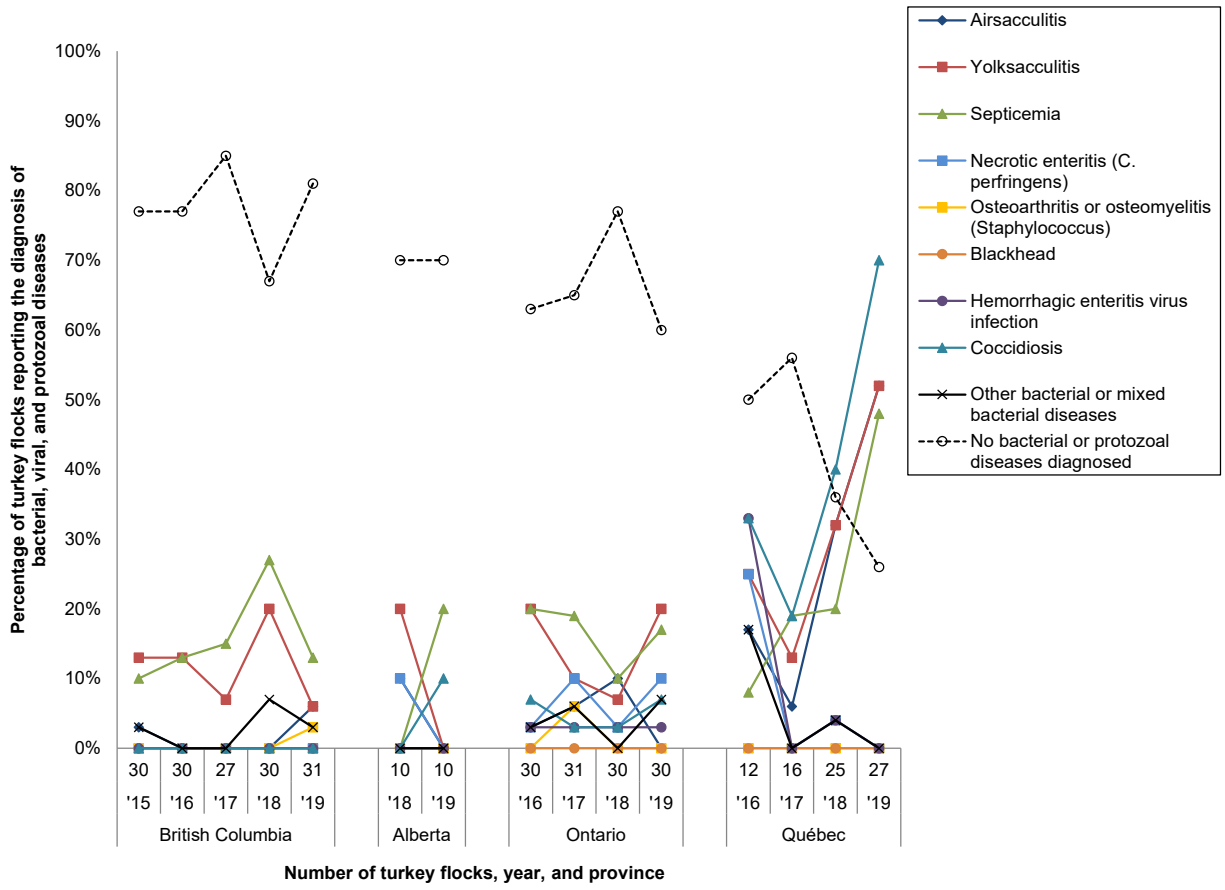
Province	British Columbia					Alberta		Ontario				Québec			
Year	'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of flocks	30	30	27	30	31	10	10	30	31	30	30	12	16	25	27
Hatching egg and/or poult sources															
Domestic	20%	30%	52%	43%	48%	20%	100%	73%	87%	83%	80%	100%	100%	84%	81%
Domestic, other provinces	63%	43%	15%	30%	42%	20%	0%	0%	0%	0%	3%	0%	6%	8%	11%
Imported	30%	67%	44%	37%	29%	90%	10%	30%	6%	20%	17%	0%	0%	12%	11%

Domestic = hatched from hatcheries located in the province where the birds were raised.

Domestic, other provinces = hatched from hatcheries located in provinces other than the province where the birds were raised.

Imported = hatching eggs and/or poults were sourced by importing hatchery from the United States or other countries.

Figure 1. 13 Percentage of turkey flocks reporting bacterial, viral, and protozoal diseases, by province, 2015 to 2019



Province	British Columbia					Alberta		Ontario				Québec			
Year	'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of flocks	30	30	27	30	31	10	10	30	31	30	30	12	16	25	27
Bacterial, viral, and protozoal diseases															
Airsacculitis	3%	0%	0%	0%	6%	10%	0%	3%	6%	10%	0%	17%	6%	32%	52%
Yolksacculitis	13%	13%	7%	20%	6%	20%	0%	20%	10%	7%	20%	25%	13%	32%	52%
Septicemia	10%	13%	15%	27%	13%	0%	20%	20%	19%	10%	17%	8%	19%	20%	48%
Necrotic enteritis (*C. perfringens*)	0%	0%	0%	0%	0%	10%	0%	3%	10%	3%	10%	25%	0%	4%	0%
Osteoarthritis or osteomyelitis (*Staphylococcus*)	0%	0%	0%	0%	3%	0%	0%	0%	6%	0%	0%	0%	0%	0%	0%
Blackhead	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hemorrhagic enteritis virus infection	0%	0%	0%	0%	0%	0%	0%	3%	3%	3%	3%	33%	0%	4%	0%
Coccidiosis	0%	0%	0%	0%	0%	0%	10%	7%	3%	3%	7%	33%	19%	40%	70%
Other bacterial or mixed bacterial diseases	3%	0%	0%	7%	3%	0%	0%	3%	6%	0%	7%	17%	0%	4%	0%
No bacterial or protozoal diseases diagnosed	77%	77%	85%	67%	81%	70%	70%	63%	65%	77%	60%	50%	56%	36%	26%

Health status was considered to be positive if the questionnaire response was "Confirmed positive" or "Likely positive". Health status was considered to be negative if the questionnaire response was "Confirmed negative" or "Likely negative". No diseases diagnosed pertains to flocks reporting "Likely Negative" in all diseases listed on the questionnaire.

In 2019, other bacterial diseases reported were pneumonia and sinusitis caused by *Ornithobacterium rhinotracheale* and salmonellosis. Other viral disease diagnosed was bluecomb enteritis, a Turkey Coronavirus Infection (TCoV).

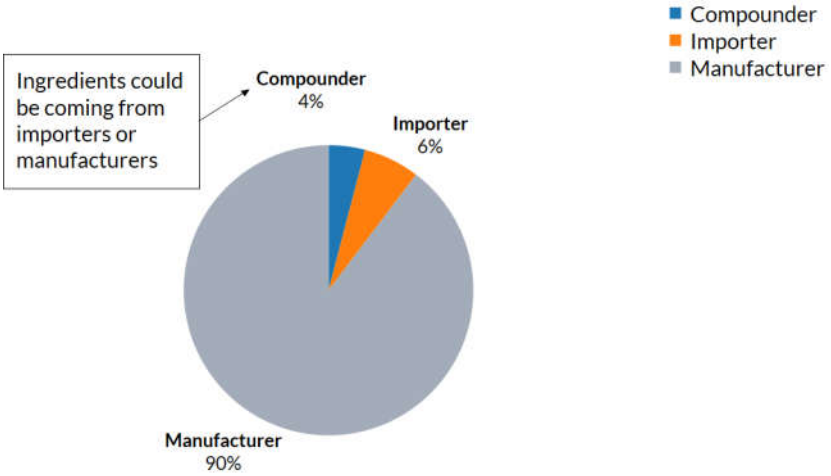
Chapter 2 Antimicrobials intended for use in animals

Antimicrobial sales: Veterinary Antimicrobial Sales Reporting (VASR)

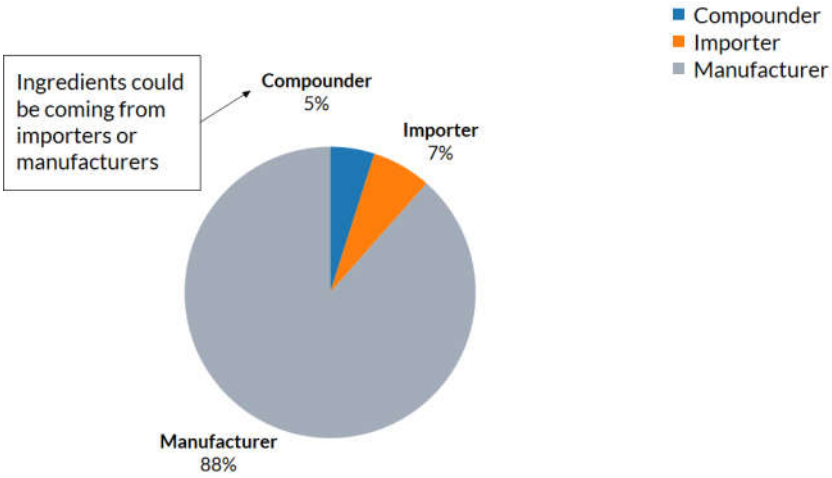
Data providers and quantities of antimicrobials reported

Figure 2. 1 Sources of medically important antimicrobials intended for use in animals, by percentage of kg sold, 2018 and 2019

a) 2018



b) 2019



Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials. Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

Coverage of provincial/territorial data

Table 2. 1 Comparison of the quantities of medically important antimicrobials reported to be sold for use in animals at the provincial-level and at the national-level, all data providers, 2018 and 2019

2018	All data providers	Manufacturers	Importers	Compounders
# of data providers	204	30	5	169
Total kg reported at the national-level	1,135,230	1,017,979	71,162	46,089
Total kg reported at the provincial-level	1,079,004	983,688	52,533	42,783
% provincial reported (kg prov/kg national)	95.0%	96.6%	73.8%	92.8%
2019	**All data providers**	**Manufacturers**	**Importers**	**Compounders**
# of data providers	84	28	5	51
Total kg reported at the national-level	1,026,915	908,494	67,930	50,491
Total kg reported at the provincial-level	1,024,181	905,986	67,705	50,490
% provincial reported (kg prov/kg national)	99.7%	99.7%	99.7%	100.0%

Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

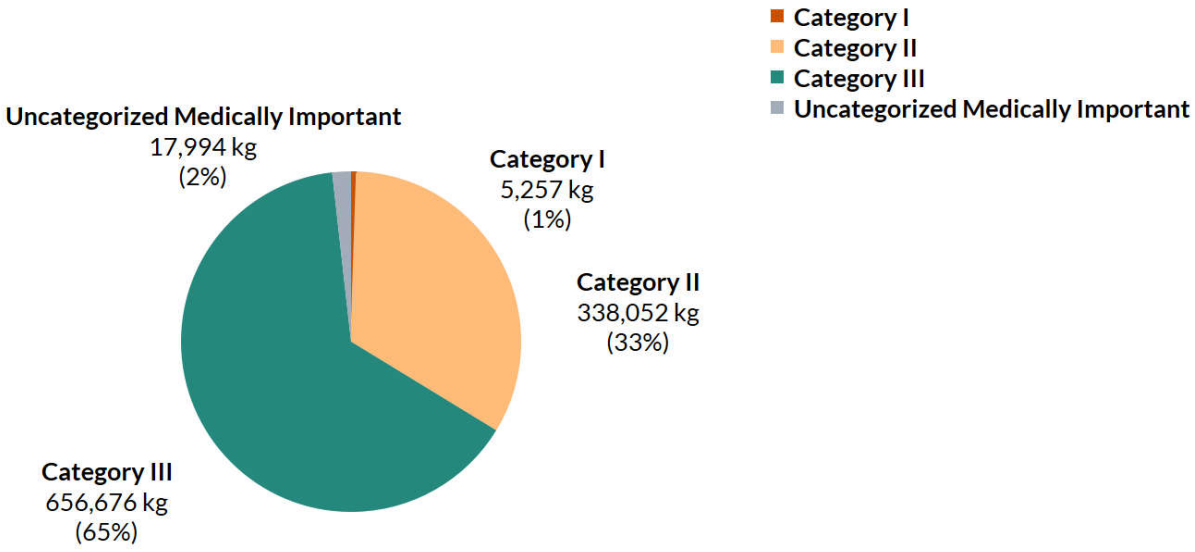
Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

The numbers in the table are for data providers reporting > 1 mg of medically important antimicrobials.

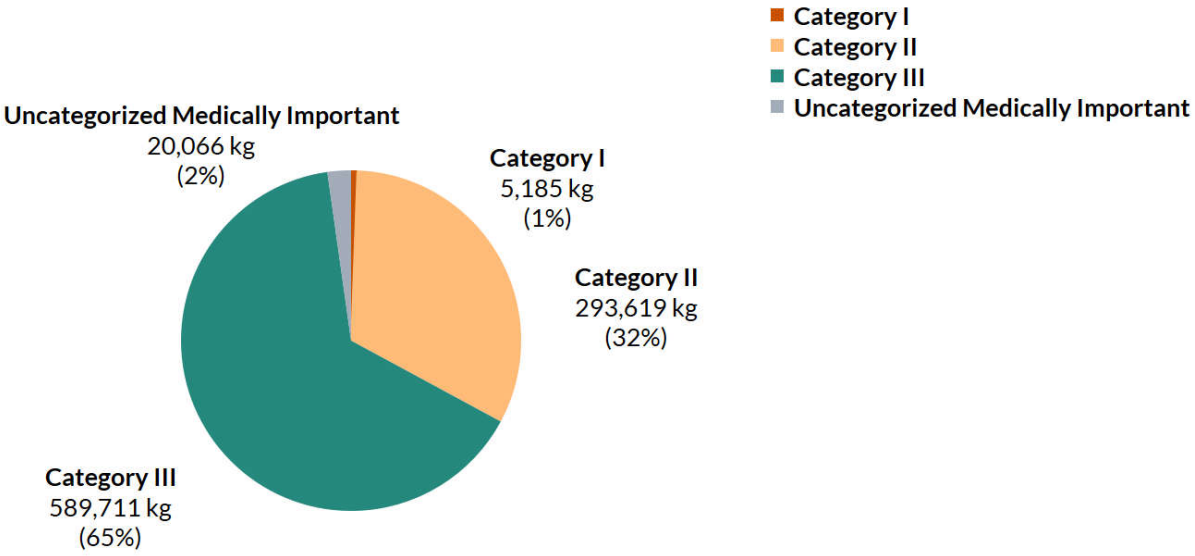
Antimicrobials sold by manufacturers

Figure 2. 2 Relative percentages of the quantities of medically important antimicrobials sold for use in animals (manufacturers), by category of importance to human medicine, 2018 and 2019

a) 2018



b) 2019



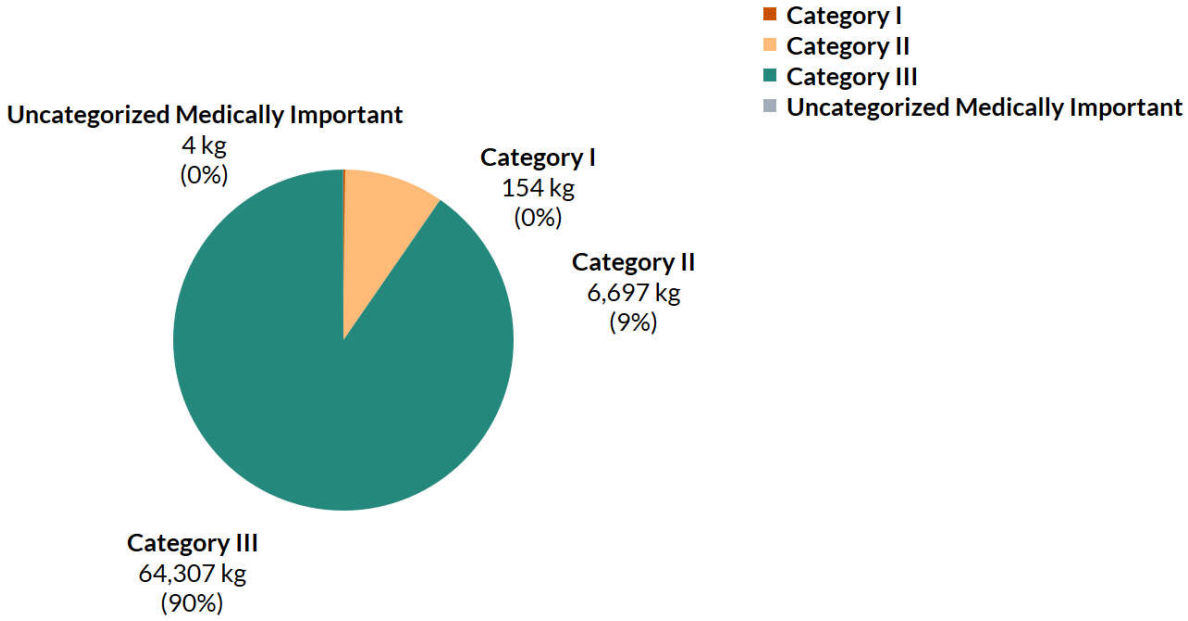
Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

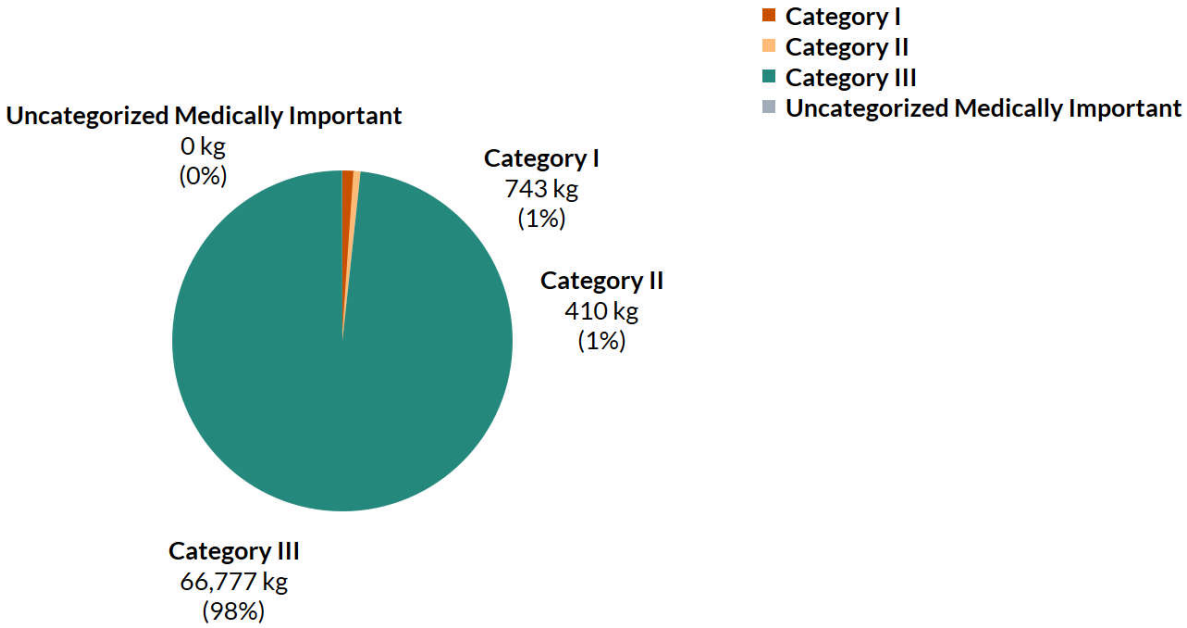
Antimicrobials sold by importers

Figure 2. 3 Relative percentages of the quantities of medically important antimicrobials sold for use in animals (importers), by category of importance to human medicine, 2018 and 2019

a) 2018



b) 2019



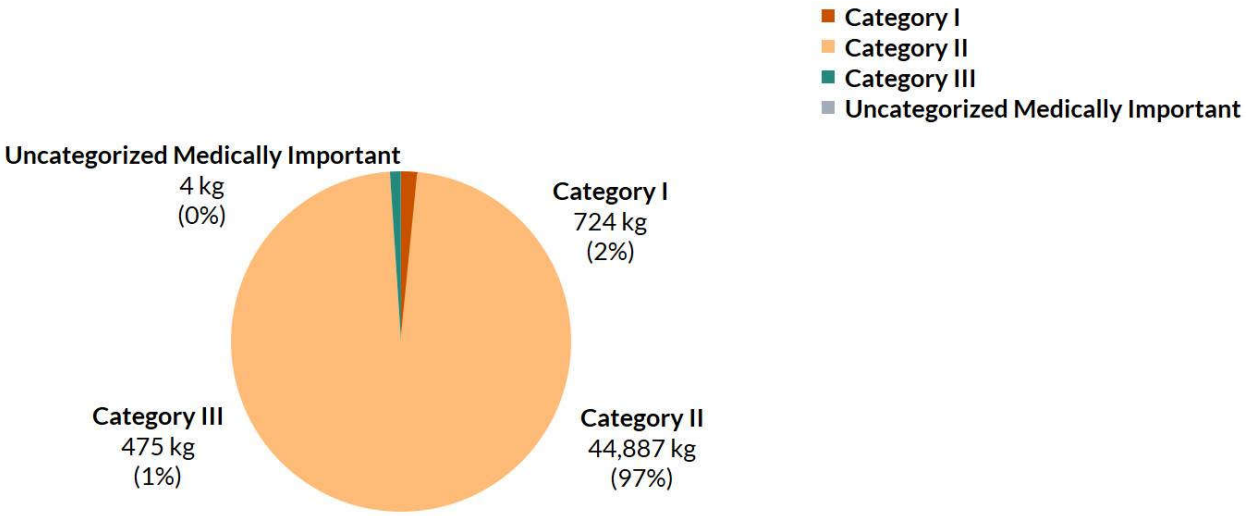
Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

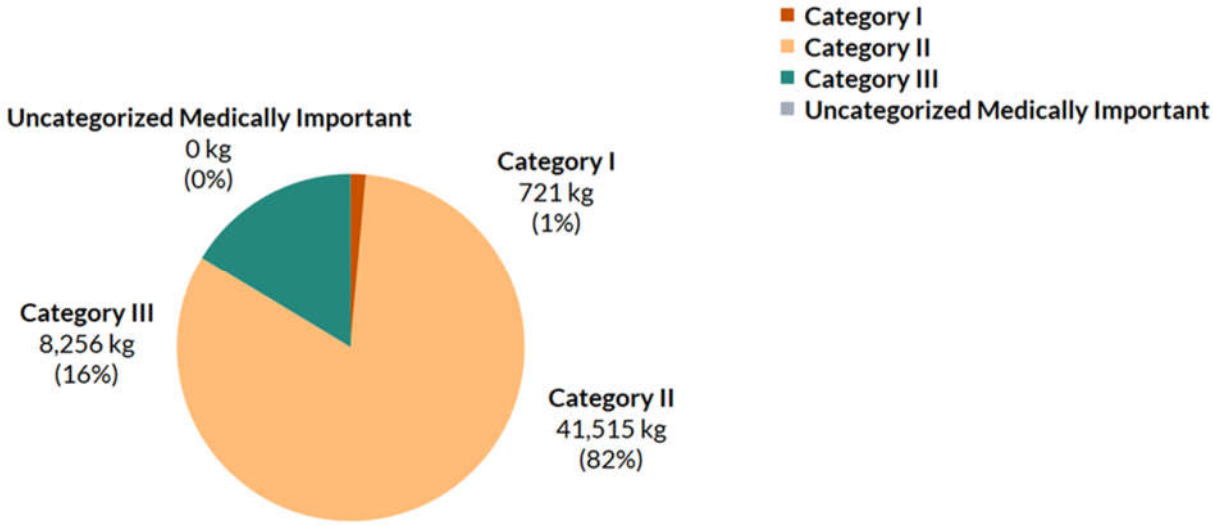
Antimicrobials sold by compounders

Figure 2. 4 Relative percentages of the quantities of medically important antimicrobials sold for use in animals (compounders), by category of importance to human medicine, 2018 and 2019

a) 2018



b) 2019

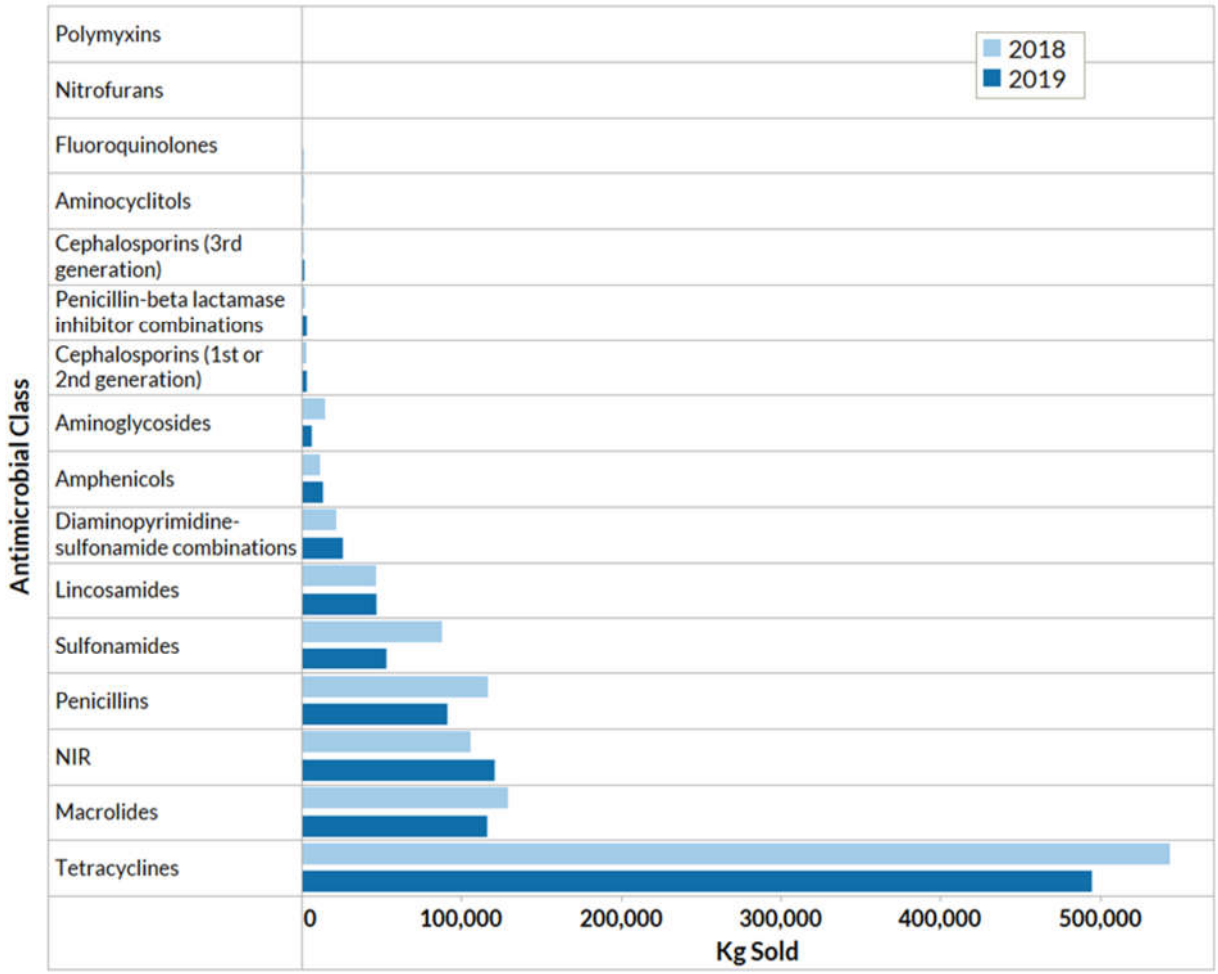


Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

Antimicrobials sold by antimicrobial class – national

Figure 2. 5 Quantities of medically important antimicrobials sold for use in animals (manufacturers and importers), by antimicrobial class, 2018 and 2019



Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

Not independently reported (NIR): aminocoumarins, bacitracins, diaminopyrimidines, fusidic acid, glycopeptides, nitroimidazoles, orthosomycins, phosphonic acid derivatives, pleuromutilins, pseudomonic acids, streptogramins, and therapeutic agents for tuberculosis.

Table 2. 2 Quantities of antimicrobials sold for use in animals (manufacturers and importers), by Category of Importance to Human Medicine and antimicrobial class, 2018 and 2019

Category of Importance to Human Medicine	Antimicrobial Class	2018 (kg)	2019 (kg)	Year diff (kg) (2019-2018)	% difference
Category I	Cephalosporins (3rd generation)	1,946	1,676	-270	-14
	Fluoroquinolones	716	937	221	31
	Penicillin-beta lactamase inhibitor combinations	2,636	2,748	112	4
	Polymyxins	16	8	-8	-50
Category II	Aminoglycosides	14,467	6,487	-7,980	-55
	Cephalosporins (1st or 2nd generation)	2,820	3,147	327	12
	Diaminopyrimidine-sulfonamide combinations	22,051	25,519	3,468	16
	Lincosamides	46,583	46,390	-193	0
	Macrolides	129,579	115,822	-13,757	-11
	Penicillins	117,222	91,095	-26,127	-22
Category III	Aminocyclitols	1,241	744	-497	-40
	Amphenicols	11,318	13,030	1,712	15
	Nitrofurans	49	23	-26	-53
	Sulfonamides	88,274	53,226	-35,048	-40
	Tetracyclines	544,102	495,116	-48,986	-9
NIR	NIR	106,121	120,455	14,334	14
Grand Total		**1,089,141**	**976,423**	**-112,718**	**-10**

Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

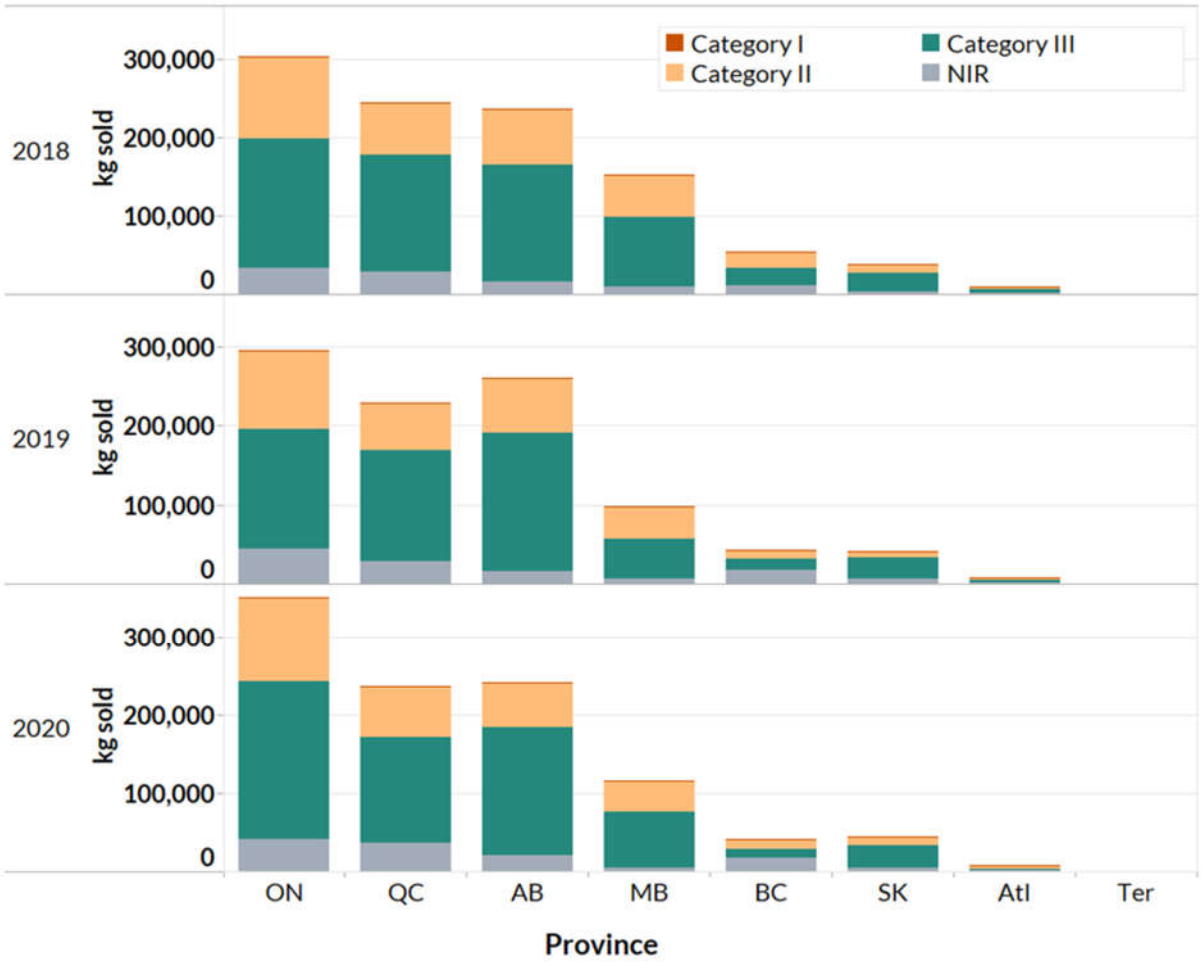
Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

Not independently reported (NIR): aminocoumarins, bacitracins, diaminopyrimidines, fusidic acid, glycopeptides, nitroimidazoles, orthosomycins, phosphonic acid derivatives, pleuromutilins, pseudomonic acids, streptogramins, and therapeutic agents for tuberculosis. Note: there are some antimicrobials included in NIR which are in the other antimicrobial categories (e.g., nitroimidazoles are Category I antimicrobials which cannot be reported separately).

Percentage difference is calculated in reference to the quantities reported in 2018.

Antimicrobials sold by antimicrobial class – provincial/territorial

Figure 2. 6 Quantities of medically important antimicrobials sold for use in animals (manufacturers and importers), by province and Category of Importance to Human Medicine, 2018 and 2019



Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

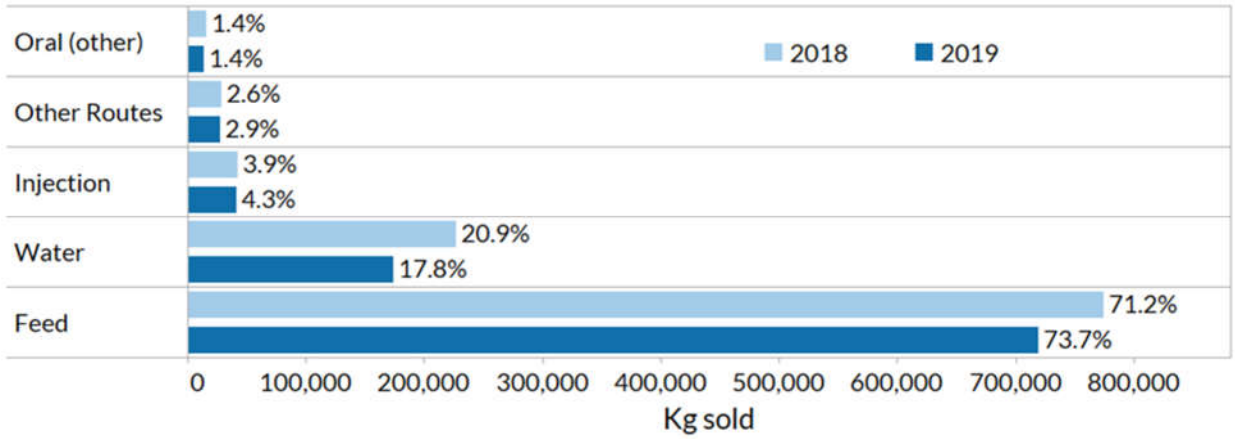
Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

Not independently reported (NIR): aminocoumarins, bacitracins, diaminopyrimidines, fusidic acid, glycopeptides, nitroimidazoles, orthosomycins, phosphonic acid derivatives, pleuromutilins, pseudomonic acids, streptogramins, and therapeutic agents for tuberculosis.

Differences in the quantities reported to be sold between the years could be related to the improvement in reporting for 2019, different numbers and types of animals in each province, differences in disease pressure, or differences in antimicrobial use or other management practices. There may be subsequent re-distribution of antimicrobials across provincial borders after the sales by the manufacturers and importers.

Antimicrobials sold by formulation

Figure 2. 7 Relative quantities (kg) of medically important antimicrobials sold by intended route of administration (manufacturers and importers), 2018 and 2019



Oral (other) = bolus, oral paste, oral powder (individual treatment), oral solution (individual treatment – mixtures and drops), tablets and capsules.

Other Routes = intrauterine, ophthalmic, otic, topical and intramammary.

Water = oral powder, oral powder (herd treatment), oral solution (herd treatment).

Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

Estimates of antimicrobials sold by animal species

Table 2. 3 Reported range and average estimates of kg of medically important antimicrobials sold by animal species, (manufacturers and importers), 2018

Animal species	Low kg	Average kg	High kg
Aquaculture	17,595	17,596	17,597
Beef Cattle	226,596	233,488	240,381
Cats and Dogs	6,373	6,373	6,373
Dairy Cattle	15,989	16,511	17,033
Horses	1,032	1,236	1,441
Other Animals/Unknown	9,859	10,274	10,690
Pigs	612,466	620,355	628,244
Poultry	146,366	147,853	149,340
Small Ruminants	17	43	69
Veal Calves	15,112	16,344	17,575
Total	**1,051,405**	**1,070,073**	**1,088,743**

Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

Note, there were a few data providers who were unable to provide their information by animal species; hence the overall total by animal species is less than the overall total kg provided for the calendar year.

Table 2. 4 Reported range and average estimates of range of kg of medically important antimicrobials sold by animal species, (manufacturers and importers), 2019

Animal species	Low kg	Average kg	High kg
Aquaculture	12,507	12,507	12,507
Beef Cattle	259,526	264,673	269,820
Cats and Dogs	7,407	7,440	7,472
Dairy Cattle	16,796	18,964	21,131
Horses	1,352	1,504	1,656
Other Animals/Unknown	10,016	10,093	10,170
Pigs	485,960	491,640	497,320
Poultry	130,185	134,351	138,517
Small Ruminants	22	68	114
Veal Calves	11,388	14,173	16,957
Total	**935,159**	**955,413**	**975,664**

Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials. Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

Note: there were a few data providers who were unable to provide their information by animal species; hence the overall total by animal species is less than the overall total kg provided.

Table 2. 5 Estimated mg/PCU_{EU} and mg/PCU_{CA} based on reported low and high kg of medically important antimicrobials sold by animal species, (manufacturers and importers), 2018

2018 (mg/PCU_{EU})			
Animal Species	**Low**	**Average**	**High**
Pigs	331	336	340
Poultry	173	175	177
Aquaculture	93	93	93
Cattle	78	80	83
Cats and Dogs	41	41	41
Horses	3	3	4
Small Ruminants	0.3	1	1
2018 (mg/PCU_{CA})			
Animal Species	**Low**	**Average**	**High**
Pigs	349	354	358
Poultry	195	197	199
Cattle	65	67	69
Aquaculture	93	93	93
Cats and Dogs	41	41	41
Horses	2	3	3
Small Ruminants	0.3	1	1

Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

Note: information from "Other Animal" species could not be ascribed to any of the current species; hence no denominator could be determined for these species and these data were excluded from this table. The denominator for aquaculture was calculated differently than for the terrestrial animal species. Please see the CIPARS 2019: Design and Methods for the approach to calculating the denominator (modified ESVAC approach).

Table 2. 6 Estimated mg/PCU_{EU} and mg/PCU_{CA} based on reported low and high kg of medically important antimicrobials sold by animal species, (manufacturers and importers), 2019

2019 (mg/PCU_{EU})			
Animal Species	Low	Average	High
Pigs	261	264	267
Poultry	150	154	159
Aquaculture	67	67	67
Cattle	84	87	90
Cats and Dogs	47	48	48
Horses	4	4	4
Small Ruminants	0.4	1	2
2019 (mg/PCU_{CA})			
Animal Species	Low	Average	High
Pigs	274	278	281
Poultry	170	175	181
Cattle	70	73	75
Aquaculture	67	67	67
Cats and Dogs	47	48	48
Horses	3	3	3
Small Ruminants	0.4	1	2

Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

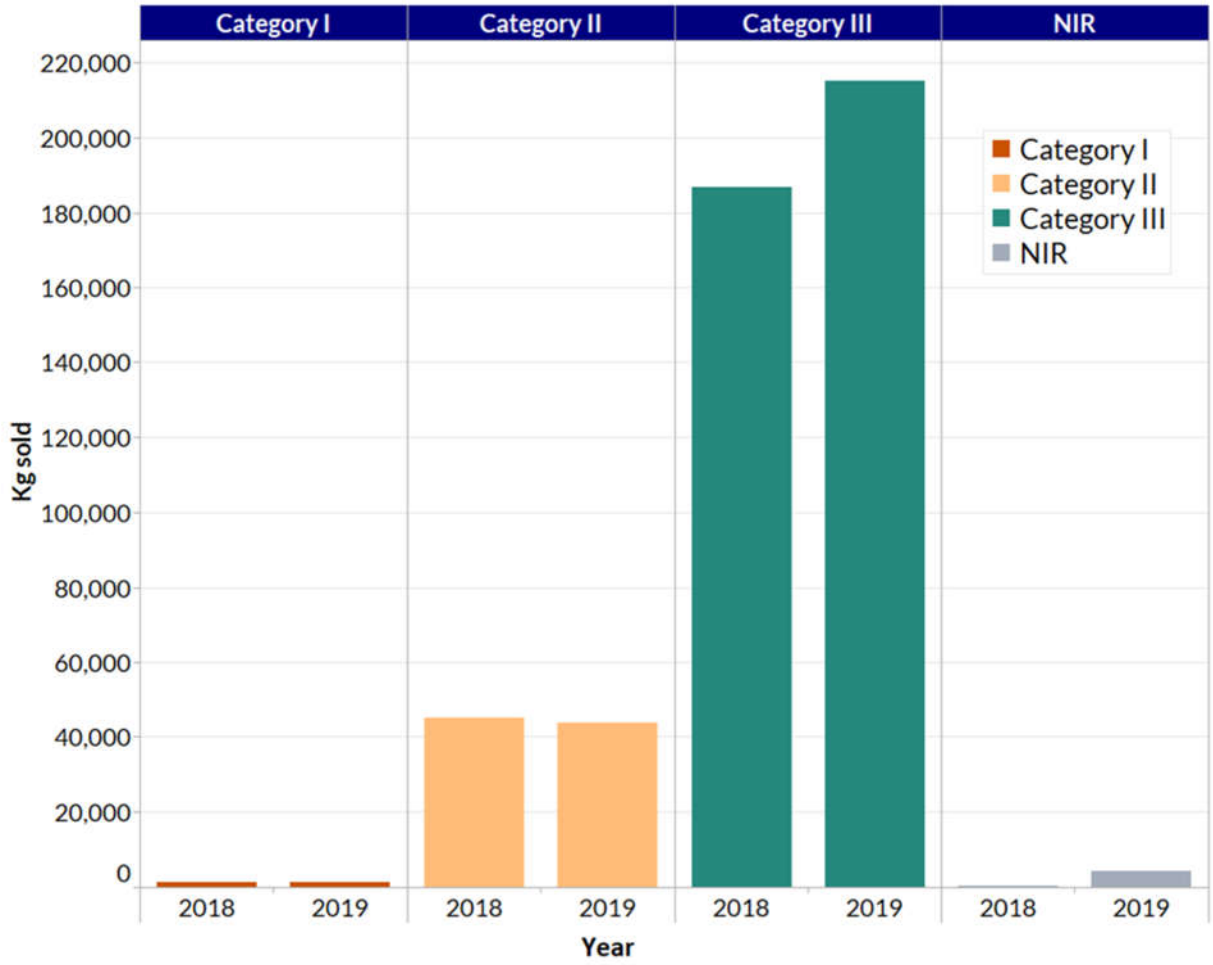
Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see 2019 CIPARS: Design and Methods for details).

Note: information from "Other Animal" species could not be ascribed to any of the current species; hence no denominator could be determined for these species and these data were excluded from this table. The denominator for aquaculture was calculated differently than for the terrestrial animal species. Please see the CIPARS 2019: Design and Methods for the approach to calculating the denominator (modified ESVAC approach).

Detailed information by animal species

Beef Cattle

Figure 2. 8 Estimated average kilograms of medically important antimicrobials sold for use in beef cattle (manufacturers and importers) by Category of Importance to Human Medicine, 2018 and 2019



Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

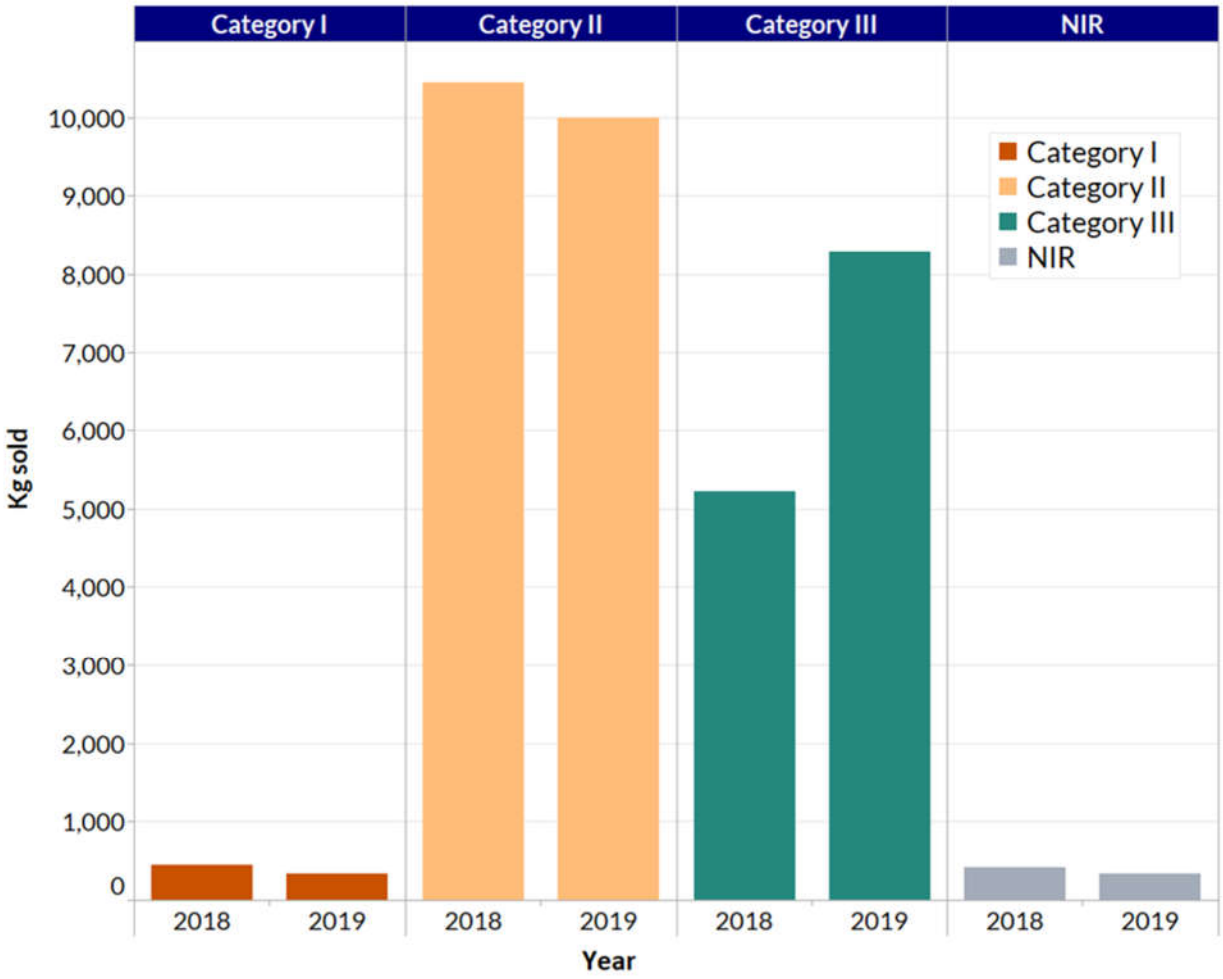
Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

Not independently reported (NIR): aminocoumarins, bacitracins, diaminopyrimidines, fusidic acid, glycopeptides, nitroimidazoles, orthosomycins, phosphonic acid derivatives, pleuromutilins, pseudomonic acids, streptogramins, and therapeutic agents for tuberculosis.

In 2019, the top 5 medically important antimicrobial classes sold for use in beef cattle were tetracyclines, macrolides, amphenicols, sulfonamides, and diaminopyrimidine-sulfonamide combinations and sulfonamides. Tetracyclines and macrolides represented ~91% of the total kg sold for use in beef cattle.

Dairy Cattle

Figure 2. 9 Estimated average kilograms of medically important antimicrobials sold for use in dairy cattle (manufacturers and importers), 2018 and 2019



Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

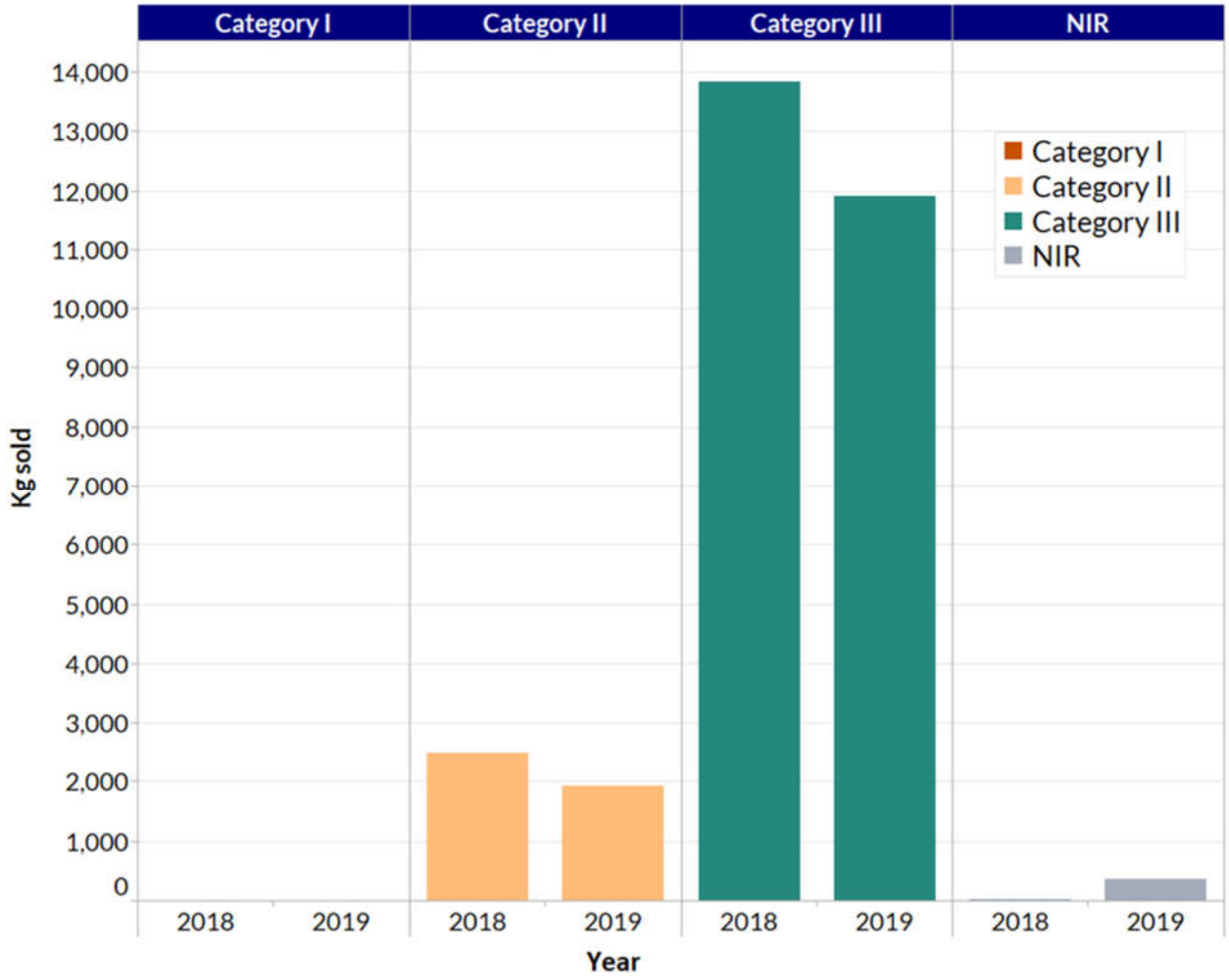
Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

Not independently reported (NIR): aminocoumarins, bacitracins, diaminopyrimidines, fusidic acid, glycopeptides, nitroimidazoles, orthosomycins, phosphonic acid derivatives, pleuromutilins, pseudomonic acids, streptogramins, and therapeutic agents for tuberculosis.

In 2019, the top 5 medically important antimicrobial classes sold for use in dairy cattle were tetracyclines, diaminopyrimidine-sulfonamide combinations, penicillins, sulfonamides, and amphenicols. Tetracyclines, diaminopyrimidine-sulfonamide combinations, and the penicillins represented ~87% of the total kg sold for use in dairy cattle.

Veal Calves

Figure 2. 10 Estimated average kilograms of medically important antimicrobials sold for use in veal calves (manufacturers and importers), 2018 and 2019



Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

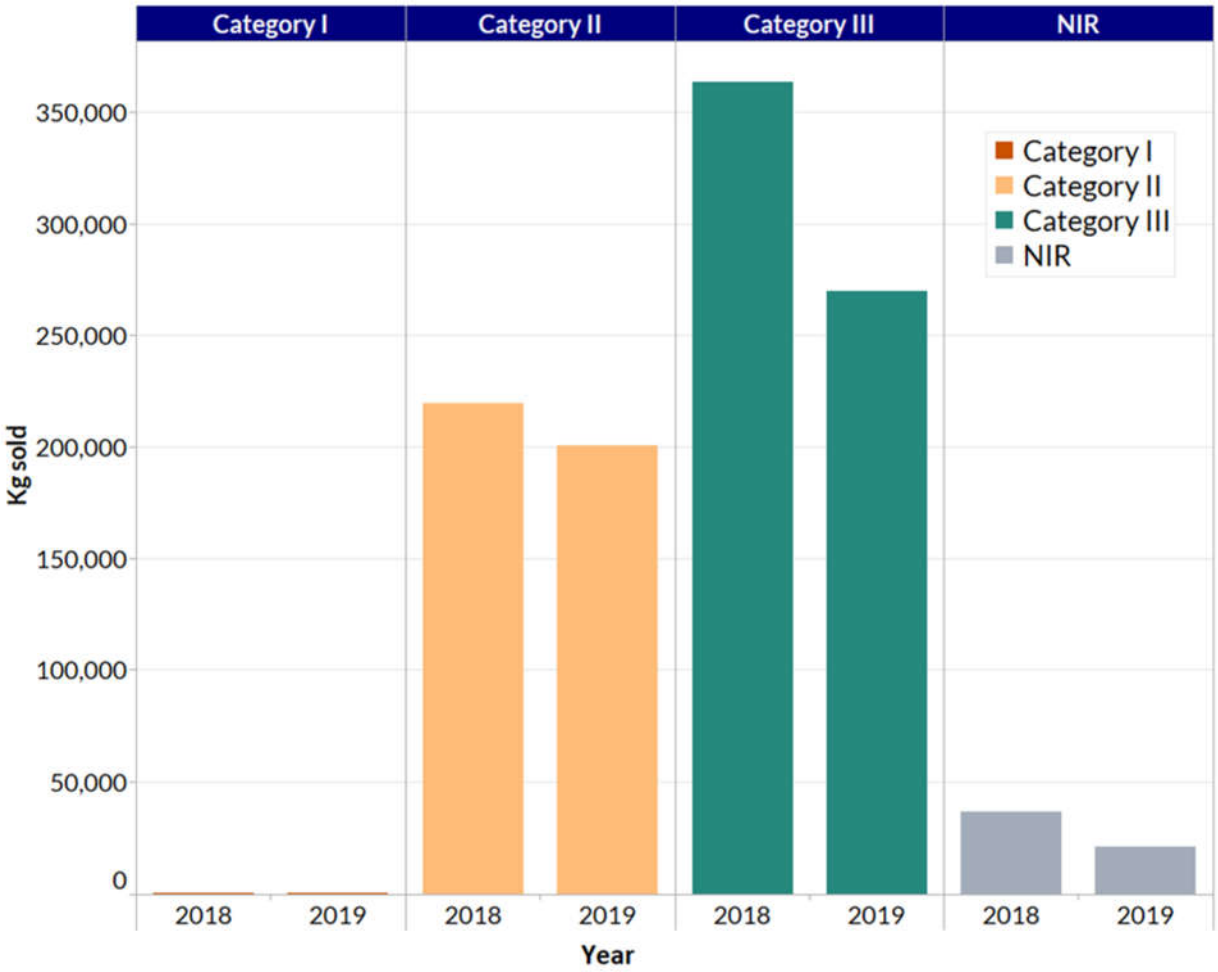
Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

Not independently reported (NIR): aminocoumarins, bacitracins, diaminopyrimidines, fusidic acid, glycopeptides, nitroimidazoles, orthosomycins, phosphonic acid derivatives, pleuromutilins, pseudomonic acids, streptogramins, and therapeutic agents for tuberculosis.

In 2019, the top 5 antimicrobial classes sold for use in veal calves were tetracyclines, penicillins, diaminopyrimidine-sulfonamide combinations, NIR, and sulfonamides. Tetracyclines represented ~81% of the total kg sold for use in veal calves.

Pigs

Figure 2. 11 Estimated average kilograms of medically important antimicrobials sold for use in pigs (manufacturers and importers), 2018 and 2019



Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

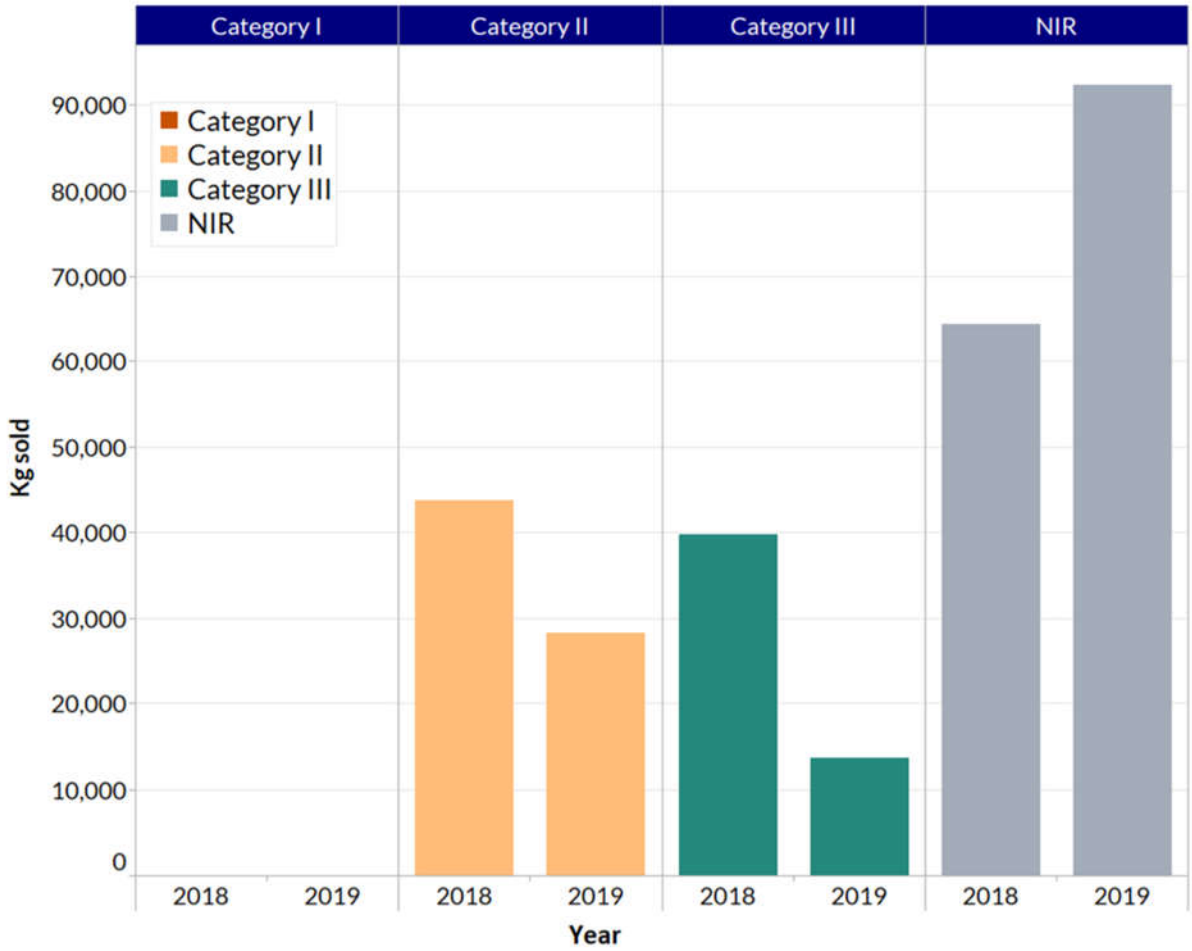
Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

Not independently reported (NIR): aminocoumarins, bacitracins, diaminopyrimidines, fusidic acid, glycopeptides, nitroimidazoles, orthosomycins, phosphonic acid derivatives, pleuromutilins, pseudomonic acids, streptogramins, and therapeutic agents for tuberculosis.

In 2019, the top 5 medically important antimicrobial classes sold for use in pigs were tetracyclines, macrolides, penicillins, lincosamides, and NIR. Tetracyclines, macrolides, and penicillins represented ~80% of the kg sold for use in pigs.

Poultry

Figure 2. 12 Estimated average kilograms of medically important antimicrobials sold for use in poultry (manufacturers and importers), 2018 and 2019



Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

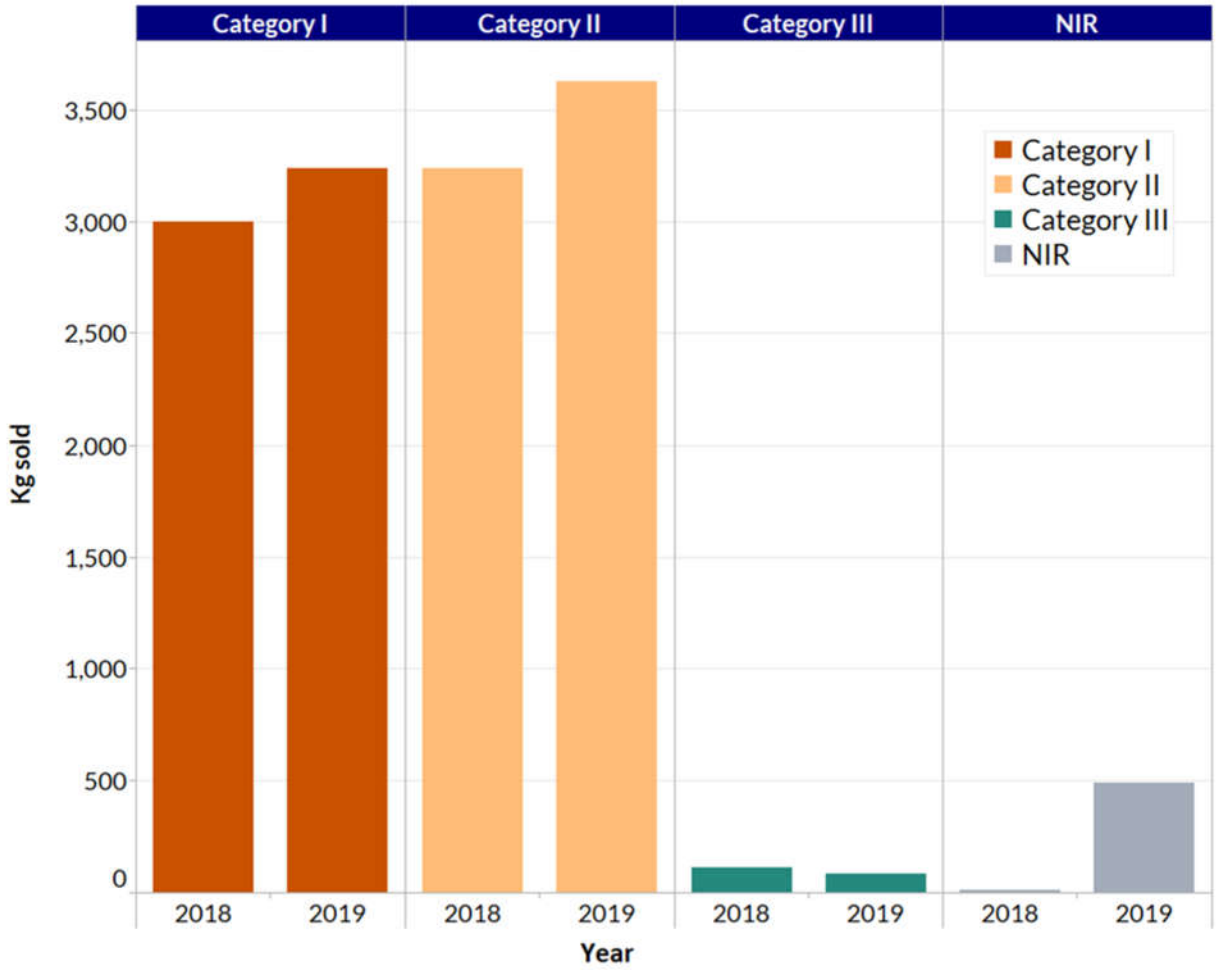
Not independently reported (NIR): aminocoumarins, bacitracins, diaminopyrimidines, fusidic acid, glycopeptides, nitroimidazoles, orthosomycins, phosphonic acid derivatives, pleuromutilins, pseudomonic acids, streptogramins, and therapeutic agents for tuberculosis.

The kilograms reported for chickens and turkeys was combined as "poultry" as careful review of the data in both 2019 indicated that there may be more uncertainty with the quantities of antimicrobials reported for turkeys, than for the other major animal species. Data providers may have challenges separating out the estimates of use between these two types of poultry.

In 2019, the top 5 medically important antimicrobial classes sold for use in poultry were NIR, penicillins, tetracyclines, macrolides, and diaminopyrimidine-sulfonamide combinations. NIR and penicillins represented 80% of the quantities of antimicrobials sold for use in poultry.

Cats and dogs

Figure 2.13 Estimated average kilograms of medically important antimicrobials sold for use in cats and dogs (manufacturers and importers), 2018 and 2019



Included: Category I (very high importance to human medicine), II (high importance to human medicine), III (medium importance to human medicine) antimicrobials, Not Independently Reported antimicrobials (NIR), and Uncategorized Medically Important antimicrobials.

Excluded: antifungals, antiparasitics, antivirals, Category IV (low importance to human medicine) antimicrobials, and Uncategorized Not Medically Important antimicrobials (see CIPARS 2019: Design and Methods for details).

Not independently reported (NIR): aminocoumarins, bacitracins, diaminopyrimidines, fusidic acid, glycopeptides, nitroimidazoles, orthosomycins, phosphonic acid derivatives, pleuromutilins, pseudomonic acids, streptogramins, and therapeutic agents for tuberculosis.

In 2019, the top 5 medically important antimicrobial classes sold for use in cats and dogs were cephalosporins (1st or 2nd generation), penicillins, β-lactamase inhibitor combinations, NIR, penicillins, and fluoroquinolones. The cephalosporins (1st or 2nd generation) and penicillin-β-lactamase inhibitor combinations represented 77% of the total kg sold for use in cats and dogs.

Antimicrobial use: Farm Surveillance in broiler chickens

Please contact phac.cipars-picra.aspc@phac-aspc.gc.ca for more detailed information.

Summary of antimicrobial use by routes of administration

Table 2. 7 Number of broiler flocks with reported antimicrobial use, by route of administration, 2019

Antimicrobial use	Route of administration			
	Any route[a] n (%)	*In ovo*/subcutaneous n (%)	Feed n (%)	Water n (%)
Any antimicrobial use	114 (78)	3 (2)	112 (76)	14 (9)
No antimicrobial use[b]	33 (22)	144 (98)	35 (24)	134 (91)
Total flocks	**147 (100)**	**147 (100)**	**147 (100)**	**147 (100)**

[a] Flocks with reported use of an antimicrobial class by feed, water, *in ovo*/subcutaneous, or any combination of these routes are included in each count.

[b] These were flocks not medicated with any of the antimicrobials listed in Table 2. 8 (next page).

Table 2. 8 Frequency and quantity of antimicrobial use in broiler chickens, 2019

Route of administration	Antimicrobial	Flocks n (%)	Ration n (%)	Days exposed median (min. ; max.)[a]	Level of drug median (min. ; max.)[b]	Quantity of antimicrobial active ingredient	
						mg/PCU	nDDDvetCA/ 1,000 Broiler chicken-days at risk
Feed					g/tonne		
II	Virginiamycin	2 (1)	6 (1)	30 (17 ; 43)	33 (22 ; 44)	1	9
	Trimethoprim sulfadiazine	8 (5)	8 (2)	9 (6 ; 12)	300 (200 ; 300)	15	67
III	Bacitracin	89 (61)	292 (61)	28 (26 ; 30)	55 (55 ; 110)	98	274
IV	Bambermycin	6 (4)	16 (3)	19 (2 ; 36)	2 (2 ; 2)	0.2	
N/A	Avilamycin	29 (20)	69 (14)	22 (20 ; 25)	20 (15 ; 30)	8	74
	No AMU in feed	35 (24)	87 (18)				
Total feed, medicated		**112 (76)**	**391 (82)**			122	425
Water			Treatments n (%)		mg/bird median (min ; max)[c]		
II	Amoxicillin	4 (3)	4	6 (5 ; 6)	83 (51 ; 124)	2	6
	Penicillin G potassium	7 (5)	7	6 (5 ; 7)	193 (107 ; 432)	14	10
	Penicillin-streptomycin	2 (1)	2	4 (4 ; 4)	116 (71 ; 160)	3	13
III	Sulfaquinoxaline	1 (1)	1	4	113	0	0
	Tetracycline	1 (1)	1	5	63	1	1
	No AMU in water	133 (90)					
Total water, medicated		14 (10)				20	29
Injection					mg/egg or chick		
II	Lincomycin-spectinomycin	3 (2)			0.75	0.01	0.1
	No AMU via injection	144 (98)					
Total injection		**3 (2)**				0.01	0.1
All routes[d]		**114 (78)**				**142**	**454**

See corresponding page for footnotes.

Table 2. 8 Frequency and quantity of antimicrobial use in broiler chickens, 2019 (continued)

Roman numerals II to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

N/A = not applicable (no classification available at the time of writing of this report).

Combination antimicrobials include the values for both antimicrobial components.

Grey shaded cells = no data or calculations/values are not applicable for broilers.

mg/PCU = milligrams/population correction unit.

DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligrams per kilogram broiler chicken per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 1 for the list of standards.

nDDDvetCA/1,000 broiler chicken-days at risk = number of DDDvetCA/1,000 broiler chicken-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

[a] Days exposed are by flock or full grow-out period (all rations combined) or 1 course of water treatment.

[b] Level of drug is in grams/tonne of feed or grams/liter drinking water. In chicks or hatching eggs, level of drug is in milligrams per chick or hatching egg, as reported by the veterinarian/producer.

[c] For water medications, the total milligrams per bird administered throughout the course of treatment is reported above; estimation methods changed where total products used by the flock was reported instead of grams per liter of drinking water (2013 to 2018 methods).

[d] The final mg/PCU and nDDDvetCA/1,000 broiler chicken-days at risk exclude coccidiostats. Flavophospholipids was included only in the mg/PCU.

Table 2. 9 Production, biomass and quantity of antimicrobials used, by province/region, 2015 to 2019

Province/ region	Year	Number of flocks	Pre-harvest weight	Age sampled	Active ingredient	Broiler weights	mg/PCU		nDDDvetCA/1,000 broiler chicken-days at risk	
			mean (kg)	mean (days)	(mg)	(kg)[a]	Total	% change[b]	Total	% change[b]
British Columbia	2015	25	2.00	33	54,617,991	592,652	92		407	
	2016	32	1.98	33	73,639,052	765,987	96	4	493	21
	2017	30	1.96	34	72,087,938	732,417	98	2	440	-11
	2018	30	1.89	33	127,714,931	1,110,366	115	17	567	29
	2019	34	2.02	35	85,486,740	790,305	108	-6	346	-39
Prairies	2015	38	1.90	34	95,950,077	746,106	129		419	
	2016	38	1.93	34	138,107,509	857,215	161	25	592	41
	2017	38	1.90	34	123,572,918	790,810	156	-3	550	-7
	2018	44	1.95	34	143,913,526	1,115,016	129	-17	406	-26
	2019	44	1.94	34	128,891,384	1,017,536	127	-2	374	-8
Ontario	2015	49	2.42	38	228,171,554	1,204,851	189		666	
	2016	40	2.24	36	111,934,726	884,702	127	-33	591	-11
	2017	39	2.29	36	140,637,788	987,244	142	13	602	2
	2018	40	2.30	37	118,826,525	937,408	127	-11	489	-19
	2019	39	2.51	38	176,933,365	955,535	185	46	548	12
Québec	2015	23	1.82	33	68,942,069	491,834	140		468	
	2016	26	1.91	33	72,682,913	544,595	133	-5	591	26
	2017	30	1.89	32	70,653,743	702,314	101	-25	470	-20
	2018	27	1.85	33	78,714,246	631,377	125	24	538	14
	2019	30	1.91	34	103,644,090	711,293	146	17	547	2
National[c]	2015	135	2.09	35	447,681,691	3,035,442	147		531	
	2016	136	2.03	34	396,364,200	3,052,498	130	-12	567	7
	2017	137	2.02	34	406,952,388	3,212,784	127	-2	527	-7
	2018	141	2.02	34	469,169,228	3,794,167	124	-2	492	-7
	2019	147	2.11	35	494,955,579	3,474,669	142	15	454	-8

See corresponding page for footnotes.

Table 2. 9 Production, biomass and quantity of antimicrobials used, by province/region, 2015 to 2019 (continued)

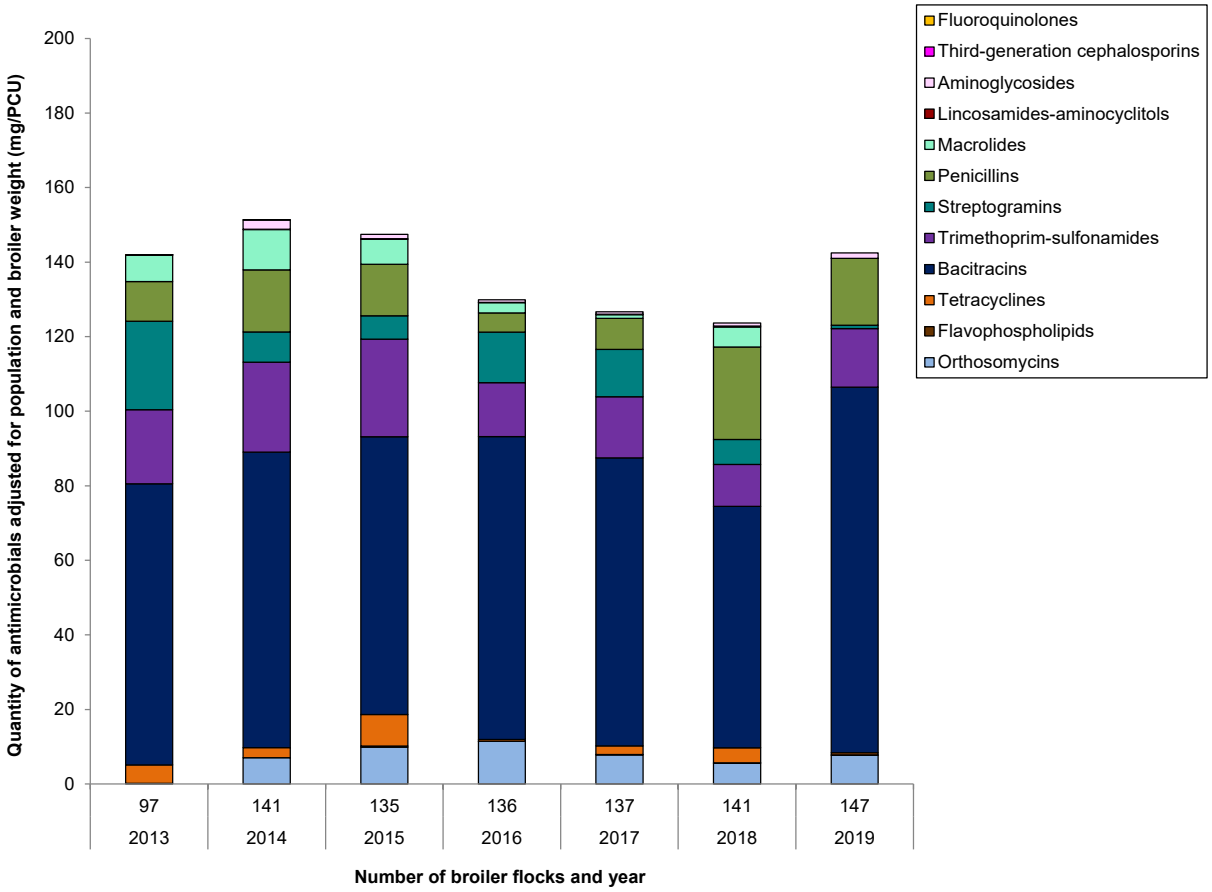
Some values presented in this report slightly differ from the previous year's reports due to flock size corrections, improvement to the database and methodology refinements.
mg/PCU = milligrams/population correction unit.
ESVAC = European Surveillance of Veterinary Antimicrobial Consumption.
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligrams per kilogram broiler chicken per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 1 for the list of standards.
nDDDvetCA/1,000 broiler chicken-days at risk = number of DDDvetCA/1,000 broiler chicken-days at risk.
For detailed indicator descriptions, please refer to the 2019 CIPARS: Design and Methods document.
The Prairies is a region including the provinces of Alberta and Saskatchewan.

[a] Population correction unit (PCU) or biomass, European weight (total flock population x ESVAC standard weight of 1 kg bird).

[b] Percent change = [(current surveillance year – previous surveillance year)/previous surveillance year] x 100.

[c] Includes only the provinces/regions surveyed and combines the quantity of antimicrobials used in feed, water and injection excluding coccidiostats, antiprotozoals and flavophospholipids.

Figure 2. 14 Quantity of antimicrobial use in all routes of administration, adjusted for population and broiler weight (mg/PCU), 2013 to 2019



Year Number of flocks		2013 97	2014 141	2015 135	2016 136	2017 137	2018 141	2019 147
Antimicrobial class								
I	Fluoroquinolones	< 0.1	0	0	0	0	< 0.1	0
	Third-generation cephalosporins	< 0.1	< 0.1	0	0	0	0	0
II	Aminoglycosides	< 0.1	3	1	1	1	1	1
	Lincosamides-aminocyclitols	0.1	0.1	0.2	0.1	0.1	0.2	< 0.1
	Macrolides	7	11	7	3	1	5	0
	Penicillins	11	17	14	5	8	25	18
	Streptogramins	24	8	6	14	13	7	1
	Trimethoprim-sulfonamides	20	24	26	14	16	11	16
III	Bacitracins	75	79	74	81	77	65	98
	Tetracyclines	5	3	8	0.4	2	4	1
IV	Flavophospholipids	0.2	0	0.3	0.03	0.1	0.1	0.2
N/A	Orthosomycins	0	7	10	11	8	6	8
Total		**142**	**151**	**147**	**130**	**127**	**124**	**142**

Roman numerals I to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification available at the time of writing of this report).

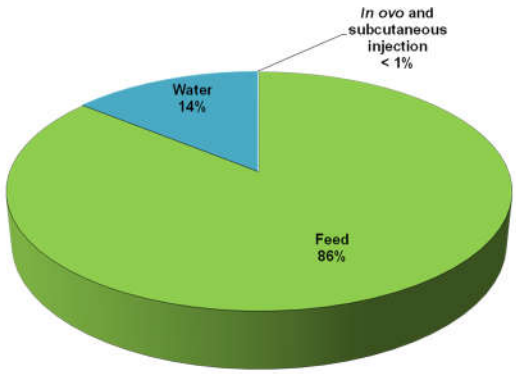
mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

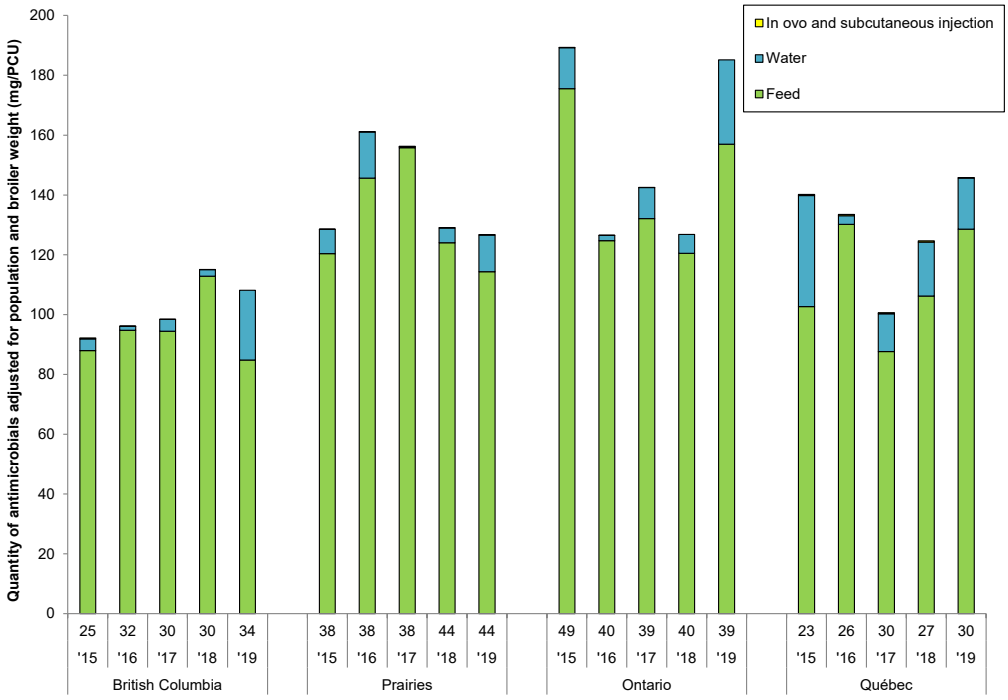
Please note, estimates have slightly changed from previous reports as a result of ongoing refinements to the database, flock population (flocks with no pre-harvest data excluded), dose corrections, and rounding.

Figure 2. 15 Quantity of antimicrobials, adjusted for population and broiler weight (mg/PCU) in 2019 and by province/region from 2015 to 2019

a) 2019



b) by province/region



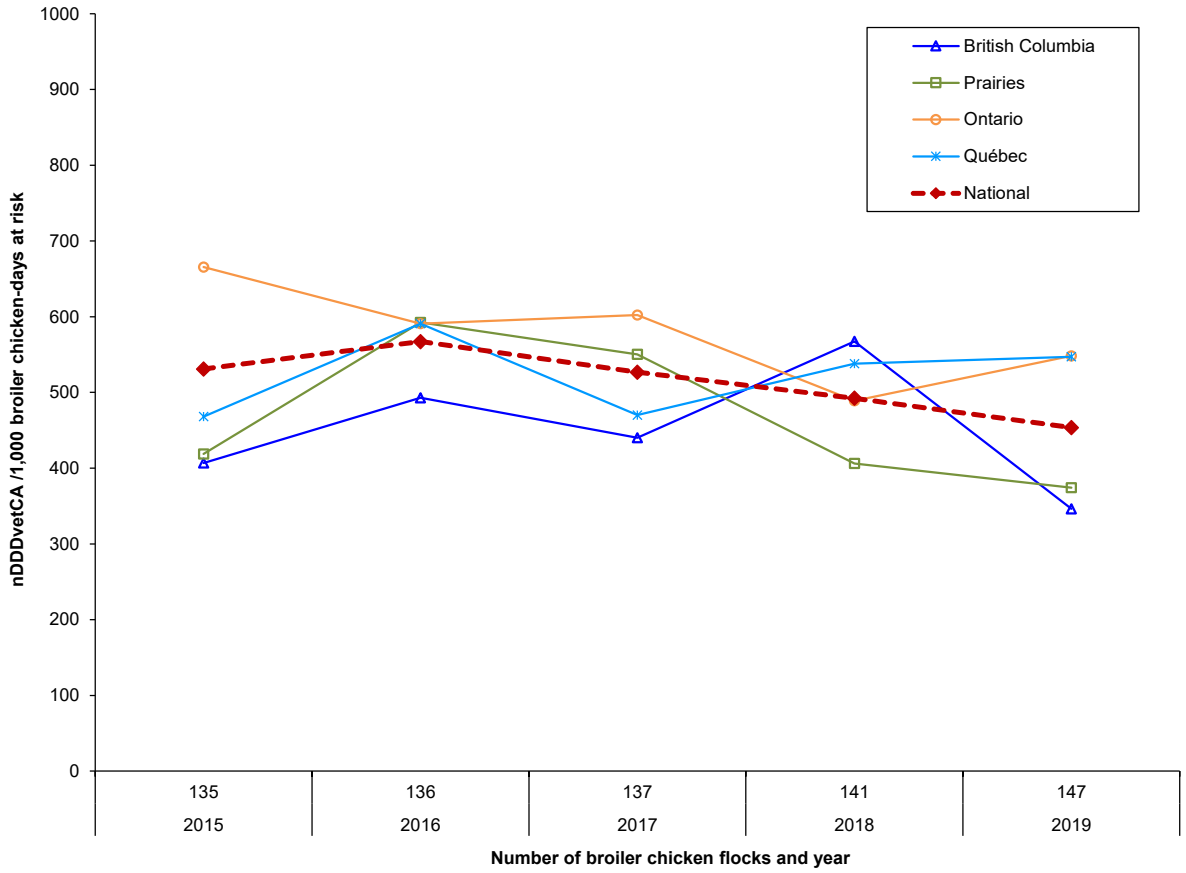
Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks	25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Route of administration																				
Feed	88	95	94	113	85	120	146	156	124	114	176	125	132	121	157	103	130	88	106	129
Water	4	1	4	2	23	8	15	0.4	5	12	14	2	10	6	28	37	3	13	18	17
In ovo and subcutaneous injection	0.3	0.03	0.1	0.02	0	0.06	0.04	0.08	0.04	0.03	0.2	0.04	0.01	0	0	0.4	0.4	0.4	0.4	0.01
Total	**92**	**96**	**98**	**115**	**108**	**129**	**161**	**156**	**129**	**127**	**189**	**127**	**142**	**127**	**185**	**140**	**133**	**101**	**125**	**146**

mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Figure 2. 16 Number of Canadian Defined Daily Doses for animals per 1,000 broiler chicken-days at risk (nDDDvetCA/1,000 broiler chicken-days at risk) for all routes of administration, by province/region, 2015 to 2019



Year Number of flocks	2015 135	2016 136	2017 137	2018 141	2019 147
Province/region					
British Columbia	407	493	440	567	346
Prairies	419	592	550	406	374
Ontario	666	591	602	489	548
Québec	468	591	470	538	547
National	**531**	**567**	**527**	**492**	**454**

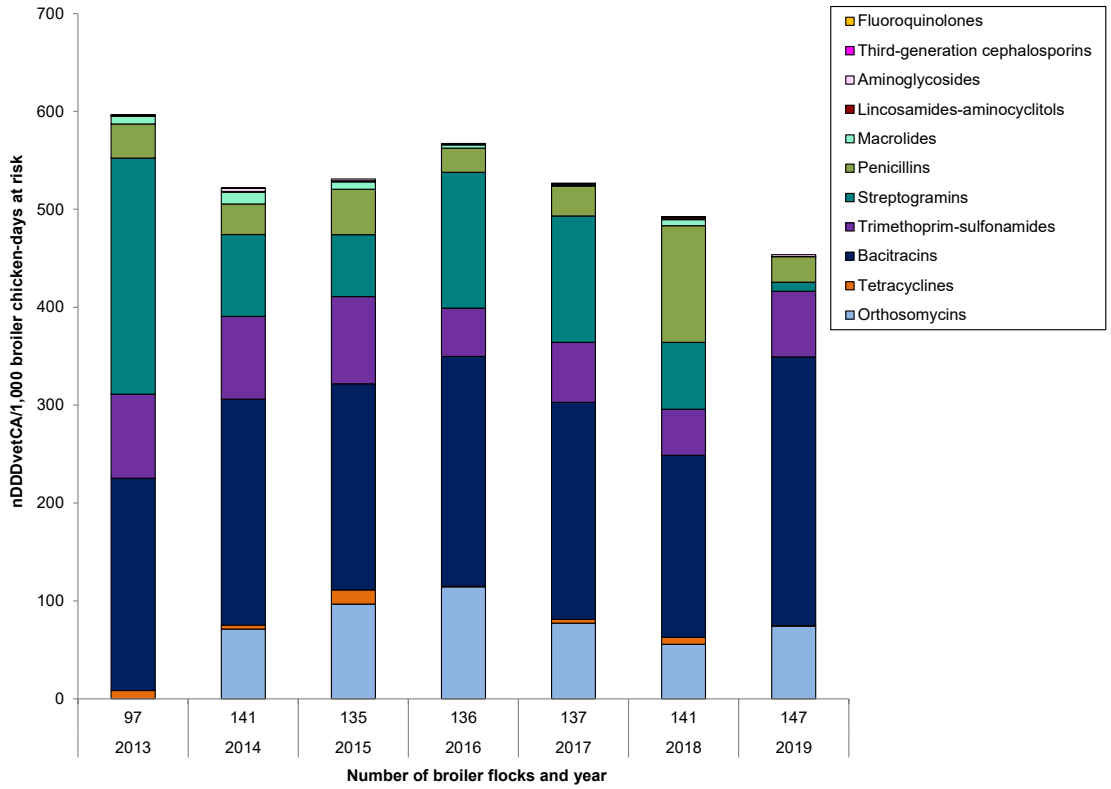
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram broiler weight per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 1 for the list of standards.

nDDDvetCA/1,000 broiler chicken-days at risk = Number of DDDvetCA/1,000 broiler chicken-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Figure 2. 17 Number of Canadian Defined Daily Doses for animals per 1,000 broiler chicken-days at risk (nDDDvetCA/1,000 broiler chicken-days at risk), for all routes of administration, 2013 to 2019



Year		2013	2014	2015	2016	2017	2018	2019
Number of flocks		97	141	135	136	137	141	147
Antimicrobial class								
I	Fluoroquinolones	< 0.1	0	0	0	0	< 0.1	0
	Third-generation cephalosporins	1	0.1	0	0	0	0	0
II	Aminoglycosides	< 0.1	3	2	1	1	1	2
	Lincosamides-aminocyclitols	1	1	1	0.7	0.8	2	0
	Macrolides	8	12	7	3	1	6	0
	Penicillins	35	31	47	25	31	119	26
	Streptogramins	241	84	63	139	129	68	9
	Trimethoprim-sulfonamides	86	85	89	49	61	47	67
III	Bacitracins	217	231	211	235	221	186	274
	Tetracyclines	9	4	14	1	4	7	1
N/A	Orthosomycins	0	71	97	114	77	56	74
Total		**596**	**522**	**531**	**567**	**527**	**492**	**454**

Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification available at the time of writing of this report).

DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram broiler weight per day ($mg_{drug}/kg_{animal}/day$); please refer to the 2019 CIPARS Design and Methods, Table A. 1 for the list of standards.

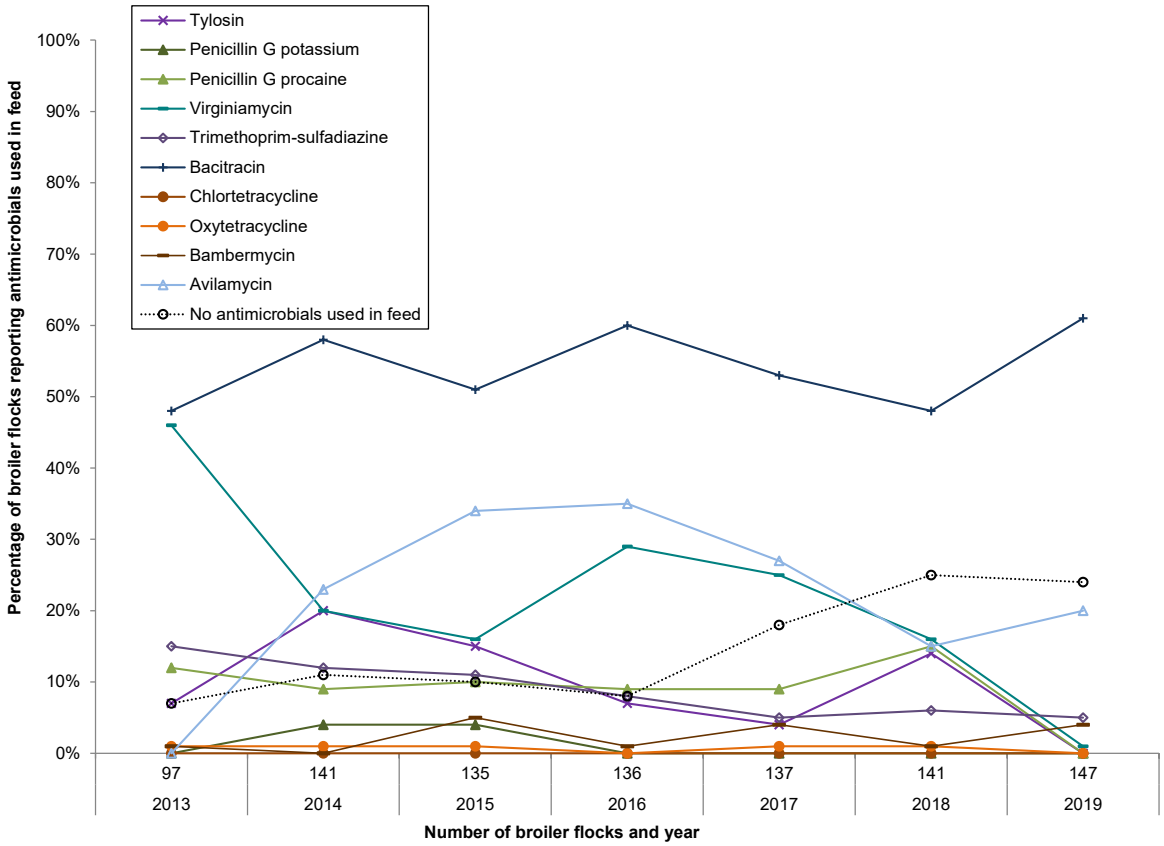
nDDDvetCA/1,000 broiler chicken-days at risk = Number of DDDvetCA/1,000 broiler chicken-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

Please note, estimates have slightly changed from previous reports as a result of ongoing refinements to the database, flock population (flocks with no preharvest data excluded), dose corrections, and rounding.

Antimicrobial use in feed by frequency

Figure 2. 18 Percentage of broiler flocks reporting antimicrobial use in feed, 2013 to 2019



Year	2013	2014	2015	2016	2017	2018	2019
Number of flocks	97	141	135	136	137	141	147
Antimicrobial							
Tylosin	**7%**	20%	15%	7%	4%	**14%**	**0%**
Penicillin G potassium	**0%**	4%	4%	0%	0%	**0%**	**0%**
II Penicillin G procaine	**12%**	9%	10%	9%	9%	**15%**	**0%**
Virginiamycin	**46%**	20%	16%	29%	25%	**16%**	**1%**
Trimethoprim-sulfadiazine	**15%**	12%	11%	8%	5%	**6%**	**5%**
Bacitracin	**48%**	58%	51%	60%	53%	**48%**	**61%**
III Chlortetracycline	**0%**	0%	0%	0%	0%	**0%**	**0%**
Oxytetracycline	**1%**	1%	1%	0%	1%	**1%**	**0%**
IV Bambermycin	**1%**	0%	5%	1%	4%	**1%**	**4%**
N/A Avilamycin	**0%**	23%	34%	35%	27%	**15%**	**20%**
No antimicrobials used in feed	**7%**	11%	10%	8%	18%	**25%**	**24%**

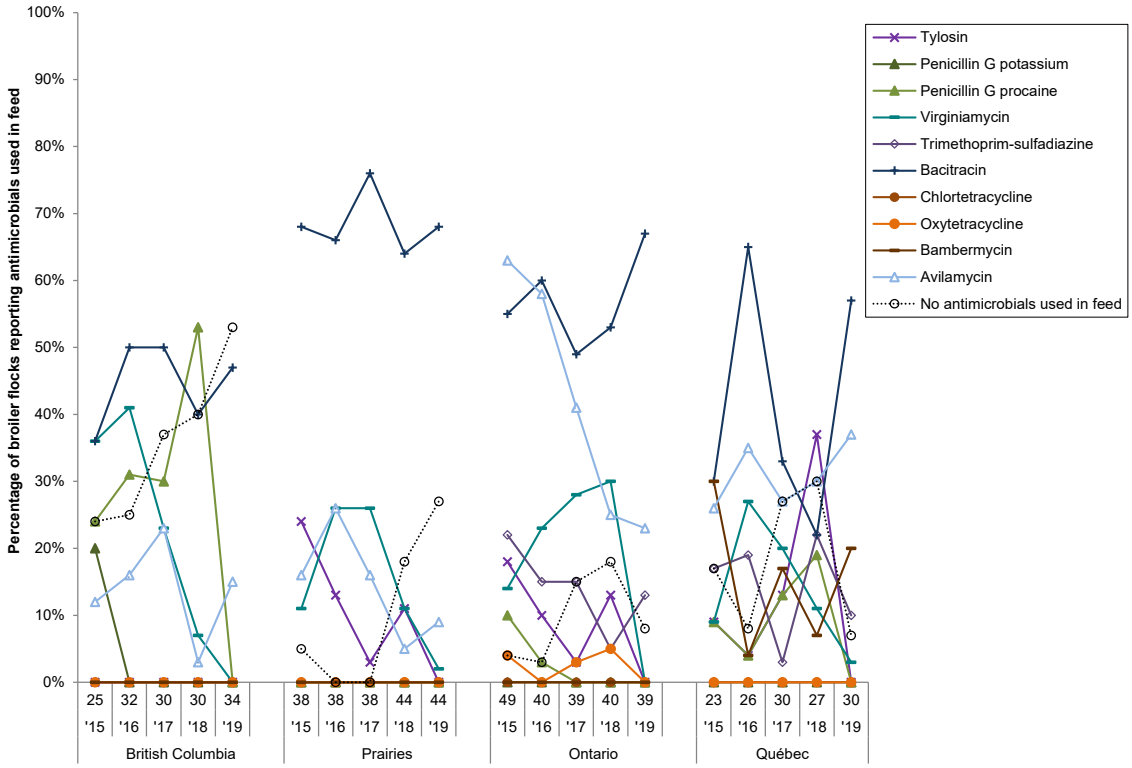
Roman numerals II to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification at the time of writing of this report).

Numbers per column may not add up to 100% as some flocks may have used an antimicrobial more than once or used multiple antimicrobials throughout the grow-out period.

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

Please note that the "no antimicrobials used in feed" pertains to flocks that did not use any of the antimicrobial classes included in this figure (Categories II to IV and avilamycin).

Figure 2. 19 Percentage of broiler flocks reporting antimicrobial use in feed, by province/region, 2015 to 2019



Number of broiler flocks, year, and province/region

Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks	25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Antimicrobial																				
II Tylosin	**0%**	0%	0%	**0%**	**0%**	**24%**	13%	3%	**11%**	**0%**	**18%**	10%	3%	**13%**	**0%**	**9%**	4%	13%	**37%**	**0%**
II Penicillin G potassium	**20%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
II Penicillin G procaine	**24%**	31%	30%	**53%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**10%**	3%	0%	**0%**	**0%**	**9%**	4%	13%	**19%**	**0%**
II Virginiamycin	**36%**	41%	23%	**7%**	**0%**	**11%**	26%	26%	**11%**	**2%**	**14%**	23%	28%	**30%**	**0%**	**9%**	27%	20%	**11%**	**3%**
II Trimethoprim-sulfadiazine	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**22%**	15%	15%	**5%**	**13%**	**17%**	19%	3%	**22%**	**10%**
III Bacitracin	**36%**	50%	50%	**40%**	**47%**	**68%**	66%	76%	**64%**	**68%**	**55%**	60%	49%	**53%**	**67%**	**30%**	65%	33%	**22%**	**57%**
III Chlortetracycline	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
III Oxytetracycline	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**4%**	0%	3%	**5%**	**0%**	**0%**	0%	0%	**0%**	**0%**
IV Bambermycin	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**30%**	4%	17%	**7%**	**20%**
N/A Avilamycin	**12%**	16%	23%	**3%**	**15%**	**16%**	26%	16%	**5%**	**9%**	**63%**	58%	41%	**25%**	**23%**	**26%**	35%	27%	**30%**	**37%**
No antimicrobials used in feed	**24%**	25%	37%	**40%**	**53%**	**5%**	0%	0%	**18%**	**27%**	**4%**	3%	15%	**18%**	**8%**	**17%**	8%	27%	**30%**	**7%**

Roman numerals II to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification at the time of writing of this report).

Numbers per column may not add up to 100% as some flocks may have used an antimicrobial more than once or used multiple antimicrobials throughout the grow-out period.

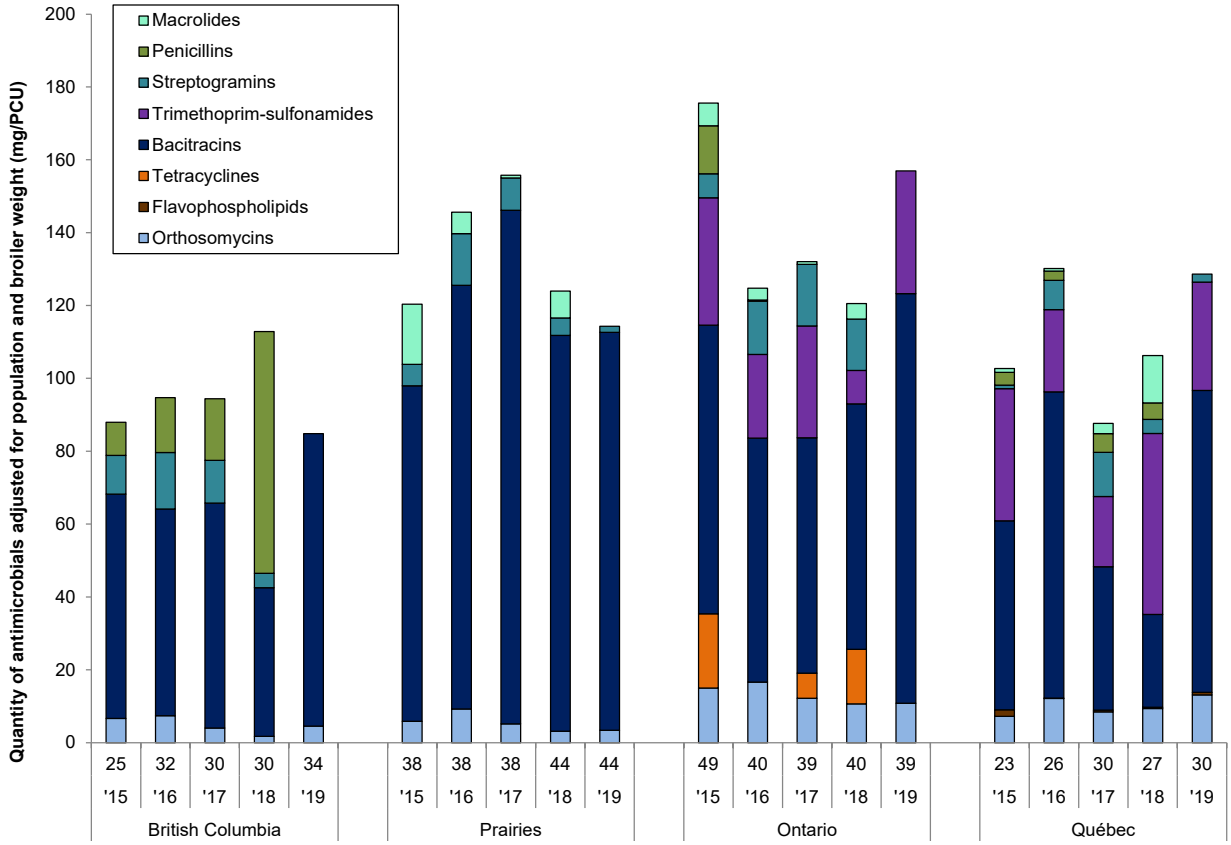
For the temporal analyses within province/region, the proportion (%) of flocks using a specific antimicrobial in the current year has been compared to the proportion (%) of flocks using the same antimicrobial in the previous 5 years and the previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences within province/region ($P \leq 0.05$) for a given antimicrobial. The presence of red areas indicates significant provincial/regional differences ($P \leq 0.05$) for a given antimicrobial within the current year (Québec-referent province).

Please note that the "no antimicrobials used in feed" pertains to flocks that did not use any of the antimicrobial classes included in this figure (Categories II to IV and avilamycin), some flocks have used coccidiostats; previous years' data were updated.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Antimicrobials use in feed by quantitative indicators

Figure 2. 20 Quantity of antimicrobial use in feed adjusted for population and broiler weight (mg/PCU), by province/region, 2015 to 2019



Number of broiler flocks, year, and province/region

Province/region		British Columbia					Prairies					Ontario					Québec				
Year		'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks		25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Antimicrobial class																					
II	Macrolides	0	0	0	0	0	17	6	1	7	0	6	3	1	4	0	1	1	3	13	0
	Penicillins	9	15	17	66	0	0	0	0	0	0	13	0.3	0	0	0	4	3	5	5	0
	Streptogramins	11	15	12	4	0	6	14	9	5	2	7	15	17	14	0	1	8	12	4	2
	Trimethoprim-sulfonamides	0	0	0	0	0	0	0	0	0	0	35	23	31	9	34	36	23	19	50	30
III	Bacitracins	62	57	62	41	80	92	116	141	109	109	79	67	65	67	113	52	84	39	26	83
	Tetracyclines	0	0	0	0	0	0	0	0	0	0	20	0	7	15	0	0	0	0	0	0
IV	Flavophospholipids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.2	1	0.4	1
N/A	Orthosomycins	7	7	4	2	5	6	9	5	3	3	15	17	12	11	11	7	12	8	9	13
Total		**88**	**95**	**94**	**113**	**85**	**120**	**146**	**156**	**124**	**114**	**176**	**125**	**132**	**121**	**157**	**103**	**130**	**88**	**106**	**129**

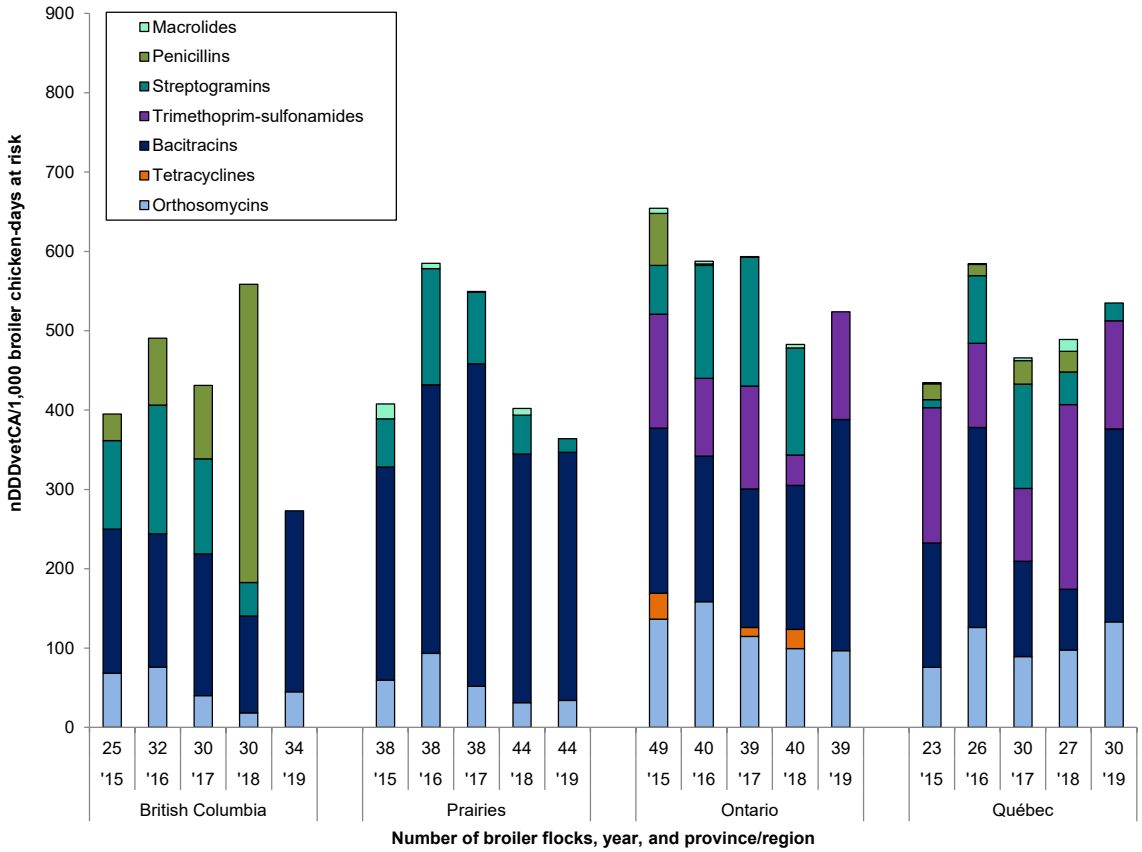
Roman numerals II to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification at the time of writing of this report).

mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Figure 2. 21 Number of Canadian Defined Daily Doses for animals per 1,000 broiler chicken-days at risk (nDDDvetCA/1,000 broiler chicken-days at risk) for antimicrobials administered in feed, by province/region, 2015 to 2019



Province/region		British Columbia					Prairies					Ontario					Québec				
Year		'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks		25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Antimicrobial class																					
II	Macrolides	0	0	0	0	0	19	7	1	8	0	6	3	1	4	0	1	1	3	15	0
	Penicillins	34	84	93	376	0	0	0	0	0	0	65	2	0	0	0	20	14	30	26	0
	Streptogramins	111	162	120	42	0	61	146	90	49	17	61	142	162	135	0	10	85	131	41	22
	Trimethoprim-sulfonamides	0	0	0	0	0	0	0	0	0	0	143	98	129	38	136	171	106	92	233	136
III	Bacitracins	182	168	179	122	228	269	339	407	314	313	208	184	175	181	291	157	252	120	77	243
	Tetracyclines	0	0	0	0	0	0	0	0	0	0	33	0	11	24	0	0	0	0	0	0
N/A	Orthosomycins	68	76	40	18	45	60	93	52	31	34	137	158	115	99	97	76	126	89	97	133
Total		**395**	**491**	**431**	**559**	**273**	**408**	**585**	**549**	**402**	**364**	**654**	**588**	**593**	**483**	**524**	**434**	**584**	**466**	**489**	**535**

Roman numerals II to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification at the time of writing of this report).

DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram broiler weight per day ($mg_{drug}/kg_{animal}/day$); please refer to the CIPARS 2019: Design and Methods document, Table A. 1 for the list of standards.

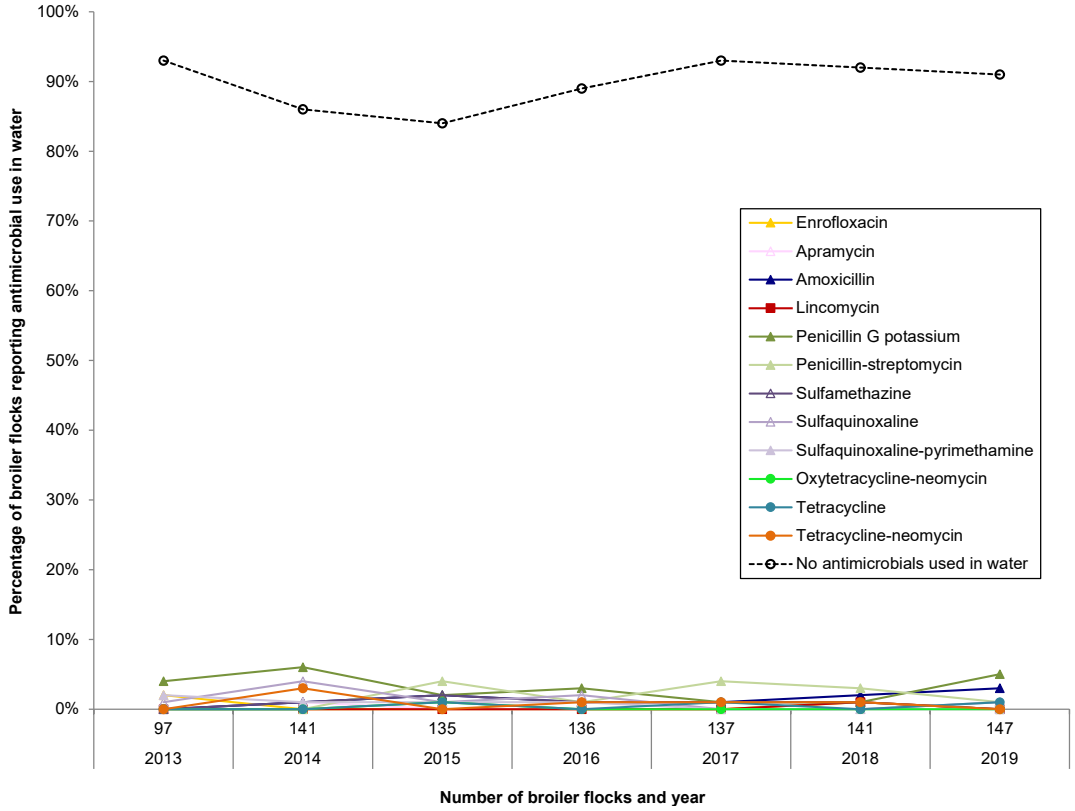
nDDDvetCA/1,000 broiler chicken-days at risk = number of DDDvetCA/1,000 broiler chicken-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Antimicrobial use in water by frequency

Figure 2. 22 Percentage of broiler flocks reporting antimicrobial use in water, 2013 to 2019



Year	2013	2014	2015	2016	2017	2018	2019
Number of flocks	97	141	135	136	137	141	147
Antimicrobial							
I Enrofloxacin	**2%**	0%	0%	0%	0%	**1%**	**0%**
II Apramycin	**0%**	1%	0%	0%	0%	**0%**	**0%**
II Amoxicillin	**0%**	1%	2%	1%	1%	**2%**	**3%**
II Lincomycin	**0%**	0%	0%	0%	0%	**1%**	**0%**
II Penicillin G potassium	**4%**	6%	2%	3%	1%	**1%**	**5%**
II Penicillin-streptomycin	**0%**	0%	4%	1%	4%	**3%**	**1%**
III Sulfamethazine	**0%**	1%	2%	1%	1%	**1%**	**0%**
III Sulfaquinoxaline	**1%**	4%	1%	2%	0%	**0%**	**1%**
III Sulfaquinoxaline-pyrimethamine	**2%**	1%	1%	1%	0%	**0%**	**0%**
III Oxytetracycline-neomycin	**0%**	0%	1%	0%	0%	**0%**	**0%**
III Tetracycline	**0%**	0%	1%	0%	1%	**0%**	**1%**
III Tetracycline-neomycin	**0%**	3%	0%	1%	1%	**1%**	**0%**
No antimicrobials used in water	**93%**	86%	84%	89%	93%	**92%**	**91%**

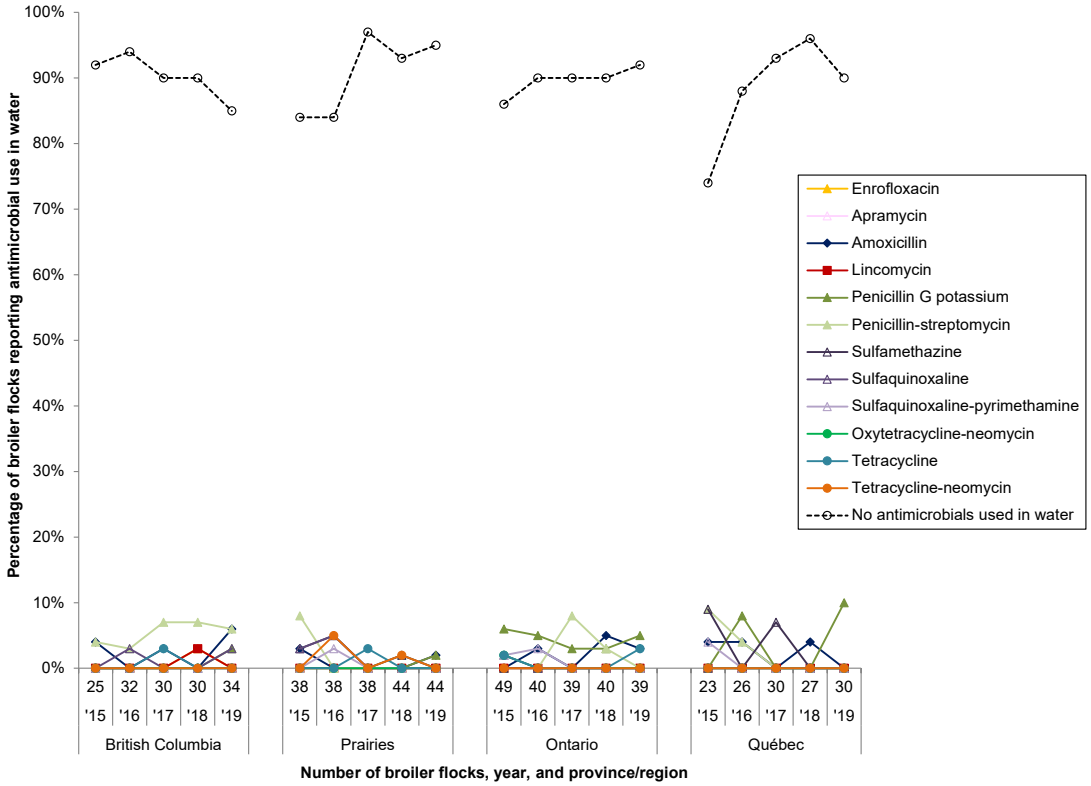
Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

Numbers per column may not add up to 100% as some flocks have used an antimicrobial more than once or used multiple antimicrobials throughout the growing period.

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

Please note that the "no antimicrobials used in water" pertains to flocks that did not use any of the antimicrobial classes included in this figure (Categories I to III).

Figure 2. 23 Percentage of broiler flocks reporting antimicrobial use in water, by province/region, 2015 to 2019



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks	25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Antimicrobial																				
I Enrofloxacin	**0%**	0%	0%	**3%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
Apramycin	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
Amoxicillin	**4%**	0%	3%	**0%**	**6%**	**3%**	0%	0%	**0%**	**2%**	**0%**	3%	0%	**5%**	**3%**	**4%**	4%	0%	**4%**	**0%**
II Lincomycin	**0%**	0%	0%	**3%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
Penicillin G potassium	**0%**	0%	0%	**0%**	**3%**	**0%**	0%	0%	**0%**	**2%**	**6%**	5%	3%	**3%**	**5%**	**0%**	8%	0%	**0%**	**10%**
Penicillin-streptomycin	**4%**	3%	7%	**7%**	**6%**	**8%**	0%	0%	**2%**	**0%**	**0%**	0%	8%	**3%**	**0%**	**9%**	4%	0%	**0%**	**0%**
Sulfamethazine	**0%**	0%	0%	**0%**	**0%**	**3%**	5%	0%	**2%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**9%**	0%	7%	**0%**	**0%**
Sulfaquinoxaline	**0%**	3%	0%	**0%**	**3%**	**3%**	5%	0%	**0%**	**0%**	**2%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
III Sulfaquinoxaline-pyrimethamine	**0%**	0%	0%	**0%**	**0%**	**0%**	3%	0%	**0%**	**0%**	**2%**	3%	0%	**0%**	**0%**	**4%**	0%	0%	**0%**	**0%**
Oxytetracycline-neomycin	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**2%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
Tetracycline	**0%**	0%	3%	**0%**	**0%**	**0%**	0%	3%	**0%**	**0%**	**2%**	0%	0%	**0%**	**3%**	**0%**	0%	0%	**0%**	**0%**
Tetracycline-neomycin	**0%**	0%	0%	**0%**	**0%**	**0%**	5%	0%	**2%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
No antimicrobials used in water	**92%**	94%	90%	**90%**	**85%**	**84%**	84%	97%	**93%**	**95%**	**86%**	90%	90%	**90%**	**92%**	**74%**	88%	93%	**96%**	**90%**

Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

Numbers per column may not add up to 100% as some flocks have used an antimicrobial more than once or used multiple antimicrobials throughout the growing period.

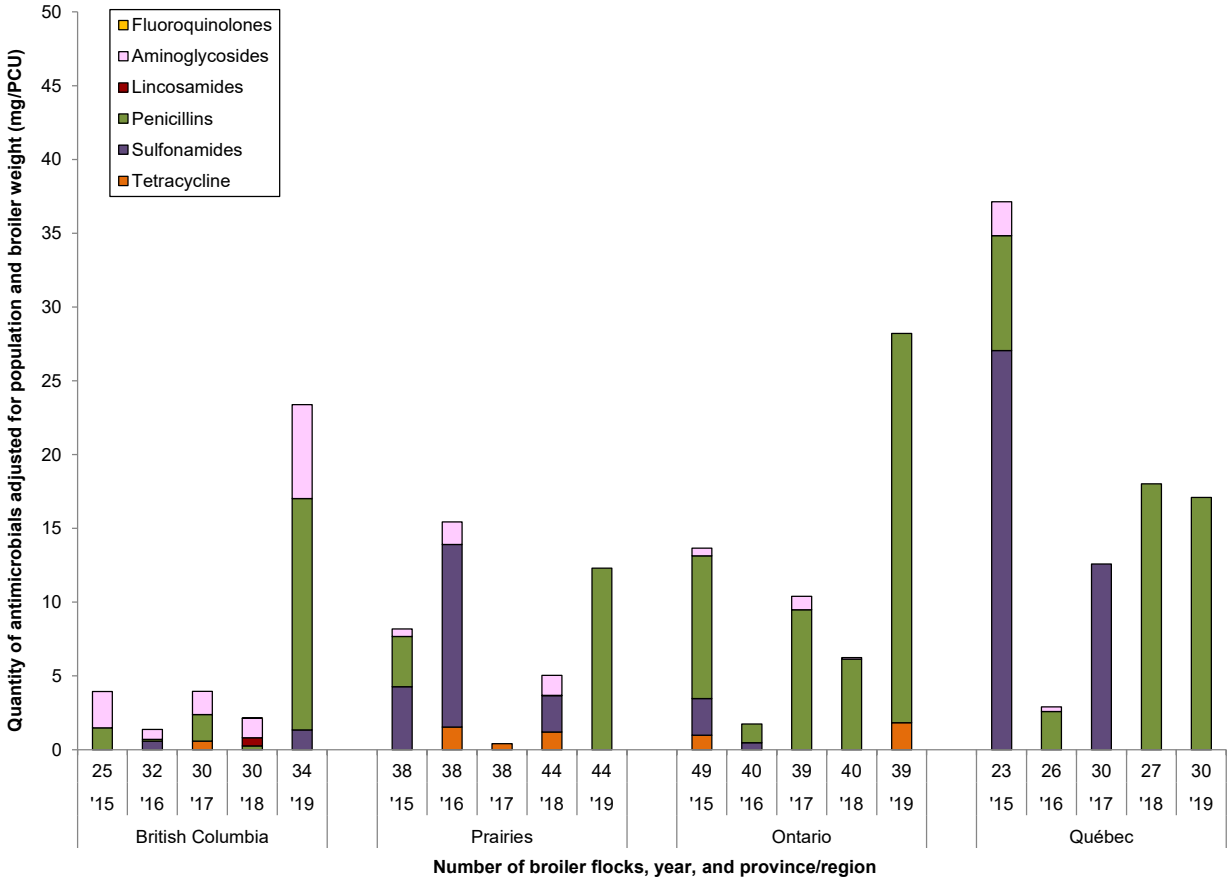
For the temporal analyses within province/region, the proportion (%) of flocks using a specific antimicrobial in the current year has been compared to the proportion (%) of flocks using the same antimicrobial in the previous 5 years and the previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences within province/region ($P \leq 0.05$) for a given antimicrobial. The presence of red areas indicates significant provincial/regional differences ($P \leq 0.05$) for a given antimicrobial within the current year (Québec-referent province).

Please note that the "no antimicrobials used in water" pertains to flocks that did not use any of the antimicrobial classes included in this figure (Categories I to III).

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Antimicrobials use in water by quantitative indicators

Figure 2. 24 Quantity of antimicrobial use in water adjusted for population and broiler weight (mg/PCU), by province/region, 2015 to 2019



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks	25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Antimicrobial class																				
I Fluoroquinolones	0	0	0	< 0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
II Aminoglycosides	2	1	2	1	6	1	2	0	1	0	1	0	1	0.1	0	2	0.3	0	0	0
II Lincosamides	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
II Penicillins	1	0.1	2	0.3	16	3	0	0	0	12	10	1	9	6	26	8	3	0	18	17
III Sulfonamides	0	1	0	0	1	4	12	0	2	0	2	0.5	0	0	0	27	0	13	0	0
III Tetracyclines	0	0	1	0	0	0	2	0.4	1	0	1.0	0	0	0	2	0	0	0	0	0
Total	**4**	**1**	**4**	**2**	**23**	**8**	**15**	**0**	**5**	**12**	**14**	**2**	**10**	**6**	**28**	**37**	**3**	**13**	**18**	**17**

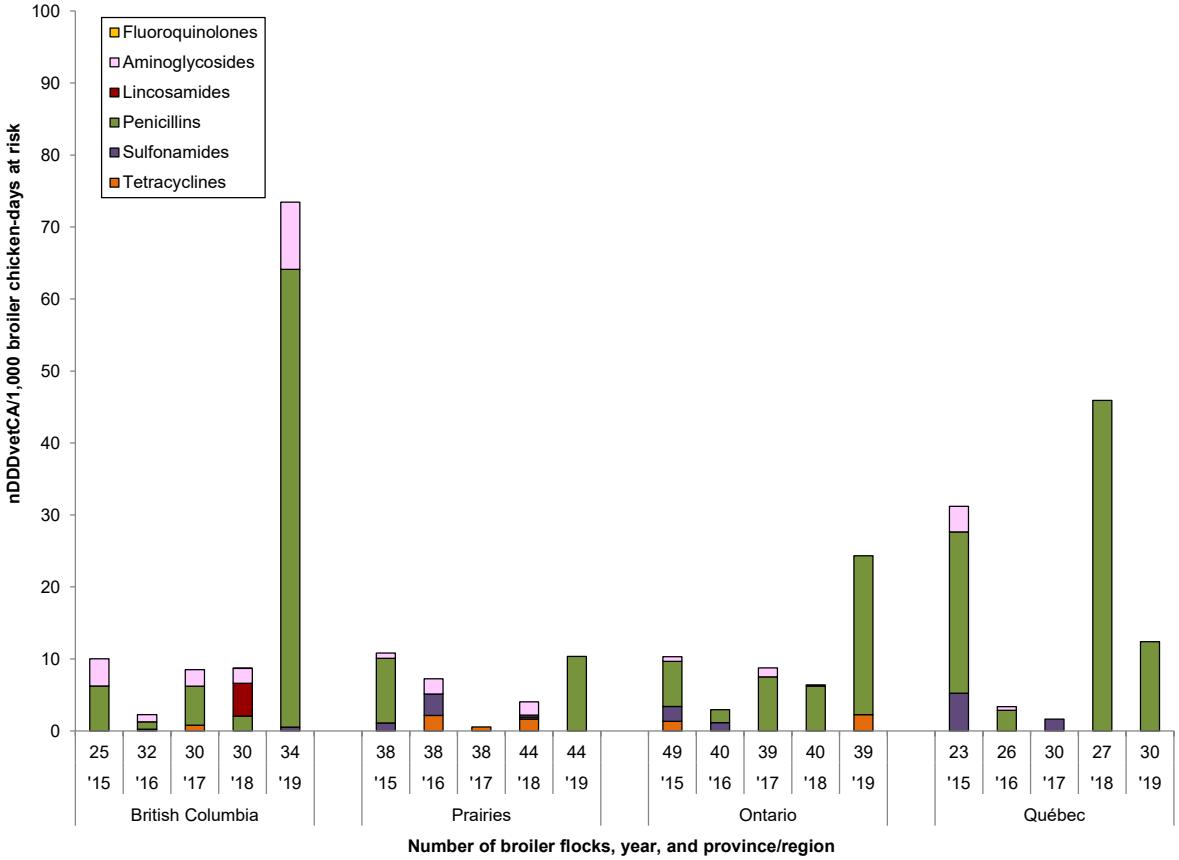
Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Figure 2. 25 Number of Canadian Defined Daily Doses for animals per 1,000 broiler chicken-days at risk (nDDDvetCA/1,000 broiler chicken-days at risk) for antimicrobials administered in water, by province/region, 2015 to 2019



Province/region		British Columbia					Prairies					Ontario					Québec				
Year		'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks		25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Antimicrobial class																					
I	Fluoroquinolones	0	0	0	< 0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
II	Aminoglycosides	4	1	2	2	9	1	2	0	2	0	1	0	1	0.1	0	4	0.5	0	0	0
	Lincosamides	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Penicillins	6	1.0	5	2	64	9	0	0	0	10	6	2	8	6	22	22	3	0	46	12
III	Sulfonamides	0	0	0	0	1	1	3	0	0	0	2	1	0	0	0	5	0	2	0	0
	Tetracyclines	0	0	1	0	0	0	2	1	2	0	1	0	0	0	2	0	0	0	0	0
Total		**10**	**2**	**8**	**9**	**73**	**11**	**7**	**1**	**4**	**10**	**10**	**3**	**9**	**6**	**24**	**31**	**3**	**2**	**46**	**12**

Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram broiler weight per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 1 for the list of standards.

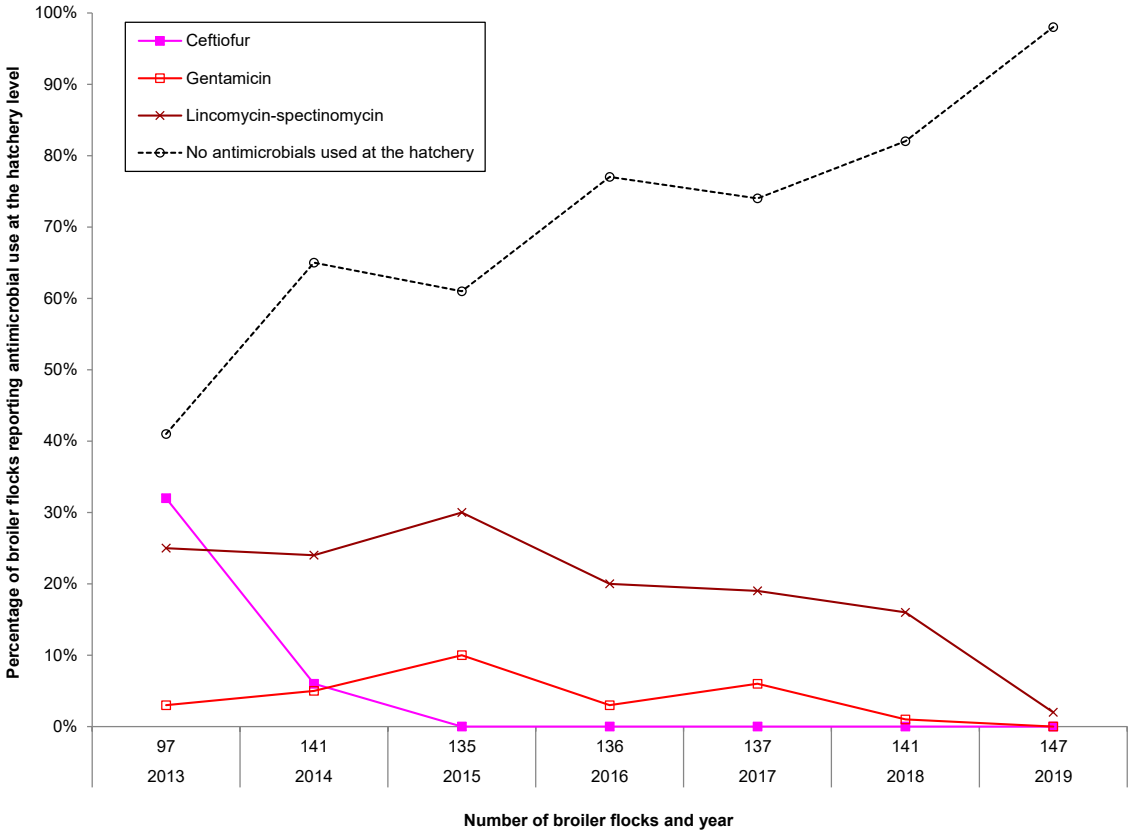
nDDDvetCA/1,000 broiler chicken-days at risk = number of DDDvetCA/1,000 broiler chicken-days at risk .

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Antimicrobial use *in ovo* or subcutaneous injection by frequency

Figure 2. 26 Percentage of broiler flocks reporting antimicrobial use *in ovo* or subcutaneous injection at the hatchery level, 2013 to 2019



Year Number of flocks		2013 97	2014 141	2015 135	2016 136	2017 137	2018 141	2019 147
Antimicrobial								
I	Ceftiofur	**32%**	6%	0%	0%	0%	**0%**	**0%**
II	Gentamicin	**3%**	5%	10%	3%	6%	**1%**	**0%**
	Lincomycin-spectinomycin	**25%**	24%	30%	20%	19%	**16%**	**2%**
	No antimicrobials used at the hatchery	**41%**	65%	61%	77%	74%	**82%**	**98%**

Roman numerals I to II indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

Numbers per column may not add up to 100% due to rounding or batches of chicks (hatched at the same time to supply 1 barn) may have used more than one antimicrobial.

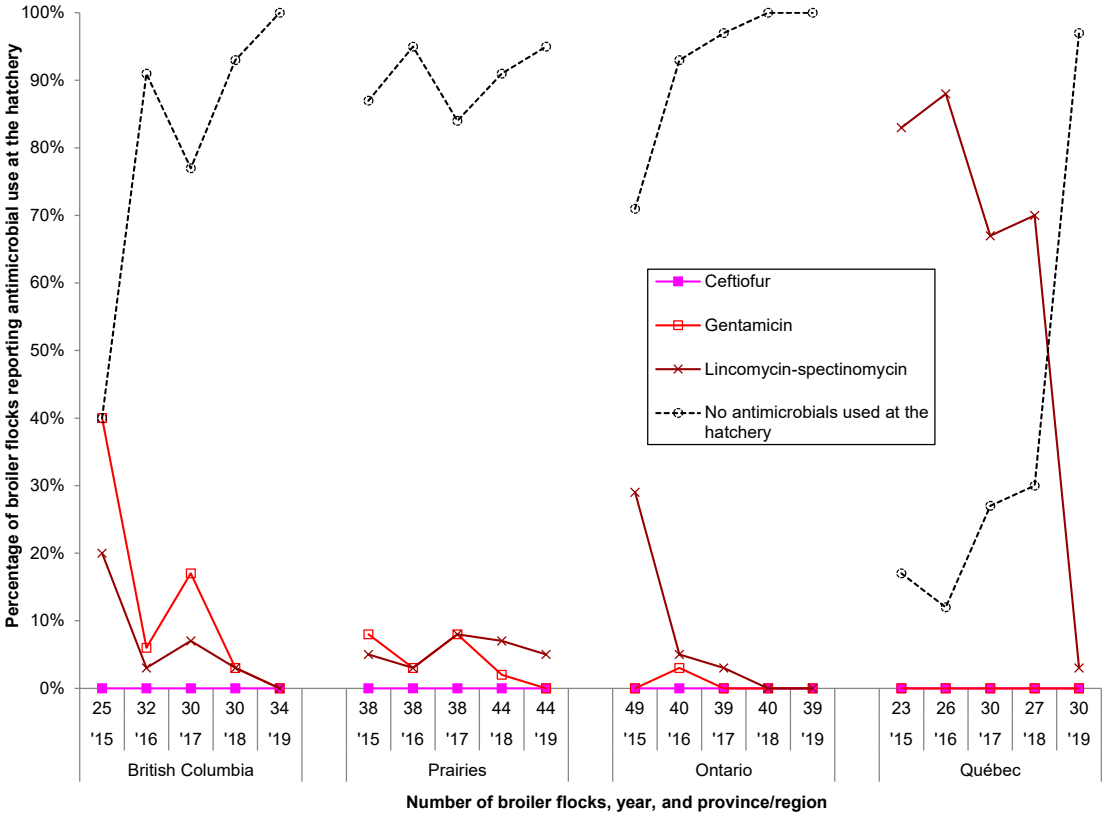
Data represent flocks medicated at the hatchery at day 18 of incubation or upon hatch.

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

Please note, percentages have slightly changed from previous reports as flocks with incomplete data were removed from the analysis above (2013 to 2017 flocks with chick placement but no pre-harvest information received).

Please note that the "no antimicrobials used at the hatchery" pertains to flocks that did not use any of the antimicrobial classes included in this figure (Categories I to II).

Figure 2. 27 Percentage of broiler flocks reporting antimicrobials used *in ovo* or subcutaneous injection at the hatchery level, by province/region, 2015 to 2019



Province/region		British Columbia					Prairies					Ontario					Québec				
Year		'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks		25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Antimicrobial																					
I	Ceftiofur	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
II	Gentamicin	**40%**	6%	17%	**3%**	**0%**	**8%**	3%	8%	**2%**	**0%**	**0%**	3%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
	Lincomycin-spectinomycin	**20%**	3%	7%	**3%**	**0%**	**5%**	3%	8%	**7%**	**5%**	**29%**	5%	3%	**0%**	**0%**	**83%**	88%	67%	**70%**	**3%**
	No antimicrobials used at the hatchery	**40%**	91%	77%	**93%**	**100%**	**87%**	95%	84%	**91%**	**95%**	**71%**	93%	97%	**100%**	**100%**	**17%**	12%	27%	**30%**	**97%**

Roman numerals I to II indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

Numbers per column may not add up to 100% due to rounding or batches of chicks (hatched at the same time to supply 1 barn) may have used more than one antimicrobial.

Data represent flocks medicated at the hatchery at day 18 of incubation or upon hatch.

For the temporal analyses within province/region, the proportion (%) of flocks using antimicrobial over the current year has been compared to the proportion (%) of flocks using the same antimicrobial during the previous 5 years and the previous surveillance year (grey areas). The presence of blue areas indicate significant differences ($P \leq 0.05$) for a given province/region and antimicrobial. The presence of red areas indicates significant provincial/regional differences ($P \leq 0.05$) for a given antimicrobial within the current year (Québec-referent province).

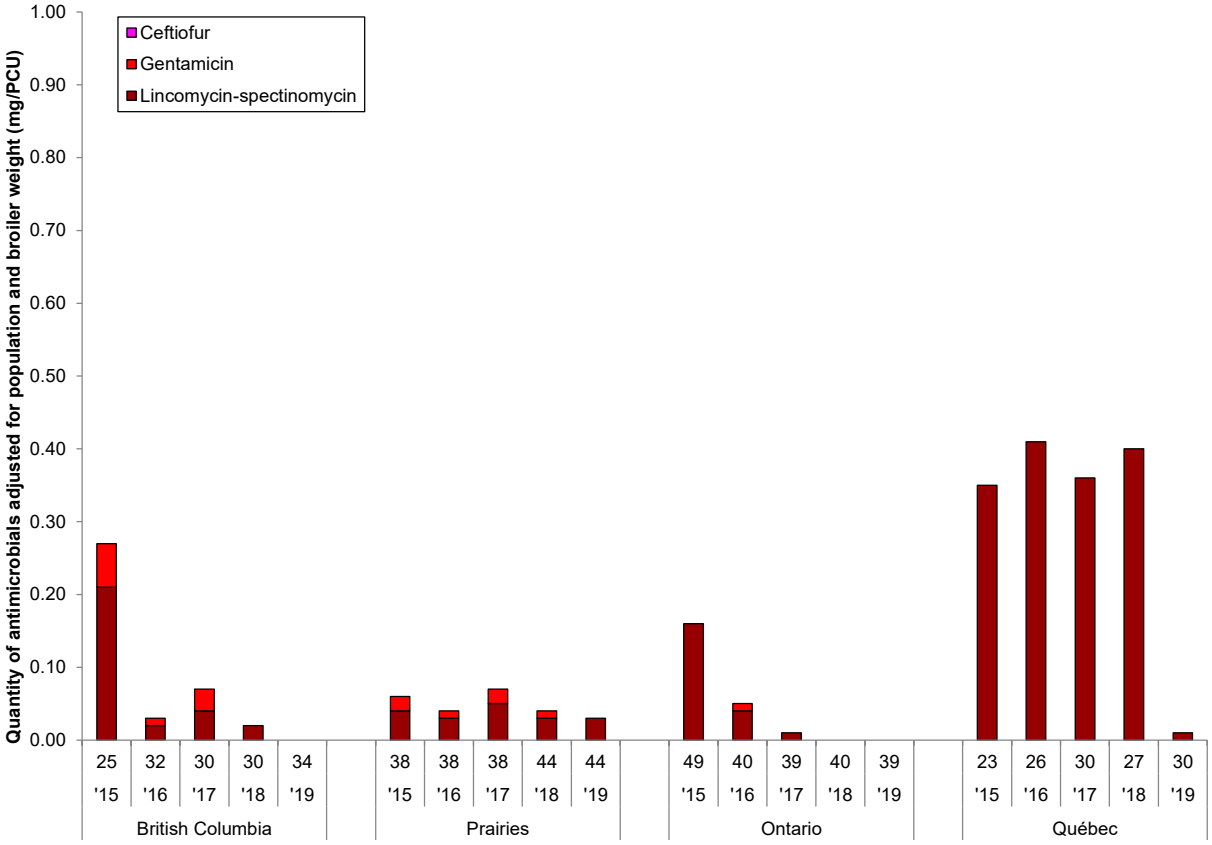
The Prairies is a region including the provinces of Alberta and Saskatchewan.

Please note, percentages have slightly changed from previous reports as flocks with incomplete data were removed from the analysis above (2013 to 2017 flocks with chick placement but no pre-harvest information received).

Please note that the "no antimicrobials used at the hatchery" pertains to flocks that did not use any of the antimicrobial classes included in this figure (Categories I to II).

Antimicrobial use *in ovo* or subcutaneous injection by quantitative indicators

Figure 2. 28 Quantity of antimicrobial use *in ovo* or subcutaneous injections, adjusted for population and broiler weight (mg/PCU), by province/region, 2015 to 2019



Province/region		British Columbia					Prairies					Ontario					Québec				
Year		'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks		25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Antimicrobial																					
I	Ceftiofur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
II	Gentamicin	0.06	0.01	0.03	0	0	0.02	0.01	0.02	0.01	0	0	0.01	0	0	0	0	0	0	0	0
	Lincomycin-spectinomycin	0.21	0.02	0.04	0.02	0	0.04	0.03	0.05	0.03	0.03	0.16	0.04	0.01	0	0	0.35	0.41	0.36	0.40	0.01
	Total	**0.27**	**0.03**	**0.07**	**0.02**	**0**	**0.06**	**0.04**	**0.08**	**0.04**	**0.03**	**0.16**	**0.04**	**0.01**	**0**	**0**	**0.35**	**0.41**	**0.36**	**0.40**	**0.01**

Roman numerals I to II indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

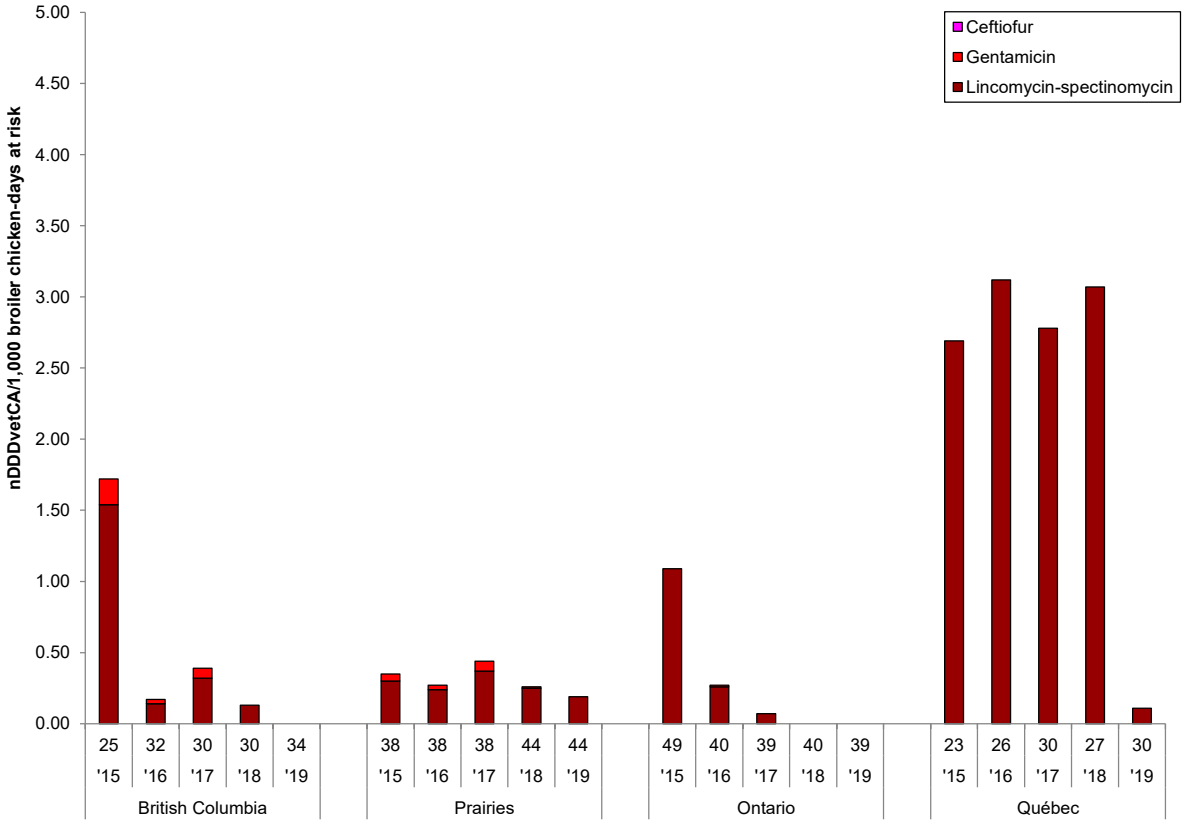
Total milligrams active ingredient was calculated using the final dose (in milligrams per hatching egg or chick) suggested by the manufacturer and expert opinion based on milligrams per body weight or residue avoidance information.

mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Figure 2. 29 Number of Canadian Defined Daily Doses for animals per 1,000 broiler chicken-days at risk (nDDDvetCA/1,000 broiler chicken-days at risk) for antimicrobials administered *in ovo* or subcutaneous injection, by province/region, 2015 to 2019



Province/region		British Columbia					Prairies					Ontario					Québec				
Year		'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks		25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Antimicrobial																					
I	Ceftiofur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
II	Gentamicin	0.18	0.03	0.07	0	0	0.05	0.03	0.07	0.01	0	0	0	0	0	0	0	0	0	0	0
	Lincomycin-spectinomycin	2	0.14	0.32	0.13	0	0	0.24	0.37	0.25	0.19	1.09	0.26	0.07	0	0	2.69	3.12	2.78	3.07	0.11
	Total	**1.72**	**0.17**	**0.40**	**0.13**	**0**	**0.35**	**0.27**	**0.44**	**0.26**	**0.19**	**1.09**	**0.28**	**0.07**	**0**	**0**	**2.69**	**3.12**	**2.78**	**3.07**	**0.11**

Roman numerals I to II indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram broiler weight per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 1 for the list of standards.

nDDDvetCA/1,000 broiler chicken-days at risk = number of DDDvetCA/1,000 broiler chicken-days at risk.

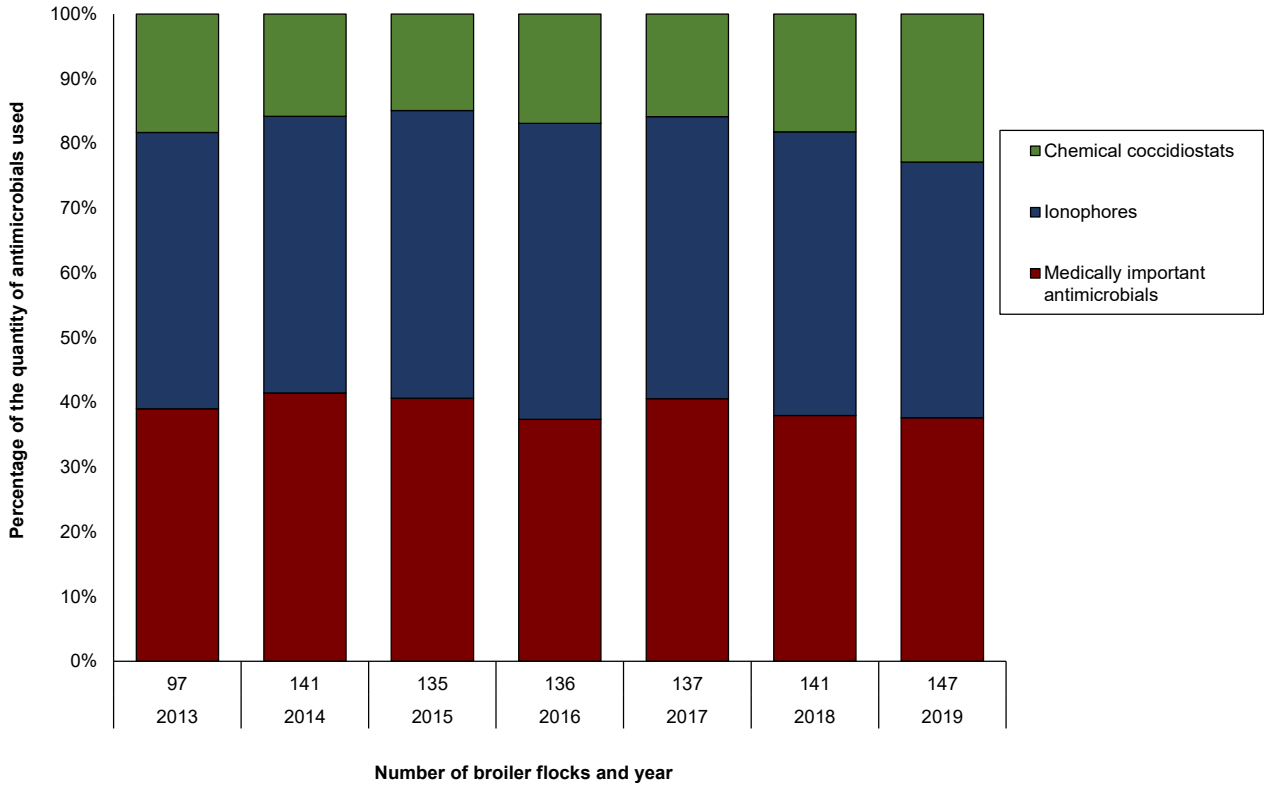
For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Please note, estimates have slightly changed from previous reports as flocks with incomplete data were removed from the analysis above (2013 to 2017 flocks with chick placement but no pre-harvest information received).

Coccidiostat use in feed by frequency

Figure 2. 30 Percentage of the quantity (milligrams of active ingredient) of antimicrobials used in broiler chicken flocks, 2013 to 2019



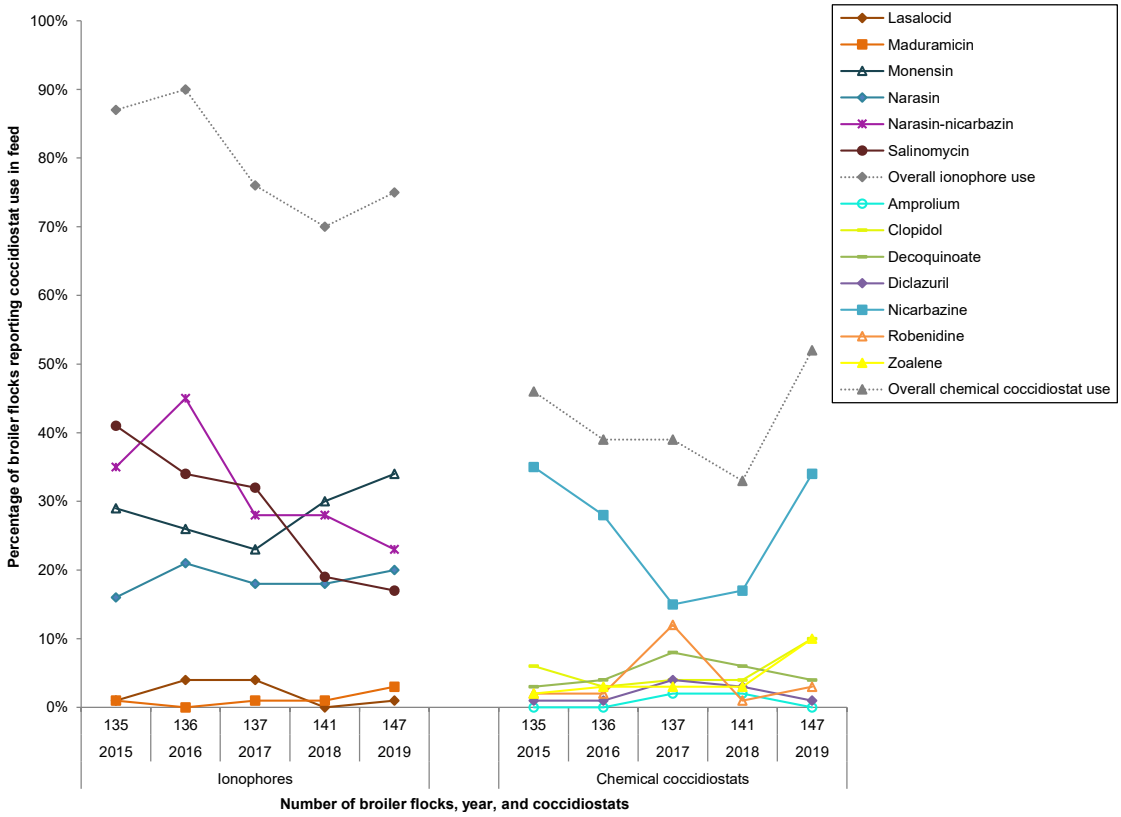
Year Number of flocks	2013 97	2014 141	2015 135	2016 136	2017 137	2018 141	2019 147
Antimicrobial classification							
Medically important antimicrobials[1]	39%	41%	40%	37%	41%	38%	38%
Ionophores	47%	46%	49%	53%	48%	51%	43%
Chemical coccidiostats	14%	13%	10%	9%	11%	11%	19%

Quantity of antimicrobials in milligrams active ingredients.

[1] Medically-important antimicrobials are the classes reported in the previous section[3].

[3] Government of Canada. Health Canada, Veterinary Drugs Directorate. List A: List of certain antimicrobial active pharmaceutical ingredients. Available at: https://www.canada.ca/en/public-health/services/antibiotic-antimicrobial-resistance/animals/veterinary-antimicrobial-sales-reporting/list-a.html.

Figure 2. 31 Percentage of broiler flocks reporting coccidiostat use in feed, 2015 to 2019

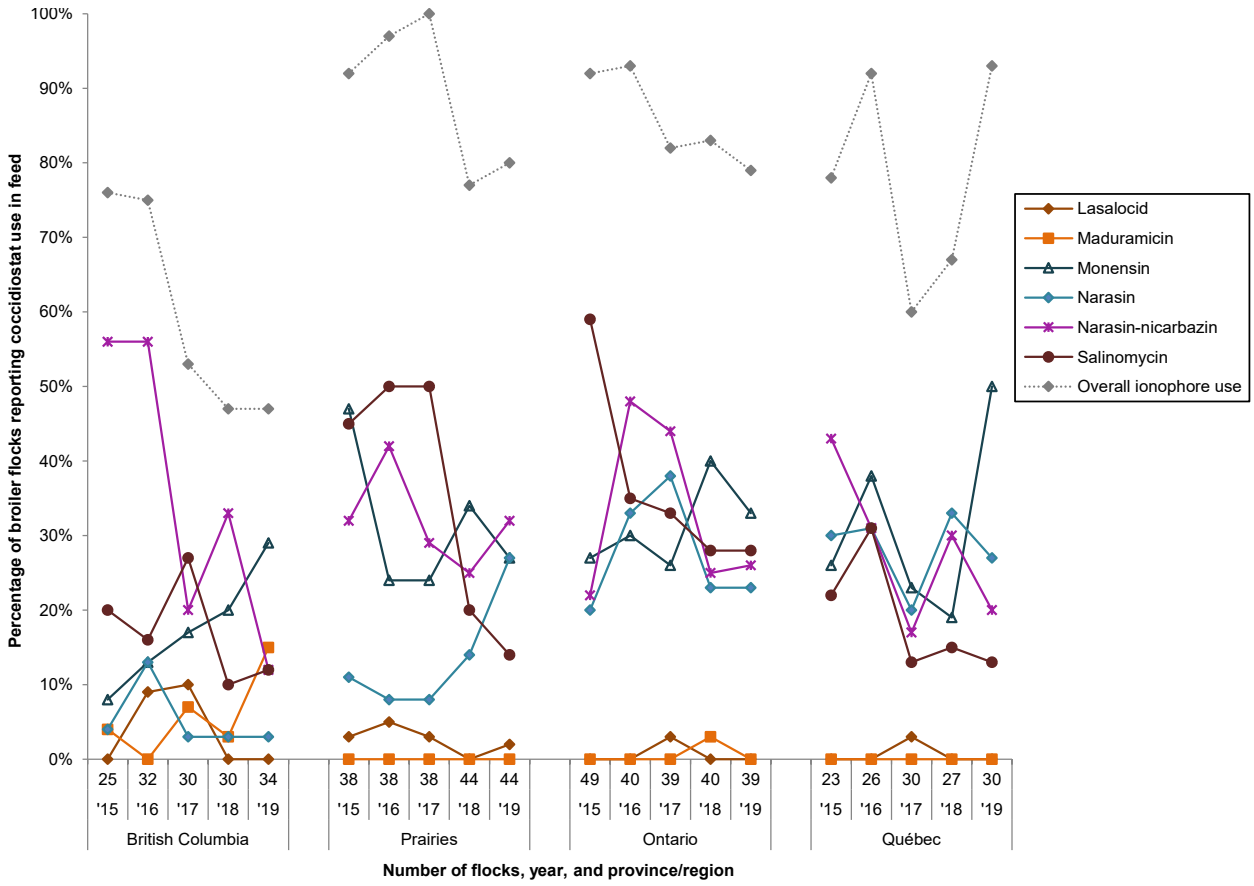


Year	2015	2016	2017	2018	2019
Number of flocks	135	136	137	141	147
Coccidiostat					
IV Lasalocid	**1%**	4%	4%	**0%**	**1%**
IV Maduramicin	**1%**	0%	1%	**1%**	**3%**
IV Monensin	**29%**	26%	23%	**30%**	**34%**
IV Narasin	**16%**	21%	18%	**18%**	**20%**
IV Narasin-nicarbazin	**35%**	45%	28%	**28%**	**23%**
IV Salinomycin	**41%**	34%	32%	**19%**	**17%**
Overall ionophore use	**87%**	90%	76%	**70%**	**75%**
N/A Amprolium	**0%**	0%	2%	**2%**	**0%**
N/A Clopidol	**6%**	3%	4%	**4%**	**10%**
N/A Decoquinoate	**3%**	4%	8%	**6%**	**4%**
N/A Diclazuril	**1%**	1%	4%	**3%**	**1%**
N/A Nicarbazine	**35%**	28%	15%	**17%**	**34%**
N/A Robenidine	**2%**	2%	12%	**1%**	**3%**
N/A Zoalene	**2%**	3%	3%	**3%**	**10%**
Overall chemical coccidiostat use	**46%**	39%	39%	**33%**	**52%**

Roman numeral IV indicates category of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification at the time of writing of this report).

For the temporal analyses, the proportion (%) of flocks using a specific coccidiostat in the current year has been compared to the proportion (%) of flocks using the same coccidiostat in the previous 5 years and the previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences ($P \leq 0.05$) for a given coccidiostat.

Figure 2. 32 Percentage of broiler flocks reporting ionophore coccidiostats in feed, by province/region, 2015 to 2019



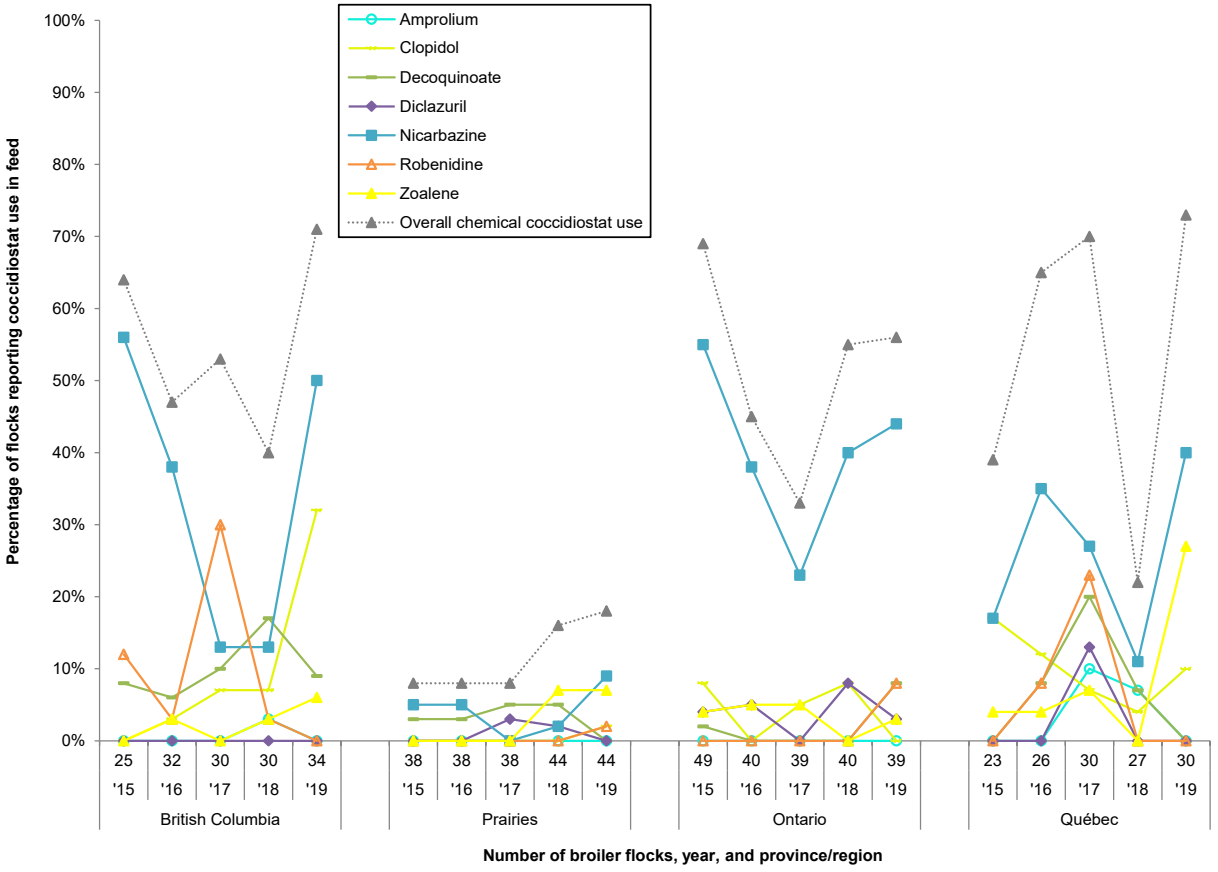
Province/region		British Columbia					Prairies					Ontario					Québec				
Year		'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks		25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Coccidiostat																					
IV	Lasalocid	**0%**	9%	10%	**0%**	**0%**	**3%**	5%	3%	**0%**	**2%**	**0%**	0%	3%	**0%**	**0%**	**0%**	0%	3%	**0%**	**0%**
	Maduramicin	**4%**	0%	7%	**3%**	**15%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**3%**	**0%**	**0%**	0%	0%	**0%**	**0%**
	Monensin	**8%**	13%	17%	**20%**	**29%**	**47%**	24%	24%	**34%**	**27%**	**27%**	30%	26%	**40%**	**33%**	**26%**	38%	23%	**19%**	**50%**
	Narasin	**4%**	13%	3%	**3%**	**3%**	**11%**	8%	8%	**14%**	**27%**	**20%**	33%	38%	**23%**	**23%**	**30%**	31%	20%	**33%**	**27%**
	Narasin-nicarbazin	**56%**	56%	20%	**33%**	**12%**	**32%**	42%	29%	**25%**	**32%**	**22%**	48%	44%	**25%**	**26%**	**43%**	31%	17%	**30%**	**20%**
	Salinomycin	**20%**	16%	27%	**10%**	**12%**	**45%**	50%	50%	**20%**	**14%**	**59%**	35%	33%	**28%**	**28%**	**22%**	31%	13%	**15%**	**13%**
	Overall ionophores use	**76%**	75%	53%	**47%**	**47%**	**92%**	97%	100%	**77%**	**80%**	**92%**	93%	82%	**83%**	**79%**	**78%**	92%	60%	**67%**	**93%**

Roman numeral IV indicates category of importance to human medicine as outlined by the Veterinary Drugs Directorate.

For the temporal analyses within province/region, the proportion (%) of flocks using a specific ionophore in the current year has been compared to the proportion (%) of flocks using the same ionophore in the previous 5 years and the previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences within province/region ($P \leq 0.05$) for a given ionophore. The presence of red areas indicates significant provincial/regional differences ($P \leq 0.05$) for a given ionophore within the current year (Québec-referent province).

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Figure 2. 33 Percentage of broiler flocks reporting chemical coccidiostats in feed, by province/region, 2015 to 2019



Province/region		British Columbia					Prairies					Ontario					Québec				
Year		'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks		25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Coccidiostat																					
N/A	Amprolium	**0%**	0%	0%	**3%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	10%	**7%**	**0%**
	Clopidol	**0%**	3%	7%	**7%**	**32%**	**0%**	0%	0%	**0%**	**2%**	**8%**	0%	5%	**8%**	**0%**	**17%**	12%	7%	**4%**	**10%**
	Decoquinoate	**8%**	6%	10%	**17%**	**9%**	**3%**	3%	5%	**5%**	**0%**	**2%**	0%	0%	**0%**	**8%**	**0%**	8%	20%	**7%**	**0%**
	Diclazuril	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	3%	**2%**	**0%**	**4%**	5%	0%	**8%**	**3%**	**0%**	0%	13%	**0%**	**0%**
	Nicarbazine	**56%**	38%	13%	**13%**	**50%**	**5%**	5%	0%	**2%**	**9%**	**55%**	38%	23%	**40%**	**44%**	**17%**	35%	27%	**11%**	**40%**
	Robenidine	**12%**	3%	30%	**3%**	**0%**	**0%**	0%	0%	**0%**	**2%**	**0%**	0%	0%	**0%**	**8%**	**0%**	8%	23%	**0%**	**0%**
	Zoalene	**0%**	3%	0%	**3%**	**6%**	**0%**	0%	0%	**7%**	**7%**	**4%**	5%	5%	**0%**	**3%**	**4%**	4%	7%	**0%**	**27%**
	Overall chemical coccidiostat use	**64%**	47%	53%	**40%**	**71%**	**8%**	8%	8%	**16%**	**18%**	**69%**	45%	33%	**55%**	**56%**	**39%**	65%	70%	**22%**	**73%**

N/A = not applicable (no classification at the time of writing of this report).

For the temporal analyses within province/region, the proportion (%) of flocks using a specific chemical coccidiostat in the current year has been compared to the proportion (%) of flocks using the same chemical coccidiostat in the previous 5 years and the previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences within province/region ($P \leq 0.05$) for a given chemical coccidiostat. The presence of red areas indicates significant provincial/regional differences ($P \leq 0.05$) for a given chemical coccidiostat within the current year (Québec-referent province).

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Antimicrobial use: Farm Surveillance in grower-finisher pigs

Please contact phac.cipars-picra.aspc@phac-aspc.gc.ca for more detailed information.

Summary of antimicrobial use by route of administration

Table 2. 10 Frequency and quantity of antimicrobial use in grower-finisher pigs, by route of administration, 2019

Route of administration	Antimicrobial	Herds	Rations or treatments	Days exposed[a]	Percent of herd exposed	Weight (kg) at exposure	Level of drug	Quantity of antimicrobial active ingredient[e]	
		n (%) Total = 107	n (%) *Total = 466	Median (min. ; max.)	Median (min. ; max.)	Median[b] (min. ; max.)[c]	Median (min. ; max.)	mg/PCU	nDDDvetCA / 1,000 GF pig-days at risk
Feed							g/tonne		
II	Lincomycin	20 (19)	35 (28)	21 (3 ; 63)	100 (50 ; 100)	70 (25 ; 130)	44 (40 ; 220)	14	24
	Lincomycin-spectinomycin	0 (0)	(0)	0 (0 ; 0)	0 (0 ; 0)	0 (0 ; 0)	0 (0 ; 0)	0	0
	Penicillin-chlortetracycline-sulfamethazine	2 (2)	2 (2)	20.5 (6 ; 35)	100 (100 ; 100)	41 (23 ; 59)			
	Penicillin						55 (55 ; 55)	1	6
	Chlortetracycline						110 (110 ; 110)	2	1
	Sulfamethazine						110 (110 ; 110)	2	3
	Penicillin	1 (1)	1 (1)	14 (14 ; 14)	100 (100 ; 100)	35 (30 ; 40)	99 (99 ; 99)	0	0
	Tilmicosin	0 (0)	(0)	0 (0 ; 0)	0 (0 ; 0)	0 (0 ; 0)	0 (0 ; 0)	0	0
	Tylosin	14 (13)	29 (24)	24.5 (3 ; 49)	100 (100 ; 100)	70 (23 ; 135)	44 (22 ; 390)	23	64
	Tylvalosin	5 (5)	9 (7)	21 (14 ; 28)	100 (100 ; 100)	55 (18 ; 135)	43 (43 ; 111)	3	13
	Virginiamycin	1 (1)	3 (2)	21 (21 ; 70)	100 (100 ; 100)	45 (27 ; 122)	11 (11 ; 11)	1	1
III	Bacitracin	0 (0)	(0)	0 (0 ; 0)	0 (0 ; 0)	0 (0 ; 0)	0 (0 ; 0)	0	0
	Chlortetracycline	14 (13)	21 (17)	17.5 (3 ; 49)	100 (50 ; 100)	38 (18 ; 94)	330 (100 ; 1210)	38	31
	Oxytetracycline	1 (1)	1 (1)	9.1 (9.1 ; 9.1)	100 (100 ; 100)	38 (25 ; 51)	440 (440 ; 440)	2	4
	Spectinomycin	0 (0)	(0)	0 (0 ; 0)	0 (0 ; 0)	0 (0 ; 0)	0 (0 ; 0)	0	0
	Sulfamethazine	0 (0)	(0)	0 (0 ; 0)	0 (0 ; 0)	0 (0 ; 0)	0 (0 ; 0)	0	0
IV	Bambermycin	1 (1)	4 (3)	31.5 (21 ; 42)	100 (100 ; 100)	68 (25 ; 135)	2 (2 ; 2)	0.1	9.1
UC	Tiamulin	6 (6)	14 (11)	21 (14 ; 35)	100 (100 ; 100)	46 (25 ; 90)	31 (22 ; 39)	6	9
AMU in feed		**62 (58)**	**123 (26)**	**21 (3 ; 70)**	**100 (50 ; 100)**	**53 (18 ; 135)**		**89**	**164**
No antimicrobial use in feed		45 (42)	231 (50)	28 (11 ; 98)	100 (50 ; 100)	78 (16 ; 140)		0	0
Ionophores									
IV	Narasin	10 (9)	37 (8)	28 (14 ; 126)	100 (50 ; 100)	75 (20 ; 136)	15 (11 ; 150)	11	
	Salinomycin	22 (21)	75 (16)	32 (10 ; 70)	100 (50 ; 100)	72 (20 ; 145)	25 (25 ; 60)	23	
Total		**32 (30)**	**112 (24)**	**28 (10 ; 126)**	**100 (50 ; 100)**	**72 (20 ; 145)**		**34**	

See corresponding footnotes on next page.

Table 2. 10 Frequency and quantity of antimicrobial use in grower-finisher pigs, by route of administration, 2019 (continued)

Route of administration	Antimicrobial	Herds	Rations or treatments	Days exposed[a]	Percent of herd exposed	Weight (kg) at exposure	Level of drug	Quantity of antimicrobial active ingredient[e]	
		n (%) Total = 107	n (%) *Total = 466	Median (min. ; max.)	Median (min. ; max.)	Median[b] (min. ; max.)[c]	Median (min. ; max.)	mg/PCU	nDDDvetCA / 1,000 GF pig-days at risk
Water							**mg/kg body weight/day**		
II	Amoxicillin	5 (5)	6 (17)	5 (4 ; 5)	100 (64 ; 100)	44 (28 ; 80)	17 (14 ; 23)	4	2
	Lincomycin	2 (2)	2 (6)	5 (5 ; 5)	100 (100 ; 100)	43 (30 ; 55)	7 (4 ; 10)	0.2	0.4
	Penicillin	7 (7)	7 (19)	5 (5 ; 10)	100 (100 ; 100)	35 (26 ; 91)	18 (3 ; 54)	3	2
	Trimethoprim-sulfadiazine	3 (3)	5 (14)	5 (5 ; 6)	100 (100 ; 100)	34 (24 ; 35)	20 (17 ; 42)	4	2
	Tylvalosin	8 (7)	10 (28)	7 (3 ; 14)	100 (24 ; 100)	51 (35 ; 85)	5 (1 ; 15)	3	5
III	Tetracycline	5 (5)	5 (14)	5 (5 ; 7)	100 (64 ; 100)	35 (35 ; 45)	23 (15 ; 31)	4	4
UC	Tiamulin	1 (1)	1 (3)	5 (5 ; 5)	50 (50 ; 50)	50 (50 ; 50)		0.02	0.04
AMU in water		**23 (21)**	**36 (100)**	**5 (3 ; 14)**	**100 (24 ; 100)**	**37 (24 ; 91)**		**19**	**15**
No antimicrobial use in water		84 (79)							
Injection							**mg/kg body weight/day**		
I	Ceftiofur	12 (11)	17 (12)	1 (1 ; 3)	1 (0.1 ; 4.5)	59 (22 ; 115)	3 (2 ; 5)	0.017	0.057
II	Ampicillin	6 (6)	6 (4)	3 (2 ; 3)	1.5 (1 ; 2)	69 (26 ; 100)	5.9 (5.9 ; 8)	0.010	0.015
	Lincomycin	14 (13)	20 (14)	3 (1 ; 4)	1.3 (0.1 ; 20)	55 (27 ; 110)	10 (3.8 ; 10.7)	0.175	0.153
	Penicillin	30 (28)	44 (31)	3 (1 ; 10)	1.8 (0.1 ; 5)	42 (25 ; 70)	20 (2 ; 60)	0.222	0.390
	Trimethoprim-sulfadoxine	8 (7)	8 (6)	3 (2 ; 3)	2 (0.2 ; 5)	48 (25 ; 82)	15 (15 ; 15)	0.067	0.077
	Tulathromyciin	14 (13)	14 (10)	1 (1 ; 2)	1.2 (0.2 ; 10)	46 (25 ; 75)	2.5 (2.5 ; 2.6)	0.010	0.125
	Tylosin	2 (2)	2 (1)	2.5 (2 ; 3)	5 (5 ; 5)	58 (55 ; 60)	11 (10 ; 12)	0.107	0.015
III	Florfenicol	16 (15)	18 (13)	2 (1 ; 3)	3.3 (0.3 ; 11)	48 (25 ; 85)	15 (11 ; 18.5)	0.023	0.124
	Oxytetracycline	2 (2)	2 (1)	1.5 (1 ; 2)	5 (5 ; 5)	36 (32.5 ; 40)	20 (20 ; 20)	0.017	0.035
UC	Tiamulin	1 (1)	1 (1)	1 (1 ; 1)	10 (10 ; 10)	60 (60 ; 60)	12 (12 ; 12)	0.652	0.013
AMU by injection		**49 (46)**	**140 (100)**	**2 (1 ; 10)**	**2 (0.1 ; 20)**	**49 (22 ; 115)**	**12 (2 ; 60)**	**0.643**	**1.004**
No antimicrobial use by injection		56 (52)							

See corresponding page for footnotes.

Table 2. 10 Frequency and quantity of antimicrobial use in grower-finisher pigs, by route of administration, 2019 (continued)

Roman numerals II to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = tiamulin is a medically important but uncategorized (UC) antimicrobial.

Grey shaded cells = no data or calculations/values are not applicable for grower-finisher pigs.

AMU = antimicrobial use.

mg/PCU = milligrams/population correction unit.

DDDvetCA = Canadian Defined Daily Doses (average labelled dose) in milligrams per kilogram grower-finisher pig weight per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 2 for the list of standards.

nDDDvetCA/1,000 GF pig-days at risk = number of DDDvetCA/1,000 grower-finisher pig-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

[a] Ration days exposed = for rations medicated with the specific antimicrobial and do not reflect the full grow-out period.

[b] Median weight at exposure = the median of all average weights of pigs exposed to a ration containing a specific antimicrobial [(Ration Start Weight + Ration End Weight)/2].

[c] Minimum (min.) and maximum (max.) pig weight at exposure = the lowest start weight and the highest end weight reported for all rations containing the specific antimicrobial, respectively.

[d] Level of drug is in grams/tonne of feed.

[e] Quantitative antimicrobial consumption estimates were calculated using reported ration days fed and predicted feed intake4, adjusted for herd average daily gain; only rations medicated with the specific antimicrobial were included in this analysis; the final mg/PCU and nDDDvetCA/1,000 GF pig-days at risk exclude coccidiostats and pyrimethamine. Flavophospholipids was included only in the mg/PCU.

[4] National Research Council. 2012. Nutrient Requirements of Swine, Eleventh Edition. Washington, DC: National Academy Press.

Table 2. 11 Production, biomass and quantity of antimicrobials used in grower-finisher pigs, by province/region, 2015 to 2019

Province/ region	Year	Number of herds	Average weight at exposure Median (min ; max)			Average grow-finish period	Active ingredient[a]	Grower-finisher pig weights[b]	mg/PCU		nDDDvetCA / 1,000 GF pig-days at risk	
		n (%)	Feed	Water	Injection	(Days)	(mg)	(kg)	Total	% change[c]	Total	% change[c]
Prairies	2015	39 (46)	70 (25 ; 121)			111	854,877,885	5,493,810	156		268	
	2016	40 (44)	69 (28 ; 136)			112	548,609,650	5,438,142	101	-35	217	-19
	2017	40 (49)	68 (23 ; 215)	30 (21 ; 65)	44 (20 ; 100)	111	597,016,065	5,359,508	111	10	185	-15
	2018	44 (45)	68 (28 ; 194)	43 (25 ; 110)	50 (25 ; 95)	112	782,080,276	5,523,828	142	27	199	7
	2019	47 (44)	70 (23 ; 125)	42 (35 ; 91)	53 (22 ; 110)	109	695,079,105	6,022,995	115	-18	198	-1
Ontario	2015	25 (29)	70 (27 ; 125)			114	454,971,382	2,306,070	197		325	
	2016	27 (30)	63 (28 ; 125)			114	298,836,760	2,422,905	123	-37	200	-39
	2017	22 (27)	70 (30 ; 125)	80 (80 ; 80)	45 (30 ; 150)	110	199,105,199	1,333,670	149	21	263	32
	2018	31 (32)	70 (30 ; 135)	35 (29 ; 50)	40 (30 ; 85)	112	248,788,752	2,152,361	116	-23	202	-23
	2019	32 (30)	71 (28 ; 165)	45 (28 ; 60)	50 (35 ; 75)	113	260,074,927	2,480,335	105	-9	205	1
Québec	2015	21 (25)	58 (22 ; 119)			115	393,836,556	1,864,200	211		268	
	2016	24 (26)	59 (25 ; 120)			117	262,132,293	1,744,568	150	-29	164	-39
	2017	20 (24)	63 (30 ; 123)	35 (25 ; 100)	43 (18 ; 120)	125	187,547,603	1,809,600	104	-31	148	-10
	2018	22 (23)	61 (30 ; 120)	45 (32 ; 80)	42 (25 ; 105)	121	204,453,093	2,052,375	100	-4	141	-5
	2019	28 (26)	58 (22 ; 120)	34 (24 ; 85)	47 (25 ; 115)	127	241,399,765	2,538,153	95	-5	95	-33
National[d]	2015	85 (18)	67 (22 ; 125)			113	1,703,685,823	9,664,080	176		281	
	2016	91 (20)	67 (25 ; 136)			114	1,109,578,703	9,605,614	116	-34	202	-28
	2017	82 (18)	68 (23 ; 215)	35 (21 ; 100)	45 (18 ; 150)	114	983,668,866	8,502,778	116	0	188	-7
	2018	97 (21)	68 (28 ; 194)	45 (25 ; 110)	45 (25 ; 105)	114	1,235,322,120	9,728,564	127	10	186	-1
	2019	107 (23)	68 (22 ; 165)	37 (24 ; 91)	49 (22 ; 115)	115	1,196,553,796	11,041,483	108	-15	172	-8

See corresponding page for footnotes.

Table 2. 11 Production, biomass and quantity of antimicrobials used in grower-finisher pigs, by province/region, 2015 to 2019 (continued)

This analysis excludes ionophore coccidiostats in feed.

mg/PCU = milligrams/population correction unit.

ESVAC = European Surveillance of Veterinary Antimicrobial Consumption.

DDDvetCA = Canadian Defined Daily Doses (average labelled dose) in milligrams per kilogram grower-finisher pig weight per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 2 for the list of standards.

nDDDvetCA/1,000 GF pig-days at risk = number of DDDvetCA/1,000 grower-finisher pig-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

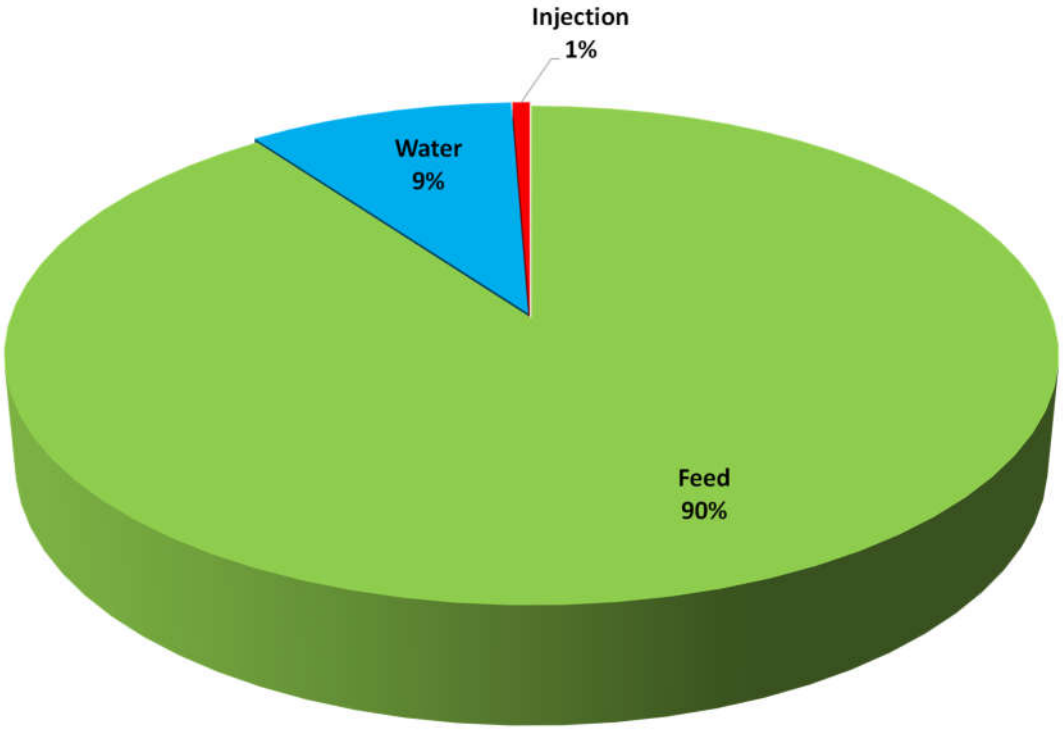
[a] Population correction unit (PCU) or biomass, European weight (total herd population x ESVAC standard weight of 65 kg pig).

[b] Percent change = [(current surveillance year – previous surveillance year)/previous surveillance year] x 100.

[c] Includes only the provinces/regions surveyed and includes only the quantity of antimicrobials used in feed, excluding ionophores.

[d] Includes only the provinces/regions surveyed and includes only the quantity of ionophores used in feed, excluding other antimicrobials.

Figure 2. 34 Quantity of antimicrobials, adjusted for dose (DDDvetCA/1,000 pig-days at risk), 2019



Quantitative estimates are based on milligrams of antimicrobial use, excluding ionophores.

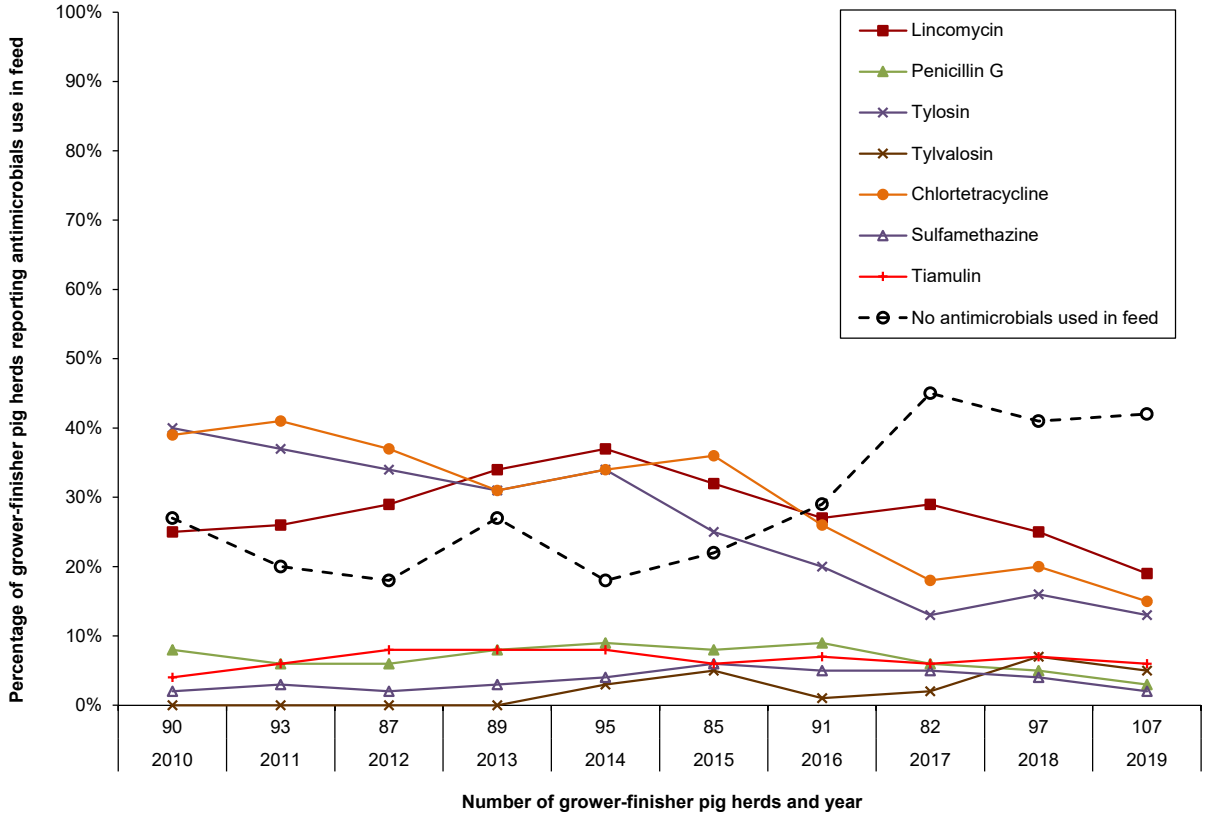
DDDvetCA = Canadian Defined Daily Doses (average labelled dose) in milligrams per kilogram grower-finisher pig weight per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 2 for the list of standards.

nDDDvetCA/1,000 GF pig-days at risk = number of DDDvetCA/ 1,000 grower-finisher pig-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

Antimicrobial use in feed by frequency

Figure 2. 35 Percentage of grower-finisher pig herds reporting antimicrobial use in feed, 2010 to 2019



Year Number of herds		2010 90	2011 93	2012 87	2013 89	2014 95	2015 85	2016 91	2017 82	2018 97	2019 107
Antimicrobial											
II	Lincomycin	**25%**	26%	29%	34%	37%	32%	27%	29%	**25%**	**19%**
	Penicillin G	**8%**	6%	6%	8%	9%	8%	9%	6%	**5%**	**3%**
	Tylosin	**40%**	37%	34%	31%	34%	25%	20%	13%	**16%**	**13%**
	Tylvalosin	**0%**	0%	0%	0%	3%	5%	1%	2%	**7%**	**5%**
III	Chlortetracycline	**39%**	41%	37%	31%	34%	36%	26%	18%	**20%**	**15%**
	Sulfamethazine	**2%**	3%	2%	3%	4%	6%	5%	5%	**4%**	**2%**
UC	Tiamulin	**4%**	6%	8%	8%	8%	6%	7%	6%	**7%**	**6%**
	No antimicrobials used in feed	**27%**	20%	18%	27%	18%	22%	29%	45%	**41%**	**42%**

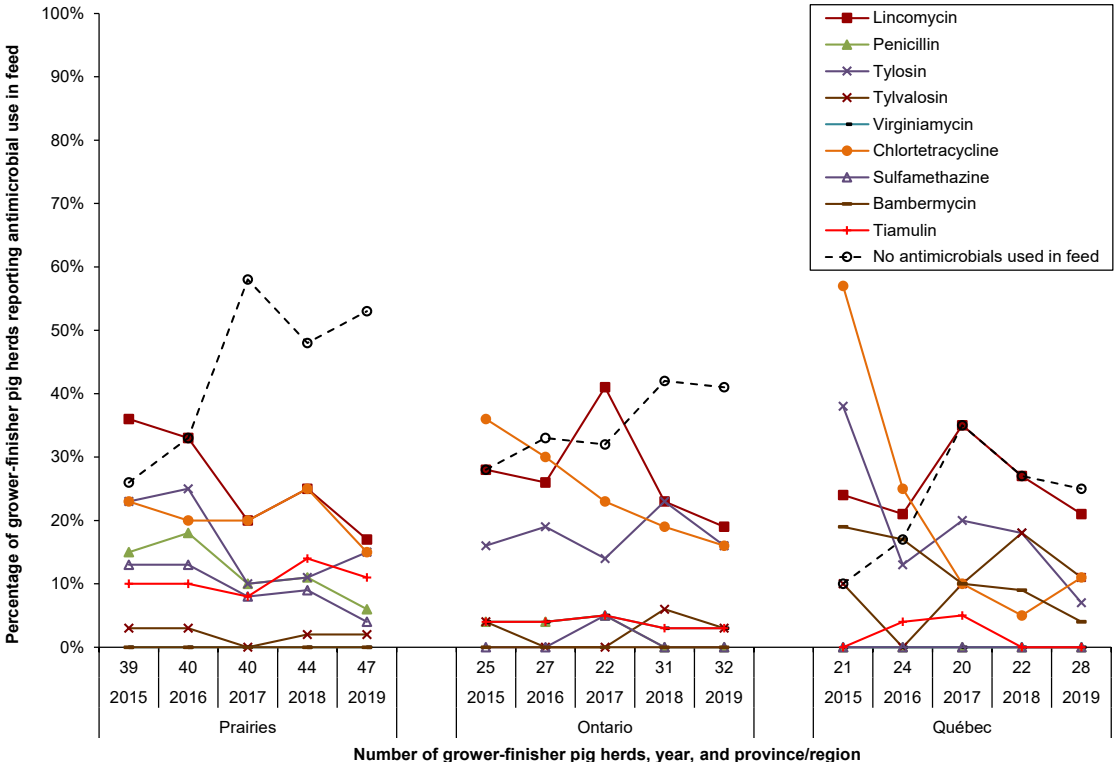
Roman numerals II to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = tiamulin is a medically important but uncategorized (UC) antimicrobial.

Only antimicrobials used by 5% of herds or more in a given year within any province/region are depicted in this figure. Antimicrobial use in feed reported by fewer than 5% of herds included Category II: tilmicosin, virginiamycin; Category III: bacitracin, neomycin, oxytetracycline, spectinomycin; Category IV: bambermycin.

For the temporal analyses, the proportion (%) of herds using a specific antimicrobial in the current year has been compared to the proportion (%) of herds using the same antimicrobial in the previous 10 years and previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences ($P \leq 0.05$) for a given antimicrobial.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 2. 36 Percentage of grower-finisher pig herds reporting antimicrobial use in feed, by province/region, 2015 to 2019



Province/region		Prairies					Ontario					Québec				
Year		2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Number of herds		39	40	40	44	47	25	27	22	31	32	21	24	20	22	28
Antimicrobial																
II	Lincomycin	**36%**	33%	20%	**25%**	**17%**	**28%**	26%	41%	**23%**	**19%**	**24%**	21%	35%	**27%**	**21%**
II	Penicillin	**15%**	18%	10%	**11%**	**6%**	**4%**	4%	5%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
II	Tylosin	**23%**	25%	10%	**11%**	**15%**	**16%**	19%	14%	**23%**	**16%**	**38%**	13%	20%	**18%**	**7%**
II	Tylvalosin	**3%**	3%	0%	**2%**	**2%**	**4%**	0%	0%	**6%**	**3%**	**10%**	0%	10%	**18%**	**11%**
II	Virginiamycin	**0%**	0%	0%	**0%**	**0%**	**4%**	4%	5%	**3%**	**3%**	**0%**	0%	0%	**0%**	**0%**
III	Chlortetracycline	**23%**	20%	20%	**25%**	**15%**	**36%**	30%	23%	**19%**	**16%**	**57%**	25%	10%	**5%**	**11%**
III	Sulfamethazine	**13%**	13%	8%	**9%**	**4%**	**0%**	0%	5%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
IV	Bambermycin	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**19%**	17%	10%	**9%**	**4%**
UC	Tiamulin	**10%**	10%	8%	**14%**	**11%**	**4%**	4%	5%	**3%**	**3%**	**0%**	4%	5%	**0%**	**0%**
	No antimicrobials used in feed	**26%**	33%	58%	**48%**	**53%**	**28%**	33%	32%	**42%**	**41%**	**10%**	17%	35%	**27%**	**25%**

Roman numerals II to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = tiamulin is a medically important but uncategorized (UC) antimicrobial.

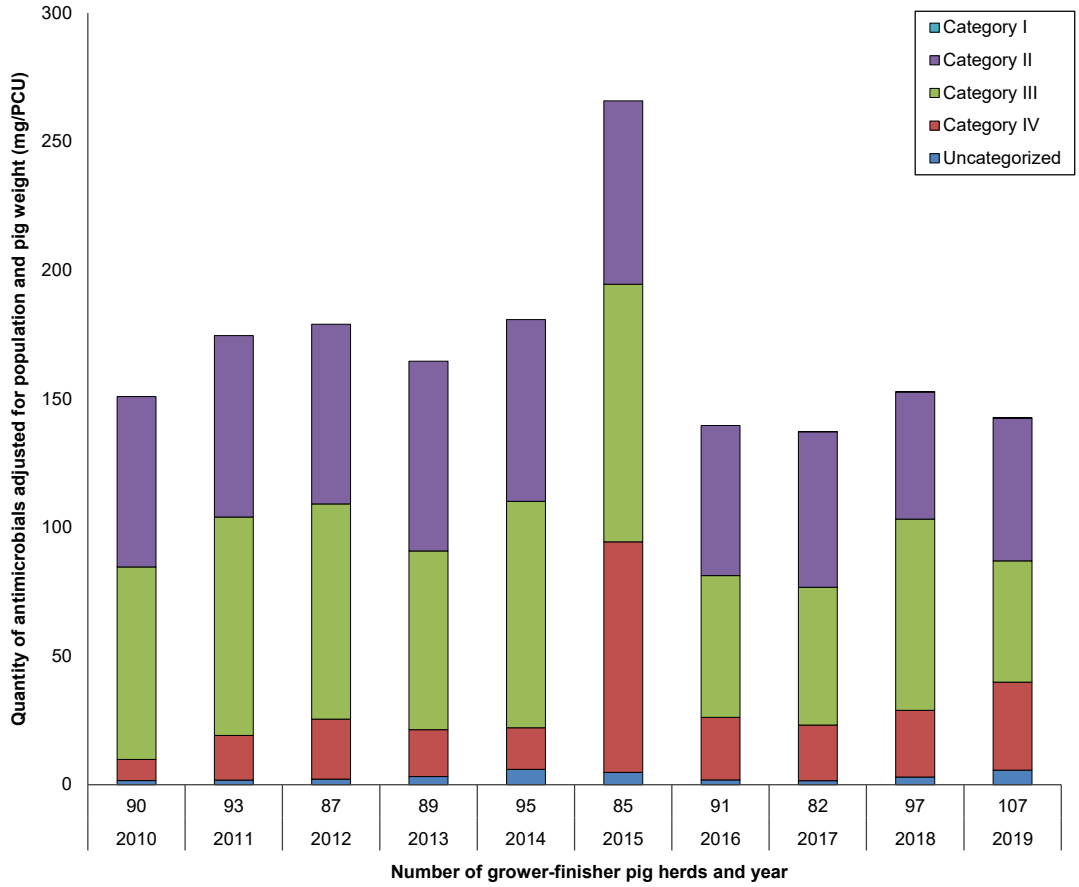
Only antimicrobials used by 5% of herds or more in a given year within any province/region are depicted in this figure. Antimicrobial use in feed reported by fewer than 5% of herds included Category II: tilmicosin; Category III: bacitracin, neomycin, oxytetracycline, and spectinomycin.

For the temporal analyses within province/region, the proportion (%) of herds using a specific antimicrobial in the current year has been compared to the proportion (%) of herds using the same antimicrobial in the previous 5 years and the previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences within province/region ($P \leq 0.05$) for a given antimicrobial. The presence of red areas indicates significant provincial/regional differences ($P \leq 0.05$) for a given antimicrobial within the current year (Québec-referent province). The presence of purple areas (2019 surveillance year; Québec-referent province) indicates significant temporal and provincial/regional differences ($P \leq 0.05$) for a given antimicrobial.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Antimicrobial use in feed by quantitative indicators

Figure 2. 37 Quantity of antimicrobial use in feed adjusted for population and pig weight (mg/PCU), by Veterinary Drugs Directorate category, 2010 to 2019



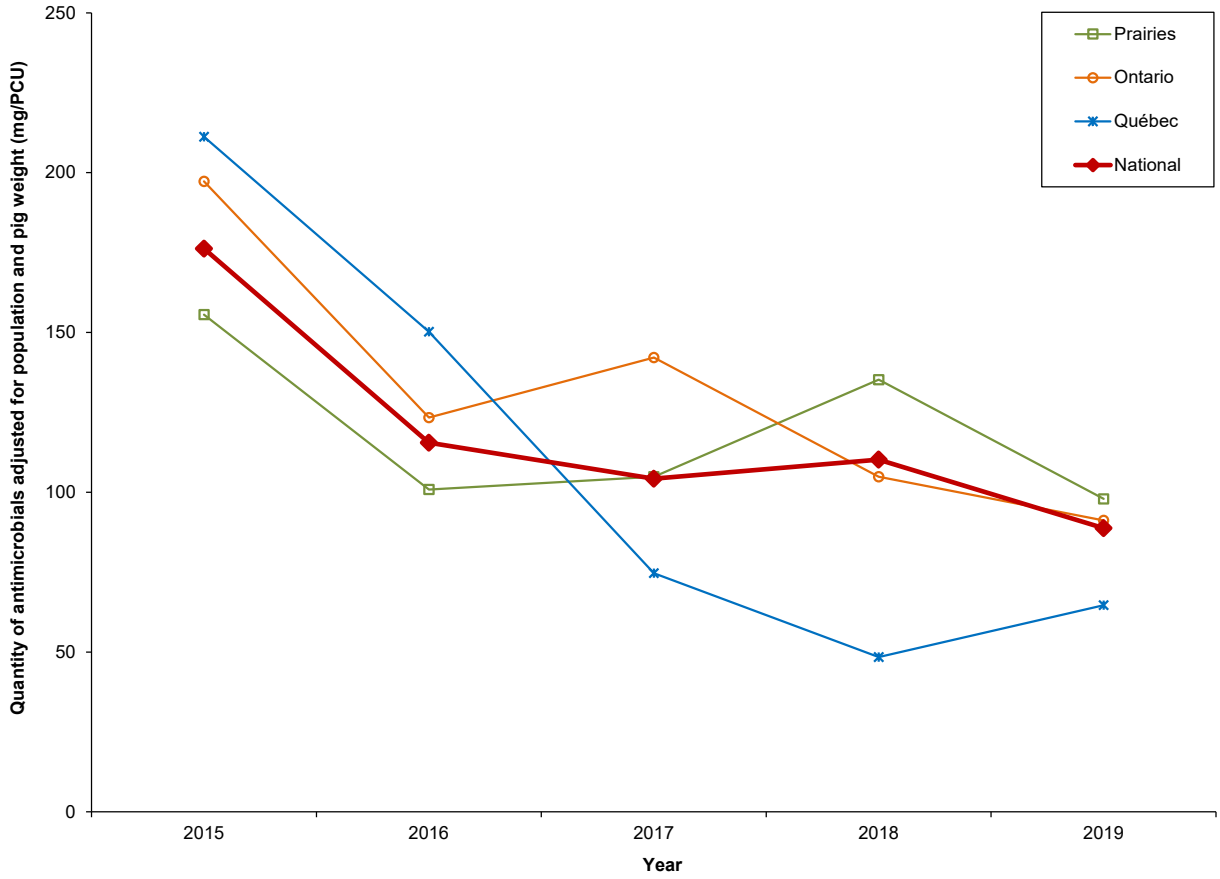
Year Number of herds	2010 92	2011 93	2012 87	2013 89	2014 95	2015 85	2016 91	2017 82	2018 97	2019 107
Category I	0	0	0	0	0	0	0	<0.1	<0.1	<0.1
Category II	66	71	70	74	71	71	58	60	49	56
Category III	75	85	84	69	88	100	55	54	74	47
Category IV	8	17	23	18	16	90	24	22	26	34
UC	2	2	2	3	6	5	2	2	3	6
Total	**151**	**175**	**179**	**165**	**181**	**266**	**140**	**137**	**153**	**143**

mg/PCU = milligrams/population correction unit.

UC = uncategorized, medically important.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

Figure 2. 38 Quantity of antimicrobial use in feed adjusted for population and pig weight (mg/PCU), by province/region, 2015 to 2019



Year Province/region	2015	2016	2017	2018	2019
Prairies	156	101	105	135	98
Ontario	197	123	142	105	91
Québec	211	150	75	48	65
National	**176**	**116**	**104**	**110**	**89**

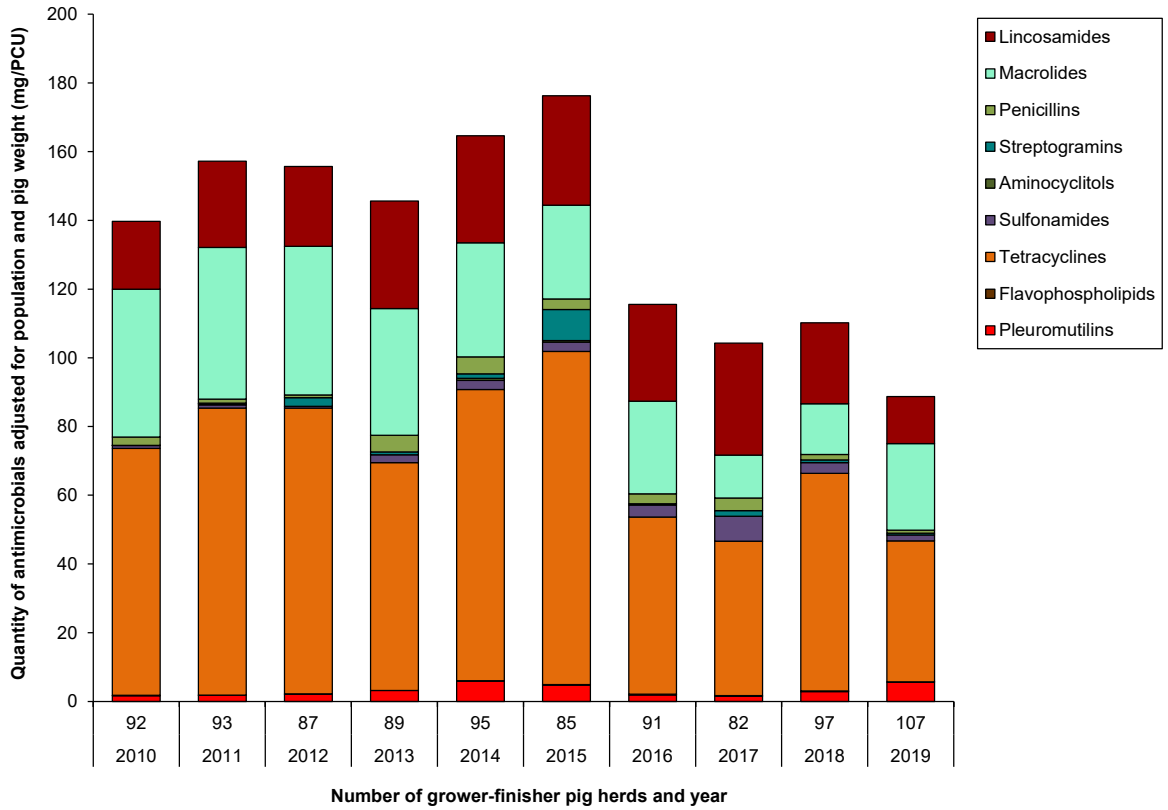
Excluded from this analysis were antimicrobials used for growth promotion and have doses lower than preventive and treatment dosage: bambermycin, narasin, and salinomycin.

mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to CIPARS 2019: Design and Methods.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 2. 39 Quantity of antimicrobial use in feed, adjusted for population and pig weight (mg/PCU), 2010 to 2019



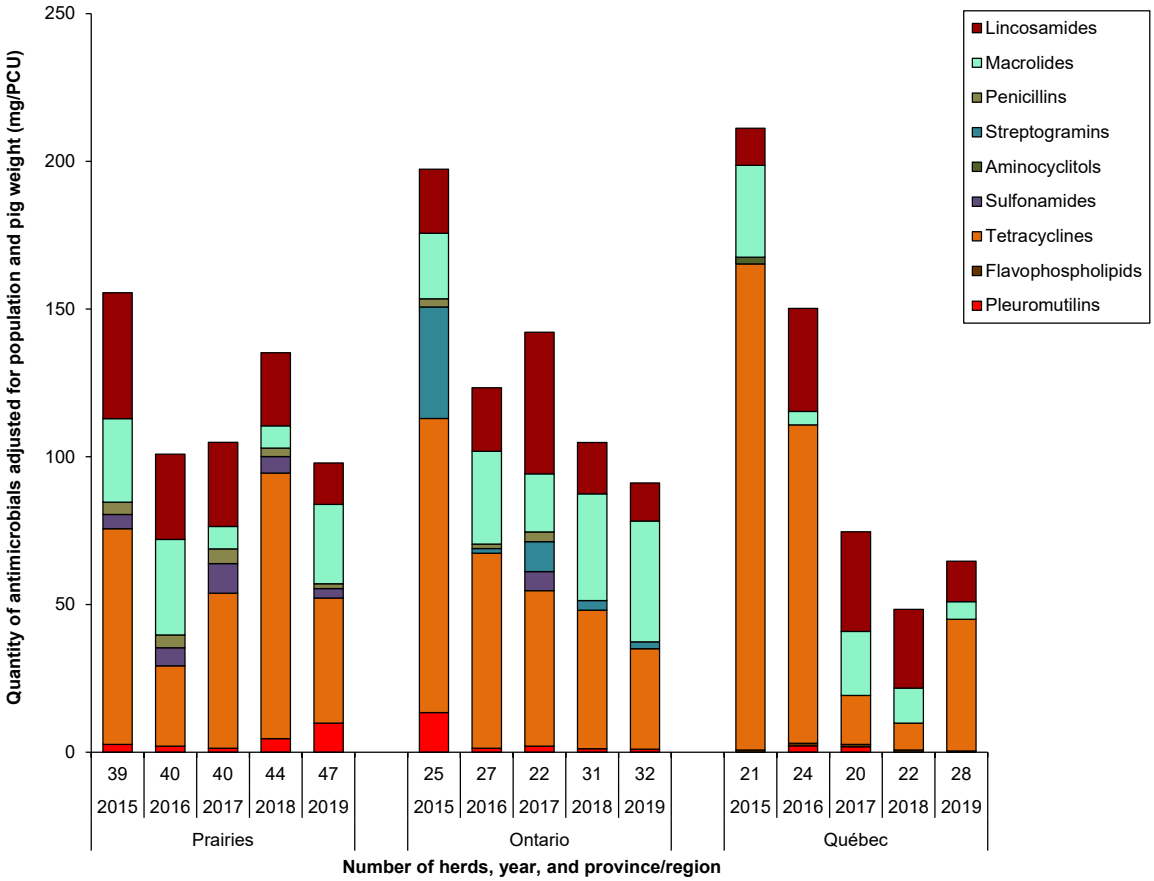
Year		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of herds		92	93	87	89	95	85	91	82	97	107
Antimicrobial class											
II	Lincosamides	19.8	25.1	23.2	31.3	31.1	31.9	28.1	32.6	23.5	13.7
	Macrolides	43.0	44.2	43.3	36.8	33.2	27.3	27.0	12.5	14.8	25.2
	Penicillins	2.4	1.2	0.8	4.9	4.9	3.0	2.9	3.7	1.6	0.9
	Streptogramins	< 0.1	0.1	2.6	0.8	1.3	9.0	0.4	1.6	0.7	0.5
III	Aminocyclitols	< 0.1	0.4	0.0	0.0	0.6	0.5	0.0	0.0	0.0	0.0
	Bacitracins	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Sulfonamides	0.8	0.9	0.5	2.3	2.7	2.7	3.5	7.3	3.2	1.7
	Tetracyclines	71.9	83.5	83.1	66.3	84.7	97.0	51.6	44.9	63.3	41.0
IV	Flavophospholipids	0.1	< 0.1	0.1	0.0	< 0.1	0.1	0.2	0.2	0.2	0.1
UC	Pleuromutilins	1.6	1.8	2.1	3.2	6.0	4.8	1.9	1.5	2.9	5.6
Total		**140.6**	**157.2**	**155.7**	**145.6**	**164.6**	**176.3**	**115.5**	**104.3**	**110.2**	**88.8**

Roman numerals II to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = pleuromutilins are medically important but uncategorized (UC).

mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to CIPARS 2019: Design and Methods document.

Figure 2. 40 Quantity of antimicrobial use in feed, adjusted for population and pig weight (mg/PCU), by province/region, 2015 to 2019



Province/region		Prairies					Ontario					Québec				
Year		2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Number of herds		39	40	40	44	47	25	27	22	31	32	21	24	20	22	28
Antimicrobial class																
II	Lincosamides	43	29	28	25	14	22	21	48	17	13	13	35	34	27	14
II	Macrolides	28	32	8	8	27	22	31	20	36	41	31	5	22	12	6
II	Penicillins	4	4	5	3	2	3	2	3	0	0	0	0	0	0	0
II	Streptogramins	0	0	0	0	0	38	2	10	3	2	0	0	0	0	0
III	Aminocyclitols	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
III	Sulfonamides	5	6	10	6	3	0	0	7	0	0	0	0	0	0	0
III	Tetracyclines	73	27	53	90	42	100	66	53	47	34	165	108	17	9	45
IV	Flavophospholipids	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
UC	Pleuromutilins	3	2	1	5	10	13	1	2	1	1	0	2	2	0	0
Total		**156**	**101**	**105**	**135**	**98**	**197**	**123**	**142**	**105**	**91**	**211**	**150**	**75**	**48**	**65**

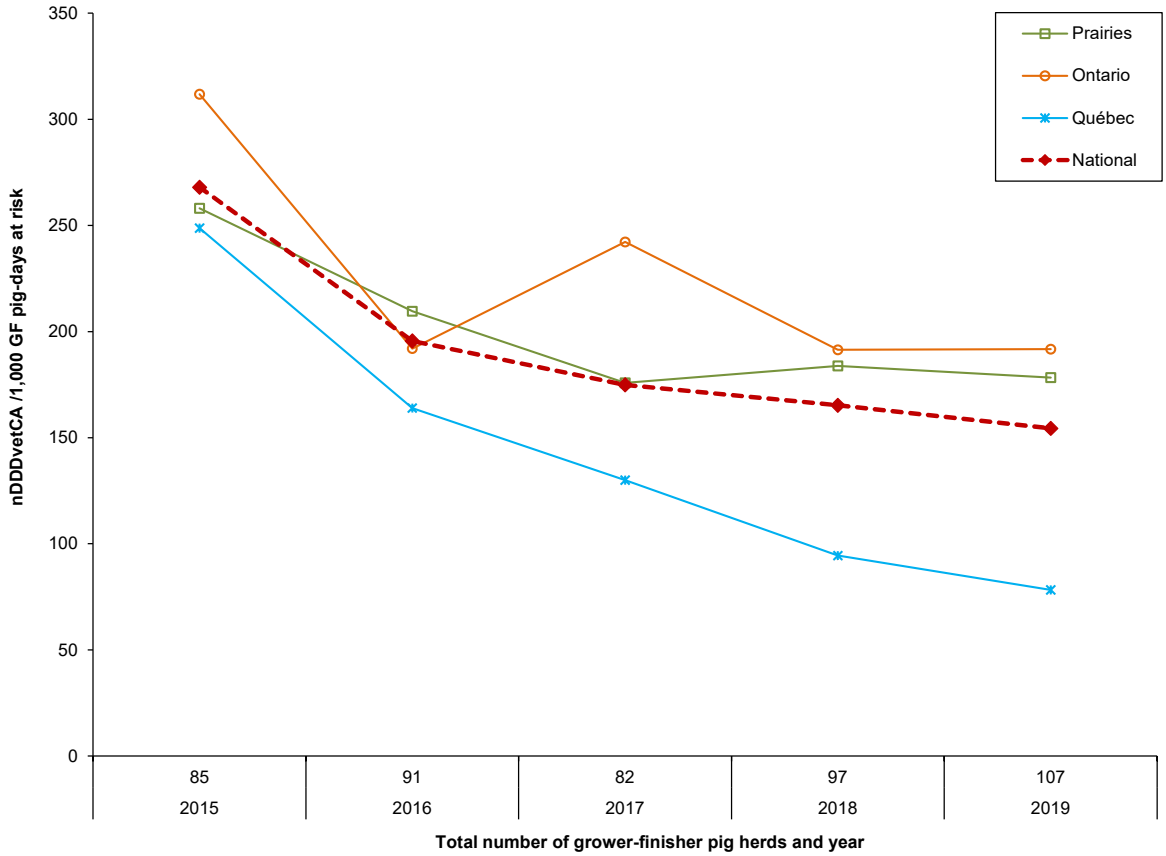
Roman numerals II to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = pleuromutilins are medically important but uncategorized (UC).

mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 2. 41 Number of Canadian Defined Daily Doses for animals per 1,000 grower-finisher pig-days at risk (nDDDvetCA/1,000 GF pig-days at risk) for antimicrobials administered in feed, by province/region, 2015 to 2019



Year Number of herds	2015 85	2016 91	2017 82	2018 97	2019 107
Province/region					
Prairies	258	210	176	184	178
Ontario	312	192	242	191	192
Québec	249	164	130	94	78
National	**268**	**196**	**175**	**165**	**154**

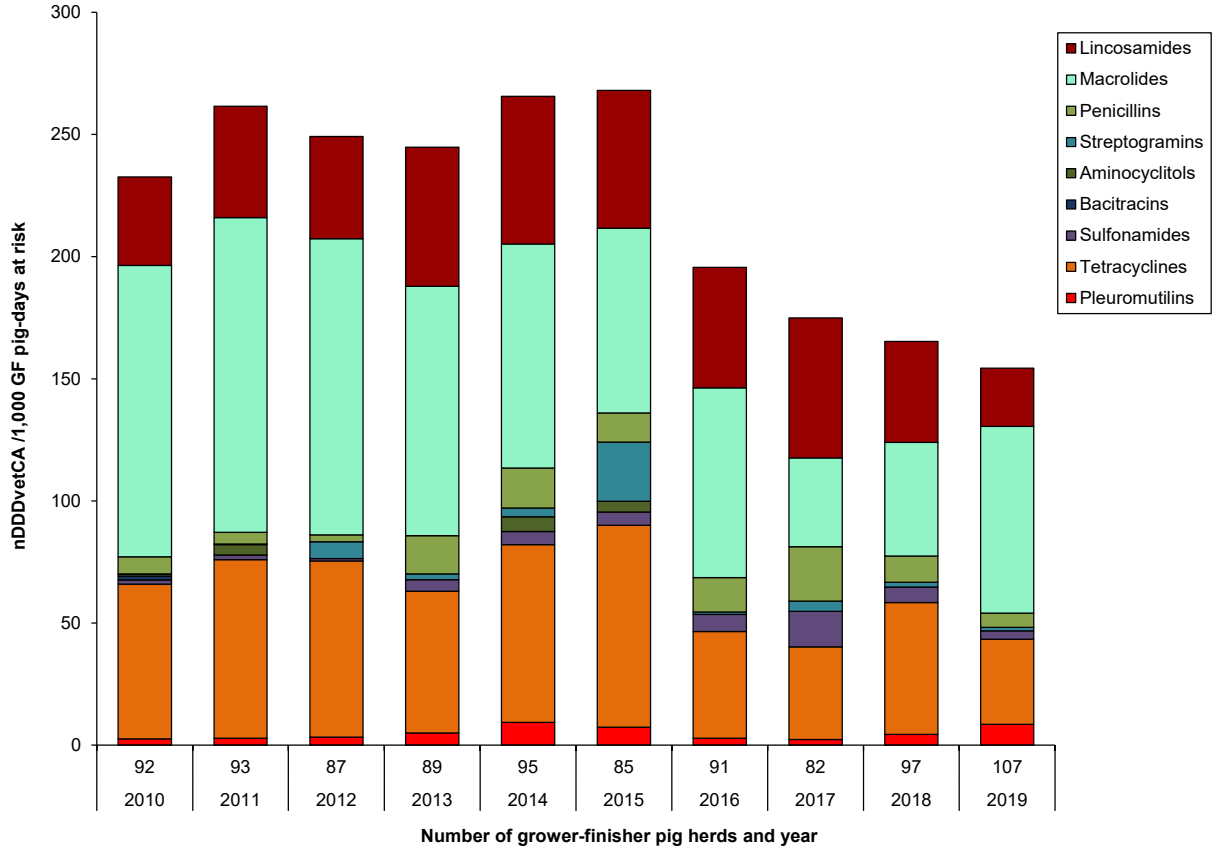
Excluded from this analysis were the ionophores, narasin and salinomycin.

DDDvetCA = Canadian Defined Daily Doses (average labelled dose) in milligrams per kilogram grower-finisher pig weight per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 2 for the list of standards.

nDDDvetCA/1,000 GF pig-days at risk = number of DDDvetCA/ 1,000 grower-finisher pig-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.
The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 2. 42 Number of Canadian Defined Daily Doses for animals per 1,000 grower-finisher pig-days at risk (nDDDvetCA/1,000 GF pig-days at risk) for antimicrobials administered in feed, 2010 to 2019



Year		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of herds		92	93	87	89	95	85	91	82	97	107
Antimicrobial class											
II	Lincosamides	36	46	42	57	60	56	49	57	41	24
	Macrolides	119	129	121	102	92	76	78	36	47	76
	Penicillins	7	5	3	16	16	12	14	22	11	6
	Streptogramins	0	0	7	2	4	24	1	4	2	1
III	Aminocyclitols	1	4	0	0	6	4	0	0	0	0
	Bacitracins	2	0	0	0	0	0	0	0	0	0
	Sulfonamides	2	2	1	5	5	6	7	15	6	3
	Tetracyclines	63	73	72	58	73	83	44	38	54	35
UC	Pleuromutilins	3	3	3	5	9	7	3	2	4	9

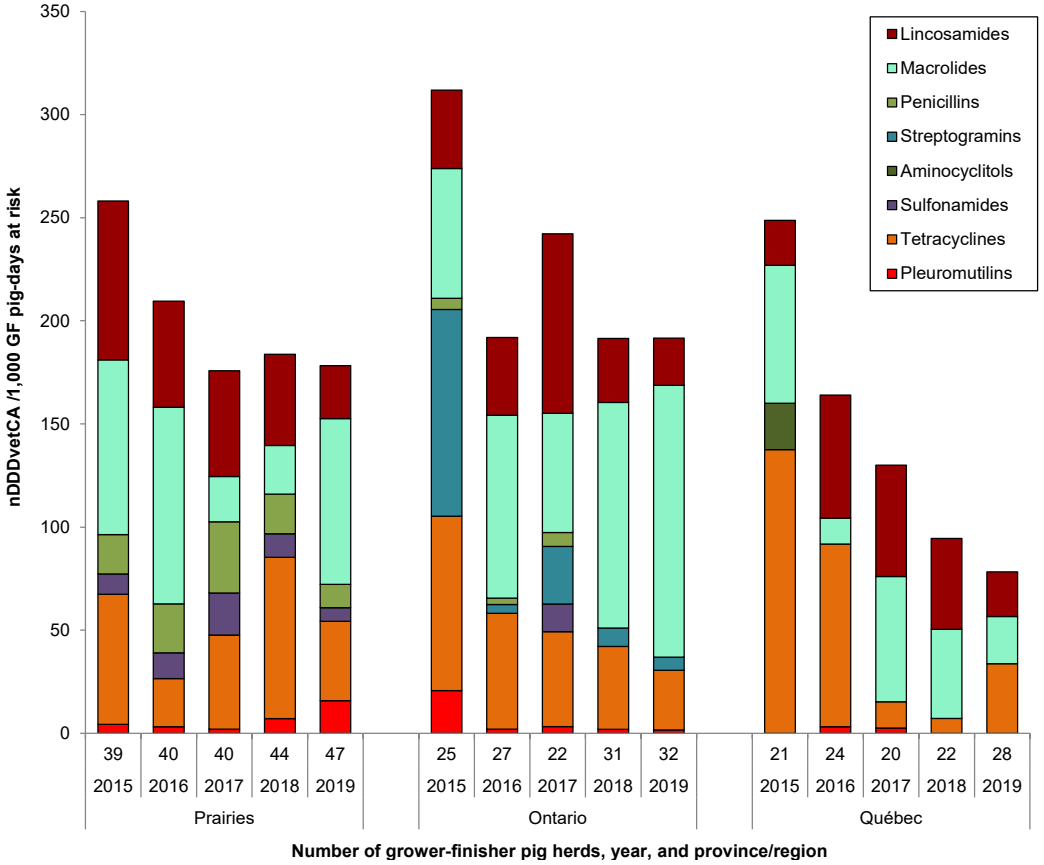
Roman numerals II to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = pleuromutilins are medically important but uncategorized (UC).

DDDvetCA = Canadian Defined Daily Doses (average labelled dose) in milligrams per kilogram grower-finisher pig weight per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 2 for the list of standards.

nDDDvetCA/1,000 GF pig-days at risk = number of DDDvetCA/ 1,000 grower-finisher pig-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

Figure 2. 43 Number of Canadian Defined Daily Doses for animals per 1,000 grower-finisher pig-days at risk (nDDDvetCA/1,000 GF pig-days at risk) for antimicrobials administered in feed, by province/region, 2015 to 2019



Province/region		Prairies					Ontario					Québec				
Year		2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Number of herds		39	40	40	44	47	25	27	22	31	32	21	24	20	22	28
Antimicrobial class																
II	Lincosamides	77	52	51	44	26	38	38	87	31	23	22	60	54	44	22
	Macrolides	85	95	22	24	80	63	89	58	109	132	67	13	61	43	23
	Penicillins	19	24	35	19	11	5	3	7	0	0	0	0	0	0	0
	Streptogramins	0	0	0	0	0	100	4	28	9	6	0	0	0	0	0
III	Aminocyclitols	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0
	Sulfonamides	10	12	20	11	7	0	0	13	0	0	0	0	0	0	0
	Tetracyclines	63	23	46	78	38	85	56	46	40	29	138	89	13	7	34
UC	Pleuromutilins	4	3	2	7	16	21	2	3	2	2	0	3	3	0	0

Roman numerals II to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = pleuromutilins are medically important but uncategorized (UC).

DDDvetCA = Canadian Defined Daily Doses (average labelled dose) in milligrams per kilogram grower-finisher pig weight per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 2 for the list of standards.

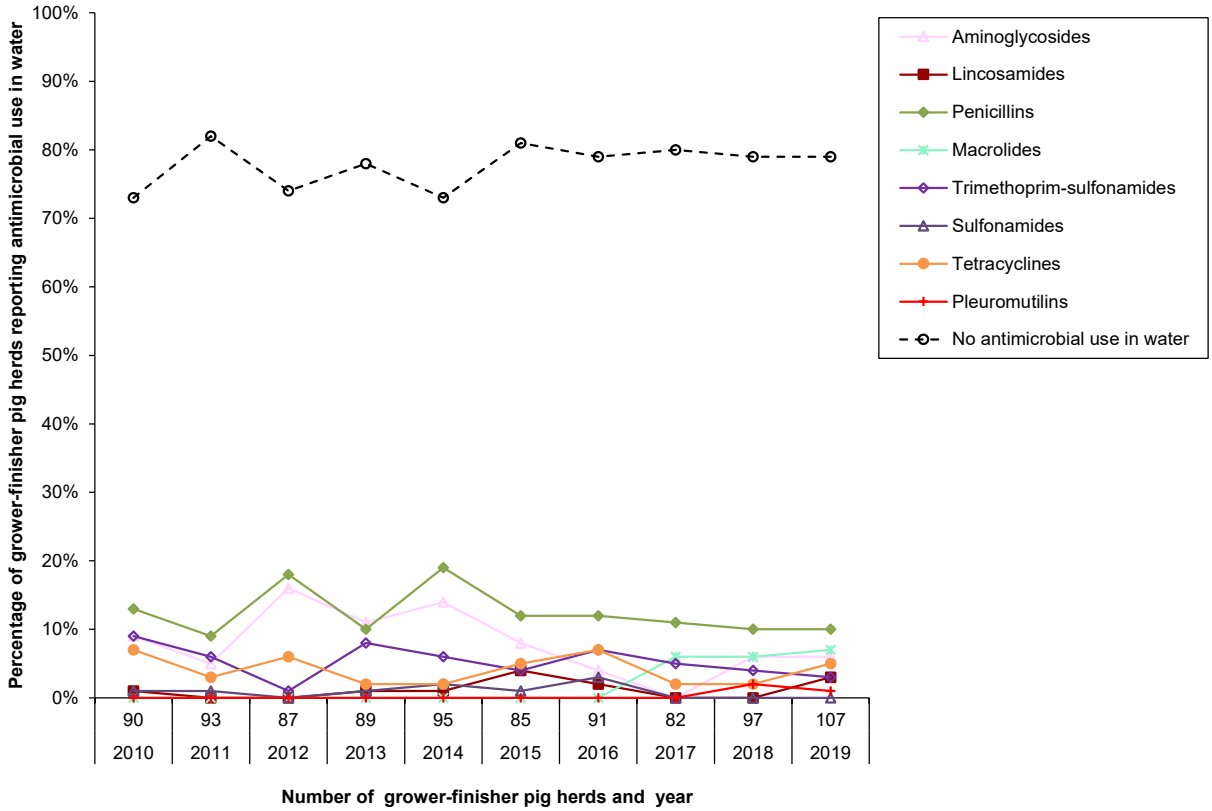
nDDDvetCA/1,000 GF pig-days at risk = number of DDDvetCA/ 1,000 grower-finisher pig-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Antimicrobial use in water by frequency

Figure 2. 44 Percentage of grower-finisher pig herds reporting antimicrobial use in water, 2010 to 2019



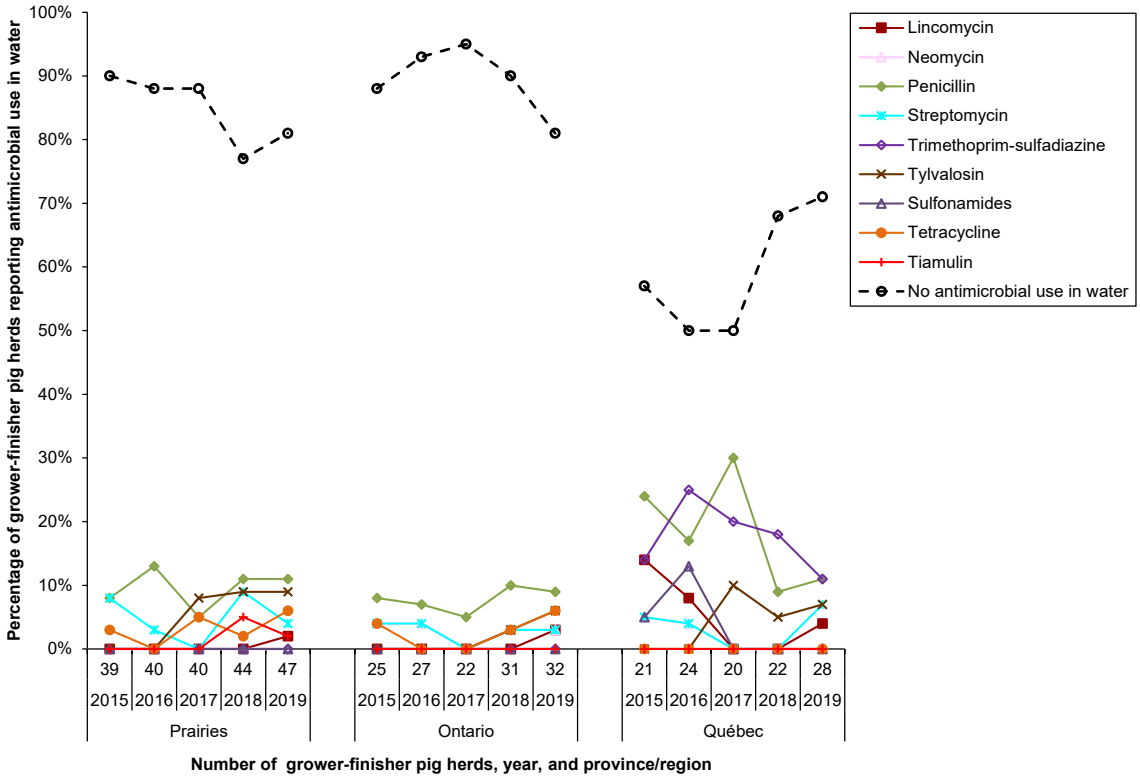
Year		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of herds		90	93	87	89	95	85	91	82	97	107
Antimicrobial											
II	Aminoglycosides	**9%**	5%	16%	11%	14%	8%	4%	0%	**6%**	**6%**
	Lincosamides	**1%**	0%	0%	1%	1%	4%	2%	0%	**0%**	**3%**
	Penicillins	**13%**	9%	18%	10%	19%	12%	12%	11%	**10%**	**10%**
	Macrolides	**0%**	0%	0%	0%	0%	0%	0%	6%	**6%**	**7%**
	Trimethoprim-sulfonamides	**9%**	6%	1%	8%	6%	4%	7%	5%	**4%**	**3%**
III	Sulfonamides	**1%**	1%	0%	1%	2%	1%	3%	0%	**0%**	**0%**
	Tetracyclines	**7%**	3%	6%	2%	2%	5%	7%	2%	**2%**	**5%**
UC	Pleuromutilins	**0%**	0%	0%	0%	0%	0%	0%	0%	**2%**	**1%**
	No antimicrobial use in water	**73%**	82%	74%	78%	73%	81%	79%	80%	**79%**	**79%**

Roman numerals II and III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = pleuromutilins are medically important but uncategorized (UC).

Only antimicrobials used by 5% of herds or more in a given year are depicted in this figure. Antimicrobial use in water reported by fewer than 5% of herds included Category III: neomycin and spectinomycin.

For the temporal analyses, the proportion (%) of herds using a specific antimicrobial in the current year has been compared to the proportion (%) of herds using the same antimicrobial in the previous 10 years and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

Figure 2. 45 Percentage of grower-finisher pig herds reporting antimicrobial use in water, by province/region, 2015 to 2019



Province/region		Prairies					Ontario					Québec				
Year		2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Number of herds		39	40	40	44	47	25	27	22	31	32	21	24	20	22	28
Antimicrobial																
II	Lincomycin	**0%**	0%	0%	**0%**	**2%**	**0%**	0%	0%	**0%**	**3%**	**14%**	8%	0%	**0%**	**4%**
	Neomycin	**0%**	0%	0%	**0%**	**0%**	**4%**	4%	0%	**3%**	**3%**	**5%**	4%	0%	**0%**	**0%**
	Penicillin	**8%**	13%	5%	**11%**	**11%**	**8%**	7%	5%	**10%**	**9%**	**24%**	17%	30%	**9%**	**11%**
	Streptomycin	**8%**	3%	0%	**9%**	**4%**	**4%**	4%	0%	**3%**	**3%**	**5%**	4%	0%	**0%**	**7%**
	Trimethoprim-sulfadiazine	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**14%**	25%	20%	**18%**	**11%**
	Tylvalosin	**0%**	0%	8%	**9%**	**9%**	**0%**	0%	0%	**3%**	**6%**	**0%**	0%	10%	**5%**	**7%**
III	Sulfonamides	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**5%**	13%	0%	**0%**	**0%**
	Tetracycline	**3%**	0%	5%	**2%**	**6%**	**4%**	0%	0%	**3%**	**6%**	**0%**	0%	0%	**0%**	**0%**
UC	Tiamulin	**0%**	0%	0%	**5%**	**2%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
	No antimicrobial use in water	**90%**	88%	88%	**77%**	**81%**	**88%**	93%	95%	**90%**	**81%**	**57%**	50%	50%	**68%**	**71%**

Roman numerals II to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = tiamulin is a medically important but uncategorized (UC) antimicrobial.

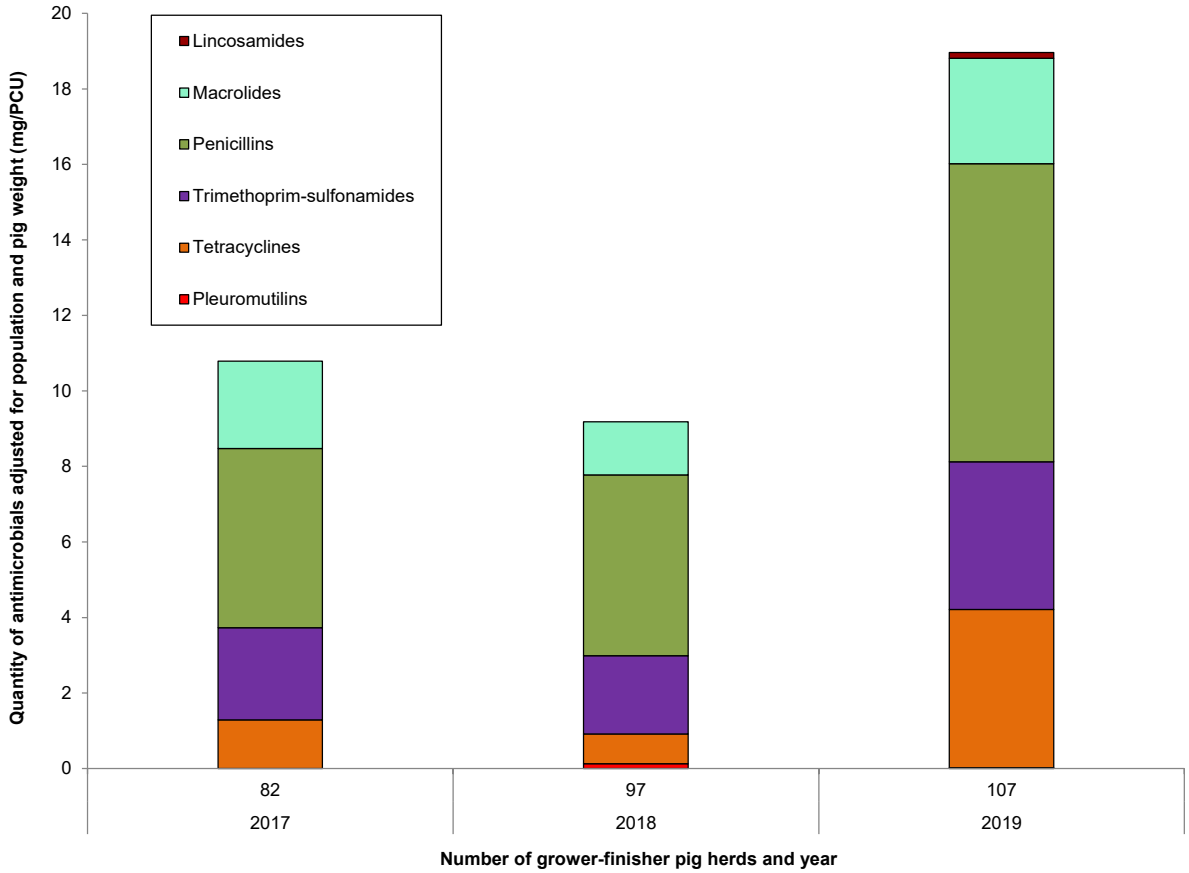
Only antimicrobials used by 5% of herds or more in a given year are depicted in this figure. Antimicrobial use in water reported by fewer than 5% of herds included Category II: neomycin; Category III: spectinomycin; and uncategorized, medically important: tiamulin.

For the temporal analyses within province/region, the proportion (%) of herds using a specific antimicrobial in the current year has been compared to the proportion (%) of herds using the same antimicrobial in the previous 5 years and the previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences within province/region ($P \leq 0.05$) for a given antimicrobial. The presence of red areas indicates significant provincial/regional differences ($P \leq 0.05$) for a given antimicrobial within the current year (Québec-referent province). The presence of purple areas (2019 surveillance year; Québec-referent province) indicates significant temporal and provincial/regional differences ($P \leq 0.05$) for a given antimicrobial.

The Prairies is a region including the provinces of Alberta, Saskatchewan and Manitoba.

Antimicrobial use in water by quantitative indicators

Figure 2. 46 Quantity of antimicrobials administered in water adjusted for population and pig weight (mg/PCU), 2017 to 2019



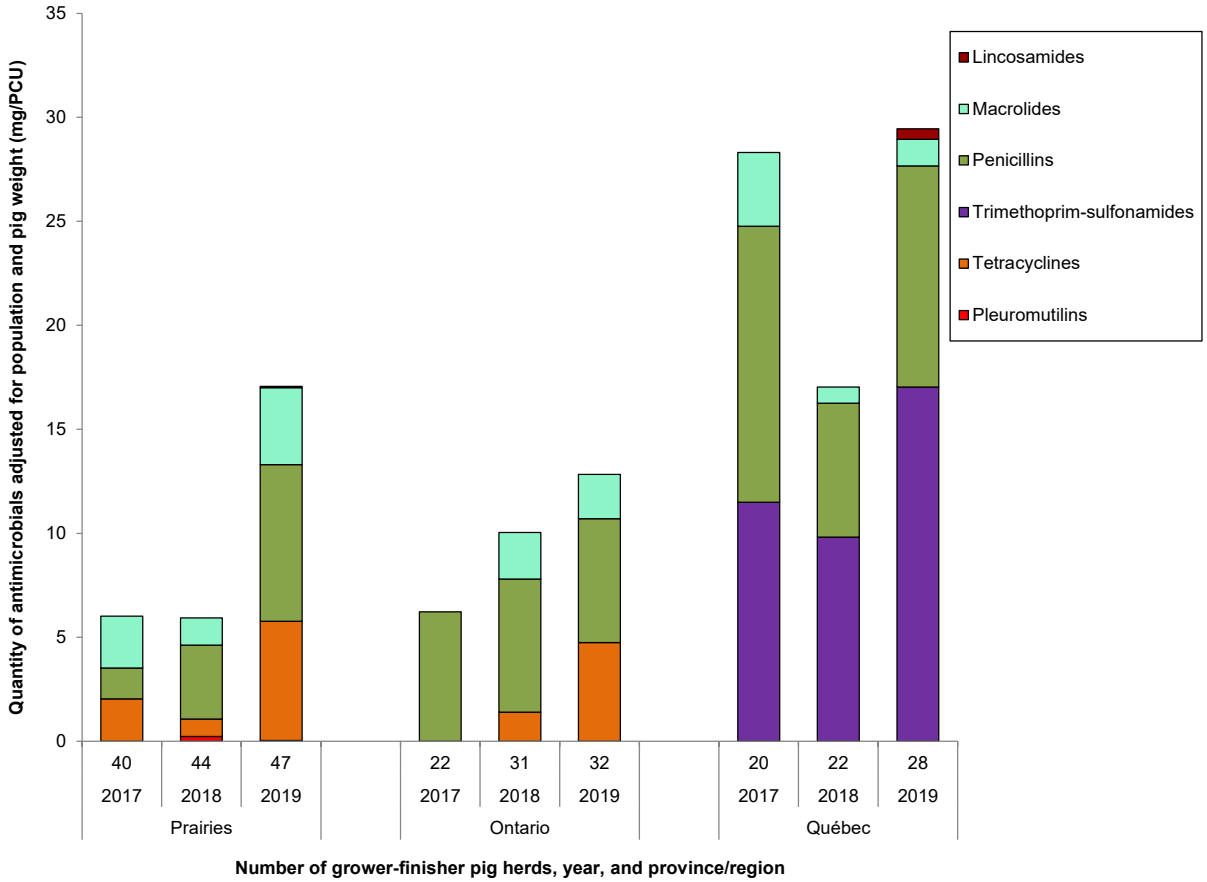
Year Number of herds		2017 82	2018 97	2019 107
Antimicrobial class				
II	Lincosamides	0.0	0.0	0.2
	Macrolides	2.3	1.4	2.8
	Penicillins	4.7	4.8	7.9
	Trimethoprim-sulfonamides	2.4	2.1	3.9
III	Tetracyclines	1.3	0.8	4.2
UC	Pleuromutilins	0.0	0.1	0.0
Total		**10.8**	**9.2**	**19.0**

Roman numerals II to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = pleuromutilins are medically important but uncategorized (UC).

mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to CIPARS 2019: Design and Methods document.

Figure 2. 47 Quantity of antimicrobials administered in water adjusted for population and pig weight (mg/PCU), by province/region, 2017 to 2019



Province/region		Prairies			Ontario			Québec		
Year		2017	2018	2019	2017	2018	2019	2017	2018	2019
Number of herds		40	44	47	22	31	32	20	22	28
Antimicrobial class										
II	Lincosamides	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.5
	Macrolides	2.5	1.3	3.7	0.0	2.2	2.1	3.5	0.8	1.3
	Penicillins	1.5	3.6	7.5	6.2	6.4	5.9	13.3	6.4	10.6
	Trimethoprim-sulfonamides	0.0	0.0	0.0	0.0	0.0	0.0	11.5	9.8	17.0
III	Tetracyclines	2.0	0.8	5.7	0.0	1.4	4.7	0.0	0.0	0.0
UC	Pleuromutilins	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		**6.0**	**5.9**	**17.1**	**6.2**	**10.0**	**12.8**	**28.3**	**17.0**	**29.4**

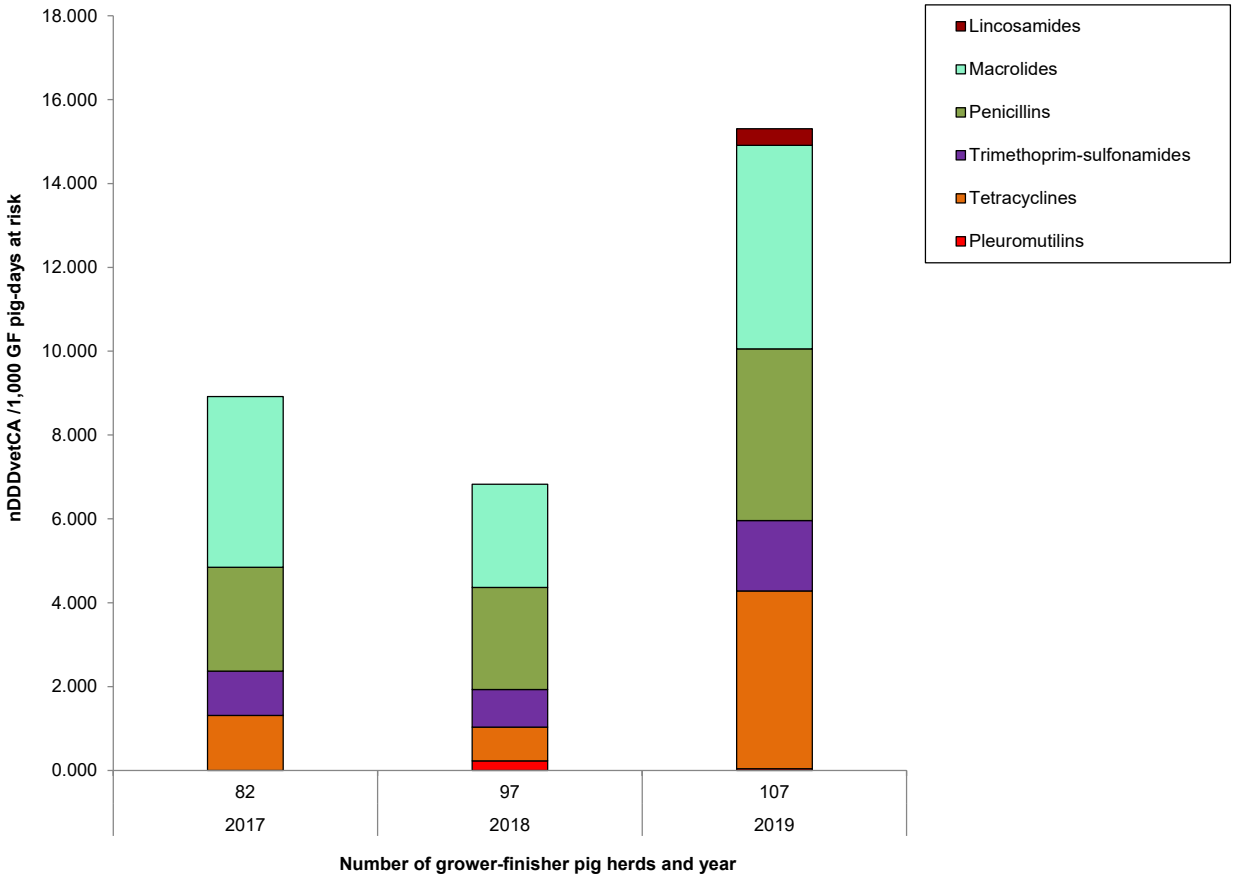
Roman numerals II to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = pleuromutilins are medically important but uncategorized (UC).

mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to CIPARS 2019: Design and Methods document.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 2. 48 Number of Canadian Defined Daily Doses for animals per 1,000 grower-finisher pig-days at risk (nDDDvetCA/1,000 GF pig-days at risk) for antimicrobials administered in water, 2017 to 2019



Year Number of herds		2017 82	2018 97	2019 107
Antimicrobial class				
II	Lincosamides	0.0	0.0	0.4
	Macrolides	4.1	2.5	4.9
	Penicillins	2.5	2.4	4.1
	Trimethoprim-sulfonamides	1.1	0.9	1.7
III	Tetracyclines	1.3	0.8	4.2
UC	Pleuromutilins	0.0	0.2	0.0
Total		**8.9**	**6.8**	**15.3**

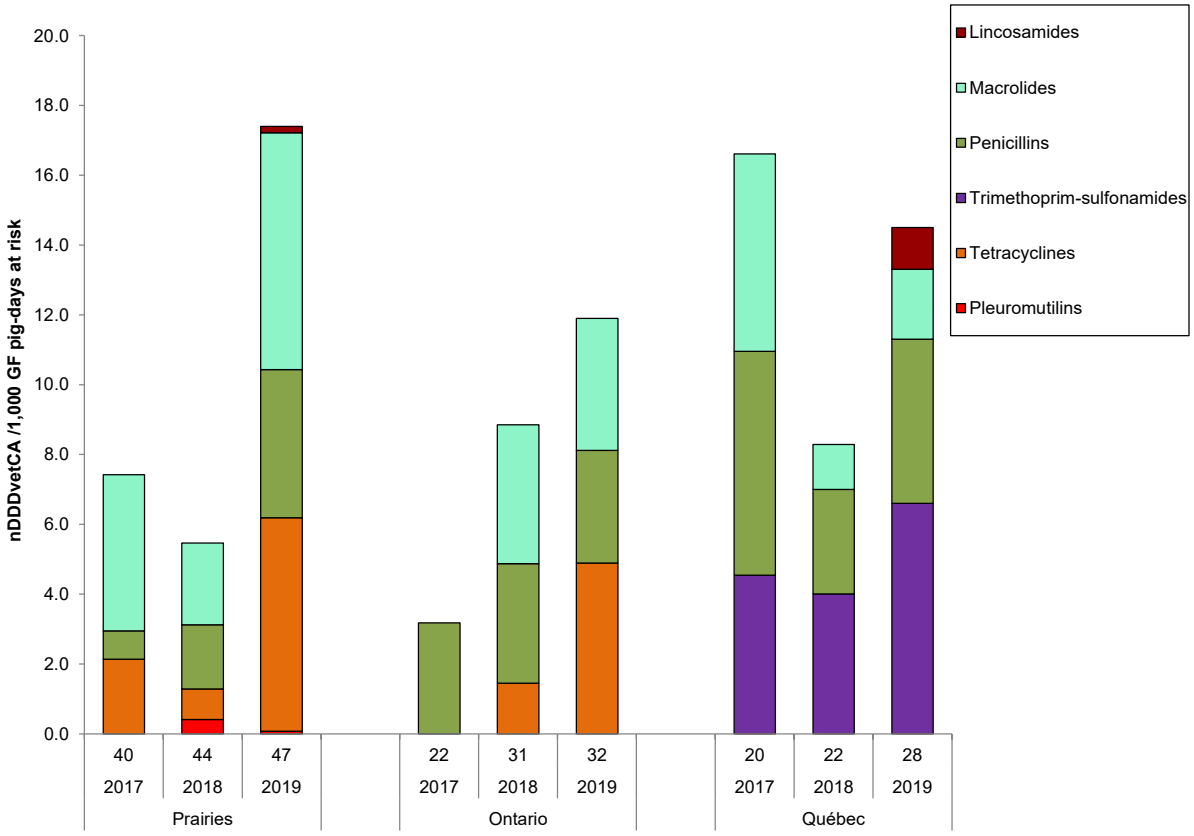
Roman numerals II to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = pleuromutilins are medically important but uncategorized (UC).

DDDvetCA = Canadian Defined Daily Doses (average labelled dose) in milligrams per kilogram grower-finisher pig weight per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 2 for the list of standards.

nDDDvetCA/1,000 GF pig-days at risk = number of DDDvetCA/ 1,000 grower-finisher pig-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

Figure 2. 49 Number of Canadian Defined Daily Doses for animals per 1,000 grower-finisher pig-days at risk (nDDDvetCA/1,000 GF pig-days at risk) for antimicrobials administered in water, by province/region, 2017 to 2019



Number of grower-finisher pig herds, year, and province/region

Province/region		Prairies			Ontario			Québec		
Year		2017	2018	2019	2017	2018	2019	2017	2018	2019
Number of herds		40	44	47	22	31	32	20	22	28
Antimicrobial class										
II	Lincosamides	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	1.2
	Macrolides	4.5	2.3	6.8	0.0	4.0	3.8	5.7	1.3	2.0
	Penicillins	0.8	1.8	4.2	3.2	3.4	3.2	6.4	3.0	4.7
	Trimethoprim-sulfonamides	0.0	0.0	0.0	0.0	0.0	0.0	4.5	4.0	6.6
III	Tetracyclines	2.1	0.9	6.1	0.0	1.4	4.9	0.0	0.0	0.0
UC	Pleuromutilins	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total		**7.4**	**5.5**	**17.4**	**3.2**	**8.9**	**11.9**	**16.6**	**8.3**	**14.5**

Roman numerals II to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = pleuromutilins are medically important but uncategorized (UC).

DDDvetCA = Canadian Defined Daily Doses (average labelled dose) in milligrams per kilogram grower-finisher pig weight per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 2 for the list of standards.

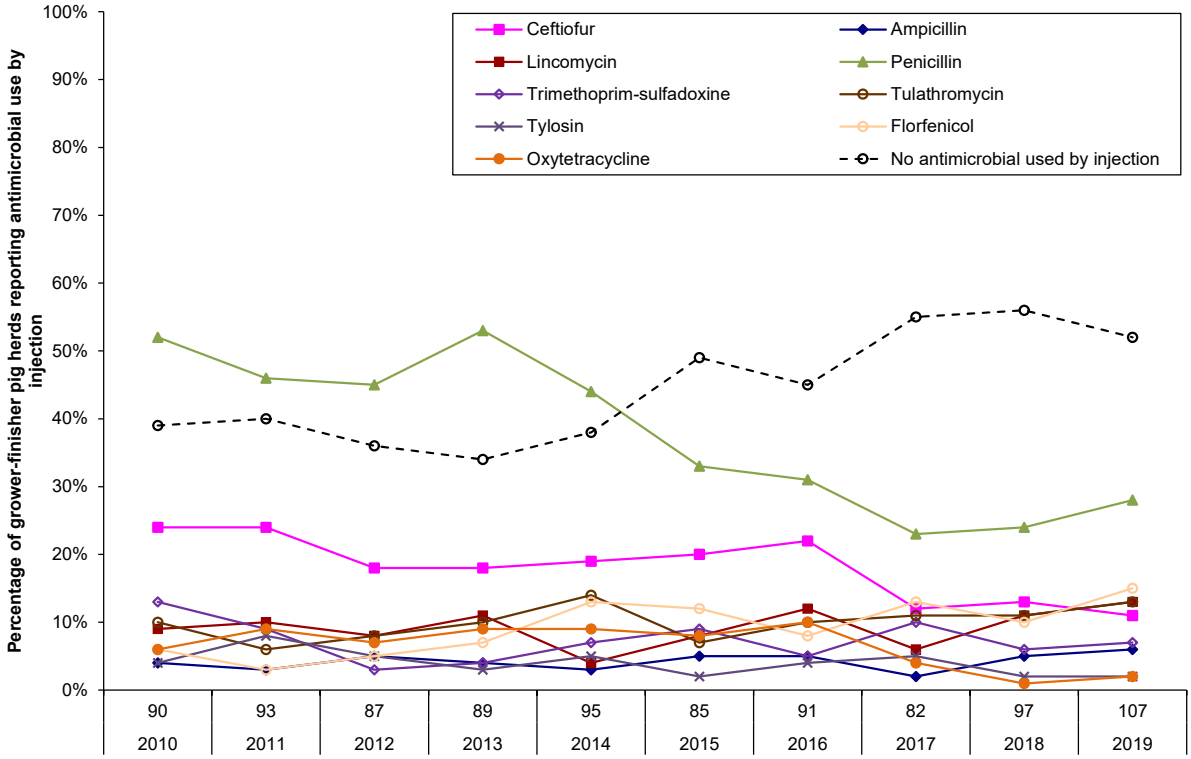
nDDDvetCA/1,000 GF pig-days at risk = number of DDDvetCA/ 1,000 grower-finisher pig-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

The Prairies is a region and includes the provinces of Alberta, Saskatchewan, and Manitoba.

Antimicrobial use by injection by frequency

Figure 2. 50 Percentage of grower-finisher pig herds reporting antimicrobial use by injection, 2010 to 2019



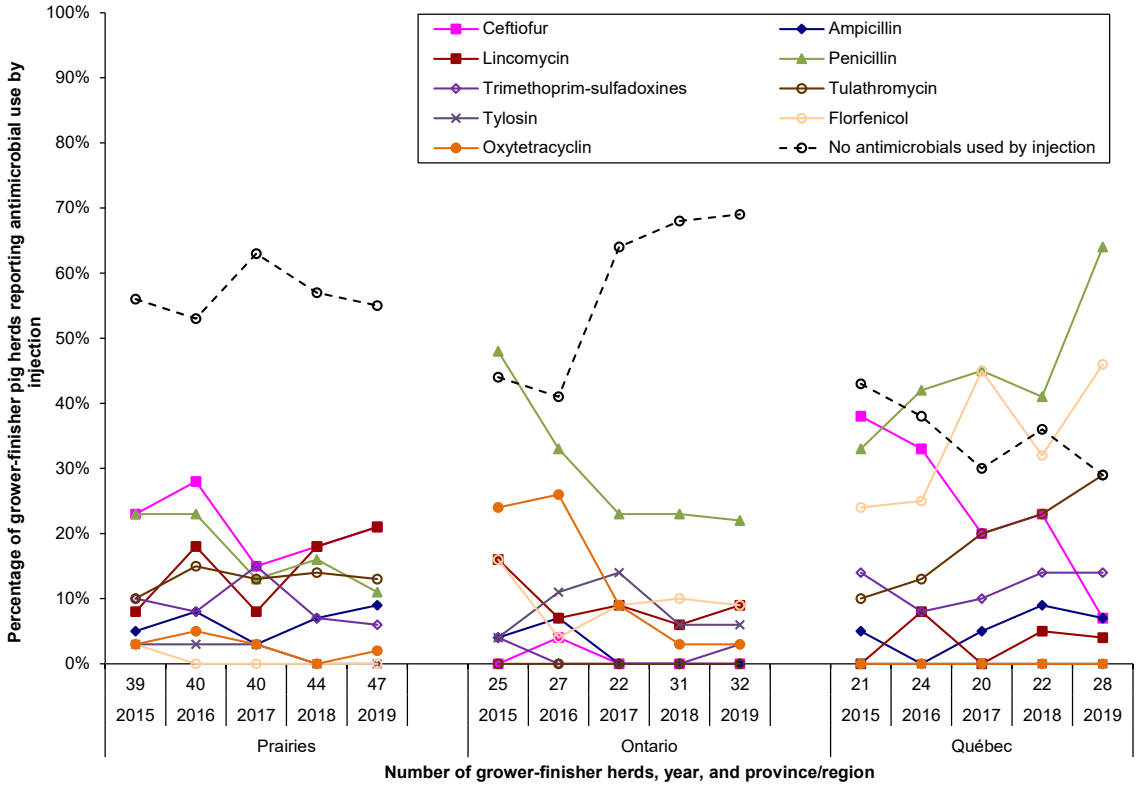
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of herds	90	93	87	89	95	85	91	82	97	107
Antimicrobial										
I Ceftiofur	**24%**	24%	18%	18%	19%	20%	22%	12%	**13%**	**11%**
II Ampicillin	**4%**	3%	5%	4%	3%	5%	5%	2%	**5%**	**6%**
II Lincomycin	**9%**	10%	8%	11%	4%	8%	12%	6%	**11%**	**13%**
II Penicillin	**52%**	46%	45%	53%	44%	33%	31%	23%	**24%**	**28%**
II Trimethoprim-sulfadoxine	**13%**	9%	3%	4%	7%	9%	5%	10%	**6%**	**7%**
II Tulathromycin	**10%**	6%	8%	10%	14%	7%	10%	11%	**11%**	**13%**
II Tylosin	**4%**	8%	5%	3%	5%	2%	4%	5%	**2%**	**2%**
III Florfenicol	**6%**	3%	5%	7%	13%	12%	8%	13%	**10%**	**15%**
III Oxytetracycline	**6%**	9%	7%	9%	9%	8%	10%	4%	**1%**	**2%**
No antimicrobials used by injection	**39%**	40%	36%	34%	38%	49%	45%	55%	**56%**	**52%**

Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

Only antimicrobials used by 5% of herds or more in a given year are depicted in this figure. Antimicrobial use by injection reported by fewer than 5% of herds included Category II: erythromycin; Category III: spectinomycin; and uncategorized, medically important: tiamulin.

For the temporal analyses, the proportion (%) of herds using a specific antimicrobial in the current year has been compared to the proportion (%) of herds using the same antimicrobial in the previous 10 years and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

Figure 2. 51 Percentage of grower-finisher pig herds reporting antimicrobial use by injection, by province/region, 2015 to 2019



Province/region	Prairies					Ontario					Québec				
Year	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Number of herds	39	40	40	44	47	25	27	22	31	32	21	24	20	22	28
Antimicrobial															
I Ceftiofur	23%	28%	15%	18%	21%	0%	4%	0%	0%	0%	38%	33%	20%	23%	7%
II Ampicillin	5%	8%	3%	7%	9%	4%	7%	0%	0%	0%	5%	0%	5%	9%	7%
II Lincomycin	8%	18%	8%	18%	21%	16%	7%	9%	6%	9%	0%	8%	0%	5%	4%
II Penicillin	23%	23%	13%	16%	11%	48%	33%	23%	23%	22%	33%	42%	45%	41%	64%
II Trimethoprim-sulfadoxine	10%	8%	15%	7%	6%	4%	0%	0%	0%	3%	14%	8%	10%	14%	14%
II Tulathromycin	10%	15%	13%	14%	13%	0%	0%	0%	0%	0%	10%	13%	20%	23%	29%
II Tylosin	3%	3%	3%	0%	0%	4%	11%	14%	6%	6%	0%	0%	0%	0%	0%
III Florfenicol	3%	0%	0%	0%	0%	16%	4%	9%	10%	9%	24%	25%	45%	32%	46%
III Oxytetracycline	3%	5%	3%	0%	2%	24%	26%	9%	3%	3%	0%	0%	0%	0%	0%
No antimicrobials used by injection	56%	53%	63%	57%	55%	44%	41%	64%	68%	69%	43%	38%	30%	36%	29%

Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

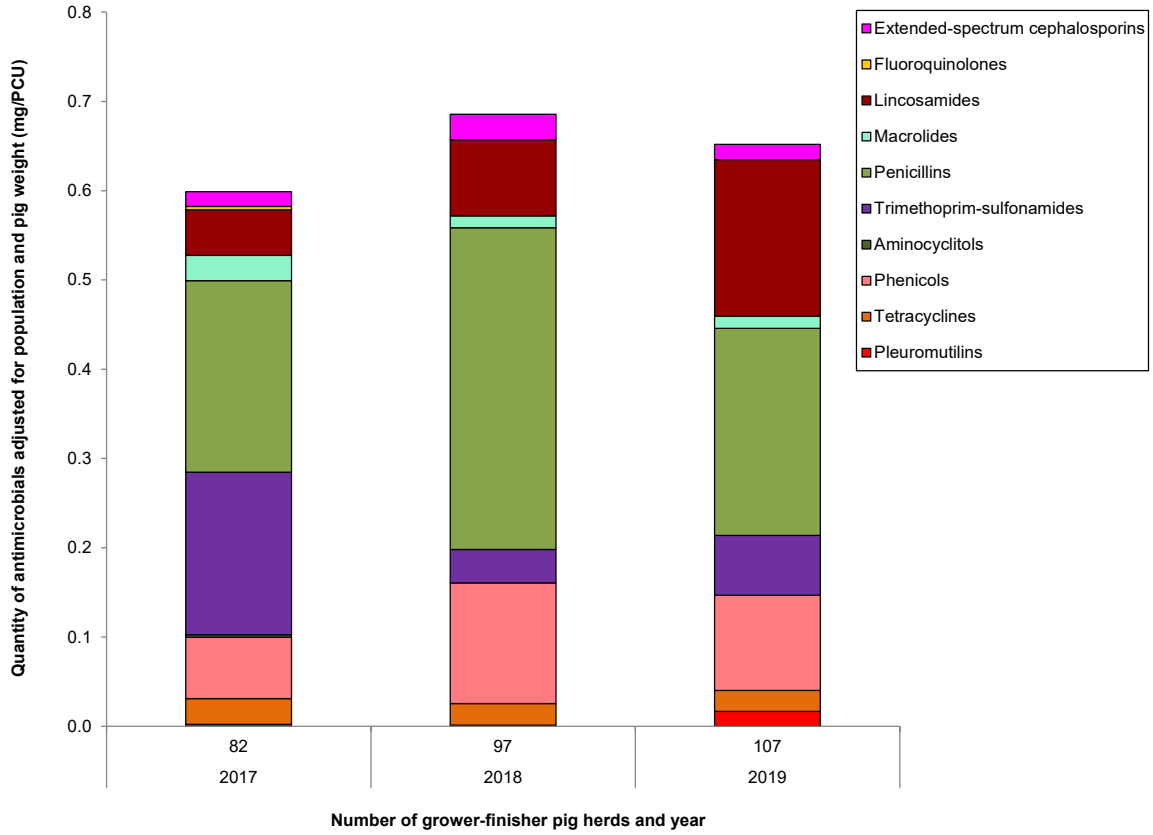
Only antimicrobials used by 5% of herds or more in a given year within any province/region are depicted in this figure. Antimicrobial use by injection reported by fewer than 5% of herds included Category II: erythromycin; Category III: spectinomycin; and uncategorized, medically important: tiamulin.

For the temporal analyses within province/region, the proportion (%) of herds using a specific antimicrobial in the current year has been compared to the proportion (%) of herds using the same antimicrobial in the previous 5 years and the previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences within province/region ($P \leq 0.05$) for a given antimicrobial. The presence of red areas indicates significant provincial/regional differences ($P \leq 0.05$) for a given antimicrobial within the current year (Québec-referent province). The presence of purple areas (2019 surveillance year; Québec-referent province) indicates significant temporal and provincial/regional differences ($P \leq 0.05$) for a given antimicrobial.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Antimicrobial use by injection by quantitative indicators

Figure 2. 52 Quantity of antimicrobials administered by injection adjusted for population and pig weight (mg/PCU), 2017 to 2019



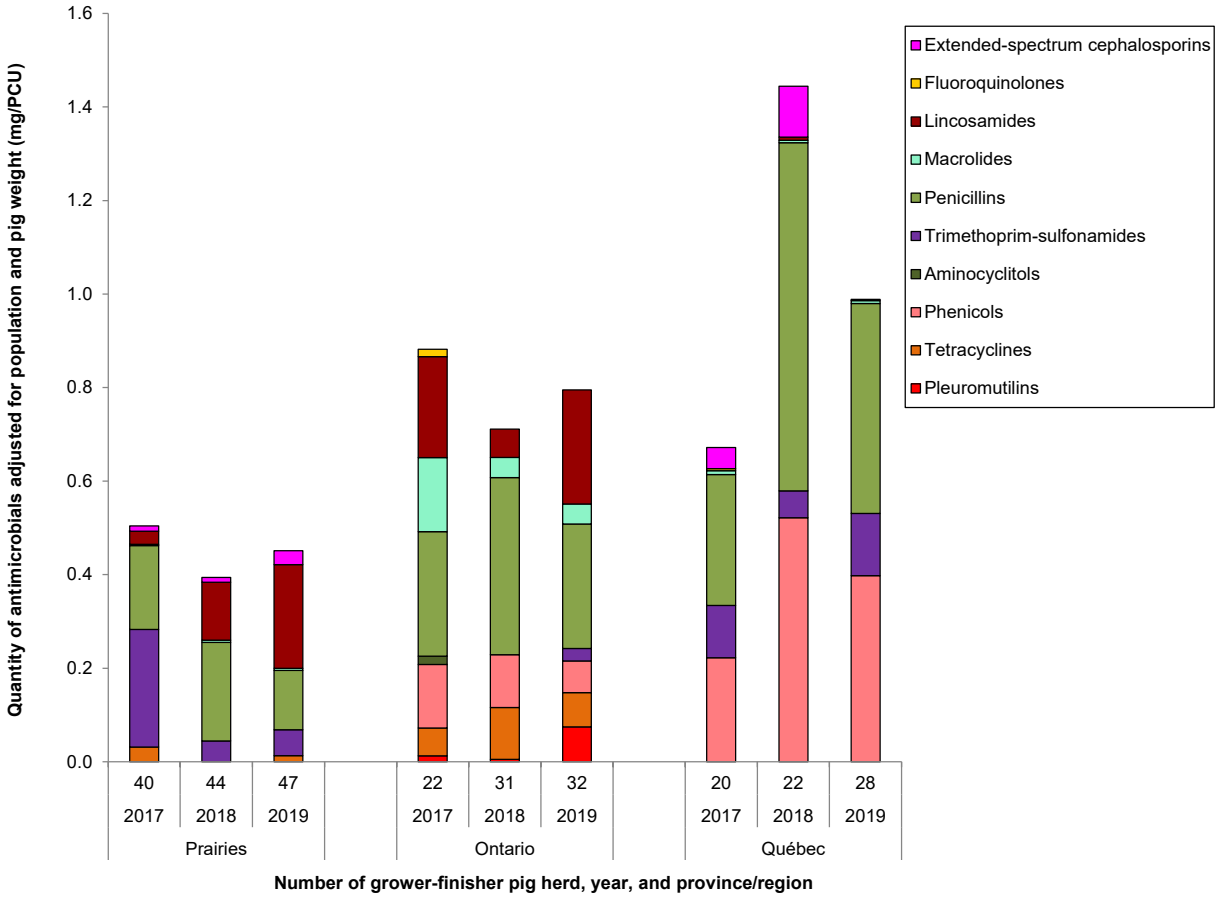
Year Number of herds		2017 82	2018 97	2019 107
Antimicrobial class				
I	Extended-spectrum cephalosporins	0.017	0.029	0.017
	Fluoroquinolones	0.004	0.000	0.000
II	Lincosamides	0.051	0.085	0.175
	Macrolides	0.028	0.013	0.014
	Penicillins	0.215	0.361	0.232
	Trimethoprim-sulfonamides	0.182	0.037	0.067
III	Aminocyclitols	0.003	0.000	0.000
	Phenicols	0.069	0.135	0.107
	Tetracyclines	0.029	0.025	0.023
UC	Pleuromutilins	0.002	0.001	0.017
Total		**0.599**	**0.686**	**0.643**

Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = pleuromutilins are medically important but uncategorized (UC).

mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to CIPARS 2019: Design and Methods document.

Figure 2. 53 Quantity of antimicrobials administered by injection adjusted for population and pig weight (mg/PCU), by province/region, 2017 to 2019



Province/region		Prairies			Ontario			Québec		
Year		2017	2018	2019	2017	2018	2019	2017	2018	2019
Number of herds		40	44	47	22	31	32	20	22	28
Antimicrobial class										
I	Extended-spectrum cephalosporins	0.011	0.010	0.030	0.000	0.000	0.000	0.045	0.108	0.003
	Fluoroquinolones	0.000	0.000	0.000	0.016	0.000	0.000	0.005	0.000	0.000
II	Lincosamides	0.028	0.124	0.221	0.216	0.061	0.244	0.000	0.007	0.000
	Macrolides	0.003	0.004	0.005	0.158	0.043	0.043	0.008	0.005	0.006
	Penicillins	0.180	0.211	0.130	0.266	0.379	0.266	0.280	0.744	0.449
	Trimethoprim-sulfonamides	0.251	0.044	0.056	0.000	0.000	0.027	0.112	0.058	0.133
III	Aminocyclitols	0.000	0.000	0.000	0.018	0.000	0.000	0.000	0.000	0.000
	Phenicols	0.000	0.000	0.000	0.136	0.113	0.068	0.222	0.521	0.398
	Tetracyclines	0.031	0.000	0.013	0.059	0.111	0.073	0.000	0.000	0.000
UC	Pleuromutilins	0.000	0.000	0.000	0.013	0.005	0.074	0.000	0.000	0.000
Total		**0.504**	**0.394**	**0.434**	**0.882**	**0.711**	**0.795**	**0.672**	**1.444**	**0.989**

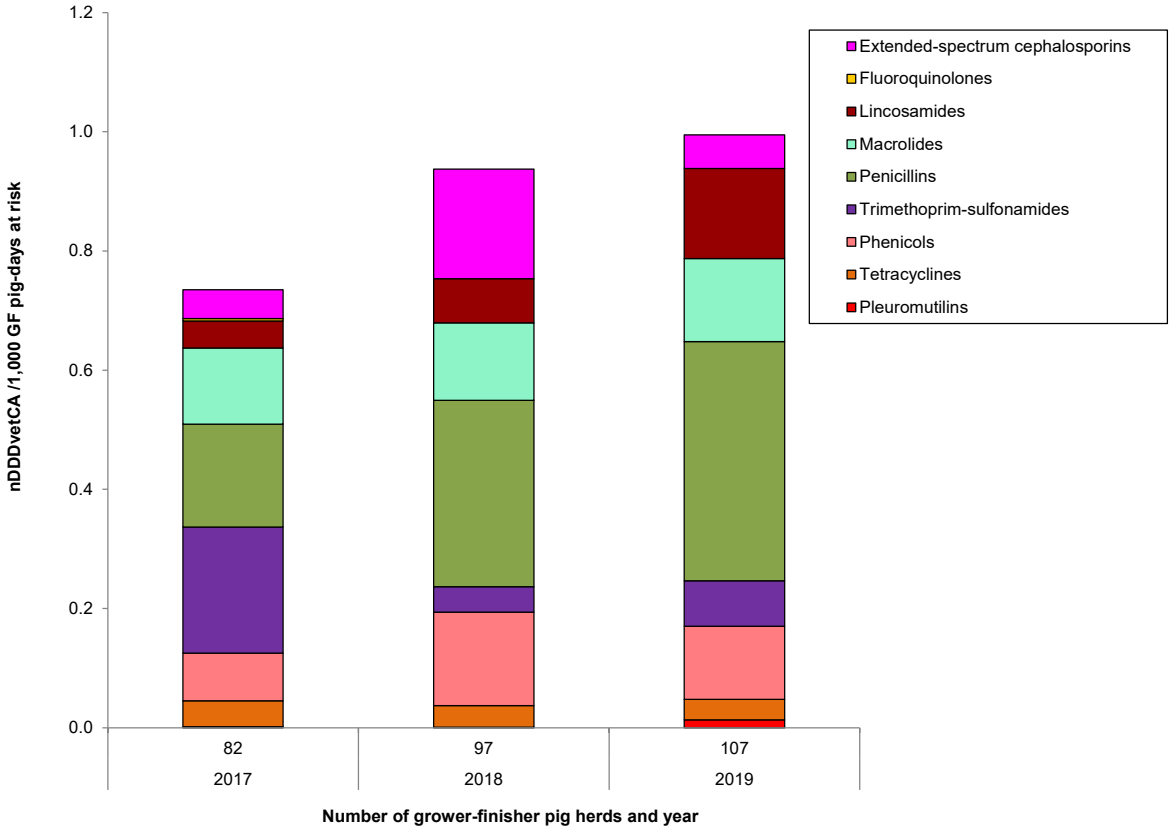
Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = pleuromutilins are medically important but uncategorized (UC).

mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to CIPARS 2019: Design and Methods document.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 2. 54 Number of Canadian Defined Daily Doses for animals per 1,000 grower-finisher pig-days at risk (nDDDvetCA/1,000 GF pig-days at risk) for antimicrobials administered by injection, 2017 to 2019



Year		2017	2018	2019
Number of herds		82	97	107
Antimicrobial class				
I	Extended-spectrum cephalosporins	0.049	0.184	0.056
	Fluoroquinolones	0.004	0.000	0.000
II	Lincosamides	0.045	0.074	0.151
	Macrolides	0.128	0.130	0.139
	Penicillins	0.173	0.313	0.402
	Trimethoprim-sulfonamides	0.211	0.043	0.076
III	Phenicols	0.080	0.157	0.123
	Tetracyclines	0.044	0.036	0.035
UC	Pleuromutilins	0.002	0.001	0.013
Total		**0.735**	**0.937**	**0.995**

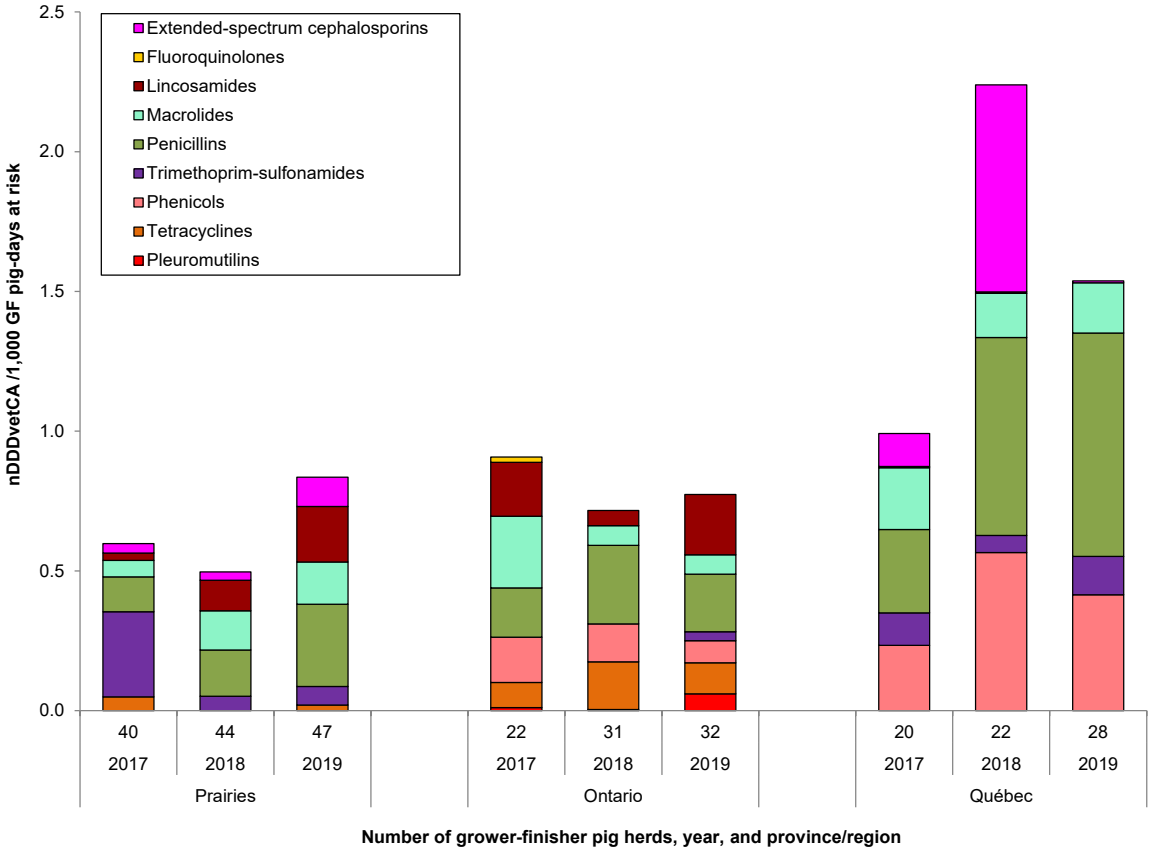
Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = pleuromutilins are medically important but uncategorized (UC).

DDDvetCA = Canadian Defined Daily Doses (average labelled dose) in milligrams per kilogram grower-finisher pig weight per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 2 for the list of standards.

nDDDvetCA/1,000 GF pig-days at risk = number of DDDvetCA/ 1,000 grower-finisher pig-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

Figure 2. 55 Number of Canadian Defined Daily Doses for animals per 1,000 grower-finisher pig-days at risk (nDDDvetCA/1,000 GF pig-days at risk) for antimicrobials administered by injection, by province/region, 2017 to 2019



Number of grower-finisher pig herds, year, and province/region

Province/region		Prairies			Ontario			Québec		
Year		2017	2018	2019	2017	2018	2019	2017	2018	2019
Number of herds		40	44	47	22	31	32	20	22	28
Antimicrobial class										
I	Extended-spectrum cephalosporins	0.03	0.03	0.10	0.00	0.00	0.00	0.12	0.74	0.01
	Fluoroquinolones	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
II	Lincosamides	0.03	0.11	0.20	0.19	0.05	0.22	0.00	0.01	0.00
	Macrolides	0.06	0.14	0.15	0.26	0.07	0.07	0.22	0.16	0.18
	Penicillins	0.12	0.17	0.29	0.18	0.28	0.21	0.30	0.71	0.80
	Trimethoprim-sulfonamides	0.30	0.05	0.07	0.00	0.00	0.03	0.12	0.06	0.14
III	Phenicols	0.00	0.00	0.00	0.16	0.14	0.08	0.23	0.57	0.41
	Tetracyclines	0.05	0.00	0.02	0.09	0.17	0.11	0.00	0.00	0.00
UC	Pleuromutilins	0.00	0.00	0.00	0.01	0.00	0.06	0.00	0.00	0.00
Total		**0.60**	**0.50**	**0.84**	**0.91**	**0.72**	**0.77**	**0.99**	**2.24**	**1.54**

Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. UC = pleuromutilins are medically important but uncategorized (UC).

DDDvetCA = Canadian Defined Daily Doses (average labelled dose) in milligrams per kilogram grower-finisher pig weight per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 2 for the list of standards.

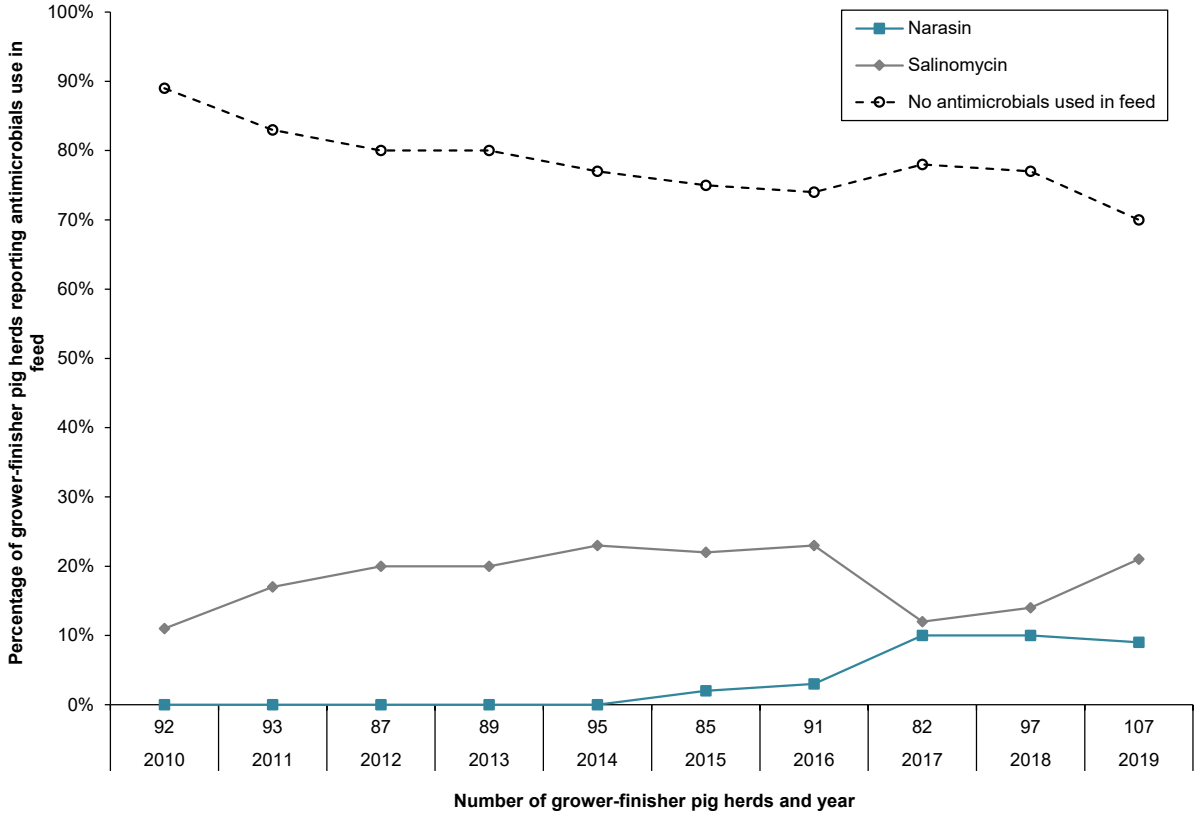
nDDDvetCA/1,000 GF pig-days at risk = number of DDDvetCA/ 1,000 grower-finisher pig-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Coccidiostat use in feed by frequency

Figure 2. 56 Percentage of grower-finisher pig herds reporting ionophore coccidiostat use in feed, 2010 to 2019

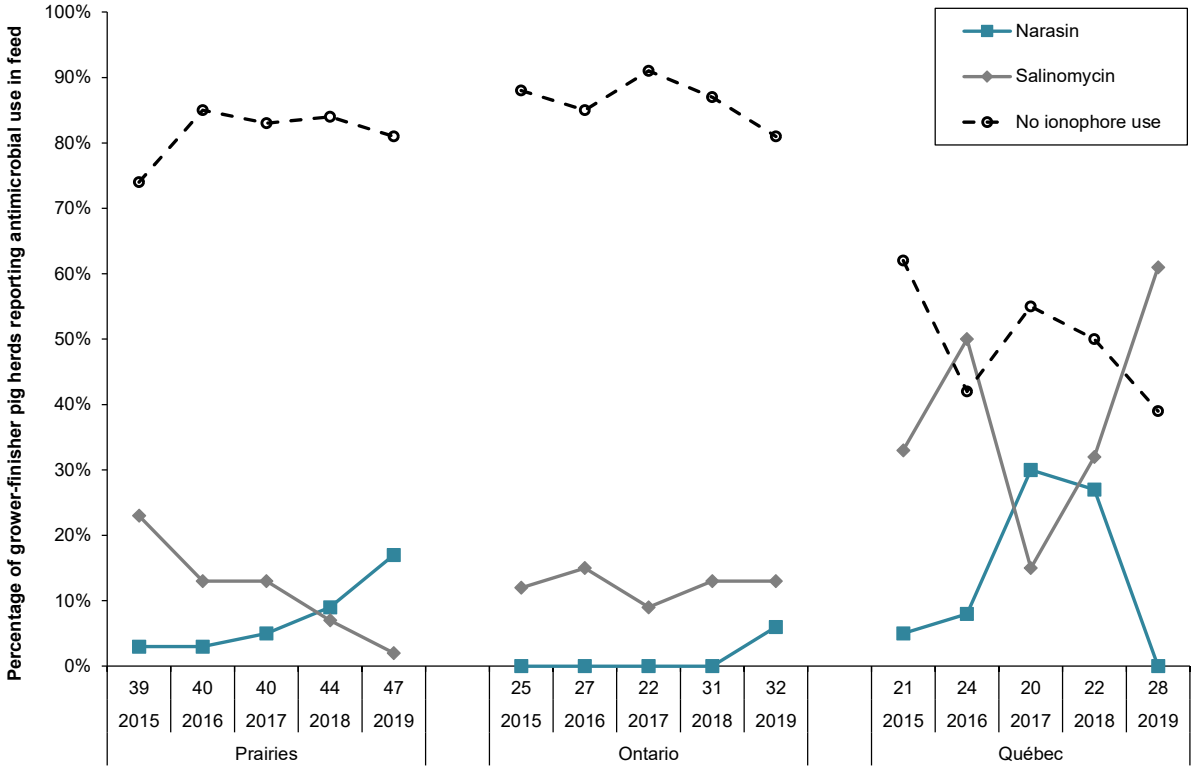


Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of herds	92	93	87	89	95	85	91	82	97	107
Antimicrobial										
IV Narasin	**0%**	0%	0%	0%	0%	2%	3%	10%	**10%**	**9%**
IV Salinomycin	**11%**	17%	20%	20%	23%	22%	23%	12%	**14%**	**21%**
No antimicrobials used in feed	**89%**	83%	80%	80%	77%	75%	74%	78%	**77%**	**70%**

Roman numeral IV indicates the ranking of antimicrobials based on importance to human medicine as outlined by the Veterinary Drugs Directorate.

For the temporal analyses, the proportion (%) of herds using a specific ionophore in the current year has been compared to the proportion (%) of herds using the same ionophore in the previous 10 years and the previous surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given ionophore.

Figure 2. 57 Percentage of grower-finisher pig herds reporting ionophore coccidiostat use in feed, by province/region, 2015 to 2019



Province/region		Prairies					Ontario					Québec				
Year		2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Number of herds		39	40	40	44	47	25	27	22	31	32	21	24	20	22	28
Coccidiostat																
IV	Narasin	**3%**	3%	5%	**9%**	**17%**	**0%**	0%	0%	**0%**	**6%**	**5%**	8%	30%	**27%**	**0%**
	Salinomycin	**23%**	13%	13%	**7%**	**2%**	**12%**	15%	9%	**13%**	**13%**	**33%**	50%	15%	**32%**	**61%**
	No ionophore use in feed	**74%**	85%	83%	**84%**	**81%**	**88%**	85%	91%	**87%**	**81%**	**62%**	42%	55%	**50%**	**39%**

Roman numeral IV indicates the ranking of antimicrobials based on importance to human medicine as outlined by the Veterinary Drugs Directorate.

For the temporal analyses within province/region, the proportion (%) of herds using a specific ionophore in the current year has been compared to the proportion (%) of herds using the same antimicrobial in the previous 5 years and the previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences within province/region ($P \leq 0.05$) for a given ionophore. The presence of red areas indicates significant provincial/regional differences ($P \leq 0.05$) for a given ionophore within the current year (Québec-referent province). The presence of purple areas (2019 surveillance year; Québec-referent province) indicates significant temporal and provincial/regional differences ($P \leq 0.05$) for a given ionophore.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Antimicrobial use: Farm Surveillance in turkeys

Please contact phac.cipars-picra.aspc@phac-aspc.gc.ca for more detailed information.

Summary of antimicrobials use by all routes of administration

Table 2. 12 Number of turkey flocks with reported antimicrobial use by route of administration, 2019

Antimicrobial use	Route of administration			
	Any route[a] n (%)	*In ovo*/subcutaneous n (%)	Feed n (%)	Water n (%)
Any antimicrobial use	65 (66)	1(1)	64 (65)	12 (12)
No antimicrobial use[b]	33 (34)	97 (99)	34 (35)	86 (88)
Total flocks	**98 (100)**	**98 (100)**	**98 (100)**	**98 (100)**

[a] Flocks with reported use of an antimicrobial class by feed, water, *in ovo*/subcutaneous, or any combination of these routes are included in each count.

[b] These were flocks that were not medicated with any of the antimicrobials listed in Table 2. 15 (next page).

Table 2. 13 Frequency and quantity of antimicrobial use in turkeys, 2019

Route of administration	Antimicrobial	Flocks n (%)	Ration n (%)	Days exposed median (min. ; max.)[a]	Level of drug median (min. ; max.)[b]	Quantity of antimicrobial active ingredient	
						mg/PCU	nDDDvetCA/ 1,000 turkey-days at risk
Feed					g/tonne		
II	Virginiamycin	5 (5)	17 (4)	48 (14 ; 70)	22 (22 ; 22)	1	3
	Trimethoprim-sulfadiazine	6 (6)	6 (1)	13 (7 ; 14)	300 (300 ; 300)	7	13
III	Bacitracin	58 (59)	260 (55)	67 (14 ; 105)	55 (55 ; 110)	63	70
	Chlortetracycline	2 (2)	2 (< 1)	13 (10 ; 15)	330 (220 ; 440)	2	1
IV	Bambermycin	5 (5)	17 (4)	60 (60 ; 102)	2 (2 ; 2)	0.2	
N/A	Avilamycin	7 (7)	17 (4)	43 (35 ; 56)	20 (15 ; 25)	1	4
No AMU in feed		35 (35)	156 (33)				
Total feed, medicated		**64 (65)**	**319 (67)**			**75**	**92**
Water		**Treatment (n)**			mg/bird median (min ; max)[c]		
I	Enrofloxacin	2 (2)	2	4 (4 ; 4)	11 (10 ; 13)	0.1	0.1
II	Amoxicillin	2 (2)	2	6 (5 ; 6)	264 (115 ; 413)	< 0.1	0.4
	Penicillin G potassium	6 (6)	6	6 (4 ; 10)	415 (42 ; 1786)	1	1
	Neomycin	1 (1)	1	5 (5 ; 5)	401 (401 ; 401)	7	2
III	Tetracycline	3 (3)	4	7 (5 ; 10)	45 (31 ; 227)	1	0.4
No AMU in water		86 (88)					
Total water, medicated		**12 (12)**	**15**			**9**	**3**
Injection					mg/egg or poult		
II	Gentamicin	1 (1)			1	< 0.1	< 0.1
No AMU via injection		97 (97)					
Total injection		**1 (1)**				**< 0.1**	**< 0.1**
All routes[d]		**65 (66)**				**84**	**95**

See corresponding footnotes on next page.

Table 2. 15 Frequency and quantity of antimicrobial use in turkeys, 2019 (continued)

Roman numerals I to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification available at the time of writing of this report).

AMU = antimicrobial use.

Combination antimicrobials include the values for both antimicrobial components.

Grey shaded cells = no data or calculations/values are not applicable for turkeys.

mg/PCU = milligrams/population correction unit.

DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligrams per kilogram turkey per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 1 for the list of standards.

nDDDvetCA/1,000 turkey-days at risk = number of DDDvetCA/1,000 turkey-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

[a] Days exposed are by flock or full grow-out period (all rations combined) or 1 course of water treatment.

[b] Level of drug is in grams/tonne of feed or grams/liter drinking water. In poults or hatching eggs, level of drug is in milligrams per poult or hatching egg, as reported by the veterinarian/producer.

[c] For water medications, the total milligrams per bird administered throughout the course of treatment is reported above; estimation methods changed where total products used by the flock was reported instead of grams per liter of drinking water (2013 to 2018 methods).

[d] The final mg/PCU and nDDDvetCA/1,000 turkey-days at risk exclude coccidiostats. Flavophospholipids was included only in the mg/PCU.

Table 2. 14 Production, biomass and quantity of antimicrobials used, by province, 2015 to 2019

Province	Year	Number of flocks	Pre-harvest weight Mean (kg)	Age sampled Mean (days)	Active ingredient (mg)	Turkey weights[a] (kg)	mg/PCU		nDDDvetCA/1,000 turkey-days at risk	
							Total	% change[b]	Total	% change[b]
British Columbia	2015	30	9	88	74,648,523	1,736,982	43		109	
	2016	30	9	88	96,083,820	1,973,663	49	13	86	-21
	2017	27	9	89	109,183,975	1,599,299	68	40	122	42
	2018	30	9	88	78,374,747	1,555,057	50	-26	123	1
	2019	31	9	88	158,397,497	1,684,303	94	87	104	-16
Alberta	2018	10	9	86	31,565,138	526,087	60		117	
	2019	10	9	88	17,065,044	488,599	35	-42	35	-70
Ontario	2016	30	10	91	101,392,940	1,170,514	87		129	
	2017	31	10	89	79,958,950	1,353,274	59	-32	102	-21
	2018	30	9	84	67,659,477	1,003,483	67	14	108	6
	2019	30	10	90	162,071,642	1,309,285	124	84	135	25
Québec	2016	12	12	96	21,101,616	485,394	43		67	
	2017	16	11	90	20,384,973	626,239	33	-25	60	-10
	2018	25	11	90	33,445,259	873,834	38	18	70	17
	2019	27	11	89	36,646,907	985,654	37	-3	58	-18
National[c]	2016	72	10	90	218,578,376	3,629,571	60		97	
	2017	74	10	89	209,527,898	3,578,812	59	-3	103	7
	2018	95	10	87	211,044,621	3,958,461	53	-9	107	3
	2019	98	10	89	374,181,091	4,467,840	84	57	95	-11

Some values presented in this report slightly differ from the previous year's reports due to flock size corrections, improvement to the database and methodology refinements.

mg/PCU = milligrams/population correction unit.

DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligrams per kilogram turkey per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 1 for the list of standards.

nDDDvetCA/1,000 turkey-days at risk = number of DDDvetCA/1,000 turkey-days at risk.

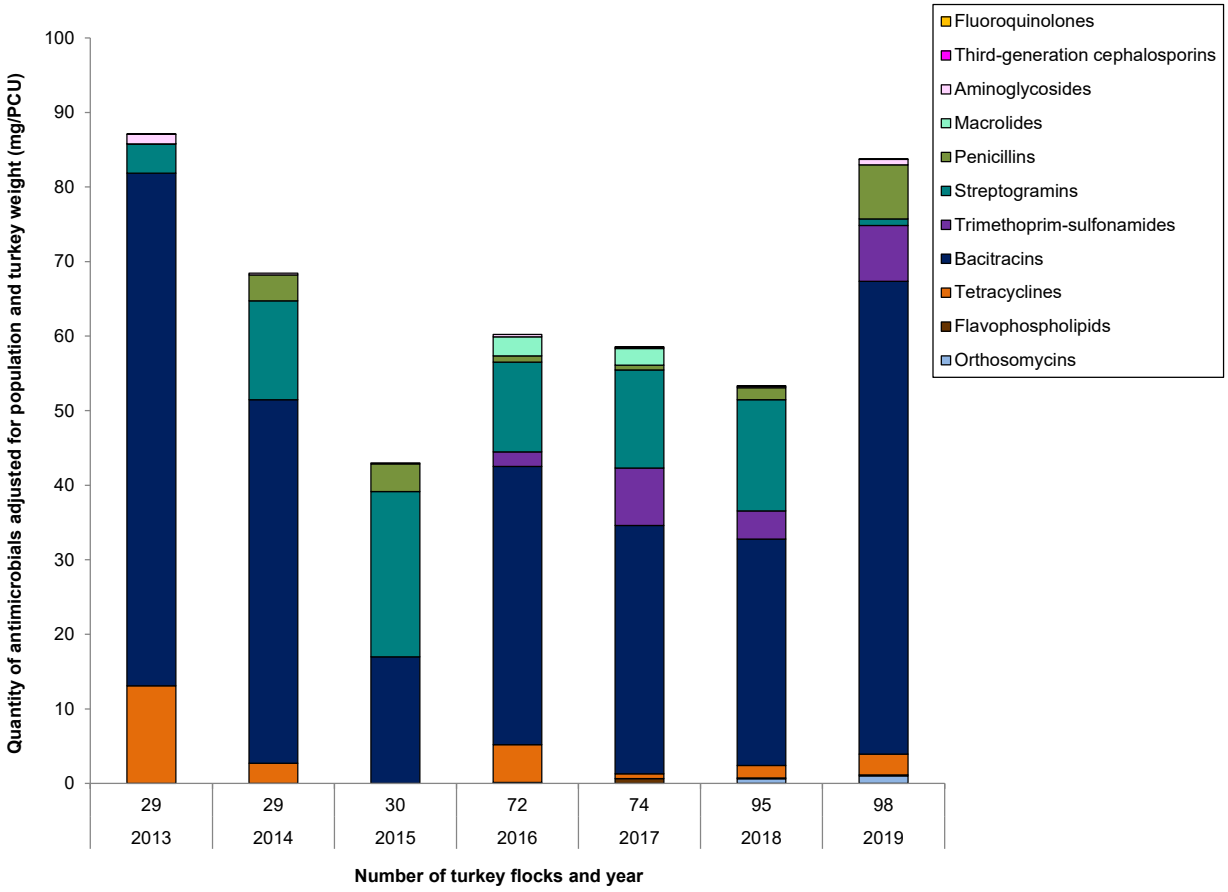
For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

[a] Population correction unit (PCU) or biomass, European weight (total flock population x ESVAC standard weight of 6.5 kg bird).

[b] Percent change = [(current surveillance year – previous surveillance year)/previous surveillance year] x 100.

[c] Includes only the provinces/regions surveyed and combines the quantity of antimicrobials used in feed, water and injection excluding coccidiostats, antiprotozoals, arsenicals and flavophospholipids.

Figure 2. 58 Quantity of antimicrobial use in all routes of administration, adjusted for population and turkey weight (mg/PCU), 2013 to 2019



Year Number of flocks		2013 29	2014 29	2015 30	2016 72	2017 74	2018 95	2019 98
Antimicrobial class								
I	Fluoroquinolones	0	0	0	0	< 0.1	< 0.1	0.1
	Third-generation cephalosporins	< 0.1	0	0	0	0	0	0
II	Aminoglycosides	1	0.3	0.1	0.3	0.2	0.2	1
	Macrolides	0	0	0	3	2	0	0
	Penicillins	0.0	3	4	1	1	2	7
	Streptogramins	4	13	22	12	13	15	1
	Trimethoprim-sulfonamides	0	0	0	2	8	4	7
III	Bacitracins	69	49	17	37	33	30	63
	Tetracyclines	13	3	0	5	1	2	3
IV	Flavophospholipids	0	0	0	0.1	0.7	0.1	0.2
N/A	Orthosomycins	0	0	0	0	0	1	1
Total		**87**	**68**	**43**	**60**	**59**	**53**	**84**

Roman numerals I to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

N/A = not applicable (no classification available at the time of writing of this report).

mg/PCU = milligrams/population correction unit.

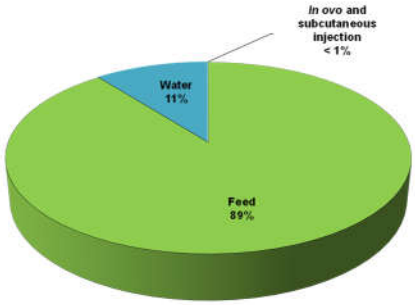
For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

2013 to 2015 data pertains to British Columbia.

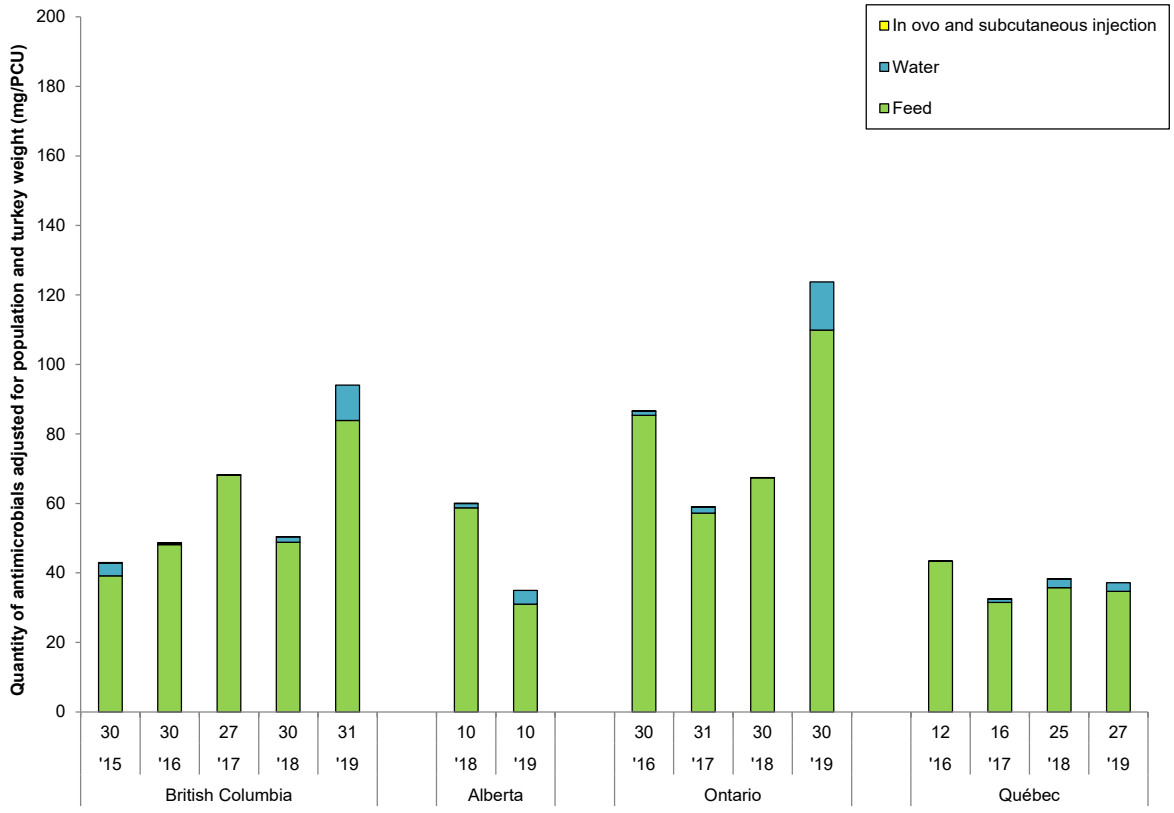
Please note, estimates have slightly varied from previous reports due to correction on the dose or level of drugs, days at risk, and birds at risk. One Alberta flock was misclassified as a British Columbia flock in 2018.

Figure 2. 59 Quantity of antimicrobials, adjusted for population and turkey weight (mg/PCU), in 2019 and by province, 2015 to 2019

a) 2019



b) by province



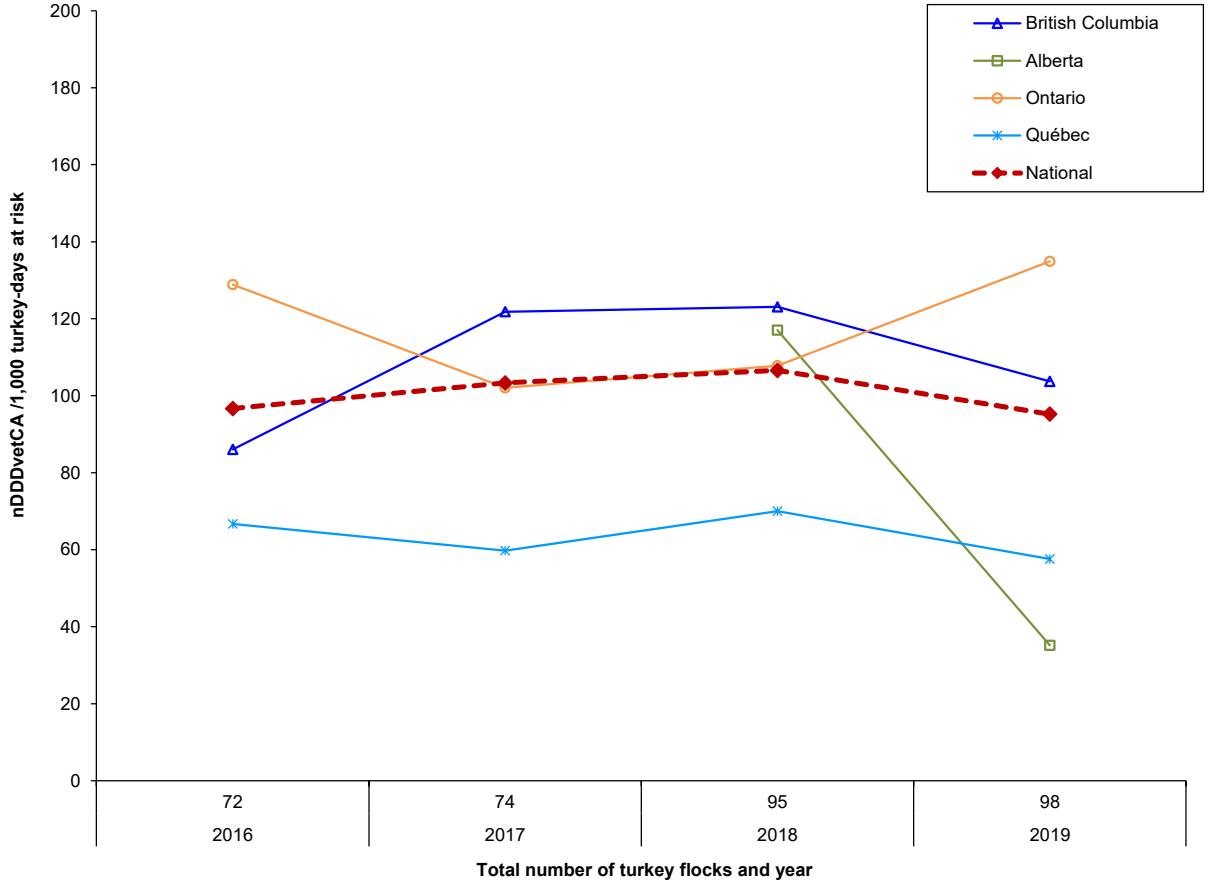
Province	British Columbia					Alberta		Ontario				Québec			
Year	'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of flocks	30	30	27	30	31	10	10	30	31	30	30	12	16	25	27
Route of administration															
Feed	39	48	68	49	84	59	31	85	57	67	110	43	32	36	35
Water	4	0.4	0	2	10	1	4	1	2	0	14	0	1	3	2
In ovo and subcutaneous injection	0.1	0.1	0.1	< 0.1	0	< 0.1	0	0.1	0.1	< 0.1	0	0.1	0.1	< 0.1	0
Total	**43**	**49**	**68**	**50**	**94**	**60**	**35**	**87**	**59**	**67**	**124**	**43**	**33**	**38**	**37**

mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

Data in figure pertains to the current year (pie) and data in table includes 2 to 5 years.

Figure 2. 60 Number of Canadian Defined Daily Doses for animals per 1,000 turkey-days at risk (nDDDvetCA/1,000 turkey-days at risk) for all routes of administration, by province, 2016 to 2019



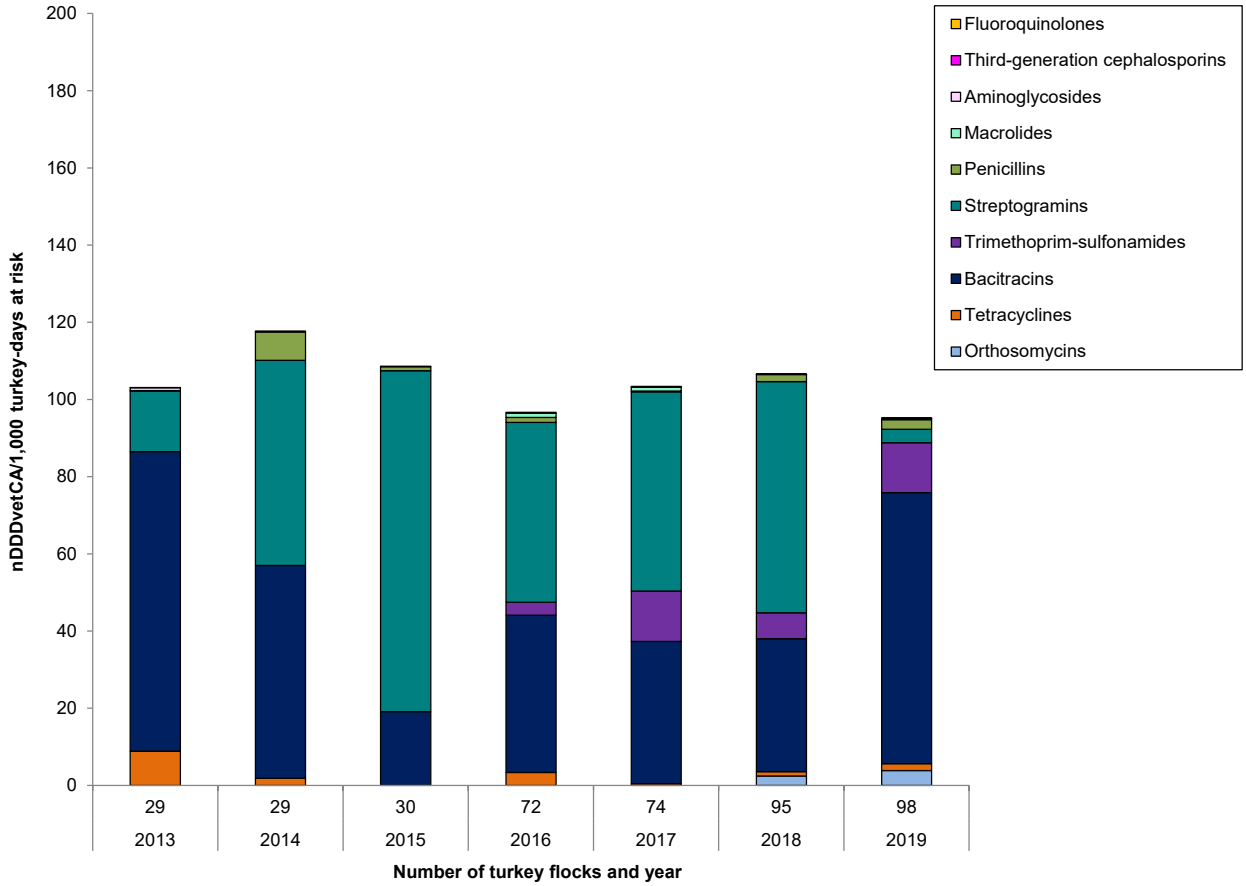
Year Number of flocks	2016 72	2017 74	2018 95	2019 98
Province				
British Columbia	86	122	123	104
Alberta			117	35
Ontario	129	102	108	135
Québec	67	60	70	58
National	**97**	**103**	**107**	**95**

DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram broiler weight per day (mg_{drug}/kg_{animal}/day); please refer to the CIPARS 2019: Design and Methods document, Table A. 1 for the list of standards.

nDDDvetCA/1,000 turkey-days at risk = Number of DDDvetCA/1,000 turkey-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

Figure 2. 61 Number of Canadian Defined Daily Doses for animals per 1,000 turkey-days at risk (nDDDvetCA/1,000 turkey-days at risk) for all routes of administration, 2013 to 2019



Year		2013	2014	2015	2016	2017	2018	2019
Number of flocks		29	29	30	72	74	95	98
Antimicrobial class								
I	Fluoroquinolones	0	0	0	0	< 0.1	< 0.1	0.1
	Third-generation cephalosporins	< 0.1	0	0	0	0	0	0
II	Aminoglycosides	0.7	0	0.1	0	0.2	0.1	0
	Macrolides	0	0	0	1	1	0	0
	Penicillins	0	7	1	1	0	2	2
	Streptogramins	16	53	88	47	52	60	3
	Trimethoprim-sulfonamides	0	0	0	3	13	7	13
III	Bacitracins	78	55	19	41	37	34	70
	Tetracyclines	9	2	0	3	0.4	1.1	2
N/A	Orthosomycins	0	0	0	0	0	2	4
Total		**103**	**118**	**109**	**97**	**103**	**107**	**95**

Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification available at the time of writing of this report).

DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram turkey weight per day (mg_{drug}/kg_{animal}/day); please refer to the 2019 CIPARS: Design and Methods document, Table A. 1 for the list of standards.

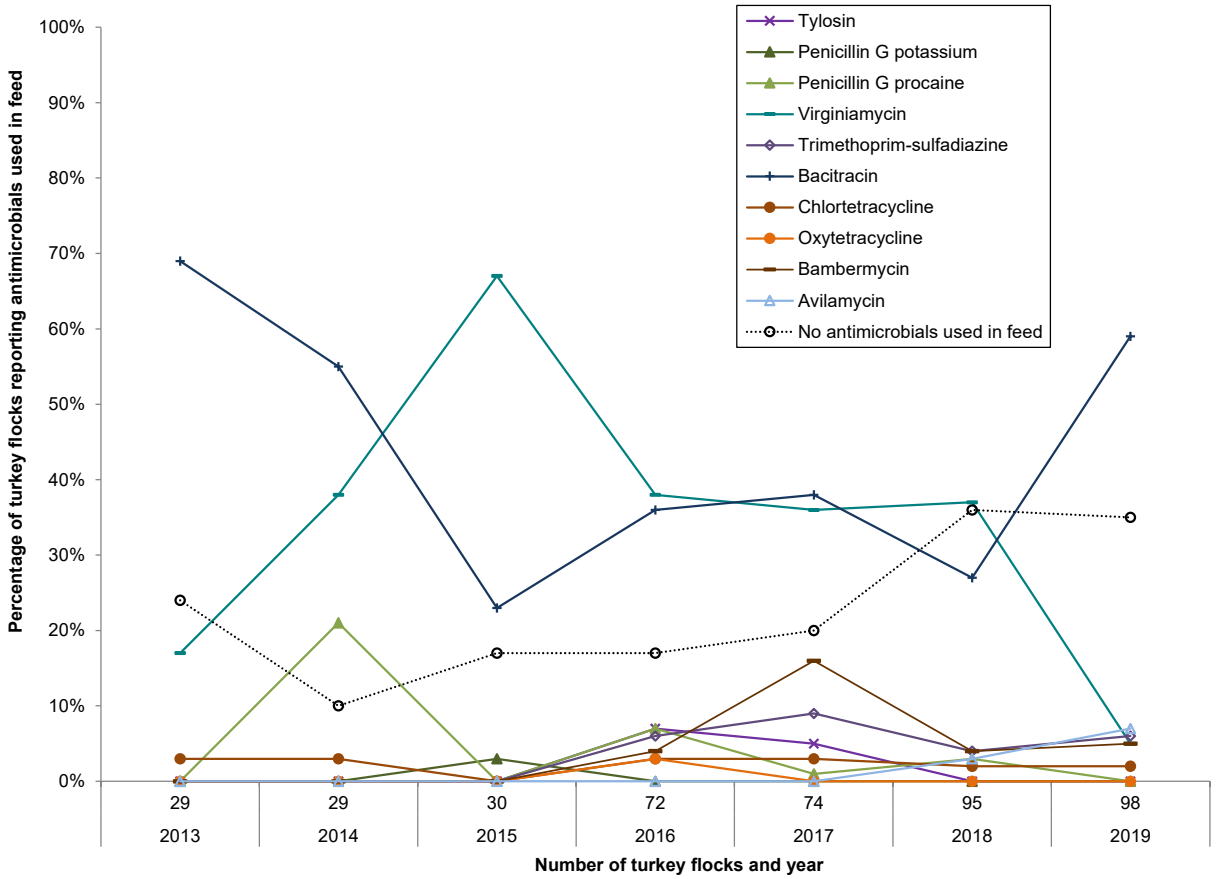
nDDDvetCA/1,000 turkey-days at risk = Number of DDDvetCA/1,000 turkey-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

2013 to 2015 data pertains to British Columbia.

Antimicrobial use in feed by frequency

Figure 2. 62 Percentage of turkey flocks reporting antimicrobial use in feed, 2013 to 2019



Year	2013	2014	2015	2016	2017	2018	2019
Number of flocks	29	29	30	72	74	95	98
Antimicrobial							
Tylosin	0%	0%	0%	**7%**	5%	**0%**	**0%**
Penicillin G potassium	0%	0%	3%	**0%**	0%	**0%**	**0%**
II Penicillin G procaine	0%	21%	0%	**7%**	1%	**3%**	**0%**
Virginiamycin	17%	38%	67%	**38%**	36%	**37%**	**5%**
Trimethoprim-sulfadiazine	0%	0%	0%	**6%**	9%	**4%**	**6%**
Bacitracin	69%	55%	23%	**36%**	38%	**27%**	**59%**
III Chlortetracycline	3%	3%	0%	**3%**	3%	**2%**	**2%**
Oxytetracycline	0%	0%	0%	**3%**	0%	**0%**	**0%**
IV Bambermycin	0%	0%	0%	**4%**	16%	**4%**	**5%**
N/A Avilamycin	0%	0%	0%	**0%**	0%	**3%**	**7%**
No antimicrobials used in feed	24%	10%	17%	**17%**	20%	**36%**	**35%**

Roman numerals II to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification at the time of writing of this report).

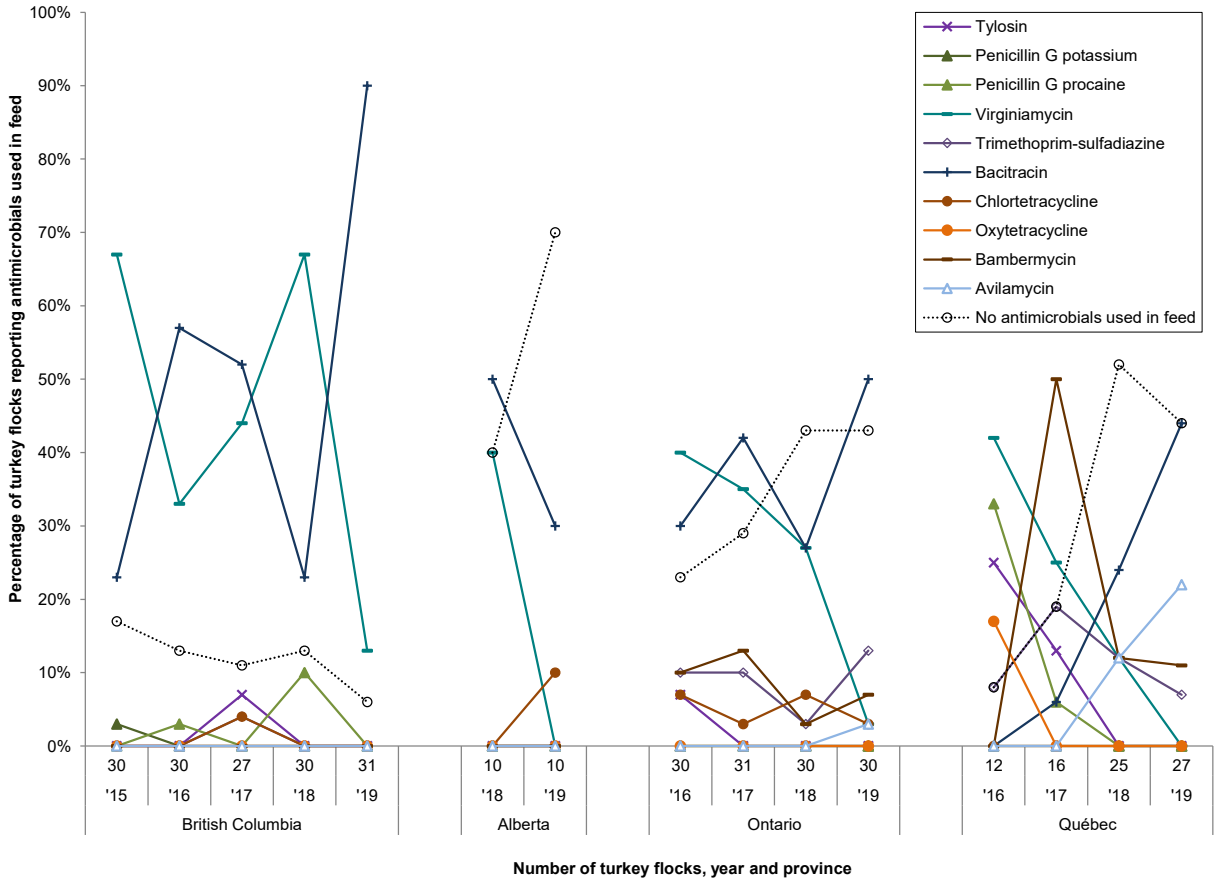
Numbers per column may not add up to 100% as some flocks may have used an antimicrobial more than once or used multiple antimicrobials throughout the grow-out period.

For the temporal analyses, the proportion (%) of flocks using a specific antimicrobial in the current year has been compared to the proportion (%) of flocks using the same antimicrobial in 2016 (program started at the national level) and the previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences ($P \leq 0.05$) for a given antimicrobial.

Please note that the "no antimicrobials used in feed" pertains to flocks that did not use any of the antimicrobial classes included in this figure (Categories II to IV and avilamycin).

2013 to 2015 data pertains to British Columbia.

Figure 2. 63 Percentage of turkey flocks reporting antimicrobial use in feed, by province, 2015 to 2019



Province	British Columbia					Alberta		Ontario				Québec			
Year	'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of flocks	30	30	27	30	31	10	10	30	31	30	30	12	16	25	27
Antimicrobial															
II Tylosin	0%	**0%**	7%	**0%**	**0%**	**0%**	**0%**	**7%**	0%	**0%**	**0%**	**25%**	13%	**0%**	**0%**
II Penicillin G potassium	3%	**0%**	0%	**0%**	**0%**	**0%**	**0%**	**0%**	0%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
II Penicillin G procaine	0%	**3%**	0%	**10%**	**0%**	**0%**	**0%**	**0%**	0%	**0%**	**0%**	**33%**	6%	**0%**	**0%**
II Virginiamycin	67%	**33%**	44%	**67%**	**13%**	**40%**	**0%**	**40%**	35%	**27%**	**3%**	**42%**	25%	**12%**	**0%**
II Trimethoprim-sulfadiazine	0%	**0%**	4%	**0%**	**0%**	**0%**	**0%**	**10%**	10%	**3%**	**13%**	**8%**	19%	**12%**	**7%**
III Bacitracin	23%	**57%**	52%	**23%**	**90%**	**50%**	**30%**	**30%**	42%	**27%**	**50%**	**0%**	6%	**24%**	**44%**
III Chlortetracycline	0%	**0%**	4%	**0%**	**0%**	**0%**	**10%**	**7%**	3%	**7%**	**3%**	**0%**	0%	**0%**	**0%**
III Oxytetracycline	0%	**0%**	0%	**0%**	**0%**	**0%**	**0%**	**0%**	0%	**0%**	**0%**	**17%**	0%	**0%**	**0%**
IV Bambermycin	0%	**0%**	0%	**0%**	**0%**	**0%**	**0%**	**10%**	13%	**3%**	**7%**	**0%**	50%	**12%**	**11%**
N/A Avilamycin	0%	**0%**	0%	**0%**	**0%**	**0%**	**0%**	**0%**	0%	**0%**	**3%**	**0%**	0%	**12%**	**22%**
No antimicrobials used in feed	17%	**13%**	11%	**13%**	**6%**	**40%**	**70%**	**23%**	29%	**43%**	**43%**	**8%**	19%	**52%**	**44%**

Roman numerals II to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification available at the time of writing of this report).

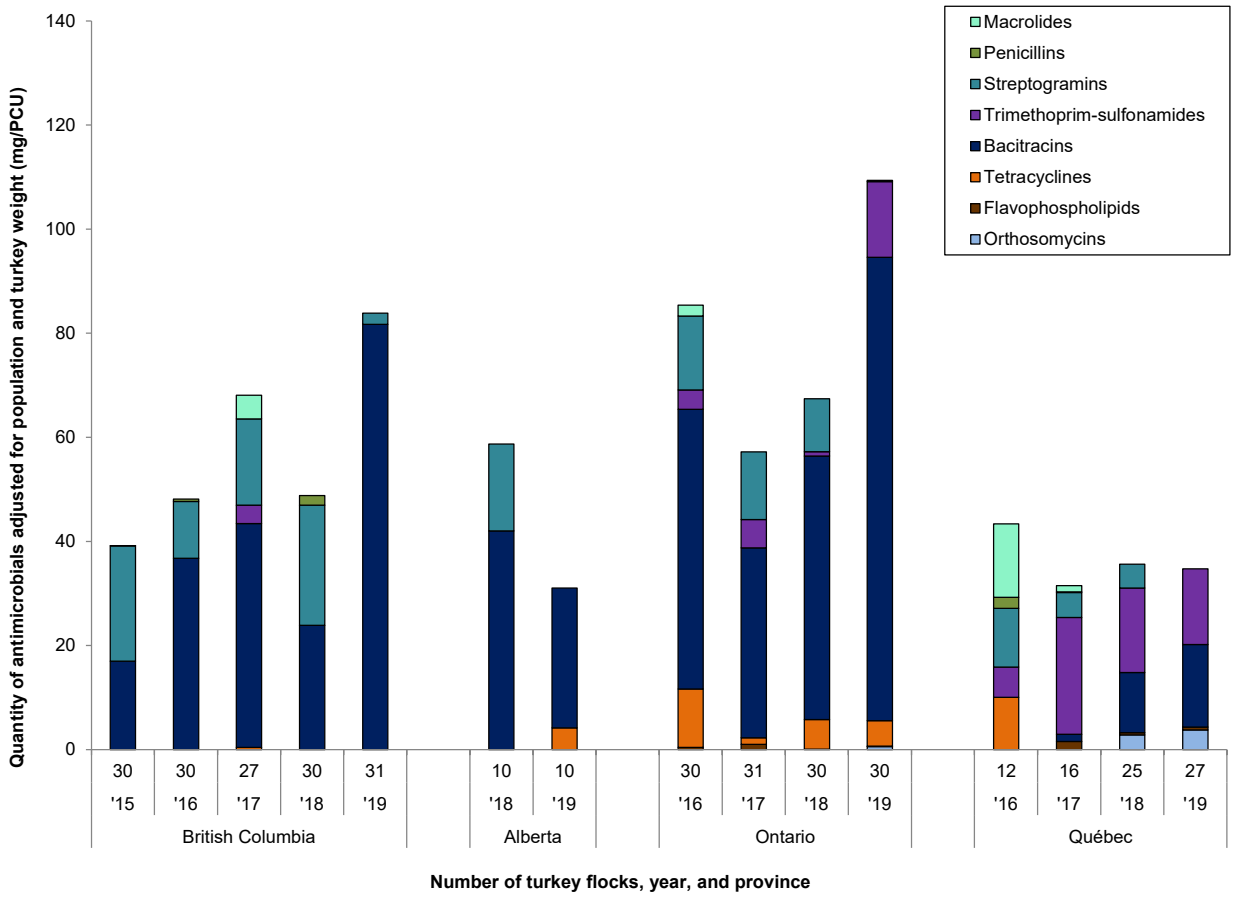
Numbers per column may not add up to 100% as some flocks may have used an antimicrobial more than once or used multiple antimicrobials throughout the grow-out period.

For the temporal analyses within province, the proportion (%) of flocks using a specific antimicrobial in the current year has been compared to the proportion (%) of flocks using the same antimicrobial in 2016 (program started at the national level) and the previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences ($P \leq 0.05$) within province for a given antimicrobial. The presence of red areas indicates significant provincial differences ($P \leq 0.05$) for a given antimicrobial within the current year (Québec-referent province).

Please note that the "no antimicrobials used in feed" pertains to flocks that did not use any of the antimicrobial classes included in this figure (Categories II to IV and avilamycin).

Antimicrobial use in feed by quantitative indicators

Figure 2. 64 Quantity of antimicrobial use in feed adjusted for population and turkey weight (mg/PCU), by province, 2015 to 2019



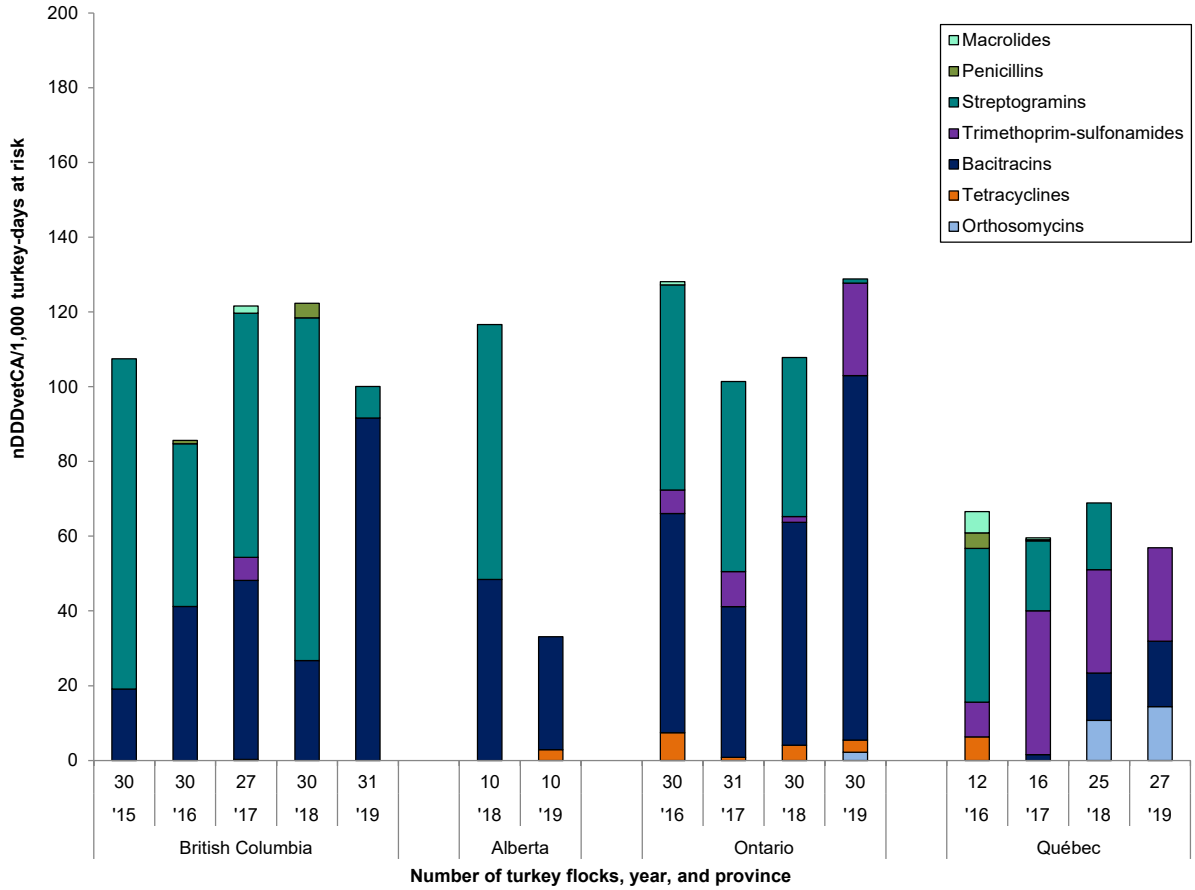
Province	British Columbia					Alberta		Ontario				Québec			
Year	'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of flocks	30	30	27	30	31	10	10	30	31	30	30	12	16	25	27
Antimicrobial class															
II Macrolides	0	0	5	0	0	0	0	2	0	0	0	14	1	0	0
II Penicillins	< 0.1	0.4	0	2	0	0	0	0	0	0	0	2	0	0	0
II Streptogramins	22	11	17	23	2	17	0	14	13	10	0	11	5	5	0
II Trimethoprim-sulfonamides	0	0	4	0	0	0	0	4	5	1	15	6	22	16	15
III Bacitracins	17	37	43	24	82	42	27	54	37	51	89	0	1	12	16
III Tetracyclines	0	0	0	0	0	0	4	11	1	6	5	10	0	0	0
IV Flavophospholipids	0	0	0	0	0	0	0	0	1	0	0.1	0	2	0	0.6
N/A Orthosomycins	0	0	0	0	0	0	0	0	0	0	1	0	0	3	4
Total	**39**	**48**	**68**	**49**	**84**	**59**	**31**	**85**	**57**	**67**	**109**	**43**	**32**	**36**	**35**

Roman numerals II to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification available at the time of writing of this report).

mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

Figure 2. 65 Number of Canadian Defined Daily Doses for animals per 1,000 turkey-days at risk (nDDDvetCA/1,000 turkey-days at risk) for antimicrobials administered in feed, by province, 2015 to 2019



Province		British Columbia					Alberta		Ontario				Québec			
Year		'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of flocks		30	30	27	30	31	10	10	30	31	30	30	12	16	25	27
Antimicrobial class																
II	Macrolides	0	0	2	0	0	0	0	1	0	0	0	6	1	0	0
	Penicillins	0	1	0	4	0	0	0	0	0	0	0	4	0	0	0
	Streptogramins	88	43	65	92	8	68	0	55	51	43	1	41	19	18	0
	Trimethoprim-sulfonamides	0	0	6	0	0	0	0	6	9	2	25	9	38	28	25
III	Bacitracins	19	41	48	27	92	48	30	59	40	60	98	0	2	13	17
	Tetracyclines	0	0	0	0	0	0	3	7	1	4	3	6	0	0	0
N/A	Orthosomycins	0	0	0	0	0	0	0	0	0	0	2	0	0	11	14
Total		**107**	**86**	**122**	**122**	**100**	**117**	**33**	**128**	**101**	**108**	**129**	**67**	**60**	**69**	**57**

Roman numerals II to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification available at the time of writing of this report).

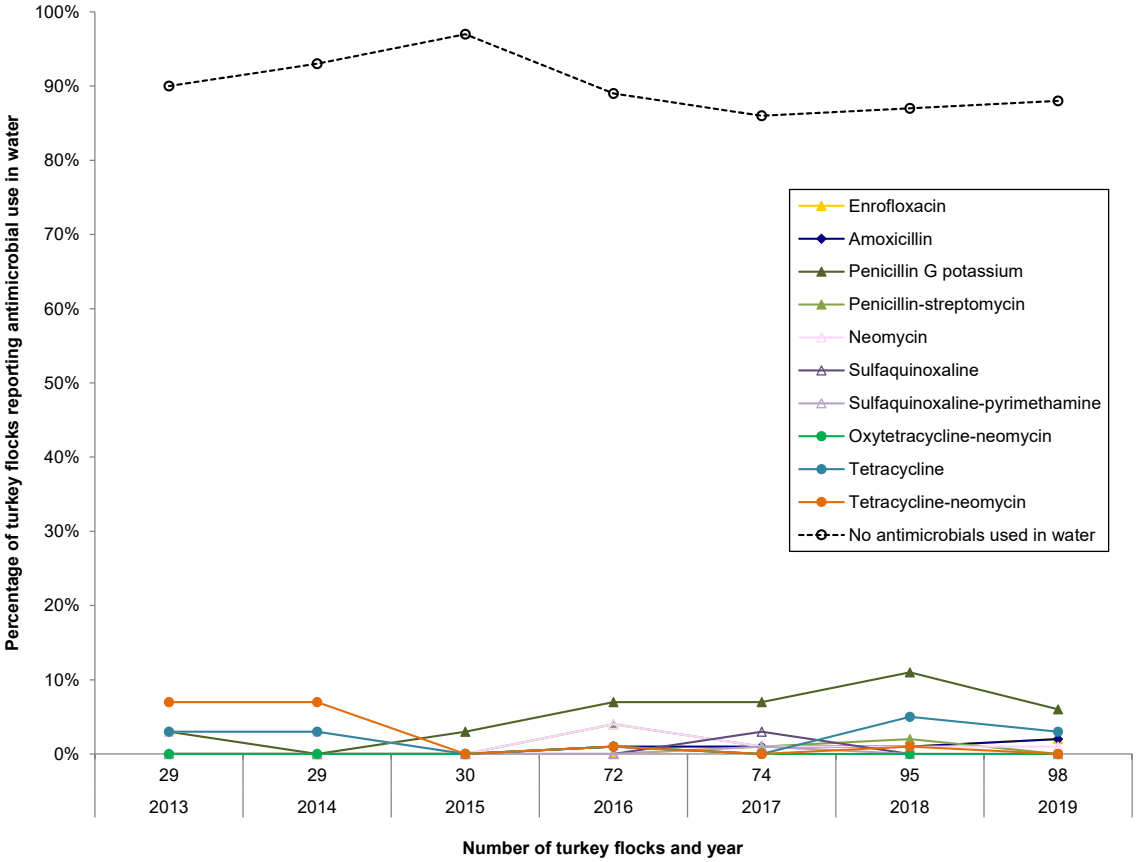
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram turkey weight per day (mg_{drug}/kg_{animal}/day); please refer to the 2019 CIPARS: Design and Methods document, Table A. 1 for the list of standards.

nDDDvetCA/1,000 turkey-days at risk = number of DDDvetCA/1,000 turkey-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

Antimicrobial use in water by frequency

Figure 2. 66 Percentage of turkey flocks reporting antimicrobial use in water, 2013 to 2019



Year	2013	2014	2015	2016	2017	2018	2019
Number of flocks	29	29	30	72	74	95	98
Antimicrobial							
I Enrofloxacin	0%	0%	0%	**0%**	1%	**1%**	**2%**
II Amoxicillin	0%	0%	0%	**1%**	1%	**1%**	**2%**
II Penicillin G potassium	3%	0%	3%	**7%**	7%	**11%**	**6%**
II Penicillin-streptomycin	0%	0%	0%	**4%**	1%	**2%**	**0%**
II Neomycin	3%	3%	0%	**4%**	1%	**1%**	**1%**
III Sulfaquinoxaline	0%	0%	0%	**0%**	3%	**0%**	**0%**
III Sulfaquinoxaline-pyrimethamine	0%	0%	0%	**0%**	1%	**0%**	**0%**
III Oxytetracycline-neomycin	0%	0%	0%	**1%**	0%	**0%**	**0%**
III Tetracycline	3%	3%	0%	**1%**	0%	**5%**	**3%**
III Tetracycline-neomycin	7%	7%	0%	**1%**	0%	**1%**	**0%**
No antimicrobials used in water	90%	93%	97%	**89%**	86%	**87%**	**88%**

Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

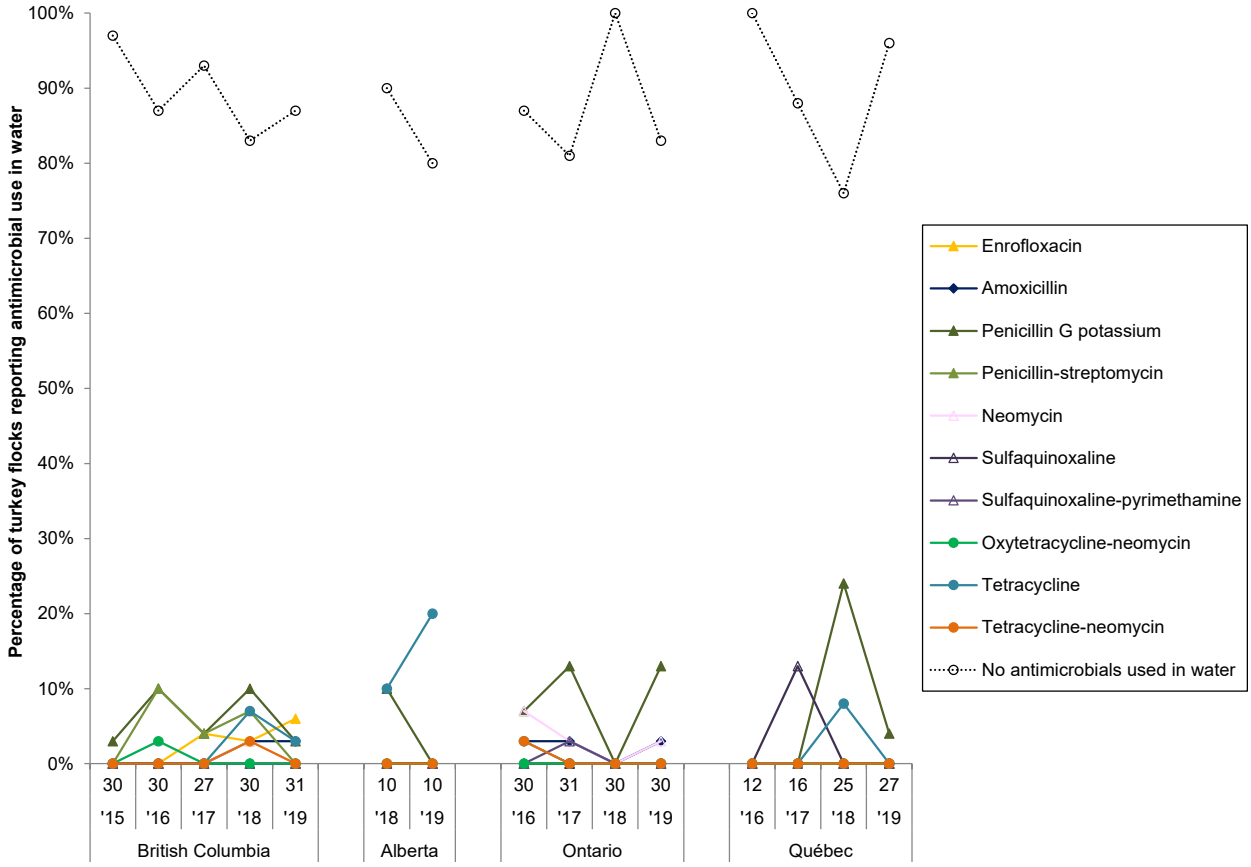
Numbers per column may not add up to 100% as some flocks have used an antimicrobial more than once or used multiple antimicrobials throughout the growing period.

For the temporal analysis, the proportion (%) of flocks using a specific antimicrobial in the current year has been compared to the proportion (%) of flocks using the same antimicrobial in 2016 (program started at the national level) and previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences ($P \leq 0.05$) for a given antimicrobial.

Please note that the "no antimicrobials used in water" pertains to flocks that did not use any of the antimicrobial classes included in this figure (Categories I to III).

2013 to 2015 data pertains to British Columbia.

Figure 2. 67 Percentage of turkey flocks reporting antimicrobial use in water, by province, 2015 to 2019



Province		British Columbia					Alberta		Ontario				Québec			
Year		'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of flocks		30	30	27	30	31	10	10	30	31	30	30	12	16	25	27
Antimicrobial																
I	Enrofloxacin	0%	**0%**	4%	**3%**	**6%**	**0%**	**0%**	**0%**	0%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
II	Amoxicillin	0%	**0%**	0%	**3%**	**3%**	**0%**	**0%**	**3%**	3%	**0%**	**3%**	**0%**	0%	**0%**	**0%**
	Penicillin G potassium	3%	**10%**	4%	**10%**	**3%**	**10%**	**0%**	**7%**	13%	**0%**	**13%**	**0%**	0%	**24%**	**4%**
	Penicillin-streptomycin	0%	**10%**	4%	**7%**	**0%**	**0%**	**0%**	**0%**	0%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
	Neomycin	0%	**3%**	0%	**3%**	**0%**	**0%**	**0%**	**7%**	3%	**0%**	**3%**	**0%**	0%	**0%**	**0%**
III	Sulfaquinoxaline	0%	**0%**	0%	**0%**	**0%**	**0%**	**0%**	**0%**	0%	**0%**	**0%**	**0%**	13%	**0%**	**0%**
	Sulfaquinoxaline-pyrimethamine	0%	**0%**	0%	**0%**	**0%**	**0%**	**0%**	**0%**	3%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
	Oxytetracycline-neomycin	0%	**3%**	0%	**0%**	**0%**	**0%**	**0%**	**0%**	0%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
	Tetracycline	0%	**0%**	0%	**7%**	**3%**	**10%**	**20%**	**3%**	0%	**0%**	**0%**	**0%**	0%	**8%**	**0%**
	Tetracycline-neomycin	0%	**0%**	0%	**3%**	**0%**	**0%**	**0%**	**3%**	0%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
	No antimicrobials used in water	97%	**87%**	93%	**83%**	**87%**	**90%**	**80%**	**87%**	81%	**100%**	**83%**	**100%**	88%	**76%**	**96%**

Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

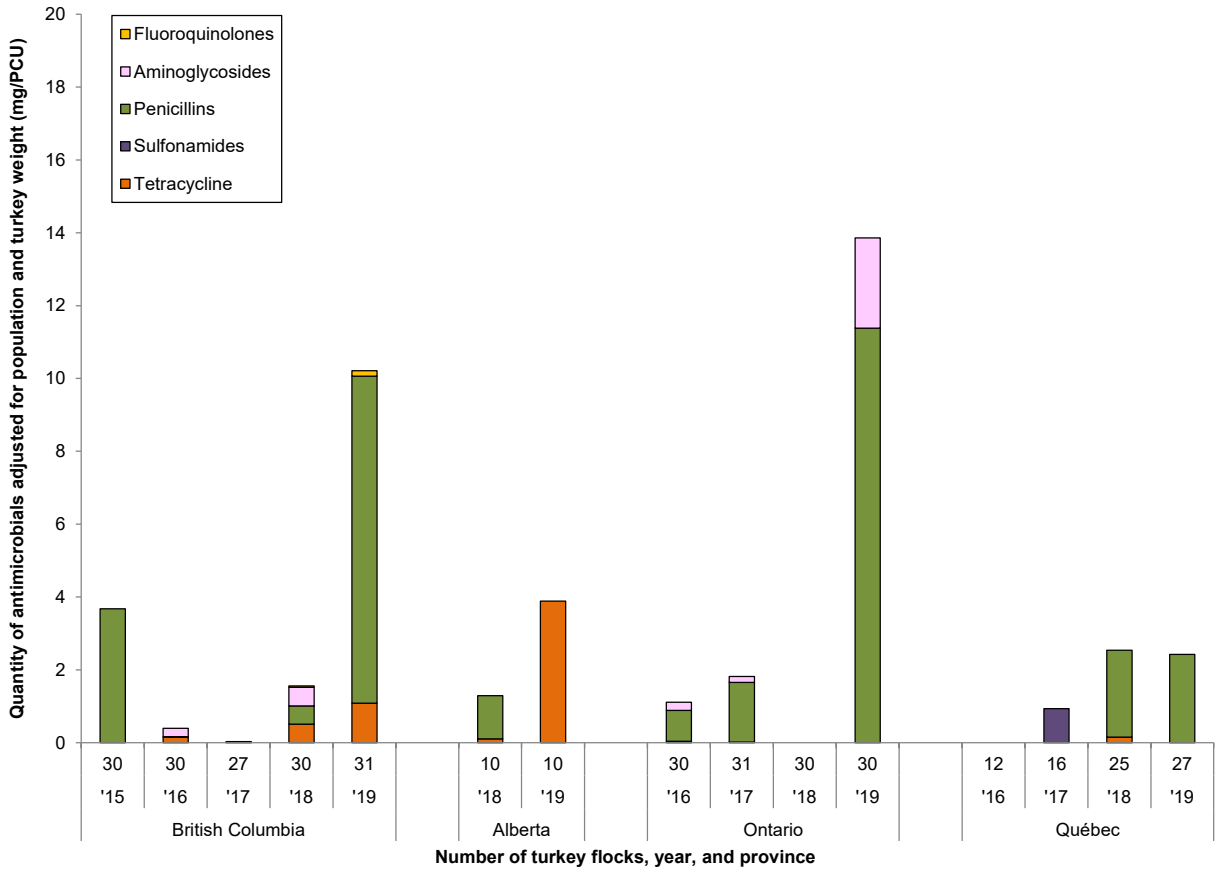
Numbers per column may not add up to 100% as some flocks have used an antimicrobial more than once or used multiple antimicrobials throughout the growing period.

For the temporal analysis within province, the proportion (%) of flocks using a specific antimicrobial in the current year has been compared to the proportion (%) of flocks using the same antimicrobial in 2016 (program started at the national level) and previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences ($P \leq 0.05$) within province for a given antimicrobial. The presence of red areas indicates significant provincial differences ($P \leq 0.05$) for a given antimicrobial within the current year (Québec-referent province).

Please note that the "no antimicrobials used in water" pertains to flocks that did not use any of the antimicrobial classes included in this figure (Categories I to III).

Antimicrobial use in water by quantitative indicators

Figure 2. 68 Quantity of antimicrobial use in water adjusted for population and turkey weight (mg/PCU), by province, 2015 to 2019



Province	British Columbia					Alberta		Ontario				Québec			
Year	'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of flocks	30	30	27	30	31	10	10	30	31	30	30	12	16	25	27
Antimicrobial class															
I Fluoroquinolones	0	0	< 0.1	< 0.1	0.2	0	0	0	0	0	0	0	0	0	0
II Aminoglycosides	0	0.2	0	1	0	0	0	0.2	0.2	0	2	0	0	0	0
II Penicillins	4	0	0	1	9	1	0	1	2	0	11	0	0	2	2
III Sulfonamides	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
III Tetracyclines	0	0.2	0	1	1	0.1	4	0	0	0	0	0	0	0	0
Total	**4**	**0.4**	**0**	**2**	**10**	**1**	**4**	**1**	**2**	**0**	**14**	**0**	**1**	**3**	**2**

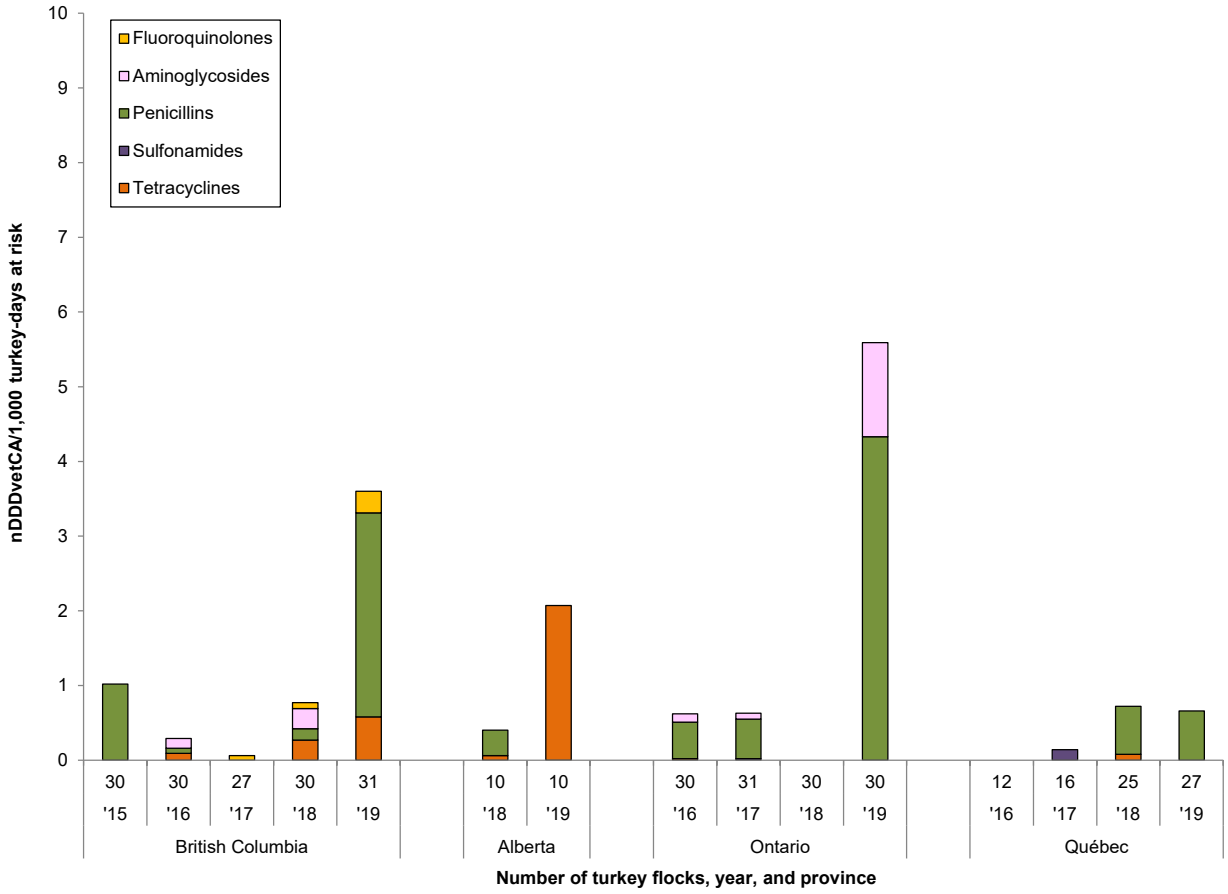
Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

mg/PCU = milligrams/population correction unit

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

Please note, estimates have slightly changed from previous reports as a result of ongoing refinements to the database, flock population, dose corrections, and rounding.

Figure 2. 69 Number of Canadian Defined Daily Doses for animals per 1,000 turkey-days at risk (nDDDvetCA/1,000 turkey-days at risk) for antimicrobials administered in water, by province, 2015 to 2019



Province	British Columbia					Alberta		Ontario				Québec			
Year	'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of flocks	30	30	27	30	31	10	10	30	31	30	30	12	16	25	27
Antimicrobial class															
I Fluoroquinolones	0	0	0.1	0.1	0.3	0	0	0	0	0	0	0	0	0	0
II Aminoglycosides	0	0.1	0	0.3	0	0	0	0.1	0.1	0	1	0	0	0	0
II Penicillins	1	0.1	0	0.2	2.7	0.3	0	0.5	0.5	0	4	0	0	1	0.7
III Sulfonamides	0	0	0	0	0	0	0	0	< 0.1	0	0	0	0.1	0	0
III Tetracyclines	0	0.1	0	0.3	1	0.1	2	< 0.1	0	0	0	0	0	0.1	0
Total	**1.0**	**0.3**	**0.1**	**0.8**	**3.6**	**0.4**	**2.1**	**0.6**	**0.6**	**0**	**6**	**0**	**0.1**	**0.7**	**0.7**

Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram turkey weight per day (mg_{drug}/kg_{animal}/day); please refer to the 2019 CIPARS Design and Methods document, Table A. 1 for the list of standards.

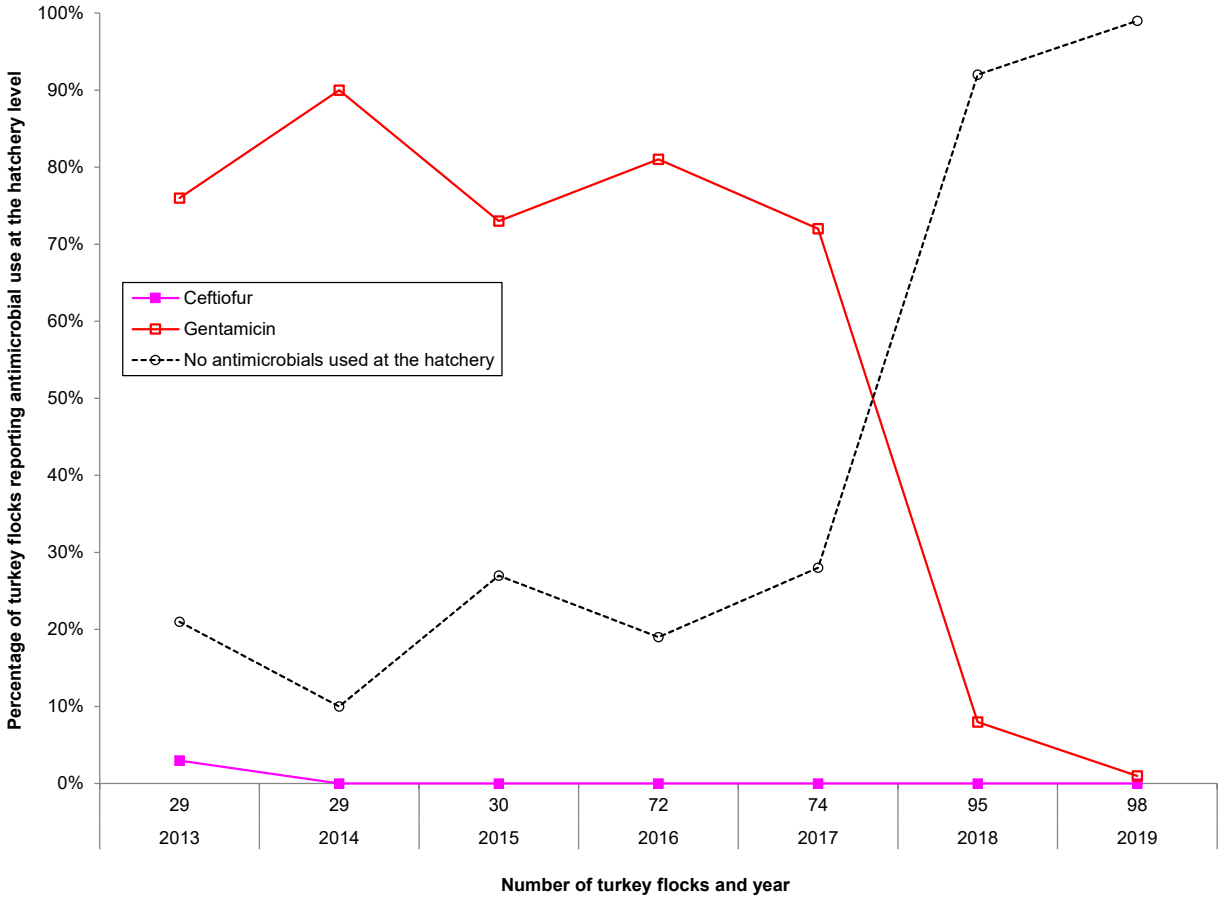
nDDDvetCA/1,000 turkey-days at risk = number of DDDvetCA/1,000 turkey-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

Please note, estimates have slightly changed from previous reports as a result of ongoing refinements to the database, flock population (flocks with no pre-harvest data excluded), dose corrections, and rounding.

Antimicrobials use *in ovo* or subcutaneous injection by frequency

Figure 2. 70 Percentage of turkey flocks reporting antimicrobial use *in ovo* or subcutaneous injection, 2013 to 2019

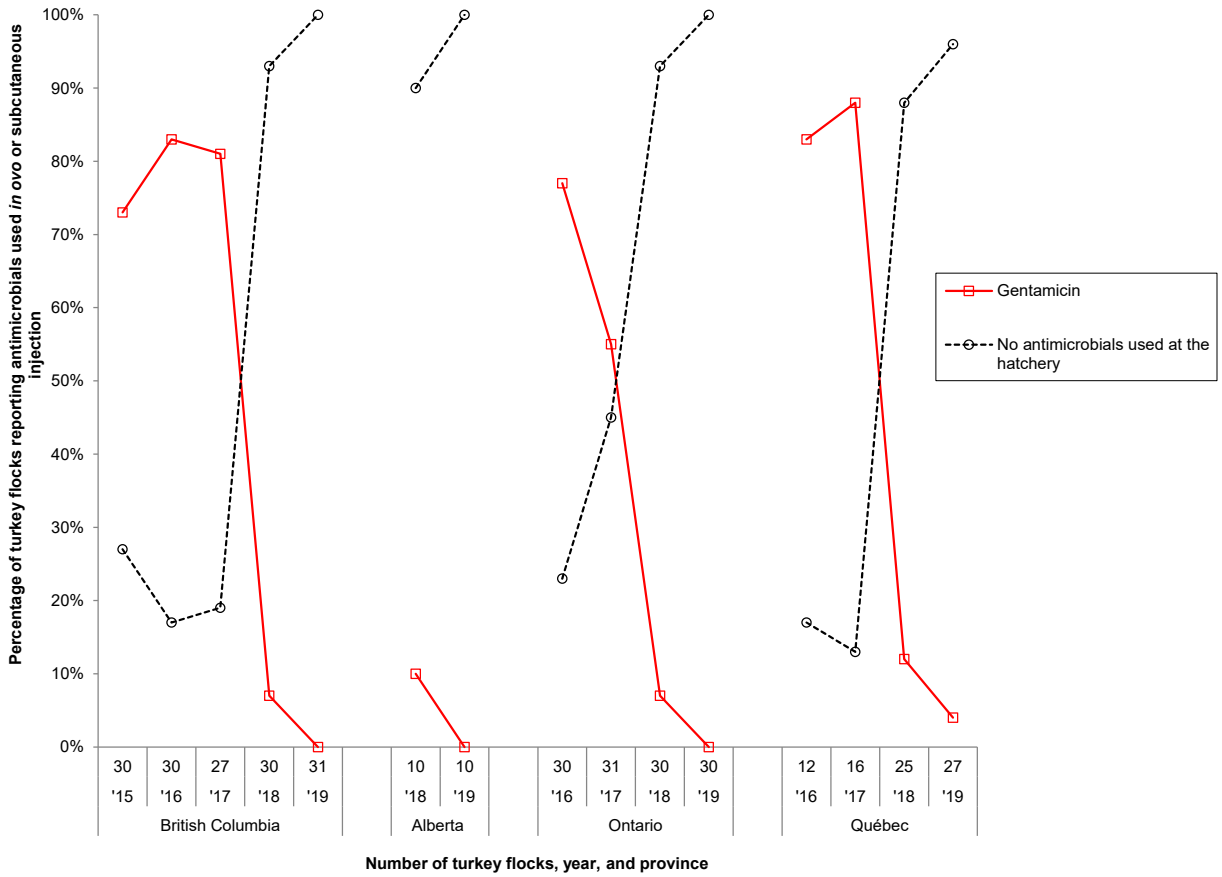


Year	2013	2014	2015	2016	2017	2018	2019
Number of flocks	29	29	30	72	74	95	98
Antimicrobial							
I Ceftiofur	3%	0%	0%	**0%**	0%	**0%**	**0%**
II Gentamicin	76%	90%	73%	**81%**	72%	**8%**	**1%**
No antimicrobials used at the hatchery	21%	10%	27%	**19%**	28%	**92%**	**99%**

Roman numerals I and II indicates category of importance to human medicine as outlined by the Veterinary Drugs Directorate.
Numbers per column may not add up to 100% due to rounding or batches of chicks (hatched at the same time to supply 1 barn) may have used more than one antimicrobial.
Data represent flocks medicated at the hatchery at day 18 of incubation or upon hatch.
For the temporal analyses, the proportion (%) of flocks using a specific antimicrobial in the current year has been compared to the proportion (%) of flocks using the same antimicrobial in 2016 (national program started) and previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences ($P \leq 0.05$) for a given antimicrobial.
Please note that the "no antimicrobials used" pertains to flocks that did not use any of the antimicrobial classes included in this figure (Categories I and II).

2013 to 2015 data pertains to British Columbia.

Figure 2. 71 Percentage of turkey flocks reporting antimicrobial use *in ovo* or subcutaneous injection, by province, 2015 to 2019



Province	British Columbia					Alberta		Ontario				Québec			
Year	'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of flocks	30	30	27	30	31	10	10	30	31	30	30	12	16	25	27
Antimicrobial															
II Gentamicin	73%	**83%**	81%	**7%**	**0%**	**10%**	**0%**	**77%**	55%	**7%**	**0%**	**83%**	88%	**12%**	**4%**
No antimicrobials used at the hatchery	27%	**17%**	19%	**93%**	**100%**	**90%**	**100%**	**23%**	45%	**93%**	**100%**	**17%**	13%	**88%**	**96%**

Roman numerals II indicates category of importance to human medicine as outlined by the Veterinary Drugs Directorate.

Numbers per column may not add up to 100% due to rounding or batches of chicks (hatched at the same time to supply 1 barn) may have used more than one antimicrobial.

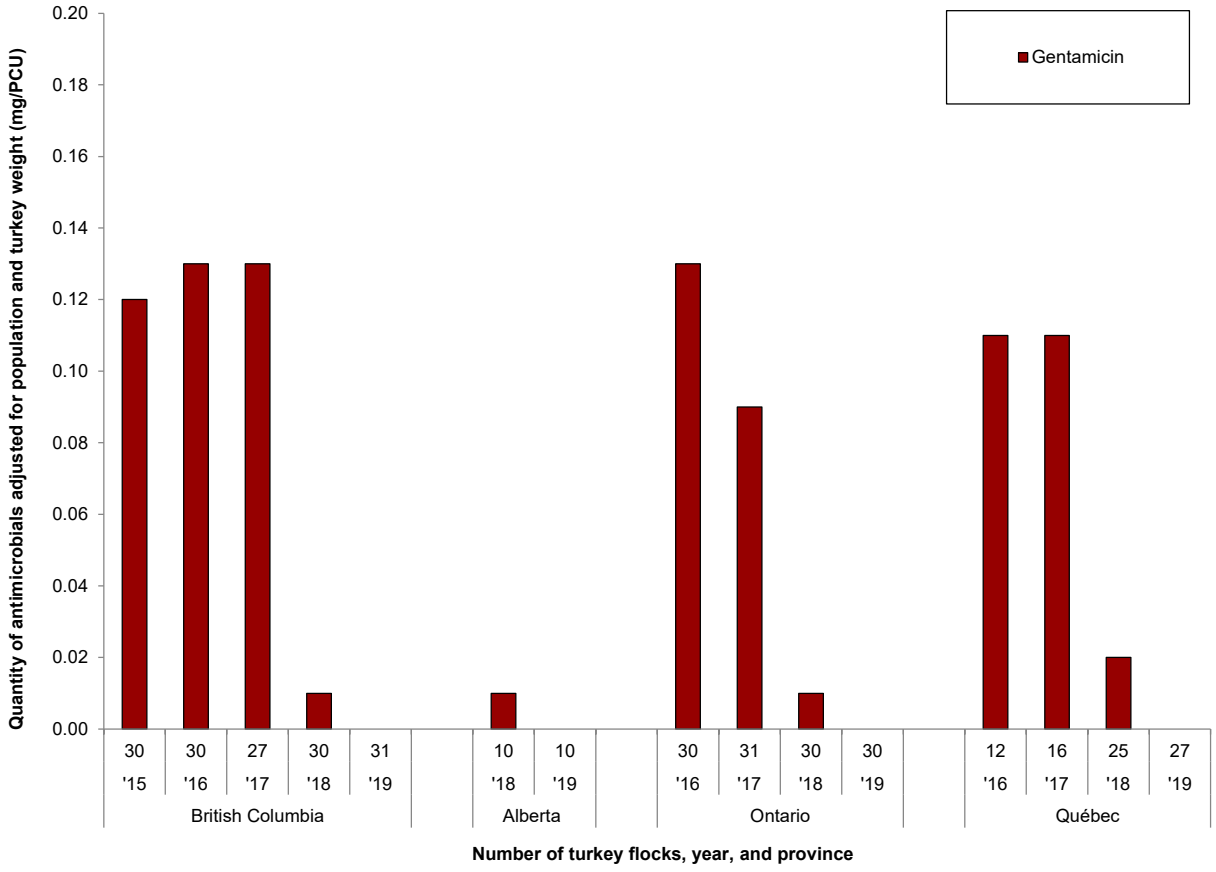
Data represent flocks medicated at the hatchery at day 18 of incubation or upon hatch.

For the temporal analyses within province, the proportion (%) of flocks using a specific antimicrobial in the current year has been compared to the proportion (%) of flocks using the same antimicrobial in 2016 (national program started) and previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences ($P \leq 0.05$) within province for a given antimicrobial. The presence of red areas indicates significant provincial differences ($P \leq 0.05$) for a given antimicrobial within the current year (Québec-referent province).

Please note that the "no antimicrobials used at the hatchery" pertains to flocks that did not use the antimicrobial class included in this figure (Categories II).

Antimicrobial use *in ovo* or subcutaneous injection by quantitative indicators

Figure 2. 72 Quantity of antimicrobial use *in ovo* or subcutaneous injection adjusted for population and turkey weight (mg/PCU), by province, 2015 to 2019



Province	British Columbia					Alberta		Ontario				Québec			
Year	'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of flocks	30	30	27	30	31	10	10	30	31	30	30	12	16	25	27
Antimicrobial															
II Gentamicin	0.12	0.13	0.13	0.01	0	0.01	0	0.13	0.09	0.01	0	0.11	0.11	0.02	0
Total	**0.12**	**0.13**	**0.13**	**0.01**	**0**	**0.01**	**0**	**0.13**	**0.09**	**0.01**	**0**	**0.11**	**0.11**	**0.02**	**0**

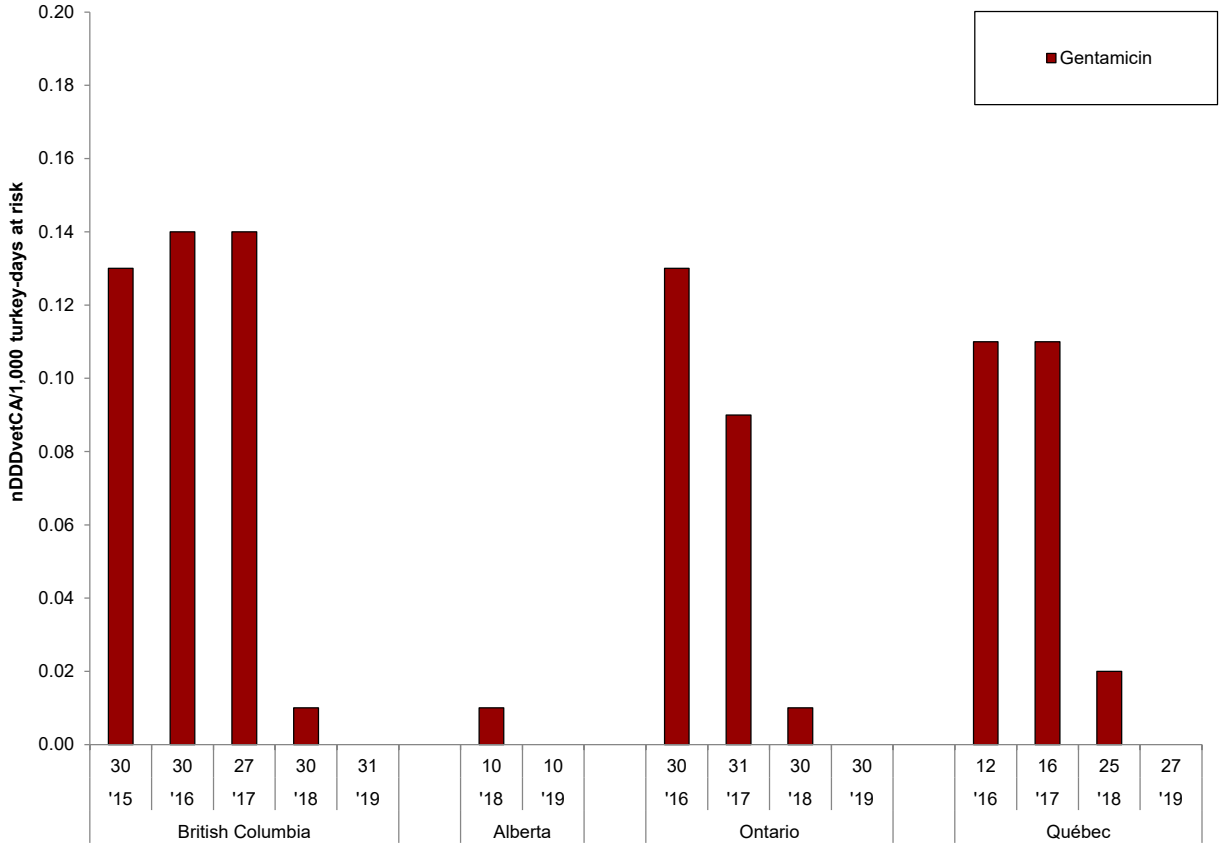
Roman numeral II indicates category of importance to human medicine as outlined by the Veterinary Drugs Directorate.

Total milligrams active ingredient was calculated using the final dose (in milligrams per hatching egg or poult) suggested by the manufacturer and expert opinion based on milligrams per body weight or residue avoidance information: gentamicin routine dose (1 mg/poult).

mg/PCU = milligrams/population correction unit.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

Figure 2. 73 Number of Canadian Defined Daily Doses for animals per 1,000 turkey-days at risk (nDDDvetCA/1,000 turkey-days at risk) for antimicrobials administered *in ovo* or subcutaneous injection, by province, 2015 to 2019



Province	British Columbia					Alberta		Ontario				Québec			
Year	'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of flocks	30	30	27	30	31	10	10	30	31	30	30	12	16	25	27
Antimicrobial															
II Gentamicin	0.13	0.14	0.14	0.01	0	0.01	0	0.13	0.09	0.01	0	0.11	0.11	0.02	0
Total	**0.13**	**0.14**	**0.14**	**0.01**	**0**	**0.01**	**0**	**0.13**	**0.09**	**0.01**	**0**	**0.11**	**0.11**	**0.02**	**0**

Roman numeral II indicates category of importance to human medicine as outlined by the Veterinary Drugs Directorate.

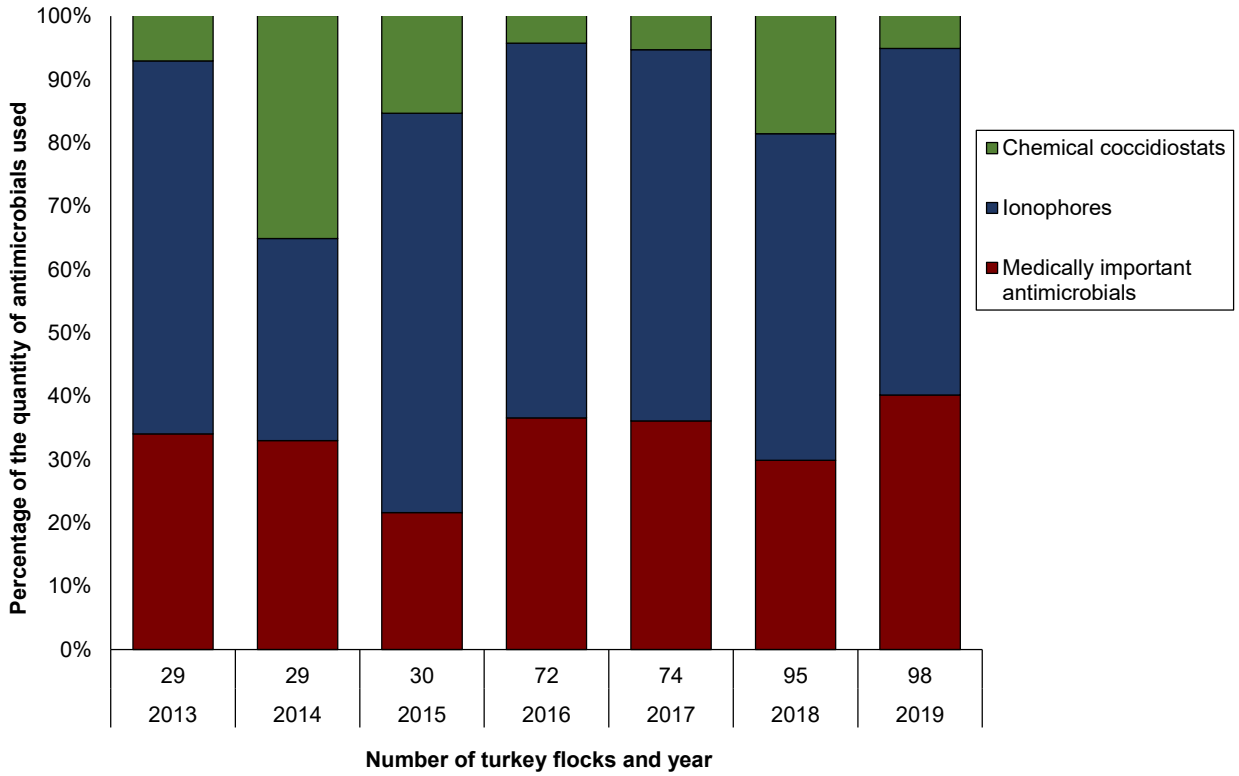
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram turkey weight per day (mg_{drug}/kg_{animal}/day); please refer to the 2019 CIPARS Design and Methods document, Table A. 1 for the list of standards.

nDDDvetCA/1,000 turkey-days at risk = number of DDDvetCA/1,000 turkey-days at risk.

For detailed indicator descriptions, please refer to the CIPARS 2019: Design and Methods document.

Coccidiostat and antiprotozoal use in feed by frequency

Figure 2. 74 Percentage of the quantity (milligrams of active ingredient) of antimicrobials used in turkey flocks, 2013 to 2019



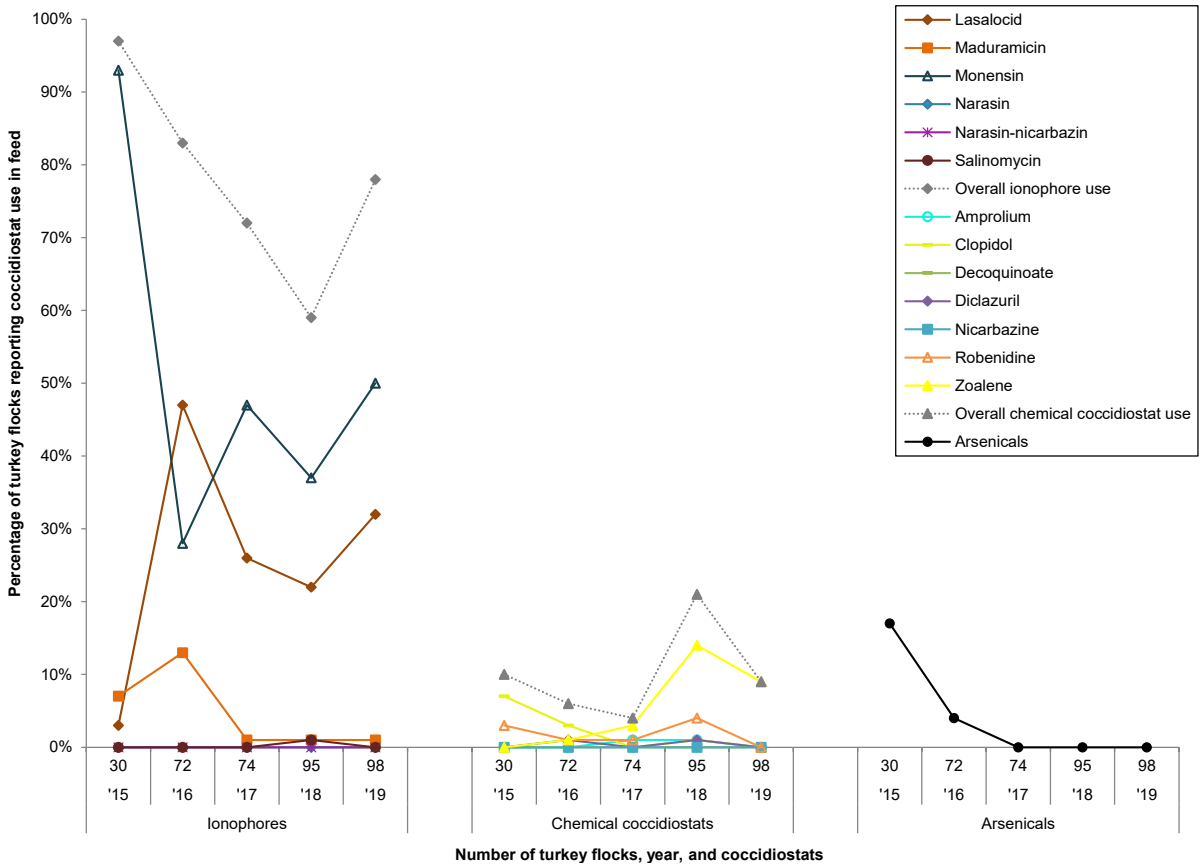
Year Number of flocks	2013 29	2014 29	2015 30	2016 72	2017 74	2018 95	2019 98
Antimicrobial classification							
Medically important antimicrobials[1]	34%	33%	22%	37%	36%	30%	40%
Ionophores	59%	32%	63%	59%	59%	52%	55%
Chemical coccidiostats	8%	35%	17%	5%	6%	19%	9%

Quantity of antimicrobials in milligrams active ingredients.

[1] Medically-important antimicrobials are the classes reported in the previous section[5].

[5] Government of Canada. Health Canada, Veterinary Drugs Directorate. List A: List of certain antimicrobial active pharmaceutical ingredients. Available at: https://www.canada.ca/en/public-health/services/antibiotic-antimicrobial-resistance/animals/veterinary-antimicrobial-sales-reporting/list-a.html.

Figure 2. 75 Percentage of turkey flocks reporting coccidiostat and other antiprotozoals use in feed, 2015 to 2019

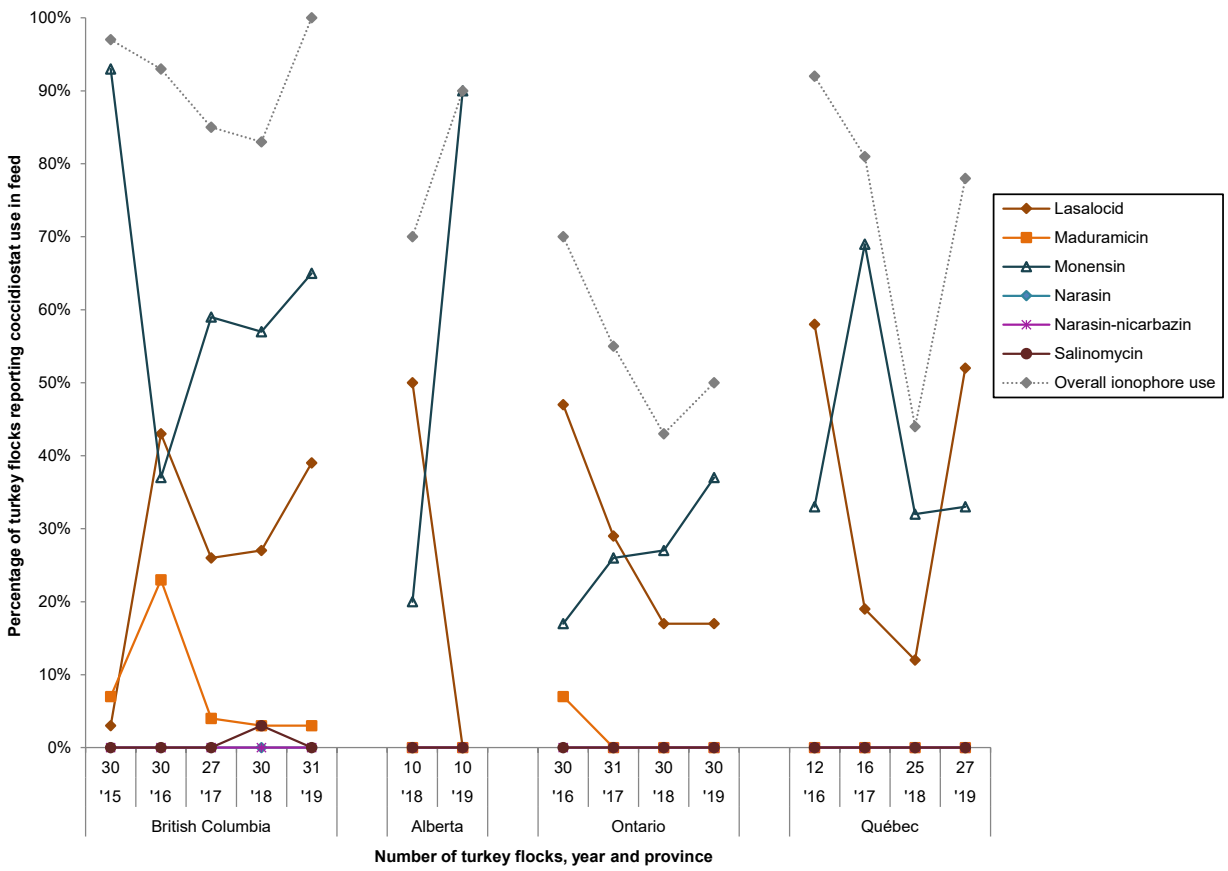


Year	2015	2016	2017	2018	2019
Number of flocks	30	72	74	95	98
Coccidiostat					
IV Lasalocid	3%	**47%**	26%	**22%**	**32%**
IV Maduramicin	7%	**13%**	1%	**1%**	**1%**
IV Monensin	93%	**28%**	47%	**37%**	**50%**
IV Narasin	0%	**0%**	0%	**0%**	**0%**
IV Narasin-nicarbazin	0%	**0%**	0%	**0%**	**0%**
IV Salinomycin	0%	**0%**	0%	**1%**	**0%**
Overall ionophore use	97%	**83%**	72%	**59%**	**78%**
N/A Amprolium	0%	**0%**	1%	**1%**	**0%**
N/A Clopidol	7%	**3%**	0%	**1%**	**0%**
N/A Decoquinoate	0%	**0%**	0%	**0%**	**0%**
N/A Diclazuril	0%	**1%**	0%	**1%**	**0%**
N/A Nicarbazine	0%	**0%**	0%	**0%**	**0%**
N/A Robenidine	3%	**1%**	1%	**4%**	**0%**
N/A Zoalene	0%	**1%**	3%	**14%**	**9%**
Overall chemical coccidiostat use	10%	**6%**	4%	**21%**	**9%**
Arsenicals	17%	**4%**	0%	**0%**	**0%**

Roman numeral IV indicates category of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification at the time of writing of this report).

For the temporal analyses, the proportion (%) of flocks using a specific coccidiostat in the current year has been compared to the proportion (%) of flocks using the same coccidiostat in 2016 (national program started) and the previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences ($P \leq 0.05$) for a given coccidiostat.

Figure 2. 76 Percentage of turkey flocks reporting ionophore coccidiostat use in feed, by province, 2015 to 2019

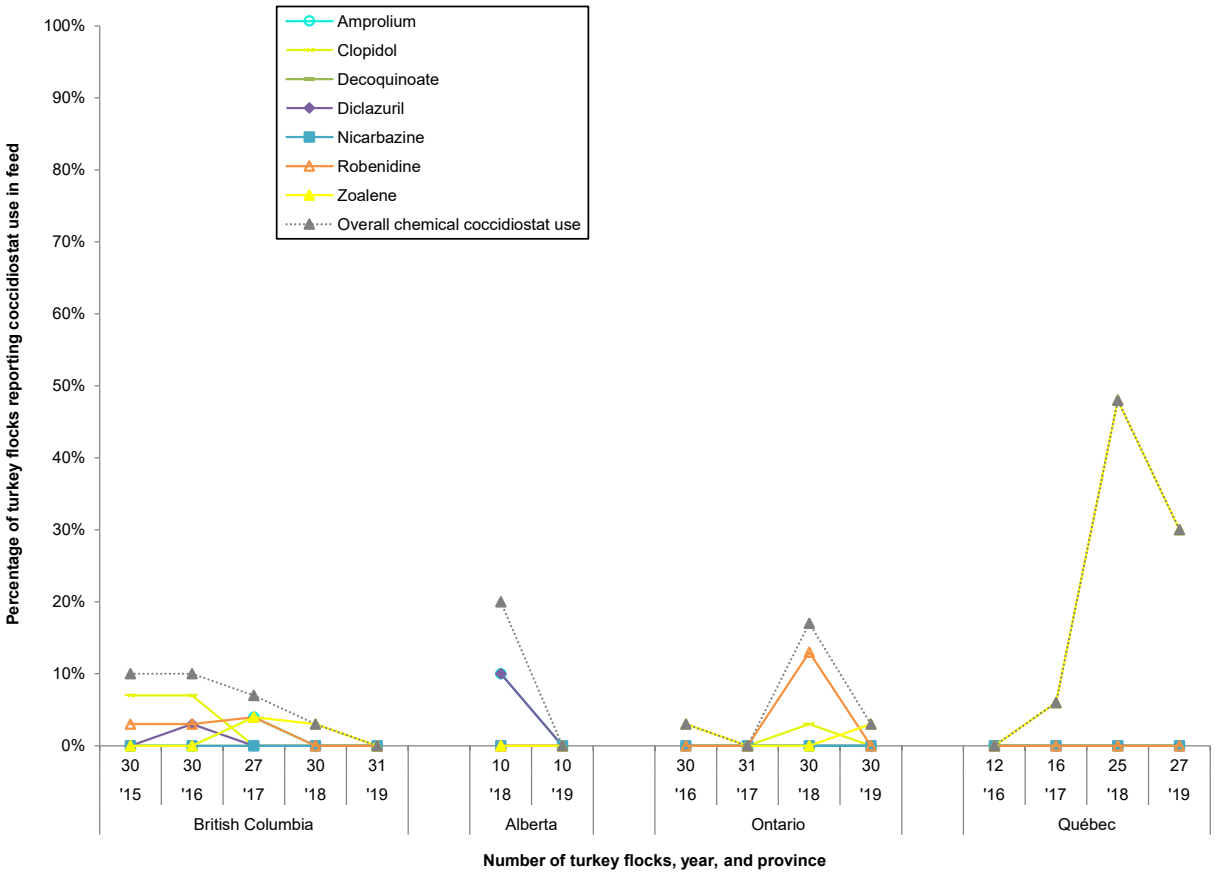


Province		British Columbia					Alberta		Ontario				Québec			
Year		'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of flocks		30	30	27	30	31	10	10	30	31	30	30	12	16	25	27
Coccidiostat																
IV	Lasalocid	3%	**43%**	26%	**27%**	**39%**	**50%**	**0%**	**47%**	29%	**17%**	**17%**	**58%**	19%	**12%**	**52%**
IV	Maduramicin	7%	**23%**	4%	**3%**	**3%**	**0%**	**0%**	**7%**	0%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
IV	Monensin	93%	**37%**	59%	**57%**	**65%**	**20%**	**90%**	**17%**	26%	**27%**	**37%**	**33%**	69%	**32%**	**33%**
IV	Narasin	0%	**0%**	0%	**0%**	**0%**	**0%**	**0%**	**0%**	0%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
IV	Narasin-nicarbazin	0%	**0%**	0%	**0%**	**0%**	**0%**	**0%**	**0%**	0%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
IV	Salinomycin	0%	**0%**	0%	**3%**	**0%**	**0%**	**0%**	**0%**	0%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
IV	**Overall ionophores use**	**97%**	**93%**	**85%**	**83%**	**100%**	**70%**	**90%**	**70%**	**55%**	**43%**	**50%**	**92%**	**81%**	**44%**	**78%**

Roman numeral IV indicates category of importance to human medicine as outlined by the Veterinary Drugs Directorate.

For the temporal analyses within province, the proportion (%) of flocks using a specific ionophore in the current year has been compared to the proportion (%) of flocks using the same ionophore in 2016 (national program started) and the previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences within province ($P \leq 0.05$) for a given ionophore. The presence of red areas indicates significant provincial differences ($P \leq 0.05$) for a given ionophore within the current year (Québec-referent province).

Figure 2. 77 Percentage of turkey flocks reporting coccidiostats and other antiprotozoals use in feed, by province, 2015 to 2019



Province		British Columbia					Alberta		Ontario				Québec			
Year		'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of flocks		30	30	27	30	31	10	10	30	31	30	30	12	16	25	27
Coccidiostat																
N/A	Amprolium	0%	**0%**	4%	**0%**	**0%**	**10%**	**0%**	**0%**	0%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
	Clopidol	7%	**7%**	0%	**0%**	**0%**	**0%**	**0%**	**0%**	0%	**3%**	**0%**	**0%**	0%	**0%**	**0%**
	Decoquinoate	0%	**0%**	0%	**0%**	**0%**	**0%**	**0%**	**0%**	0%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
	Diclazuril	0%	**3%**	0%	**0%**	**0%**	**10%**	**0%**	**0%**	0%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
	Nicarbazine	0%	**0%**	0%	**0%**	**0%**	**0%**	**0%**	**0%**	0%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
	Robenidine	3%	**3%**	4%	**0%**	**0%**	**0%**	**0%**	**0%**	0%	**13%**	**0%**	**0%**	0%	**0%**	**0%**
	Zoalene	0%	**0%**	4%	**3%**	**0%**	**0%**	**0%**	**3%**	0%	**0%**	**3%**	**0%**	6%	**48%**	**30%**
	Overall chemical coccidiostat use	10%	**10%**	7%	**3%**	**0%**	**20%**	**0%**	**3%**	0%	**17%**	**3%**	**0%**	6%	**48%**	**30%**

N/A = not applicable (no classification at the time of writing of this report).

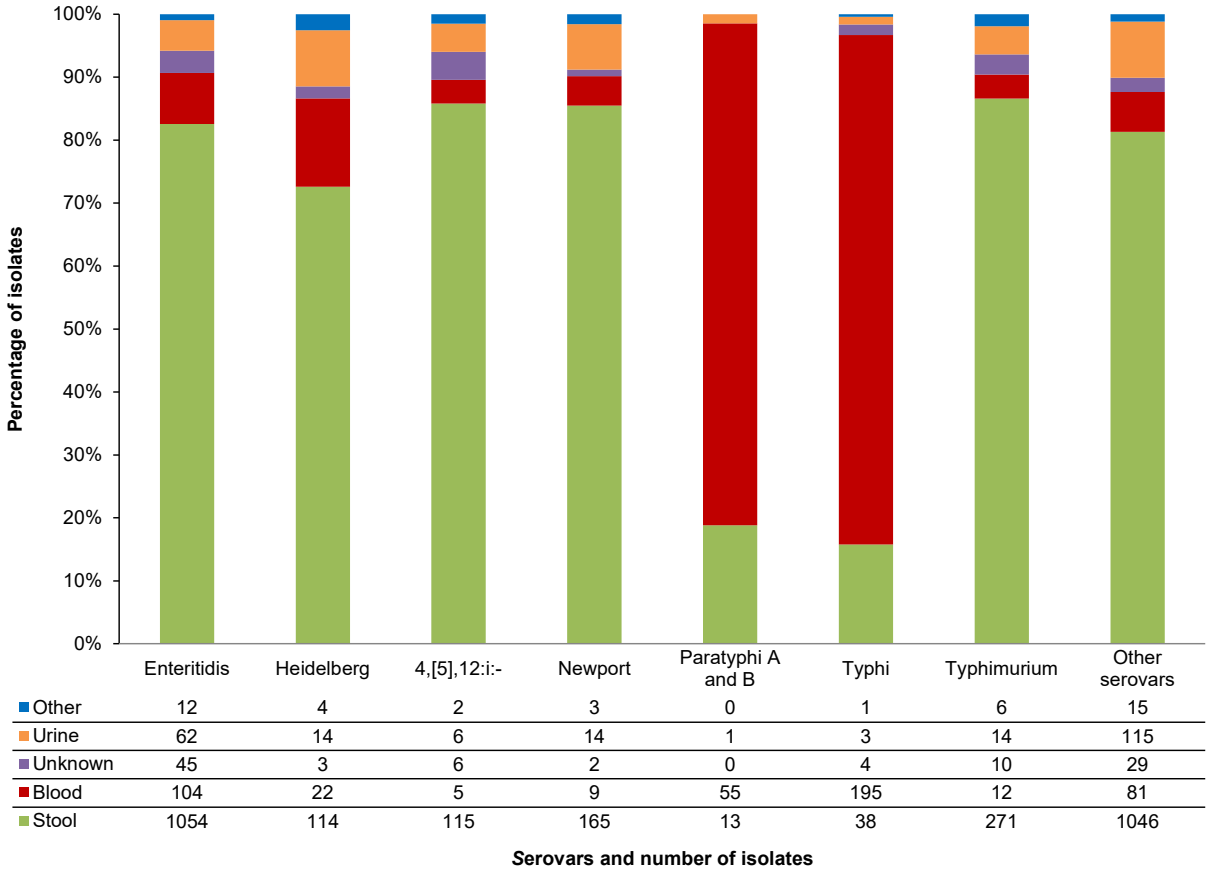
For the temporal analyses within province, the proportion (%) of flocks using a specific chemical coccidiostat in the current year has been compared to the proportion (%) of flocks using the same chemical coccidiostat in 2016 (national program started) and the previous surveillance year (grey areas). The presence of blue areas indicates significant temporal differences within province ($P \leq 0.05$) for a given chemical coccidiostat. The presence of red areas indicates significant provincial differences ($P \leq 0.05$) for a given chemical coccidiostat within the current year (Québec-referent province).

Chapter 3 Antimicrobial resistance

Human Surveillance

Serovar distribution

Figure 3. 1 Proportion of human *Salmonella* serovars from all sample sources, 2019



	Enteritidis	Heidelberg	4,[5],12:i:-	Newport	Paratyphi A and B	Typhi	Typhimurium	Other serovars
Other	12	4	2	3	0	1	6	15
Urine	62	14	6	14	1	3	14	115
Unknown	45	3	6	2	0	4	10	29
Blood	104	22	5	9	55	195	12	81
Stool	1054	114	115	165	13	38	271	1046

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.

Multiclass resistance

Table 3. 1 Number of antimicrobial classes in resistance patterns of *Salmonella* serovars from humans, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia																				
Enteritidis	80 (38.6)	57	17	6			1	1	3		1			1	1		2	1	20	5
Typhi	45 (21.7)	5	39	1				1										6	40	
Newport	26 (12.6)	22		1		3		3	3					4	4	4	3			4
Paratyphi A and B	16 (7.7)	1	15															7	15	
Other serovars	13 (6.3)	8	1		3	1	1	4	2		1			4	1		2	2	4	4
4,[5],12:i:-	12 (5.8)	7			4	1	2	5	5		1			5	1		3	1		5
Typhimurium	12 (5.8)	5		2	3	2	1	3	5		2			6	3		5	1	3	7
Heidelberg	3 (1.4)	2	1						1	1	1	1								
Total	**207 (100)**	**107**	**73**	**10**	**10**	**7**	**5**	**17**	**19**	**1**	**6**	**1**		**20**	**10**	**4**	**15**	**18**	**82**	**25**
Alberta																				
Enteritidis	85 (36.3)	55	24	2	3	1		5	4					5	1		2	3	28	3
Newport	35 (15.0)	17	2	1	7	8		12	10	2	2	2		15	13	13	15		2	16
Typhi	29 (12.4)	3	22	1	3			4	3					3	2		1	6	26	
Typhimurium	28 (12.0)	17		4	6	1	1	8	7	4	4	4		11	2		7	1	1	10
Other serovars	19 (8.1)	11			4	4	3	7	7	1	5	1		8	6		5	2	6	8
Paratyphi A and B	14 (6.0)		14															3	14	
Heidelberg	13 (5.6)	8	2	2	1			2	4	1	1	1		1					1	2
4,[5],12:i:-	11 (4.7)	2		1	8		1	8	7					9			1		2	8
Total	**234 (100)**	**113**	**64**	**11**	**32**	**14**	**5**	**46**	**42**	**8**	**12**	**8**		**52**	**24**	**13**	**31**	**15**	**80**	**47**
Saskatchewan																				
Enteritidis	74 (58.7)	47	24	1	2			3	1					2	2		2		25	4
Typhimurium	16 (12.7)	7		1	5	3	2	9	8	4	4	4		9	4		7		3	9
Newport	8 (6.3)	7			1									1	1	1	1			1
4,[5],12:i:-	7 (5.6)	1	1	1	4			5	4					5			1		1	5
Heidelberg	6 (4.8)	4	1	1			1	1	1											1
Other serovars	6 (4.8)	4			2		1	2	2		1			2	2				1	2
Typhi	5 (4.0)	2			3			2	3					3	1		1	2	3	2
Paratyphi A and B	4 (3.2)		4															1	4	
Total	**126 (100)**	**72**	**30**	**4**	**17**	**3**	**4**	**22**	**19**	**4**	**5**	**4**		**22**	**10**	**1**	**12**	**3**	**37**	**24**
Manitoba																				
Enteritidis	75 (49.0)	51	22		1	1	1	2	2					2	1		1	1	22	4
Typhimurium	21 (13.7)	7		5	8	1		13	7	1	1	1		14	3		9		2	10
Other serovars	19 (12.4)	17	1		1		1	1	2	1	1	1		1				1	1	1
Typhi	15 (9.8)	3	10	2				2										1	12	
Newport	9 (5.9)	4	1		2	2		2	2			1		4	4	4	4			4
4,[5],12:i:-	6 (3.9)	2			4			4	2					3		1	2		1	4
Heidelberg	5 (3.3)	2		2	1			3	3	1	1	1		1						1
Paratyphi A and B	3 (2.0)	1	2																2	
Total	**153 (100)**	**87**	**36**	**9**	**17**	**4**	**2**	**27**	**18**	**3**	**3**	**4**		**25**	**8**	**5**	**16**	**3**	**40**	**24**
Ontario																				
Enteritidis	272 (32.2)	126	133	6	7		1	9	9			1		8	1		1	6	136	12
Typhimurium	136 (16.1)	90	7	9	28	2	2	34	35	5	4	2		37	5	1	30	2	2	39
Typhi	130 (15.4)	14	82	5	29			33	29		14			30	29		27	29	113	3
Other serovars	89 (10.5)	58	4	4	13	10	10	24	20	5	9	5		26	10		14	11	24	26
Newport	79 (9.4)	64		2	5	8		9	8					13	13	13	13		2	14
4,[5],12:i:-	60 (7.1)	18	3	3	36		7	37	36	1	1	1		37	5		7		3	41
Heidelberg	51 (6.0)	38	4	9			6	10	6	2	2	2		6						
Paratyphi A and B	27 (3.2)	2	24	1													1	3	25	
Total	**844 (100)**	**410**	**257**	**39**	**118**	**20**	**26**	**156**	**143**	**13**	**30**	**11**		**157**	**63**	**14**	**93**	**51**	**305**	**135**

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

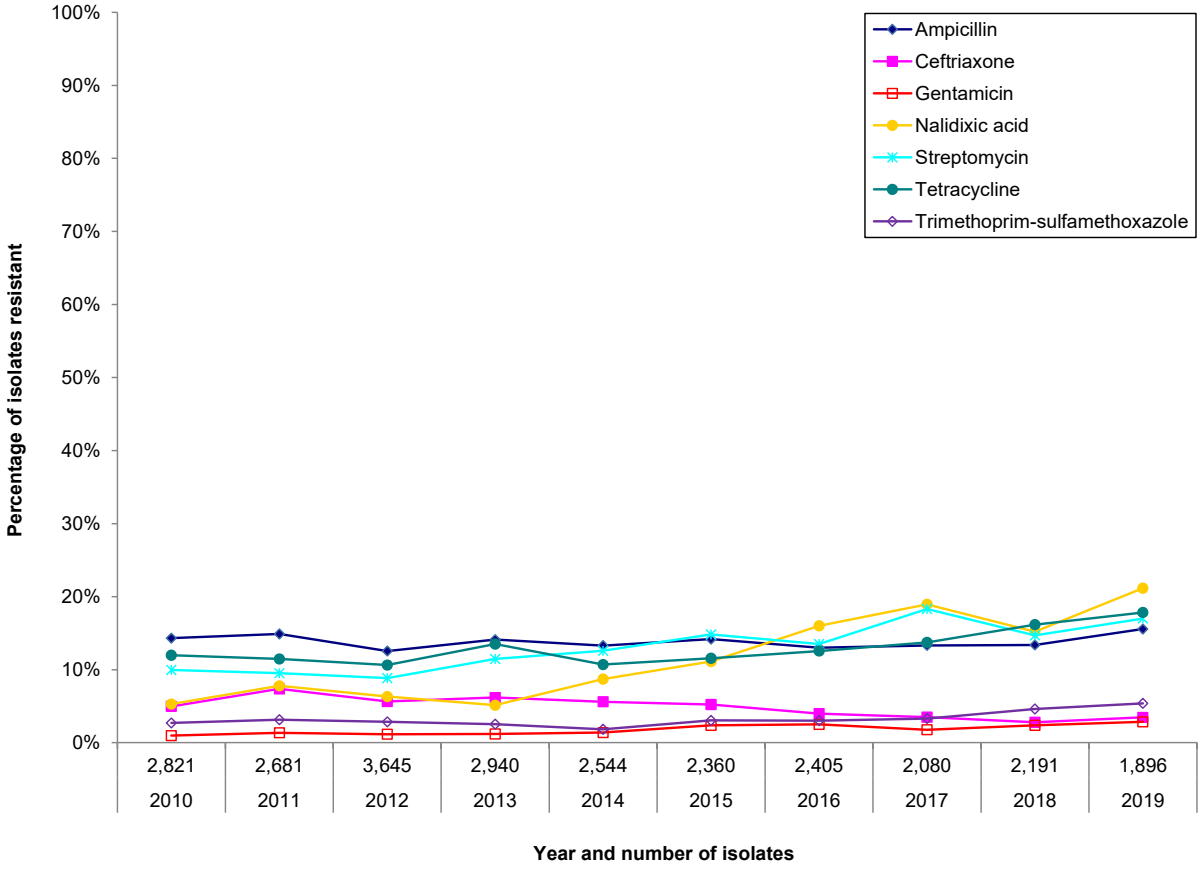
Table 3. 1 Number of antimicrobial classes in resistance patterns of human *Salmonella* serovars from humans, 2019 (continued)

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Québec																				
Enteritidis	109 (33.0)	61	48																45	3
Typhimurium	59 (17.9)	44	4	2	9		1	12	9					11	3		9			12
Other serovars	45 (13.6)	26	2	6	6	5	3	15	11	5	8	5		15	5		9	4	9	16
Heidelberg	42 (12.7)	26	12	4			1	7	12	9	9	9		1						1
4,[5],12:i:-	30 (9.1)	12	2	2	14		3	15	16	1				13	1		2		2	16
Newport	25 (7.6)	18	1	1	2	3		6	5					6	6	5	3		1	6
Typhi	15 (4.5)	3	10		2			2	2					2	1		1	3	12	
Paratyphi A and B	5 (1.5)		5															1	4	1
Total	**330 (100)**	**190**	**84**	**15**	**33**	**8**	**8**	**57**	**55**	**15**	**17**	**14**		**48**	**16**	**5**	**24**	**8**	**73**	**55**
New Brunswick																				
Enteritidis	67 (54.0)	45	20		2			2	2					2				2	20	2
Heidelberg	21 (16.9)	14	3	4			1	6	3	3	3	3		2	1					1
Typhimurium	19 (15.3)	13		1	5			5	6					6			5			5
Other serovars	10 (8.1)	10																		
4,[5],12:i:-	3 (2.4)	1			1	1	1	2	2		1			2	1		1	1		2
Newport	3 (2.4)	3																		
Typhi	1 (0.8)		1																1	
Total	**124 (100)**	**86**	**24**	**5**	**8**	**1**	**2**	**15**	**13**	**3**	**4**	**3**		**12**	**2**		**6**	**3**	**21**	**10**
Nova Scotia																				
Enteritidis	57 (57.6)	40	15	1	1			1	2					1				1	16	1
Typhimurium	14 (14.1)	7		1	6			6	6					7	1		6			7
Heidelberg	12 (12.1)	11	1					1												
Other serovars	7 (7.1)	4		1	1	1	1	3	2	1	2	1		2			2		1	3
Newport	5 (5.1)	4	1																	1
4,[5],12:i:-	3 (3.0)	1			2			2	2					2	1		1			2
Typhi	1 (1.0)			1				1											1	
Total	**99 (100)**	**67**	**17**	**4**	**10**	**1**	**1**	**14**	**12**	**1**	**2**	**1**		**12**	**2**		**9**	**1**	**18**	**14**
Prince Edward Island																				
Enteritidis	8 (72.7)	5	3																3	
Heidelberg	1 (9.1)	1																		
4,[5],12:i:-	1 (9.1)				1		1	1	1					1					1	1
Typhimurium	1 (9.1)				1			1	1					1			1			1
Total	**11 (100)**	**6**	**3**		**2**		**1**	**2**	**2**					**2**			**1**		**4**	**2**
Newfoundland and Labrador																				
Enteritidis	60 (76.9)	48	11		1			1	1					1				1	12	
Typhimurium	7 (9.0)	1		1	5			6	6					6			5			5
Other serovars	5 (6.4)	3		1	1			2	1		1	1		1					1	2
Heidelberg	3 (3.8)	2	1					1												
Newport	2 (2.6)	2																		
4,[5],12:i:-	1 (1.3)				1			1	1					1						1
Total	**78 (100)**	**56**	**12**	**2**	**8**			**11**	**9**		**1**	**1**		**9**			**5**	**1**	**13**	**8**
National																				
Enteritidis	887 (40.2)	535	317	16	17	2	3	24	24		1	1		22	6		8	15	327	34
Typhimurium	313 (14.2)	191	11	26	76	9	7	97	90	14	15	11		108	21	1	84	4	11	105
Typhi	241 (10.9)	30	164	10	37			45	37		14			38	33		30	47	208	5
Other serovars	213 (9.7)	141	8	12	31	21	20	58	47	13	28	14		59	24		32	20	47	62
Newport	192 (8.7)	141	5	5	17	24		32	28	2	2	3		43	41	40	39		5	46
Heidelberg	157 (7.1)	108	25	22	2		9	31	30	17	17	17		11	1				1	6
4,[5],12:i:-	134 (6.1)	44	6	7	75	2	15	80	76	2	3	1		78	9	1	18	2	10	85
Paratyphi A and B	69 (3.1)	4	64	1													1	15	64	1
Total	**2,206 (100)**	**1,194**	**600**	**99**	**255**	**58**	**54**	**367**	**332**	**48**	**80**	**47**		**359**	**135**	**42**	**212**	**103**	**673**	**344**

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

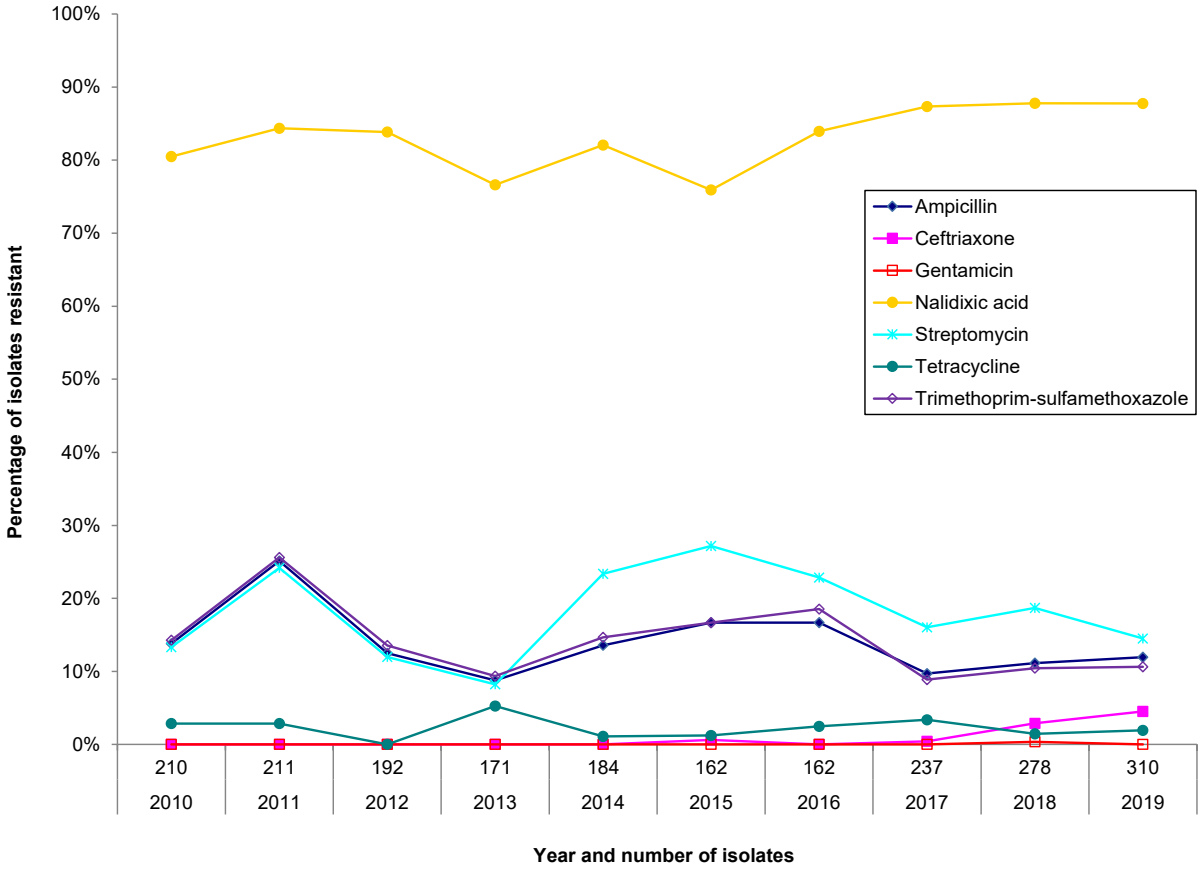
Figure 3. 2 Temporal variations in resistance of non-typhoidal *Salmonella* from humans, 2010 to 2019



Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of isolates	2,821	2,681	3,645	2,940	2,544	2,360	2,405	2,080	2,191	1,896
Antimicrobial										
Ampicillin	**14%**	15%	13%	14%	13%	14%	13%	13%	**13%**	**16%**
Ceftriaxone	**5%**	7%	6%	6%	6%	5%	4%	4%	**3%**	**3%**
Gentamicin	**1%**	1%	1%	1%	1%	2%	2%	2%	**2%**	**3%**
Nalidixic acid	**5%**	8%	6%	5%	9%	11%	16%	19%	**15%**	**21%**
Streptomycin	**10%**	10%	9%	11%	13%	15%	14%	18%	**15%**	**17%**
Tetracycline	**12%**	11%	11%	14%	11%	12%	13%	14%	**16%**	**18%**
Trimethoprim-sulfamethoxazole	**3%**	3%	3%	3%	2%	3%	3%	3%	**5%**	**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 previous 10 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

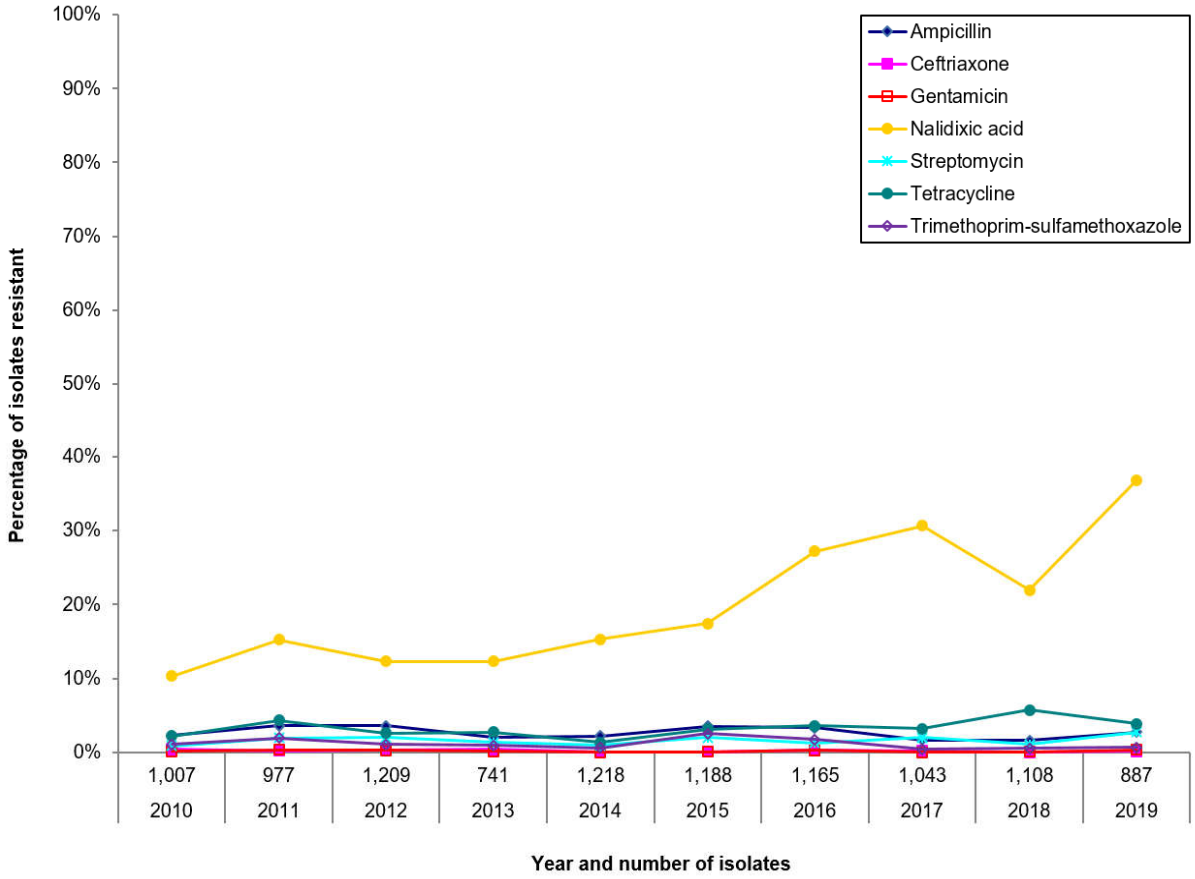
Figure 3. 3 Temporal variations in resistance of typhoidal *Salmonella* from humans, 2010 to 2019



Year Number of isolates	2010 210	2011 211	2012 192	2013 171	2014 184	2015 162	2016 162	2017 237	2018 278	2019 310
Antimicrobial										
Ampicillin	**14%**	25%	13%	9%	14%	17%	17%	10%	**11%**	**12%**
Ceftriaxone	**0%**	0%	0%	0%	0%	1%	0%	0%	**3%**	**5%**
Gentamicin	**0%**	0%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Nalidixic acid	**80%**	84%	84%	77%	82%	76%	84%	87%	**88%**	**88%**
Streptomycin	**13%**	24%	12%	8%	23%	27%	23%	16%	**19%**	**15%**
Tetracycline	**3%**	3%	0%	5%	1%	1%	2%	3%	**1%**	**2%**
Trimethoprim-sulfamethoxazole	**14%**	26%	14%	9%	15%	17%	19%	9%	**10%**	**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 previous 10 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

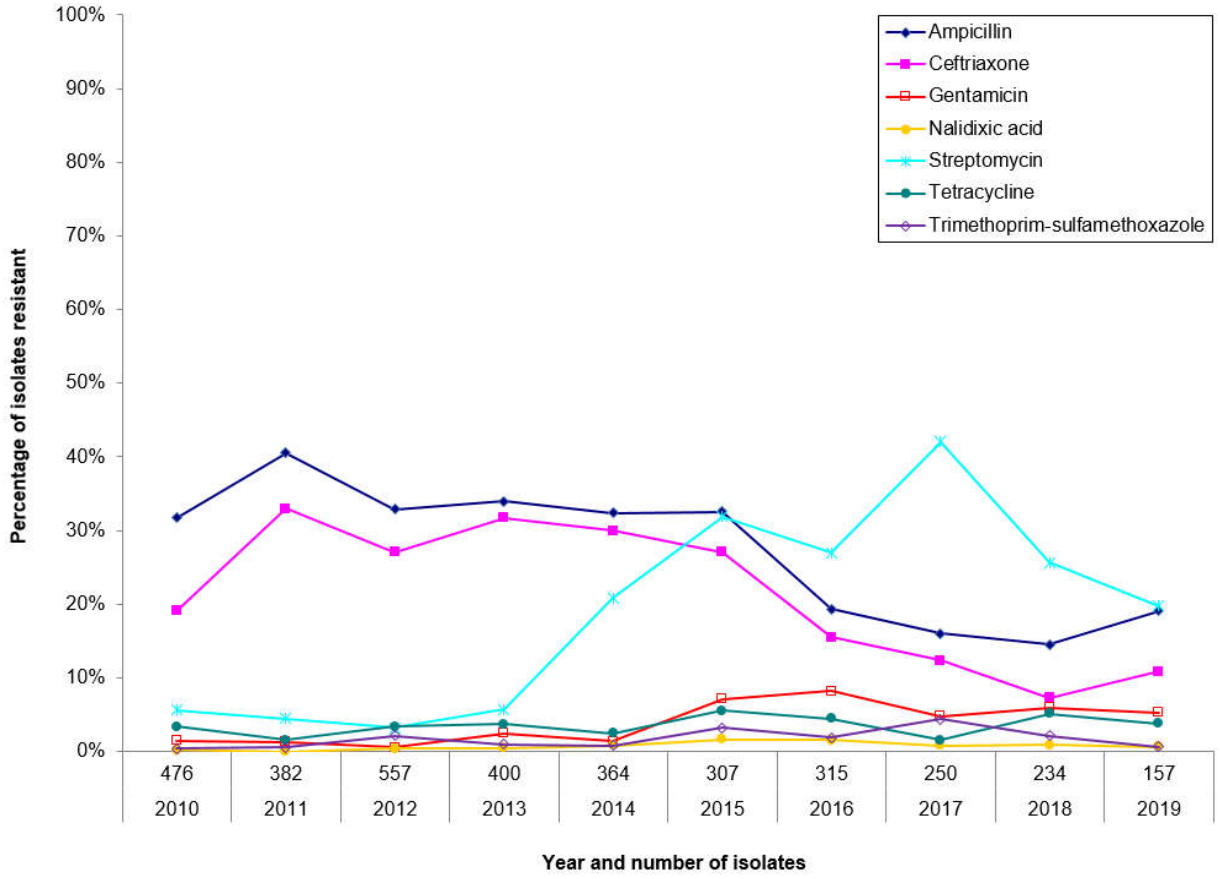
Figure 3. 4 Temporal variations in resistance of *Salmonella* Enteritidis from humans, 2010 to 2019



Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of isolates	1,007	977	1,209	741	1,218	1,188	1,165	1,043	1,108	887
Antimicrobial										
Ampicillin	**2%**	4%	4%	2%	2%	4%	3%	2%	**2%**	**3%**
Ceftriaxone	**0%**	0%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Gentamicin	**0%**	0%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Nalidixic acid	**10%**	15%	12%	12%	15%	17%	27%	31%	**22%**	**37%**
Streptomycin	**1%**	2%	2%	1%	1%	2%	1%	2%	**1%**	**3%**
Tetracycline	**2%**	4%	3%	3%	1%	3%	4%	3%	**6%**	**4%**
Trimethoprim-sulfamethoxazole	**1%**	2%	1%	1%	1%	3%	2%	0%	**1%**	**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 previous 10 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

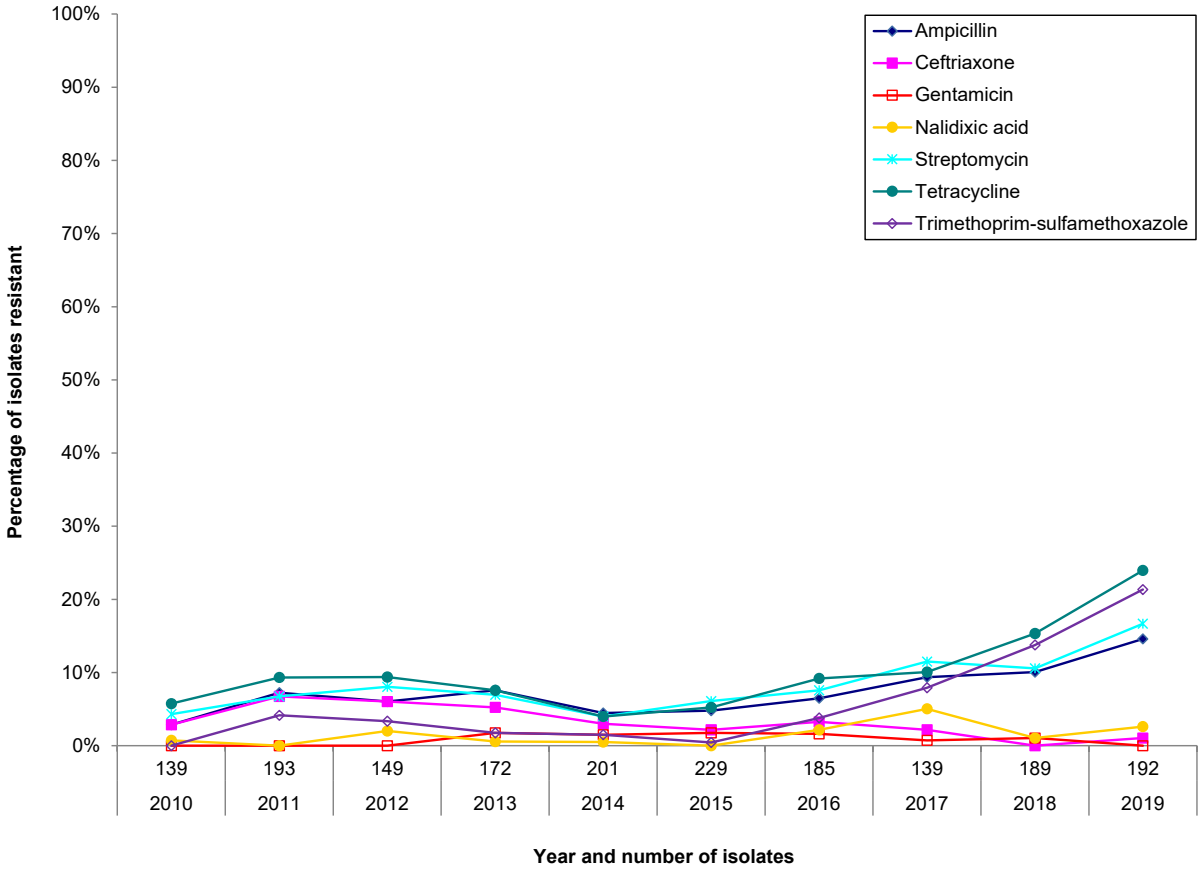
Figure 3. 5 Temporal variations in resistance of *Salmonella* Heidelberg from humans, 2010 to 2019



Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2018
Number of isolates	476	382	557	400	364	307	315	250	234	157
Antimicrobial										
Ampicillin	**32%**	41%	33%	34%	32%	33%	19%	16%	**15%**	**19%**
Ceftriaxone	**19%**	33%	27%	32%	30%	27%	16%	12%	**7%**	**11%**
Gentamicin	**1%**	1%	1%	3%	1%	7%	8%	5%	**6%**	**5%**
Nalidixic acid	**0%**	0%	0%	1%	1%	2%	2%	1%	**1%**	**1%**
Streptomycin	**6%**	4%	3%	6%	21%	32%	27%	42%	**26%**	**20%**
Tetracycline	**3%**	2%	3%	4%	2%	6%	4%	2%	**5%**	**4%**
Trimethoprim-sulfamethoxazole	**0%**	1%	2%	1%	1%	3%	2%	4%	**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 previous 10 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

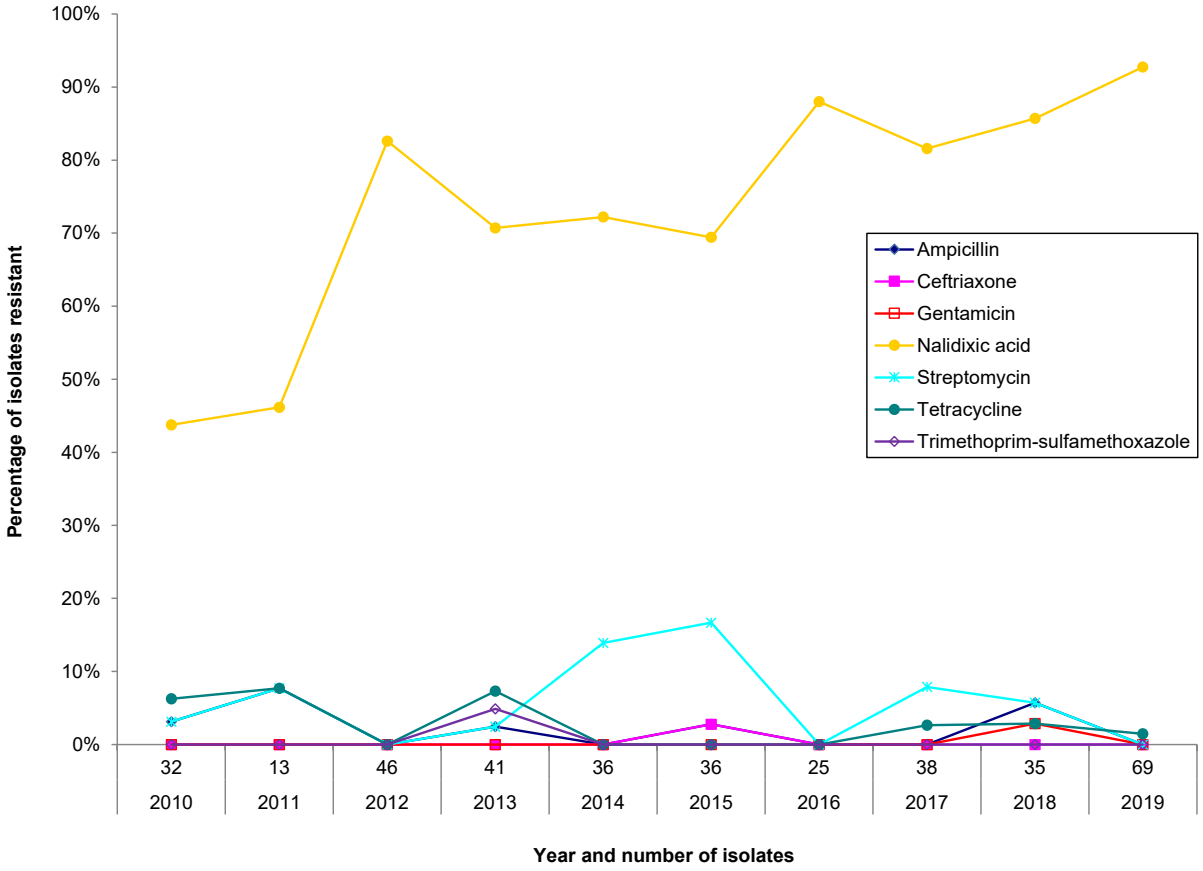
Figure 3. 6 Temporal variations in resistance of *Salmonella* Newport from humans, 2010 to 2019



Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of isolates	139	193	149	172	201	229	185	139	189	192
Antimicrobial										
Ampicillin	**3%**	7%	6%	8%	4%	5%	6%	9%	**10%**	**15%**
Ceftriaxone	**3%**	7%	6%	5%	3%	2%	3%	2%	**0%**	**1%**
Gentamicin	**0%**	0%	0%	2%	1%	2%	2%	1%	**1%**	**0%**
Nalidixic acid	**1%**	0%	2%	1%	0%	0%	2%	5%	**1%**	**3%**
Streptomycin	**4%**	7%	8%	7%	4%	6%	8%	12%	**11%**	**17%**
Tetracycline	**6%**	9%	9%	8%	4%	5%	9%	10%	**15%**	**24%**
Trimethoprim-sulfamethoxazole	**0%**	4%	3%	2%	1%	0%	4%	8%	**14%**	**21%**

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 previous 10 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

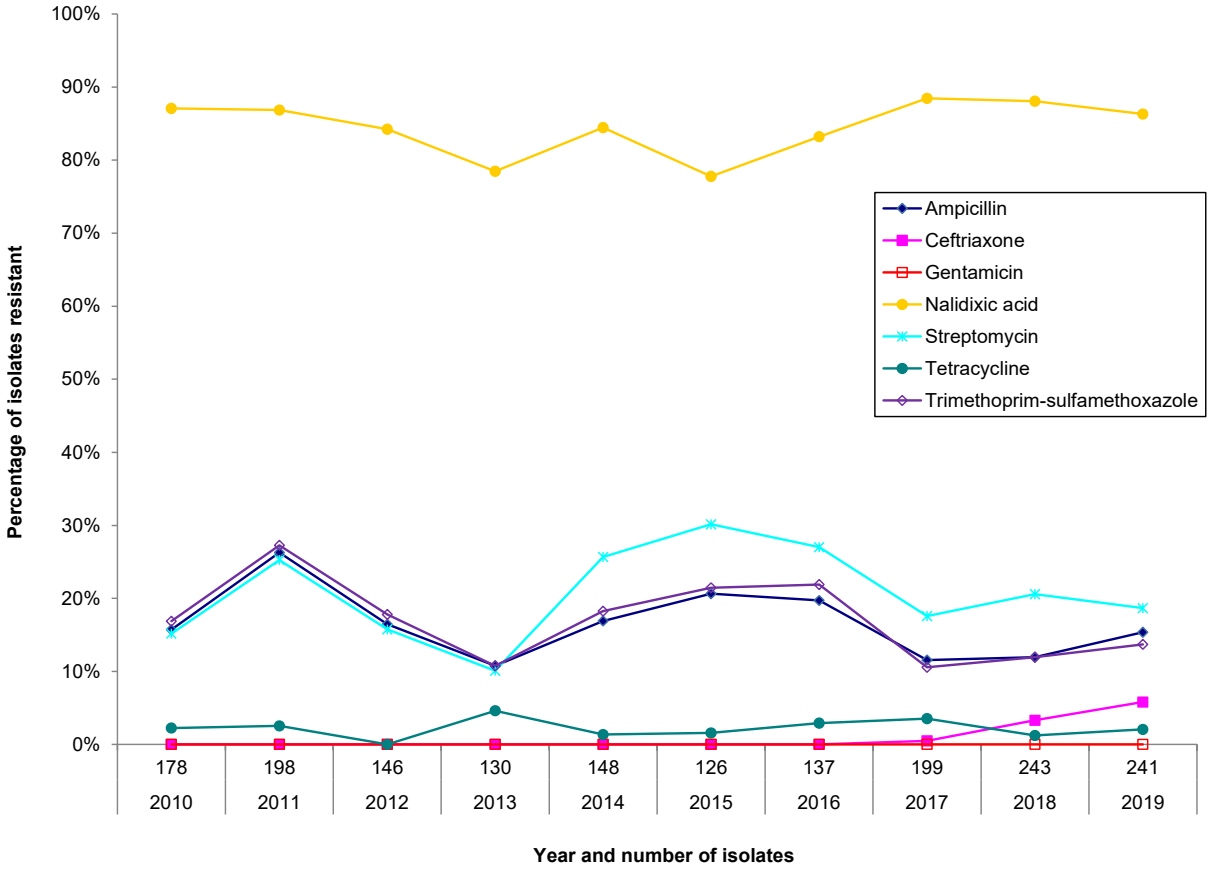
Figure 3. 7 Temporal variations in resistance of *Salmonella* Paratyphi A and B from humans, 2010 to 2019



Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of isolates	32	13	46	41	36	36	25	38	35	69
Antimicrobial										
Ampicillin	**3%**	8%	0%	2%	0%	3%	0%	0%	**6%**	**0%**
Ceftriaxone	**0%**	0%	0%	0%	0%	3%	0%	0%	**0%**	**0%**
Gentamicin	**0%**	0%	0%	0%	0%	0%	0%	0%	**3%**	**0%**
Nalidixic acid	**44%**	46%	83%	71%	72%	69%	88%	82%	**86%**	**93%**
Streptomycin	**3%**	8%	0%	2%	14%	17%	0%	8%	**6%**	**0%**
Tetracycline	**6%**	8%	0%	7%	0%	0%	0%	3%	**3%**	**1%**
Trimethoprim-sulfamethoxazole	**0%**	0%	0%	5%	0%	0%	0%	0%	**0%**	**0%**

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the previous 10 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

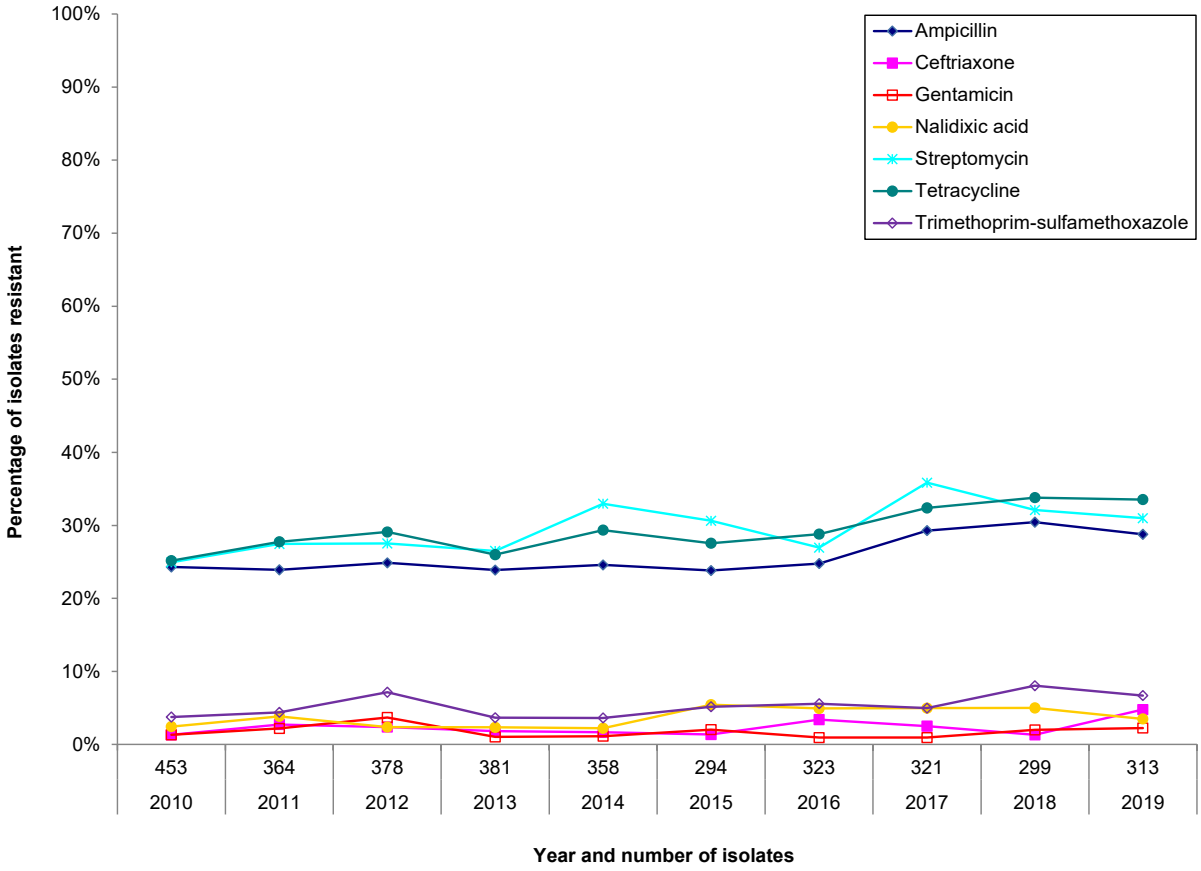
Figure 3. 8 Temporal variations in resistance of *Salmonella* Typhi from humans, 2010 to 2019



Year Number of isolates	2010 178	2011 198	2012 146	2013 130	2014 148	2015 126	2016 137	2017 199	2018 243	2019 241
Antimicrobial										
Ampicillin	**16%**	26%	16%	11%	17%	21%	20%	12%	**12%**	**15%**
Ceftriaxone	**0%**	0%	0%	0%	0%	0%	0%	1%	**3%**	**6%**
Gentamicin	**0%**	0%	0%	0%	0%	0%	0%	0%	**0%**	**0%**
Nalidixic acid	**87%**	87%	84%	78%	84%	78%	83%	88%	**88%**	**86%**
Streptomycin	**15%**	25%	16%	10%	26%	30%	27%	18%	**21%**	**19%**
Tetracycline	**2%**	3%	0%	5%	1%	2%	3%	4%	**1%**	**2%**
Trimethoprim-sulfamethoxazole	**17%**	27%	18%	11%	18%	21%	22%	11%	**12%**	**14%**

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the previous 10 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

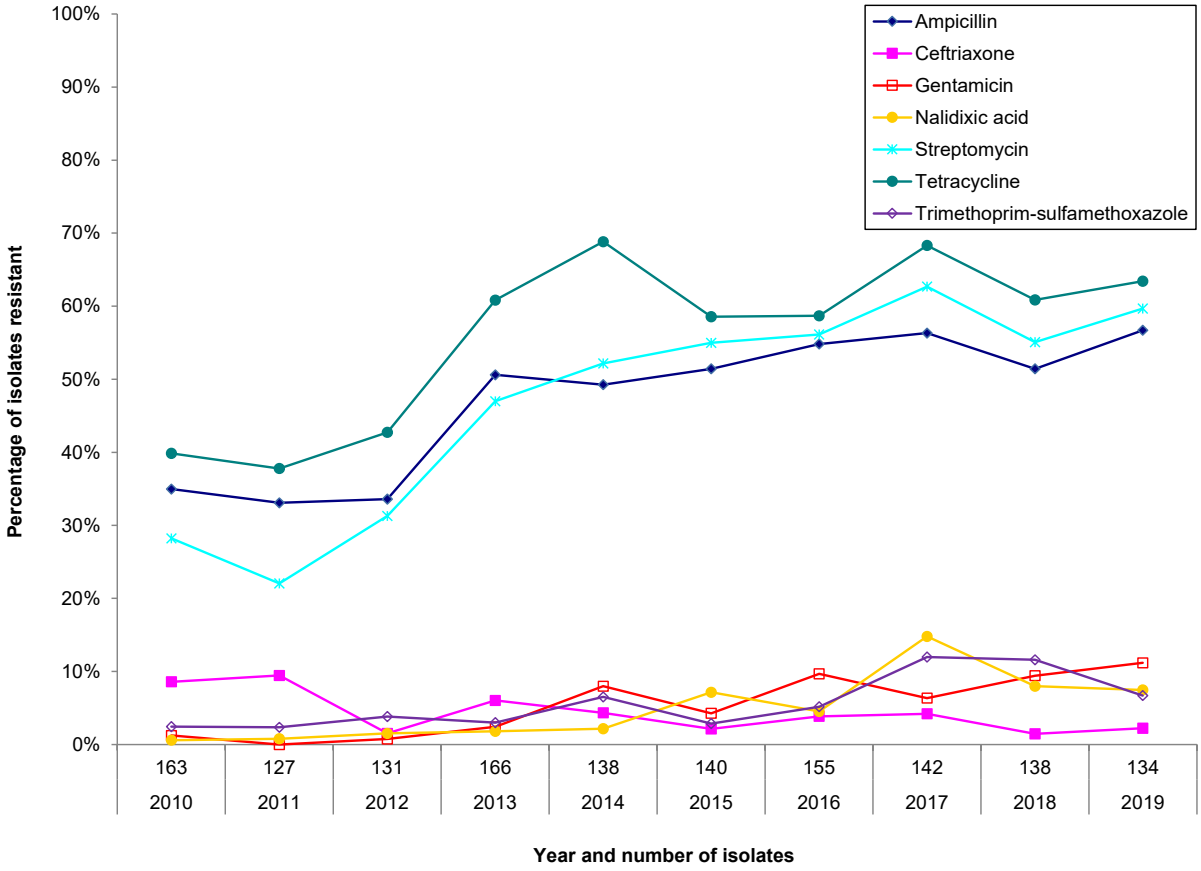
Figure 3. 9 Temporal variations in resistance of *Salmonella* Typhimurium from humans, 2010 to 2019



Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of isolates	453	364	378	381	358	294	323	321	299	313
Antimicrobial										
Ampicillin	**24%**	24%	25%	24%	25%	24%	25%	29%	**30%**	**29%**
Ceftriaxone	**1%**	3%	2%	2%	2%	1%	3%	2%	**1%**	**5%**
Gentamicin	**1%**	2%	4%	1%	1%	2%	1%	1%	**2%**	**2%**
Nalidixic acid	**2%**	4%	2%	2%	2%	5%	5%	5%	**5%**	**4%**
Streptomycin	**25%**	27%	28%	27%	33%	31%	27%	36%	**32%**	**31%**
Tetracycline	**25%**	28%	29%	26%	29%	28%	29%	32%	**34%**	**34%**
Trimethoprim-sulfamethoxazole	**4%**	4%	7%	4%	4%	5%	6%	5%	**8%**	**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 previous 10 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

Figure 3. 10 Temporal variations in resistance of *Salmonella* 4,[5],12:i:- from humans, 2010 to 2019



Year Number of isolates	2010 163	2011 127	2012 131	2013 166	2014 138	2015 140	2016 155	2017 142	2018 138	2019 134
Antimicrobial										
Ampicillin	**35%**	33%	34%	51%	49%	51%	55%	56%	**51%**	**57%**
Ceftriaxone	**9%**	9%	2%	6%	4%	2%	4%	4%	**1%**	**2%**
Gentamicin	**1%**	0%	1%	2%	8%	4%	10%	6%	**9%**	**11%**
Nalidixic acid	**1%**	1%	2%	2%	2%	7%	5%	15%	**8%**	**7%**
Streptomycin	**28%**	22%	31%	47%	52%	55%	56%	63%	**55%**	**60%**
Tetracycline	**40%**	38%	43%	61%	69%	59%	59%	68%	**61%**	**63%**
Trimethoprim-sulfamethoxazole	**2%**	2%	4%	3%	7%	3%	5%	12%	**12%**	**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 previous 10 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

Retail Meat Surveillance

Multiclass resistance

Table 3. 2 Number of antimicrobial classes in resistance patterns of *Escherichia coli* from beef, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia	69 (47.3)	57	6	4	2			6	2					3			1	1	1	10
Prairies	4 (2.7)	4																		
Ontario	1 (0.7)		1																	1
Québec	72 (49.3)	55	10	3	4			4	2					6	2		3		1	17
National	**146 (100)**	**116**	**17**	**7**	**6**			**10**	**4**					**9**	**2**		**4**	**1**	**2**	**28**

Antimicrobial abbreviations are defined in the Appendix.

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

The Prairies is a region including the provinces of Alberta and Saskatchewan.

For Ontario and the Prairies in 2019, a partial year of retail sampling was conducted due to difficulties in staffing field personnel. As a result, the sampling target and subsequent isolate yields were not achieved and results should be interpreted with caution.

Table 3. 3 Number of antimicrobial classes in resistance patterns of *Salmonella* from chicken, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia																				
Enteritidis	42 (54.5)	42																		
Kentucky	28 (36.4)	3	2	22	1			25	5	5	5	3							1	23
Schwarzengrund	2 (2.6)	2																		
Less common serovars	5 (6.5)	5																		
Total	**77 (100)**	**52**	**2**	**22**	**1**			**25**	**5**	**5**	**5**	**3**							**1**	**23**
Prairies																				
Enteritidis	1 (100)	1																		
Total	**1 (100)**	**1**																		
Québec																				
Kentucky	36 (44.4)	2	6	28				32	3	2	2	2								28
Heidelberg	20 (24.7)	13	5	2				3	6	3	3	3								
Infantis	6 (7.4)	6																		
Enteritidis	4 (4.9)	3	1																1	
Hadar	3 (3.7)			3				3												3
Thompson	2 (2.5)	2																		
Typhimurium	2 (2.5)	1		1										1						1
Less common serovars	8 (9.9)	6		2			1	2						1						2
Total	**81 (100)**	**33**	**12**	**36**			**1**	**40**	**9**	**5**	**5**	**5**		**2**					**1**	**34**
National																				
Kentucky	64 (40.3)	5	8	50	1			57	8	7	7	5							1	51
Enteritidis	47 (29.6)	46	1																1	
Heidelberg	21 (13.2)	14	5	2				3	6	3	3	3								
Infantis	6 (3.8)	6																		
Less common serovars	21 (13.2)	15		6			1	5						2						6
Total	**159 (100)**	**86**	**14**	**58**	**1**		**1**	**65**	**14**	**10**	**10**	**8**		**2**					**2**	**57**

Antimicrobial abbreviations are defined in the Appendix.

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

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

The Prairies is a region including the provinces of Alberta and Saskatchewan.

For Ontario and the Prairies in 2019, a partial year of retail sampling was conducted due to difficulties in staffing field personnel. As a result, the sampling target and subsequent isolate yields were not achieved and results should be interpreted with caution.

Table 3. 4 Number of antimicrobial classes in resistance patterns of *Escherichia coli* from chicken, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia	82 (41.2)	22	14	26	20		15	37	39	8	7	8		27	3		1		12	43
Prairies	4 (2.0)	1		3			1	3	2					1						1
Québec	113 (56.8)	40	22	40	11		16	34	30	3	2	3		40	20		6		2	48
National	**199 (100)**	**63**	**36**	**69**	**31**		**32**	**74**	**71**	**11**	**9**	**11**		**68**	**23**		**7**		**14**	**92**

Antimicrobial abbreviations are defined in the Appendix.

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

The Prairies is a region including the provinces of Alberta and Saskatchewan.

For Ontario and the Prairies in 2019, a partial year of retail sampling was conducted due to difficulties in staffing field personnel. As a result, the sampling target and subsequent isolate yields were not achieved and results should be interpreted with caution.

Table 3. 5 Number of antimicrobial classes in resistance patterns of *Campylobacter* from chicken, 2019

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	53 (71.6)	33	11	9									13	13	16
Campylobacter coli	19 (25.7)	7	9	3									9	9	6
Campylobacter spp.	2 (2.7)	1	1										1	1	
Total	**74 (100)**	**41**	**21**	**12**									**23**	**23**	**22**
Prairies															
Campylobacter jejuni	1 (100)		1										1	1	
Total	**1 (100)**		**1**										**1**	**1**	
Québec															
Campylobacter jejuni	53 (86.9)	30	12	11				1	4	5	5		7	7	19
Campylobacter coli	8 (13.1)	2	5	1				1	1	2	2		1	1	4
Total	**61 (100)**	**32**	**17**	**12**				**2**	**5**	**7**	**7**		**8**	**8**	**23**
National															
Campylobacter jejuni	107 (78.7)	63	24	20				1	4	5	5		21	21	35
Campylobacter coli	27 (19.9)	9	14	4				1	1	2	2		10	10	10
Campylobacter spp.	2 (1.5)	1	1										1	1	
Total	**136 (100)**	**73**	**39**	**24**				**2**	**5**	**7**	**7**		**32**	**32**	**45**

Antimicrobial abbreviations are defined in the Appendix.

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

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

The Prairies is a region including the provinces of Alberta and Saskatchewan.

For Ontario and the Prairies in 2019, a partial year of retail sampling was conducted due to difficulties in staffing field personnel. As a result, the sampling target and subsequent isolate yields were not achieved and results should be interpreted with caution.

Table 3. 6 Number of antimicrobial classes in resistance patterns of *Escherichia coli* from pork, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia	17 (22.1)	16	1						1											
Prairies	1 (1.3)	1																		
Ontario	2 (2.6)	2																		
Québec	57 (74.0)	35	7	11	4			9	9					12	7		3		1	19
National	**77 (100)**	**54**	**8**	**11**	**4**			**9**	**10**					**12**	**7**		**3**		**1**	**19**

Antimicrobial abbreviations are defined in the Appendix.

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

The Prairies is a region including the provinces of Alberta and Saskatchewan.

For Ontario and the Prairies in 2019, a partial year of retail sampling was conducted due to difficulties in staffing field personnel. As a result, the sampling target and subsequent isolate yields were not achieved and results should be interpreted with caution.

Table 3. 7 Number of antimicrobial classes in resistance patterns of *Salmonella* from turkey, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia																				
Reading	40 (61.5)	21	10	3	6			9	16					9						9
Enteritidis	13 (20.0)	13																		
Heidelberg	3 (4.6)	2	1					1												
Kentucky	3 (4.6)			3				3												3
Uganda	3 (4.6)			3				3						3						3
Less common serovars	3 (4.6)	1		2				2												2
Total	**65 (100)**	**37**	**11**	**11**	**6**			**18**	**16**					**12**						**17**
Prairies																				
Reading	3 (100)	1	1	1				1	1					1						1
Total	**3 (100)**	**1**	**1**	**1**				**1**	**1**					**1**						**1**
Ontario																				
Reading	2 (100)	2																		
Total	**2 (100)**	**2**																		
Québec																				
Heidelberg	11 (24.4)	7	1	3			1	4	2					1						
Uganda	8 (17.8)	2		6				6						6						6
Reading	5 (11.1)	4		1				1						1						1
Schwarzengrund	5 (11.1)	5																		
Muenchen	4 (8.9)	2		2				2						2						2
Alachua	2 (4.4)	2																		
Albany	2 (4.4)	1	1					1												
Enteritidis	2 (4.4)	2																		
Kentucky	2 (4.4)			2				2												2
Agona	1 (2.2)	1																		
Infantis	1 (2.2)	1																		
Muenster	1 (2.2)	1																		
Typhimurium	1 (2.2)	1																		
Total	**45 (100)**	**29**	**2**	**14**			**1**	**16**	**2**					**10**						**11**
National																				
Reading	50 (43.5)	28	11	5	6			11	17					11						11
Enteritidis	15 (13.0)	15																		
Heidelberg	14 (12.2)	9	2	3			1	5	2					1						
Uganda	11 (9.6)	2		9				9						9						9
Kentucky	5 (4.3)			5				5												5
Schwarzengrund	5 (4.3)	5																		
Muenchen	4 (3.5)	2		2				2						2						2
Less common serovars	11 (9.6)	8	1	2				3												2
Total	**115 (100)**	**69**	**14**	**26**	**6**		**1**	**35**	**19**					**23**						**29**

Antimicrobial abbreviations are defined in the Appendix.

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

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

The Prairies is a region including the provinces of Alberta and Saskatchewan.

For Ontario and the Prairies in 2019, a partial year of retail sampling was conducted due to difficulties in staffing field personnel. As a result, the sampling target and subsequent isolate yields were not achieved and results should be interpreted with caution.

Table 3. 8 Number of antimicrobial classes in resistance patterns of *Escherichia coli* from turkey, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia	86 (47.5)	40	10	21	15		11	33	33	6	6	5		23	8	1	2		2	30
Prairies	3 (1.7)	1	1	1				1	1					1						1
Ontario	2 (1.1)	1		1				1	1											1
Québec	90 (49.7)	48	12	24	6		5	21	19			1		22	8		4			32
National	**181 (100)**	**90**	**23**	**47**	**21**		**16**	**56**	**54**	**6**	**6**	**6**		**46**	**16**	**1**	**6**		**2**	**64**

Antimicrobial abbreviations are defined in the Appendix.

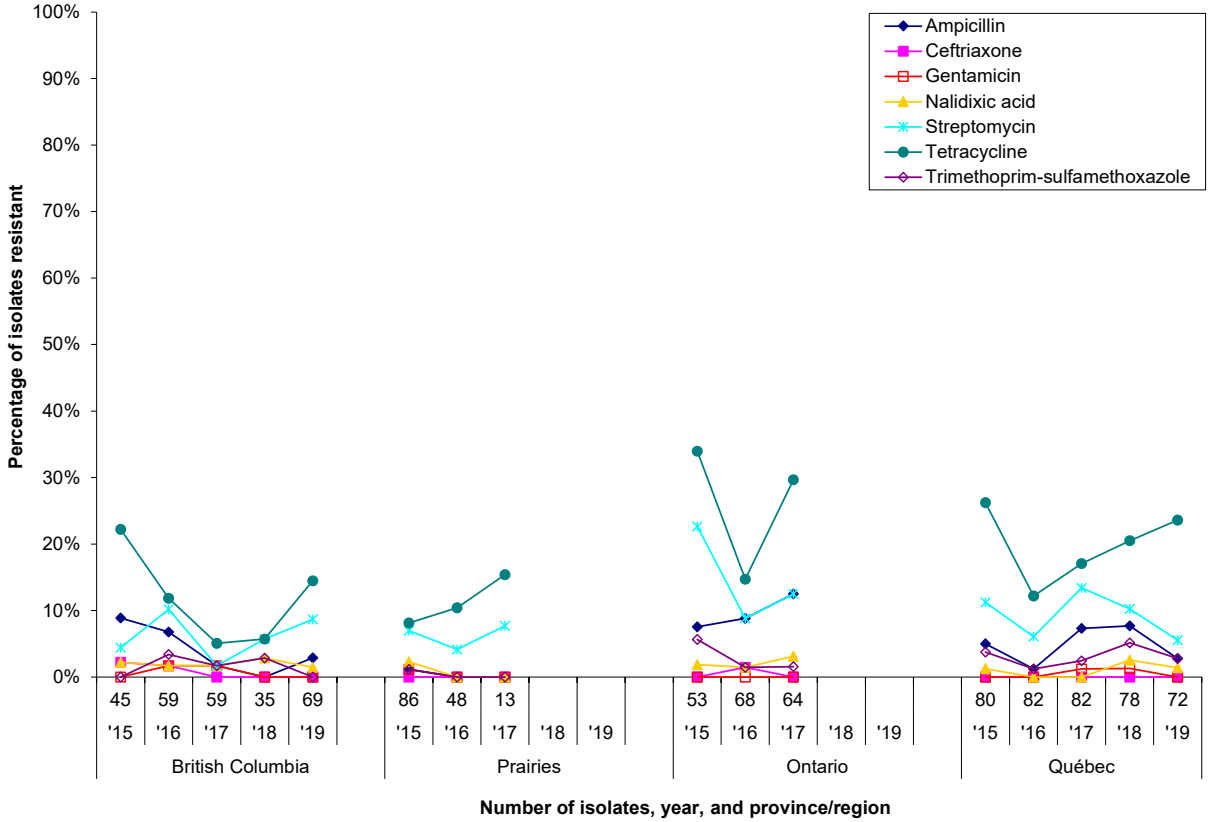
Red, blue, and black numbers indicate isolates resistant to antimicrobials in Categories I, II, and III of importance to human medicine, respectively.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

For Ontario and the Prairies in 2019, a partial year of retail sampling was conducted due to difficulties in staffing field personnel. As a result, the sampling target and subsequent isolate yields were not achieved and results should be interpreted with caution.

Temporal antimicrobial resistance summary

Figure 3. 11 Temporal variations in resistance of *Escherichia coli* isolates from beef, 2015 to 2019



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of isolates	45	59	59	35	69	86	48	13	7	4	53	68	64	2	1	80	82	82	78	72
Antimicrobial																				
Ampicillin	**9%**	7%	2%	**0%**	**3%**	**1%**	0%	0%	**0%**	**0%**	**8%**	9%	13%	**50%**	**0%**	**5%**	1%	7%	**8%**	**3%**
Ceftriaxone	**2%**	2%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	1%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
Gentamicin	**0%**	2%	2%	**0%**	**0%**	**1%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	1%	**1%**	**0%**
Nalidixic acid	**2%**	2%	2%	**3%**	**1%**	**2%**	0%	0%	**0%**	**0%**	**2%**	1%	3%	**0%**	**0%**	**1%**	0%	0%	**3%**	**1%**
Streptomycin	**4%**	10%	2%	**6%**	**9%**	**7%**	4%	8%	**0%**	**0%**	**23%**	9%	13%	**50%**	**0%**	**11%**	6%	13%	**10%**	**6%**
Tetracycline	**22%**	12%	5%	**6%**	**14%**	**8%**	10%	15%	**14%**	**0%**	**34%**	15%	30%	**50%**	**100%**	**26%**	12%	17%	**21%**	**24%**
Trimethoprim-sulfamethoxazole	**0%**	3%	2%	**3%**	**0%**	**1%**	0%	0%	**0%**	**0%**	**6%**	1%	2%	**50%**	**0%**	**4%**	1%	2%	**5%**	**3%**

For the temporal analyses within 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 previous 5 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

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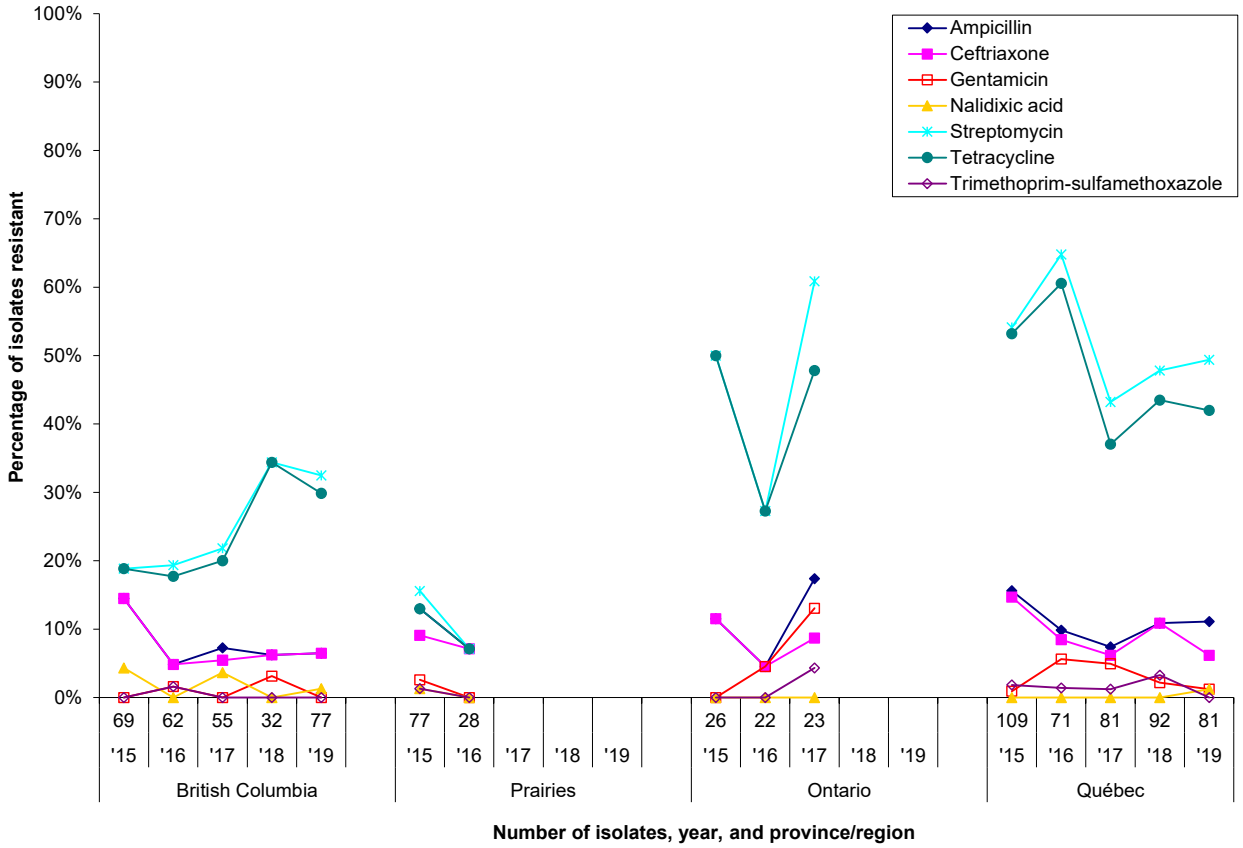
Figure 3. 12 Temporal variations in resistance of *Salmonella* isolates from chicken, 2015 to 2019



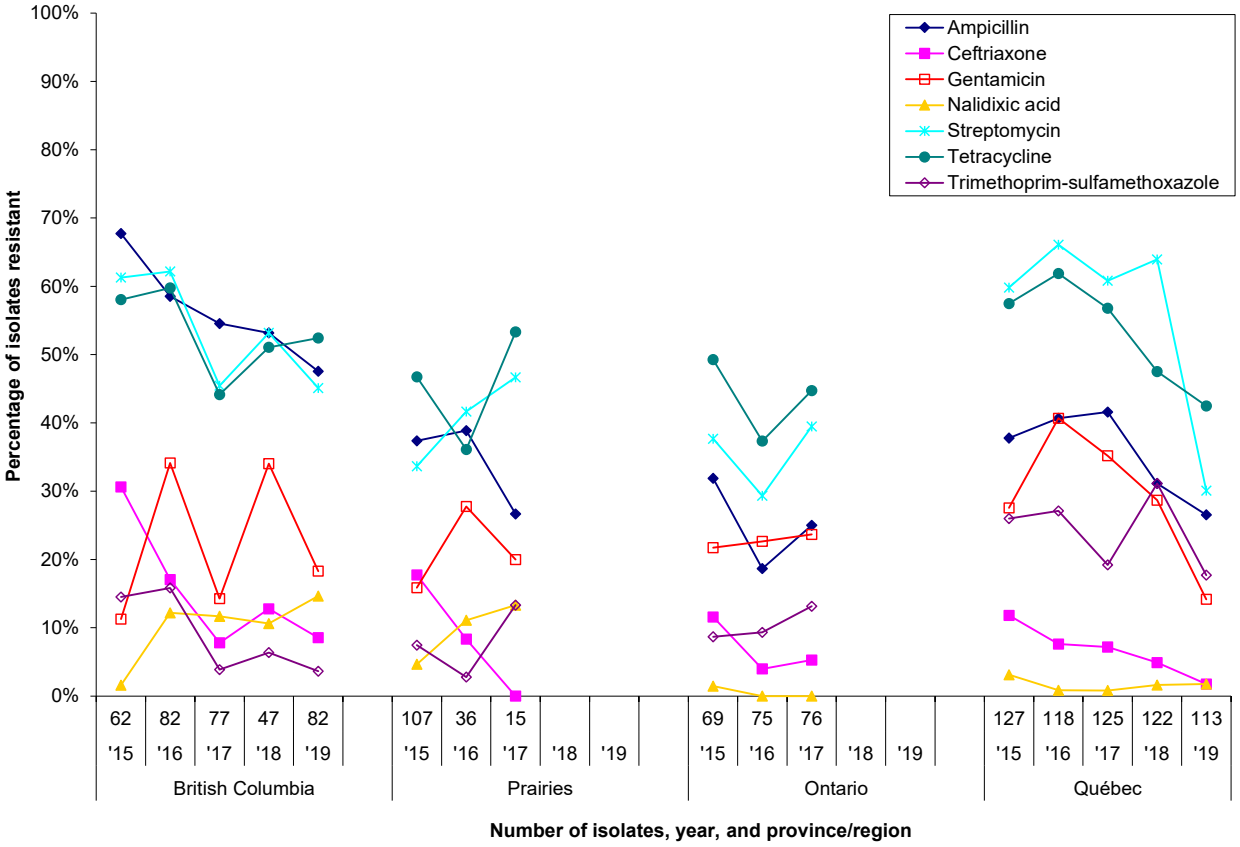
Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of isolates	69	62	55	32	77	77	28	8	3	1	26	22	23	0	0	109	71	81	92	81
Antimicrobial																				
Ampicillin	**14%**	5%	7%	**6%**	**6%**	**13%**	7%	0%	**0%**	**0%**	**12%**	5%	17%			**16%**	10%	7%	**11%**	**11%**
Ceftriaxone	**14%**	5%	5%	**6%**	**6%**	**9%**	7%	0%	**0%**	**0%**	**12%**	5%	9%			**15%**	8%	6%	**11%**	**6%**
Gentamicin	**0%**	2%	0%	**3%**	**0%**	**3%**	0%	0%	**33%**	**0%**	**0%**	5%	13%			**1%**	6%	5%	**2%**	**1%**
Nalidixic acid	**4%**	0%	4%	**0%**	**1%**	**1%**	0%	0%	**33%**	**0%**	**0%**	0%	0%			**0%**	0%	0%	**0%**	**1%**
Streptomycin	**19%**	19%	22%	**34%**	**32%**	**16%**	7%	13%	**33%**	**0%**	**50%**	27%	61%			**54%**	65%	43%	**48%**	**49%**
Tetracycline	**19%**	18%	20%	**34%**	**30%**	**13%**	7%	13%	**0%**	**0%**	**50%**	27%	48%			**53%**	61%	37%	**43%**	**42%**
Trimethoprim-sulfamethoxazole	**0%**	2%	0%	**0%**	**0%**	**1%**	0%	0%	**0%**	**0%**	**0%**	0%	4%			**2%**	1%	1%	**3%**	**0%**

For the temporal analyses within 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 previous 5 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

For Ontario and the Prairies in 2018 and 2019, a partial year of retail sampling was conducted due to difficulties in staffing field personnel. As a result, the sampling target and subsequent isolate yields were not achieved and results should be interpreted with caution. For this reason, data only appear in the table and have been omitted in the figure.

Figure 3. 13 Temporal variations in resistance of *Escherichia coli* isolates from chicken, 2015 to 2019



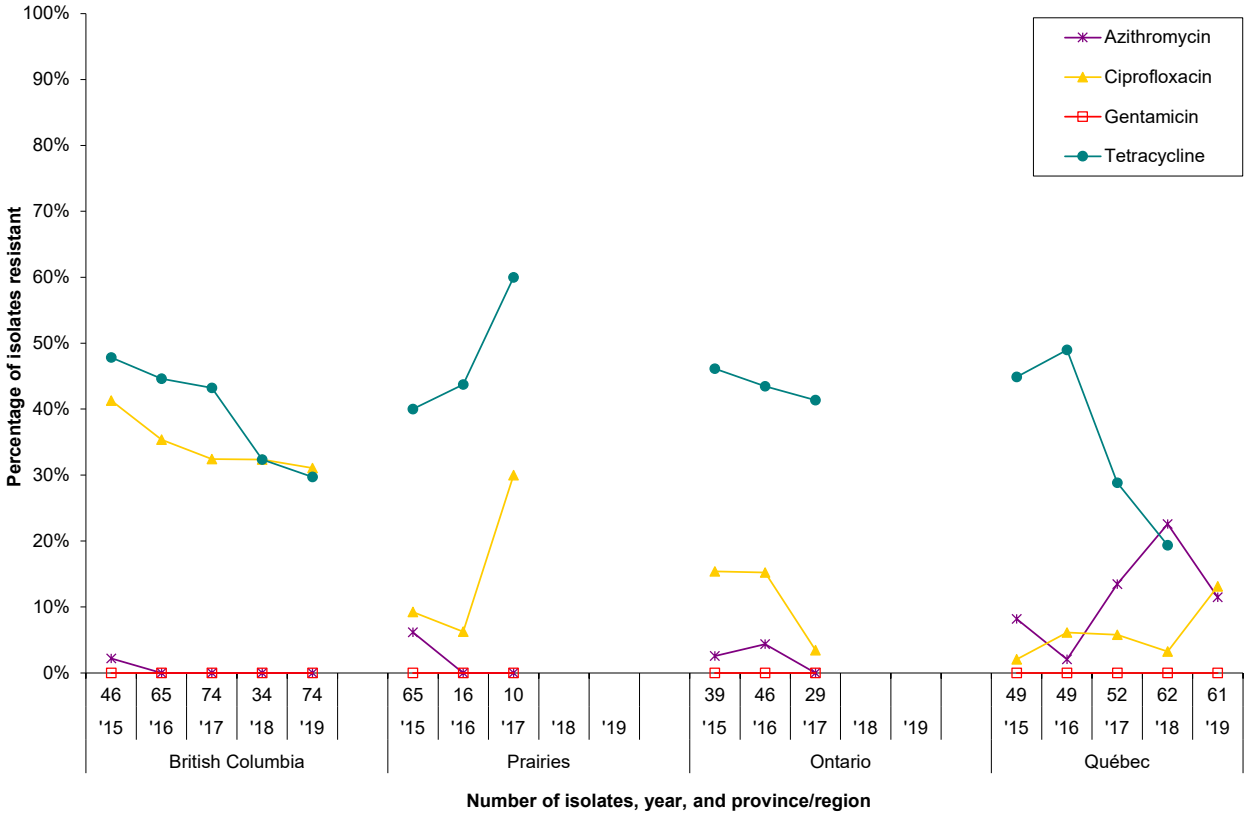
Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of isolates	62	82	77	47	82	107	36	15	9	4	69	75	76	2	0	127	118	125	122	113
Antimicrobial																				
Ampicillin	**68%**	59%	55%	**53%**	**48%**	**37%**	39%	27%	**44%**	**50%**	**32%**	19%	25%	**0%**		**38%**	41%	42%	**31%**	**27%**
Ceftriaxone	**31%**	17%	8%	**13%**	**9%**	**18%**	8%	0%	**0%**	**0%**	**12%**	4%	5%	**0%**		**12%**	8%	7%	**5%**	**2%**
Gentamicin	**11%**	34%	14%	**34%**	**18%**	**16%**	28%	20%	**33%**	**25%**	**22%**	23%	24%	**100%**		**28%**	41%	35%	**29%**	**14%**
Nalidixic acid	**2%**	12%	12%	**11%**	**15%**	**5%**	11%	13%	**11%**	**0%**	**1%**	0%	0%	**0%**		**3%**	1%	1%	**2%**	**2%**
Streptomycin	**61%**	62%	45%	**53%**	**45%**	**34%**	42%	47%	**33%**	**75%**	**38%**	29%	39%	**100%**		**60%**	66%	61%	**64%**	**30%**
Tetracycline	**58%**	60%	44%	**51%**	**52%**	**47%**	36%	53%	**56%**	**25%**	**49%**	37%	45%	**0%**		**57%**	62%	57%	**48%**	**42%**
Trimethoprim-sulfamethoxazole	**15%**	16%	4%	**6%**	**4%**	**7%**	3%	13%	**11%**	**0%**	**9%**	9%	13%	**0%**		**26%**	27%	19%	**31%**	**18%**

For the temporal analyses within 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 previous 5 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

For Ontario and the Prairies in 2018 and 2019, a partial year of retail sampling was conducted due to difficulties in staffing field personnel. As a result, the sampling target and subsequent isolate yields were not achieved and results should be interpreted with caution. For this reason, data only appear in the table and have been omitted in the figure.

Figure 3. 14 Temporal variations in resistance of *Campylobacter* isolates from chicken, 2015 to 2019



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of isolates	46	65	74	34	74	65	16	10	6	1	39	46	29	1	0	49	49	52	62	61
Antimicrobial																				
Azithromycin	**2%**	0%	0%	**0%**	**0%**	**6%**	0%	0%	**0%**	**0%**	**3%**	4%	0%	**0%**	**0%**	**8%**	2%	13%	**23%**	**11%**
Ciprofloxacin	**41%**	35%	32%	**32%**	**31%**	**9%**	6%	30%	**17%**	**100%**	**15%**	15%	3%	**0%**	**0%**	**2%**	6%	6%	**3%**	**13%**
Gentamicin	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
Tetracycline	**48%**	45%	43%	**32%**	**30%**	**40%**	44%	60%	**50%**	**0%**	**46%**	43%	41%	**0%**	**0%**	**45%**	49%	29%	**19%**	**38%**

For the temporal analyses within 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 previous 5 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

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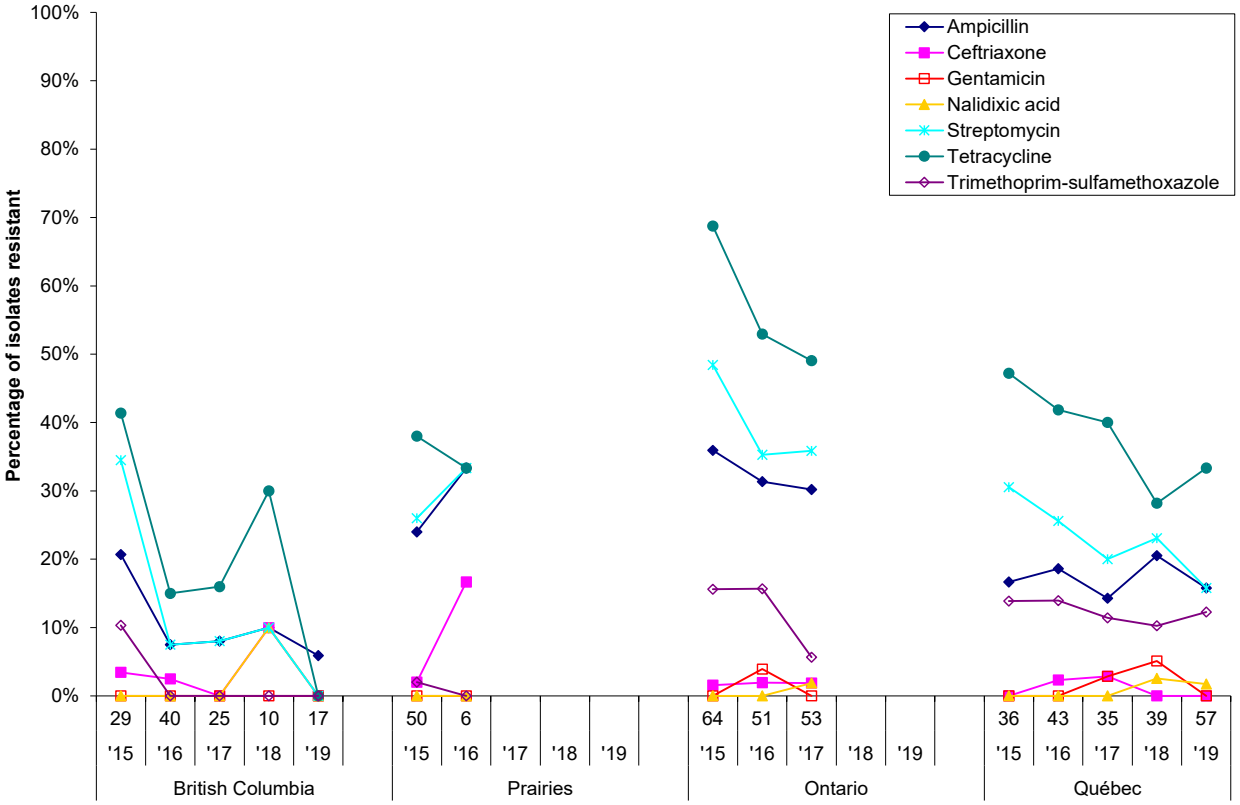
Figure 3. 15 Temporal variations in resistance of *Escherichia coli* isolates from pork, 2015 to 2019



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of isolates	29	40	25	10	17	50	6	2	1	1	64	51	53	1	2	36	43	35	39	57
Antimicrobial																				
Ampicillin	**21%**	8%	8%	**10%**	**6%**	**24%**	33%	0%	**0%**	**0%**	**36%**	31%	30%	**100%**	**0%**	**17%**	19%	14%	**21%**	**16%**
Ceftriaxone	**3%**	3%	0%	**10%**	**0%**	**2%**	17%	0%	**0%**	**0%**	**2%**	2%	2%	**0%**	**0%**	**0%**	2%	3%	**0%**	**0%**
Gentamicin	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	4%	0%	**0%**	**0%**	**0%**	0%	3%	**5%**	**0%**
Nalidixic acid	**0%**	0%	0%	**10%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	2%	**0%**	**0%**	**0%**	0%	0%	**3%**	**2%**
Streptomycin	**34%**	8%	8%	**10%**	**0%**	**26%**	33%	0%	**0%**	**0%**	**48%**	35%	36%	**100%**	**0%**	**31%**	26%	20%	**23%**	**16%**
Tetracycline	**41%**	15%	16%	**30%**	**0%**	**38%**	33%	0%	**0%**	**0%**	**69%**	53%	49%	**100%**	**0%**	**47%**	42%	40%	**28%**	**33%**
Trimethoprim-sulfamethoxazole	**10%**	0%	0%	**0%**	**0%**	**2%**	0%	0%	**0%**	**0%**	**16%**	16%	6%	**0%**	**0%**	**14%**	14%	11%	**10%**	**12%**

For the temporal analyses within 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 previous 5 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

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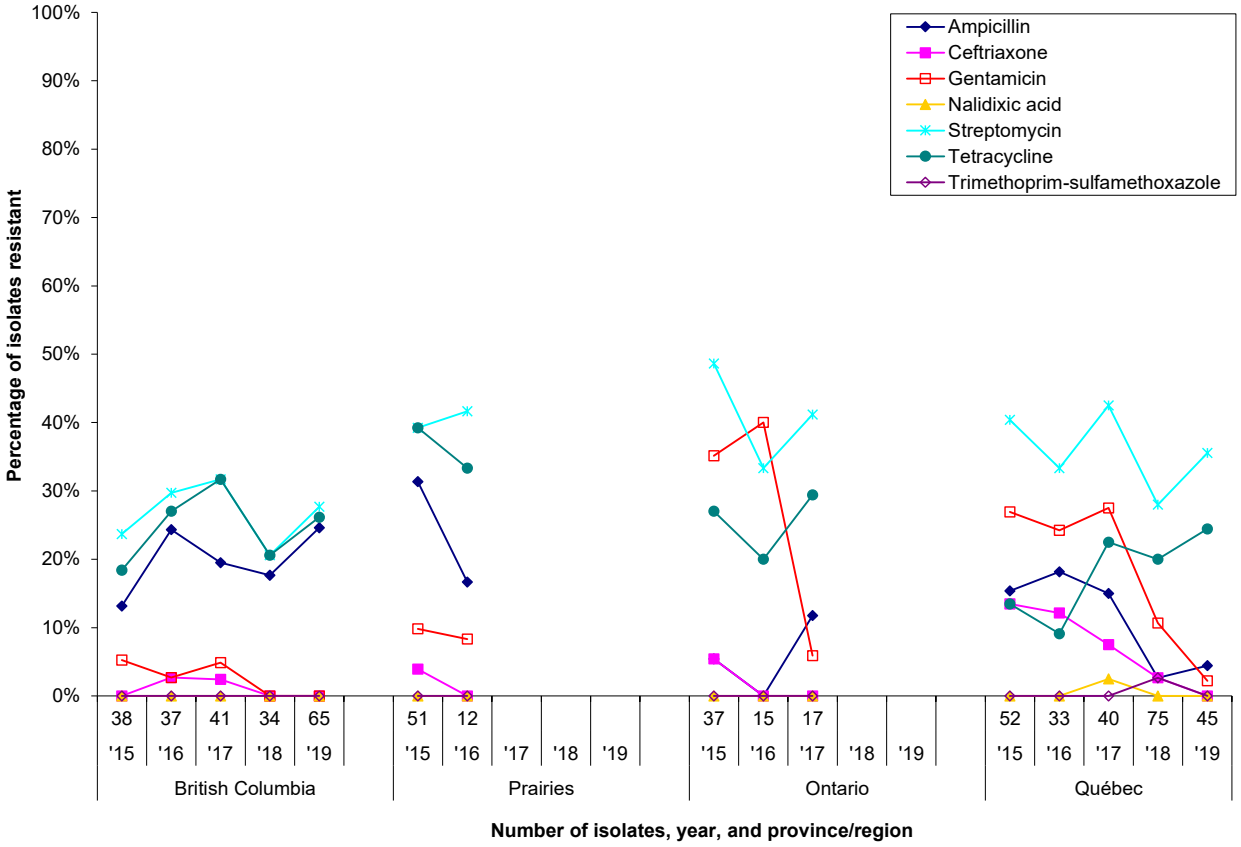
Figure 3. 16 Temporal variations in resistance of *Salmonella* isolates from turkey, 2015 to 2019



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of isolates	38	37	41	34	65	51	12	3	3	3	37	15	17	0	2	52	33	40	75	45
Antimicrobial																				
Ampicillin	**13%**	24%	20%	**18%**	**25%**	**31%**	17%	0%	**67%**	**33%**	**5%**	0%	12%		**0%**	**15%**	18%	15%	**3%**	**4%**
Ceftriaxone	**0%**	3%	2%	**0%**	**0%**	**4%**	0%	0%	**0%**	**0%**	**5%**	0%	0%		**0%**	**13%**	12%	8%	**3%**	**0%**
Gentamicin	**5%**	3%	5%	**0%**	**0%**	**10%**	8%	0%	**0%**	**0%**	**35%**	40%	6%		**0%**	**27%**	24%	28%	**11%**	**2%**
Nalidixic acid	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%		**0%**	**0%**	0%	3%	**0%**	**0%**
Streptomycin	**24%**	30%	32%	**21%**	**28%**	**39%**	42%	0%	**33%**	**33%**	**49%**	33%	41%		**0%**	**40%**	33%	43%	**28%**	**36%**
Tetracycline	**18%**	27%	32%	**21%**	**26%**	**39%**	33%	0%	**33%**	**33%**	**27%**	20%	29%		**0%**	**13%**	9%	23%	**20%**	**24%**
Trimethoprim-sulfamethoxazole	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%		**0%**	**0%**	0%	0%	**3%**	**0%**

For the temporal analyses within 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 previous 5 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

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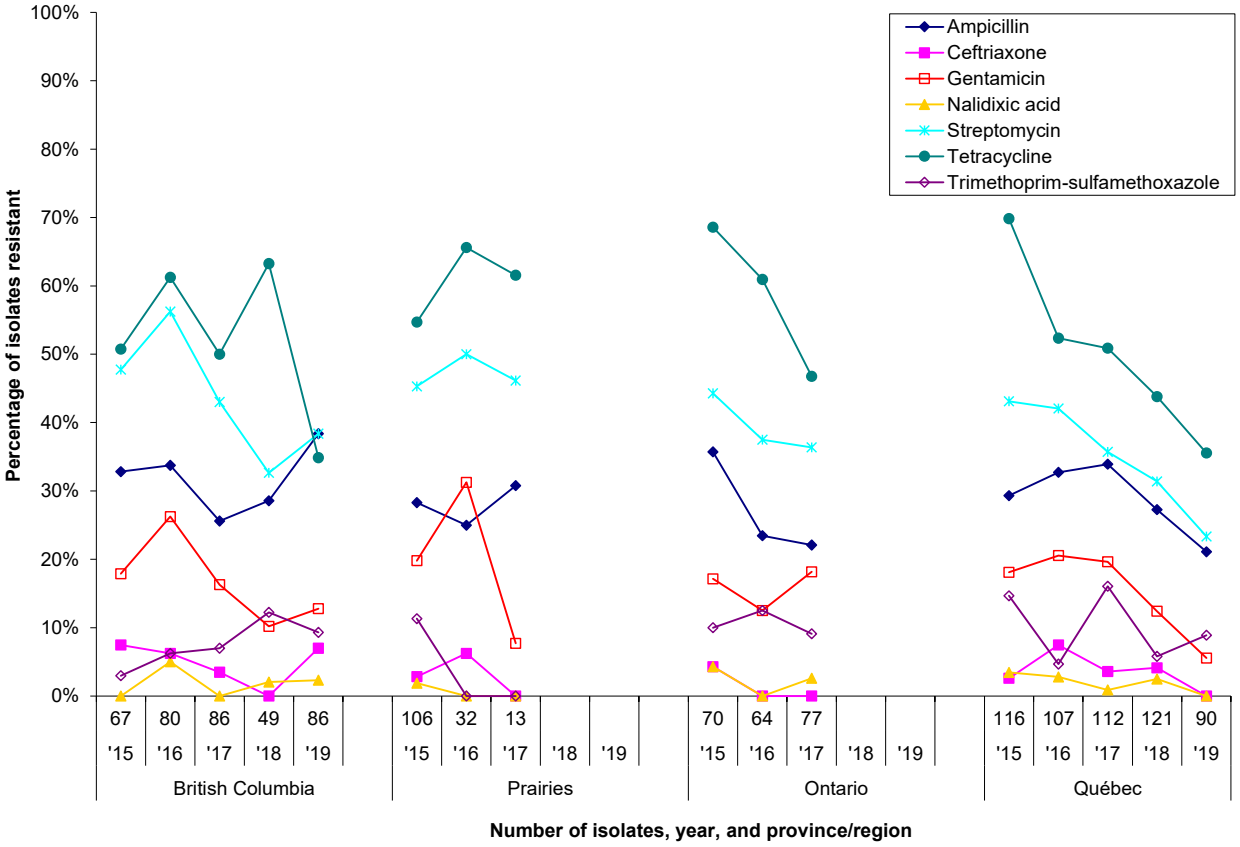
Figure 3. 17 Temporal variations in resistance of *Escherichia coli* isolates from turkey, 2015 to 2019



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of isolates	67	80	86	49	86	106	32	13	7	3	70	64	77	2	2	116	107	112	121	90
Antimicrobial																				
Ampicillin	**33%**	34%	26%	**29%**	**38%**	**28%**	25%	31%	**29%**	**33%**	**36%**	23%	22%	**0%**	**50%**	**29%**	33%	34%	**27%**	**21%**
Ceftriaxone	**7%**	6%	3%	**0%**	**7%**	**3%**	6%	0%	**0%**	**0%**	**4%**	0%	0%	**0%**	**0%**	**3%**	7%	4%	**4%**	**0%**
Gentamicin	**18%**	26%	16%	**10%**	**13%**	**20%**	31%	8%	**14%**	**0%**	**17%**	13%	18%	**0%**	**0%**	**18%**	21%	20%	**12%**	**6%**
Nalidixic acid	**0%**	5%	0%	**2%**	**2%**	**2%**	0%	0%	**0%**	**0%**	**4%**	0%	3%	**0%**	**0%**	**3%**	3%	1%	**2%**	**0%**
Streptomycin	**48%**	56%	43%	**33%**	**38%**	**45%**	50%	46%	**29%**	**33%**	**44%**	38%	36%	**50%**	**50%**	**43%**	42%	36%	**31%**	**23%**
Tetracycline	**51%**	61%	50%	**63%**	**35%**	**55%**	66%	62%	**71%**	**33%**	**69%**	61%	47%	**50%**	**50%**	**70%**	52%	51%	**44%**	**36%**
Trimethoprim-sulfamethoxazole	**3%**	6%	7%	**12%**	**9%**	**11%**	0%	0%	**0%**	**0%**	**10%**	13%	9%	**0%**	**0%**	**15%**	5%	16%	**6%**	**9%**

For the temporal analyses within 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 previous 5 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

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Recovery results

Table 3. 9 Retail Meat Surveillance recovery rates, 2003 to 2019

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*	
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						
		2014	**43%**	43/100						
		2015	**42%**	45/108						
		2016	**45%**	59/130						
		2017	**44%**	59/135						
		2018	**47%**	35/75						
		2019	**51%**	69/135						
	Prairies	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						
		2014	**53%**	97/184						
		2015	**46%**	86/186						
		2016	**62%**	48/78						
		2017	**42%**	13/31						
		2018	**35%**	7/20						
		2019	**50%**	4/8						
	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						
		2014	**51%**	121/236						
		2015	**46%**	53/116						
		2016	**56%**	68/122						
		2017	**51%**	64/126						
		2018	**50%**	2/4						
		2019	**33%**	1/3						
	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	**42%**	74/175						
		2014	**41%**	85/207						
		2015	**39%**	79/203						
		2016	**43%**	82/192						
		2017	**39%**	82/210						
		2018	**36%**	78/214						
		2019	**43%**	72/168						

See corresponding footnotes at the end of the table.

Table 3. 9 Retail Meat Surveillance recovery rates, 2003 to 2019 (continued)

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*	
	Atlantic	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	**58%**	83/143						
		2014	**57%**	118/207						
		2015[e]								
		2016[e]								
		2017[e]								
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		
		2014	**98%**	65/66	**27%**	36/133	**32%**	43/133		
		2015	**91%**	62/68	**51%**	69/136	**35%**	47/136		
		2016	**94%**	82/87	**36%**	62/173	**38%**	65/172		
		2017	**89%**	77/87	**32%**	55/173	**43%**	74/173		
		2018	**94%**	47/50	**33%**	32/97	**35%**	34/97		
		2019	**91%**	82/90	**43%**	77/180	**41%**	74/180		
	Prairies	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		
		2014	**97%**	109/112	**36%**	81/222	**30%**	67/222		
		2015	**95%**	107/113	**35%**	77/220	**30%**	65/220		
		2016	**90%**	36/40	**37%**	28/76	**21%**	16/76		
		2017	**94%**	15/16	**24%**	8/33	**30%**	10/33		
		2018	**90%**	9/10	**15%**	3/20	**30%**	6/20		
		2019	**100%**	4/4	**13%**	1/8	**13%**	1/8		
	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		
		2014	**92%**	144/157	**24%**	75/312	**25%**	78/312		
		2015	**91%**	69/76	**17%**	26/151	**26%**	40/151		
		2016	**93%**	75/81	**14%**	22/160	**29%**	46/160		
		2017	**93%**	76/82	**14%**	23/164	**18%**	29/164		
		2018	**100%**	2/2	**0%**	0/4	**25%**	1/4		
		2019	**0%**	0/2	**0%**	0/4	**0%**	0/4		

See corresponding footnotes at the end of the table.

Table 3. 9 Retail Meat Surveillance recovery rates, 2003 to 2019 (continued)

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*	
	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		
		2014	**93%**	129/138	**33%**	92/276	**20%**	54/276		
		2015	**93%**	127/136	**40%**	109/272	**18%**	49/272		
		2016	**92%**	118/128	**28%**	71/256	**19%**	49/254		
		2017	**89%**	125/140	**29%**	81/281	**19%**	52/281		
		2018	**86%**	122/142	**33%**	95/285	**22%**	62/285		
		2019	**70%**	113/162	**36%**	81/224	**27%**	61/224		
	Atlantic	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	**92%**	133/144	**31%**	44/144	**47%**	67/144		
		2014	**86%**	179/207	**31%**	64/207	**25%**	52/206		
		2015[e]								
		2016[e]								
		2017[e]								
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				
		2014	**22%**	29/131	**2%**	2/132				
		2015	**21%**	29/136						
		2016	**23%**	40/172						
		2017	**15%**	25/172						
		2018	**10%**	10/98						
		2019	**9%**	17/180						
	Prairies	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				
		2014	**22%**	48/223	**1%**	3/223				
		2015	**23%**	50/220						
		2016	**8%**	6/78						
		2017	**6%**	2/31						
		2018	**5%**	1/20						
		2019	**13%**	1/8						

See corresponding footnotes at the end of the table.

Table 3. 9 Retail Meat Surveillance recovery rates, 2003 to 2019 (continued)

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*	
	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				
		2014	**41%**	127/312	**2%**	6/312				
		2015	**42%**	64/152						
		2016	**32%**	51/160						
		2017	**32%**	53/164						
		2018	**25%**	1/4						
		2019	**50%**	2/4						
	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				
		2014	**18%**	49/276	**<1%**	2/276				
		2015	**13%**	36/272						
		2016	**17%**	43/256						
		2017	**13%**	35/280						
		2018	**14%**	39/284						
		2019	**21%**	57/272						
	Atlantic	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	**40%**	57/143	**1%**	2/142				
		2014	**41%**	86/209	**6%**	13/208				
		2015[e]								
		2016[e]								
		2017[e]								

See corresponding footnotes at the end of the table.

Table 3. 9 Retail Meat Surveillance recovery rates, 2003 to 2019 (continued)

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*
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	
		2014	**97%**	64/66	**25%**	31/122	**23%**	28/122	
		2015	**99%**	67/68	**32%**	38/118	**20%**	24/118	
		2016	**94%**	80/85	**24%**	36/152	**7%**	10/153	
		2017	**99%**	86/87	**30%**	41/139	**13%**	9/72	
		2018	**96%**	49/51	**37%**	34/91			
		2019	**96%**	86/90	**37%**	65/174			
	Prairies	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	
		2014	**93%**	103/111	**22%**	44/196	**7%**	13/196	
		2015	**99%**	106/107	**31%**	51/165	**7%**	11/165	
		2016	**97%**	32/33	**29%**	12/41	**7%**	3/41	
		2017	**100%**	13/13	**18%**	3/17	**8%**	1/13	
		2018	**88%**	7/8	**25%**	3/12			
		2019	**75%**	3/4	**60%**	3/5			
	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	
		2014	**92%**	143/156	**13%**	40/310	**9%**	28/310	
		2015	**92%**	70/76	**24%**	37/152	**5%**	8/152	
		2016	**81%**	64/79	**9%**	15/158	**4%**	6/158	
		2017	**94%**	77/82	**11%**	17/161	**6%**	5/88	
		2018	**100%**	2/2	**0%**	0/4			
		2019	**100%**	2/2	**50%**	2/4			
	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	
		2014	**86%**	119/138	**19%**	51/262	**2%**	5/262	
		2015	**86%**	116/135	**21%**	52/247	**4%**	9/247	
		2016	**84%**	107/128	**14%**	33/238	**3%**	6/237	
		2017	**80%**	112/140	**16%**	40/247	**5%**	5/105	
		2018	**85%**	121/142	**28%**	77/271			
		2019	**80%**	90/112	**22%**	45/204			
	Atlantic	2013	**85%**	107/126	**19%**	24/126	**23%**	29/124	
		2014	**76%**	143/187	**12%**	23/187	**8%**	15/185	
		2015[e]							
		2016[e]							
		2017[e]							

See corresponding footnotes at the end of the table.

Table 3. 9 Retail Meat Surveillance recovery rates, 2003 to 2019 (continued)

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 Prairies is a region including the provinces of Alberta and Saskatchewan.

For Ontario and the Prairies in 2018 and 2019, a partial year of retail sampling was conducted due to difficulties in staffing field personnel. As a result, the sampling target and subsequent isolate yields were not achieved and results should be interpreted with caution.

The Atlantic region includes New Brunswick, Nova Scotia, and Prince Edward Island.

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

[b] Enhancement to the *Salmonella* recovery method yielded higher recovery rates from retail chicken in 2007 than in prior years.

[c] For the Atlantic region, 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 Atlantic region 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] No retail sampling was conducted in the Atlantic region from 2015 to 2019.

Abattoir Surveillance

Multiclass resistance

Table 3. 10 Number of antimicrobial classes in resistance patterns of *Escherichia coli* from beef cattle, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Beef Cattle	119	67	37	13	2			14						19			3			43

Antimicrobial abbreviations are defined in the Appendix.

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

Table 3. 11 Number of antimicrobial classes in resistance patterns of *Campylobacter* from beef cattle, 2019

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	Lincosamides	Macrolides		Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	CLI	AZM	ERY	FLR	CIP	NAL	TET
Campylobacter jejuni	71 (68.9)	31	30	10					1	1		11	11	39
Campylobacter coli	25 (24.3)	4	10	9	2			7	7	7		7	7	17
Campylobacter spp.	7 (6.8)		6	1								3	7	1
Total	**103 (100)**	**35**	**46**	**20**	**2**			**7**	**8**	**8**		**21**	**25**	**57**

Antimicrobial abbreviations are defined in the Appendix.

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

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

Table 3. 12 Number of antimicrobial classes in resistance patterns of *Salmonella* from chickens, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Kentucky	66 (40.7)	2	3	61				63	6	6	6	6								61
Enteritidis	31 (19.1)	29	2																2	
Heidelberg	14 (8.6)	5	5	4				4	7	5	5	5		2	2		1			
Typhimurium	8 (4.9)			6	2			2	2					8			2			8
8,20:-:z6	6 (3.7)			6				6												6
Infantis	5 (3.1)	3			1	1		2	1		1			2	1		1		2	2
Rough:g,m:-	4 (2.5)	4																		
Schwarzengrund	4 (2.5)	4																		
Less common serovars	24 (14.8)	9	4	11				9	2	1	1	1		3	1					14
Total	**162 (100)**	**56**	**14**	**88**	**3**	**1**		**86**	**18**	**12**	**13**	**12**		**15**	**4**		**4**		**4**	**91**

Antimicrobial abbreviations are defined in the Appendix.

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

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

Table 3. 13 Number of antimicrobial classes in resistance patterns of *Escherichia coli* from chickens, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Chickens	216	67	37	87	25		34	105	60	8	7	8		85	40		6	1	11	92

Antimicrobial abbreviations are defined in the Appendix.

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

Table 3. 14 Number of antimicrobial classes in resistance patterns of *Campylobacter* from chickens, 2019

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	Lincosamides	Macrolides		Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	CLI	AZM	ERY	FLR	CIP	NAL	TET
Campylobacter jejuni	184 (89.0)	80	64	40				8	12	12		43	43	82
Campylobacter coli	20 (10.0)	9	6	4	1			4	4	4		6	6	5
Campylobacter spp.	2 (1.0)		2									2	2	
Total	**206 (100)**	**89**	**72**	**44**	**1**			**12**	**16**	**16**		**51**	**51**	**87**

Antimicrobial abbreviations are defined in the Appendix.

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

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

Table 3. 15 Number of antimicrobial classes in resistance patterns of *Salmonella* from pigs, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Derby	48 (28.4)	20	2	21	5			26	4	1	1	1		26	2		1			26
Typhimurium	22 (13.0)	1	2	1	18			19	19					19			16			19
4,[5],12:i:-	18 (10.7)	1	3	3	11			14	13					14	2	1	1			14
Infantis	18 (10.7)	13		2	3			5	4	3	3	3		4			3			5
London	13 (7.7)	11	1	1					1											2
Putten	9 (5.3)	9																		
Bovismorbificans	5 (3.0)	5																		
Brandenburg	5 (3.0)	1	3	1				1	1					1	1					3
Uganda	5 (3.0)	5																		
Less common serovars	26 (15.4)	12	4	8	1	1	1	9	3	1	1	1		11	5	1	2			10
Total	**169 (100)**	**78**	**15**	**37**	**38**	**1**	**1**	**74**	**45**	**5**	**5**	**5**		**75**	**10**	**2**	**23**			**79**

Antimicrobial abbreviations are defined in the Appendix.

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

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

Table 3. 16 Number of antimicrobial classes in resistance patterns of *Escherichia coli* from pigs, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Pigs	137	35	32	52	18			56	41	3	3	2		43	18		17			76

Antimicrobial abbreviations are defined in the Appendix.

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

Table 3. 17 Number of antimicrobial classes in resistance patterns of *Campylobacter* from pigs, 2019

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	Lincosamides	Macrolides		Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	CLI	AZM	ERY	FLR	CIP	NAL	TET
Campylobacter jejuni	2 (1.0)		1	1				1	1	1				2
Campylobacter coli	206 (98.0)	62	72	68	4			58	59	59		21	21	132
Campylobacter spp.	2 (1.0)			2					1	1		1	2	2
Total	**210 (100)**	**62**	**73**	**71**	**4**			**59**	**61**	**61**		**22**	**23**	**136**

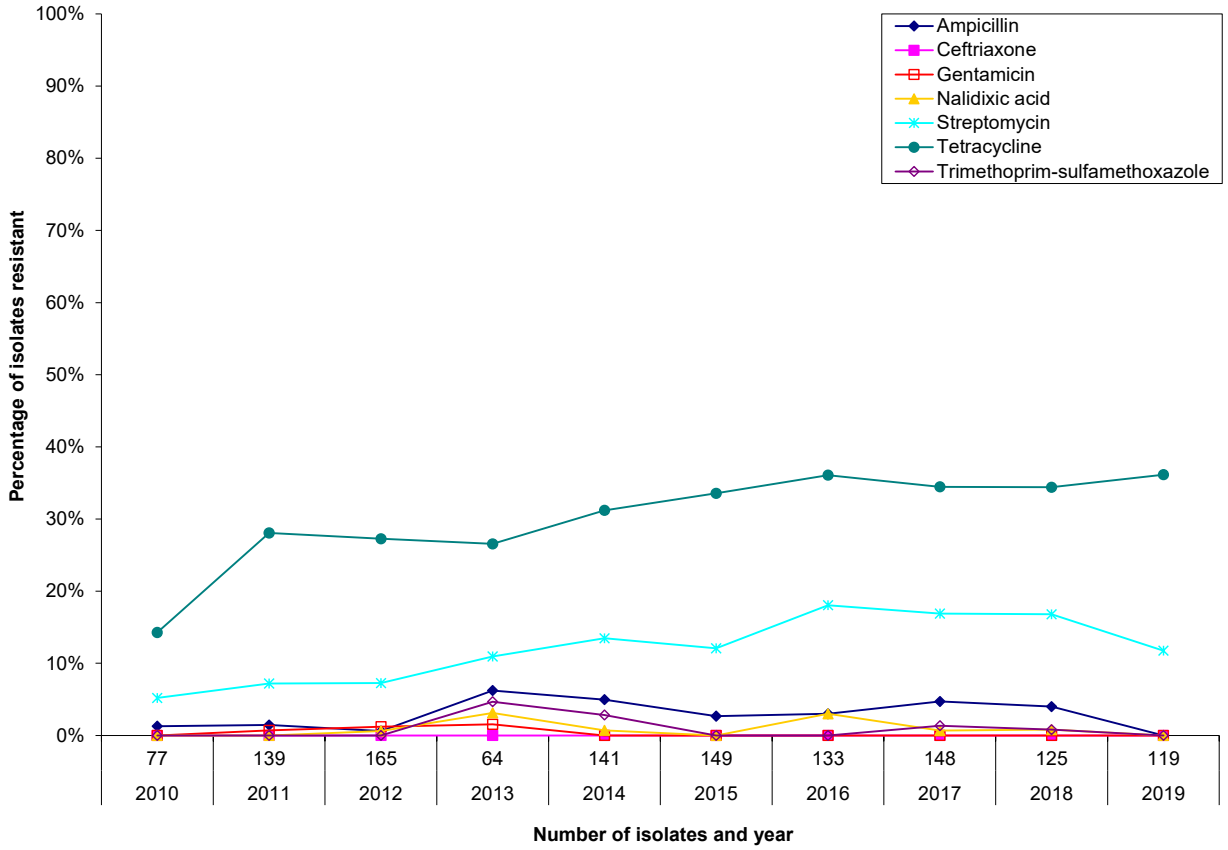
Antimicrobial abbreviations are defined in the Appendix.

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

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

Temporal antimicrobial resistance summary

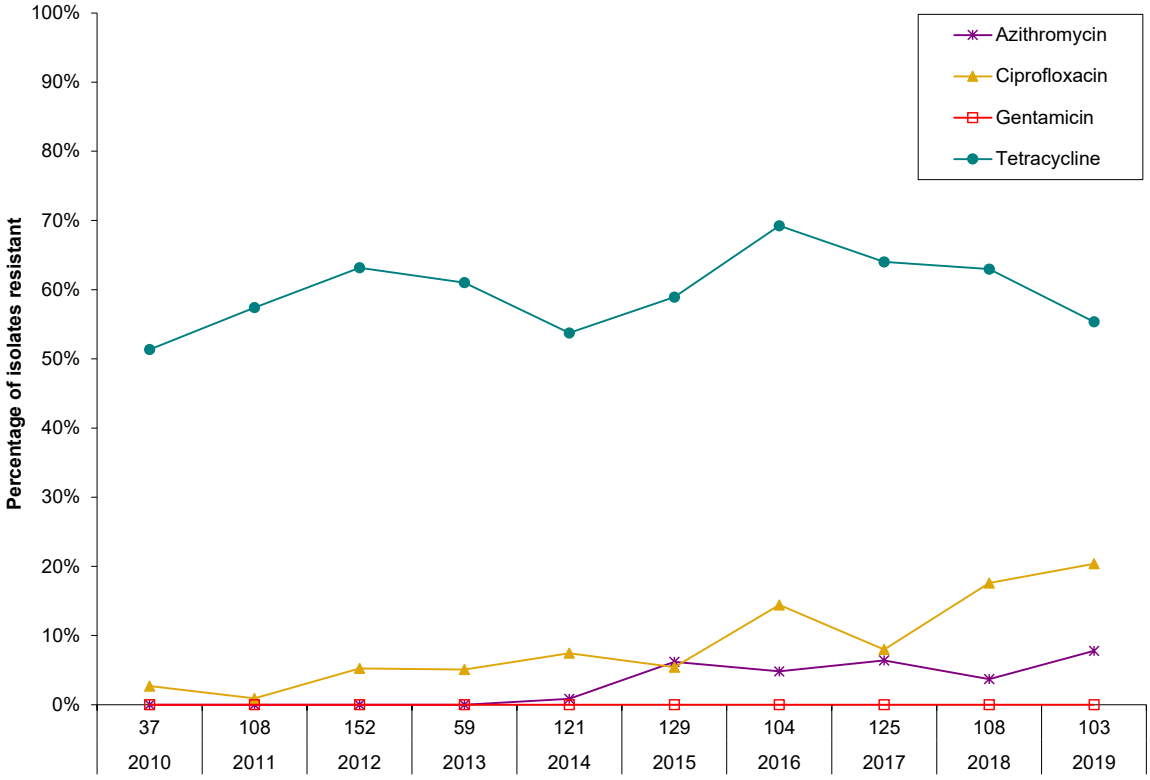
Figure 3. 18 Temporal variations in resistance of *Escherichia coli* isolates from beef cattle, 2010 to 2019



Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of isolates	77	139	165	64	141	149	133	148	125	119
Antimicrobial										
Ampicillin	**1%**	1%	1%	6%	5%	**3%**	3%	5%	**4%**	**0%**
Ceftriaxone	**0%**	0%	0%	0%	0%	**0%**	0%	0%	**0%**	**0%**
Gentamicin	**0%**	1%	1%	2%	0%	**0%**	0%	0%	**0%**	**0%**
Nalidixic acid	**0%**	0%	1%	3%	1%	**0%**	3%	1%	**1%**	**0%**
Streptomycin	**5%**	7%	7%	11%	13%	**12%**	18%	17%	**17%**	**12%**
Tetracycline	**14%**	28%	27%	27%	31%	**34%**	36%	34%	**34%**	**36%**
Trimethoprim-sulfamethoxazole	**0%**	0%	0%	5%	3%	**0%**	0%	1%	**1%**	**0%**

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the previous 10 years, 5 years, and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

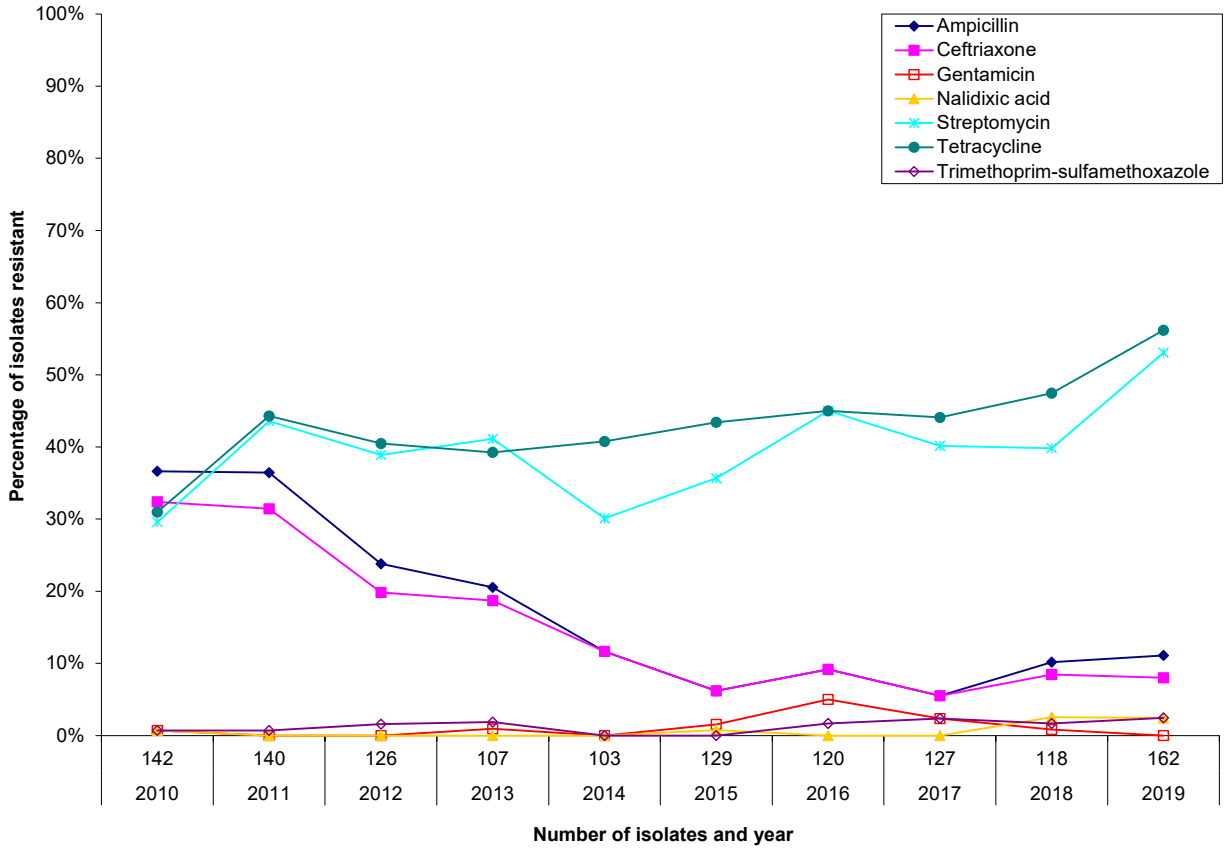
Figure 3. 19 Temporal variations in resistance of *Campylobacter* from beef cattle, 2010 to 2019



Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of isolates	37	108	152	59	121	129	104	125	108	103
Antimicrobial										
Azithromycin	**0%**	0%	0%	0%	1%	**6%**	5%	6%	**4%**	**8%**
Ciprofloxacin	**3%**	1%	5%	5%	7%	**5%**	14%	8%	**18%**	**20%**
Gentamicin	**0%**	0%	0%	0%	0%	**0%**	0%	0%	**0%**	**0%**
Tetracycline	**51%**	57%	63%	61%	54%	**59%**	69%	64%	**63%**	**55%**

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 previous 10 years, 5 years, and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

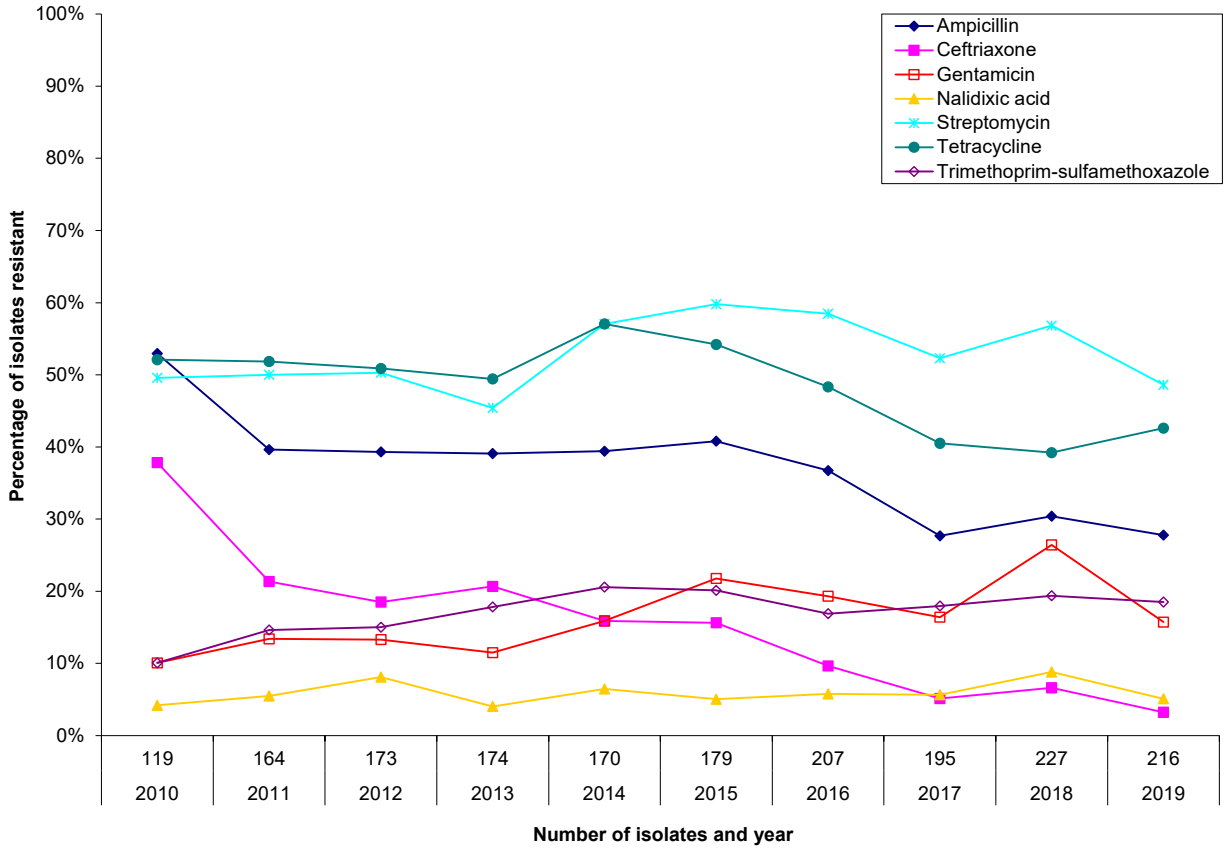
Figure 3. 20 Temporal variations in resistance of *Salmonella* isolates from chicken, 2010 to 2019



Year Number of isolates	2010 142	2011 140	2012 126	2013 107	2014 103	2015 129	2016 120	2017 127	2018 118	2019 162
Antimicrobial										
Ampicillin	**37%**	36%	24%	21%	12%	**6%**	9%	6%	**10%**	**11%**
Ceftriaxone	**32%**	31%	20%	19%	12%	**6%**	9%	6%	**8%**	**8%**
Gentamicin	**1%**	0%	0%	1%	0%	**2%**	5%	2%	**1%**	**0%**
Nalidixic acid	**1%**	0%	0%	0%	0%	**1%**	0%	0%	**3%**	**2%**
Streptomycin	**30%**	44%	39%	41%	30%	**36%**	45%	40%	**40%**	**53%**
Tetracycline	**31%**	44%	40%	39%	41%	**43%**	45%	44%	**47%**	**56%**
Trimethoprim-sulfamethoxazole	**1%**	1%	2%	2%	0%	**0%**	2%	2%	**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 previous 10 years, 5 years, and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

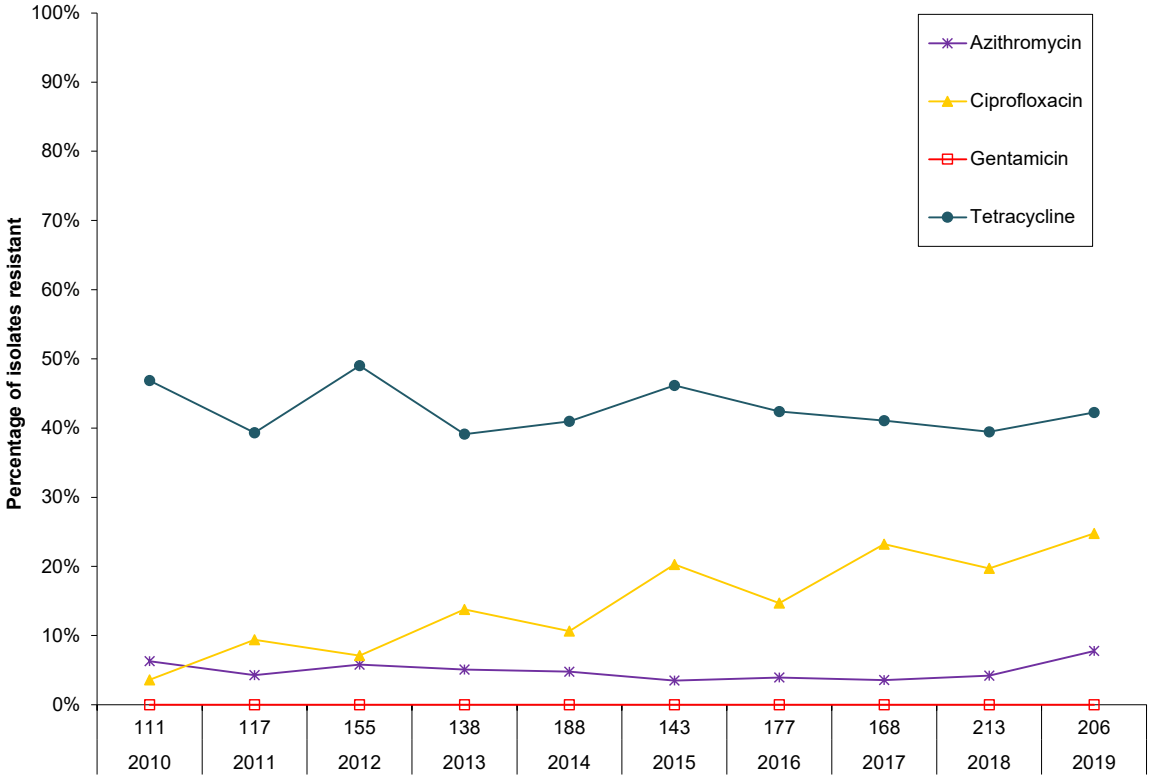
Figure 3. 21 Temporal variations in resistance of *Escherichia coli* isolates from chicken, 2010 to 2019



Year Number of isolates	2010 119	2011 164	2012 173	2013 174	2014 170	2015 179	2016 207	2017 195	2018 227	2019 216
Antimicrobial										
Ampicillin	**53%**	40%	39%	39%	39%	**41%**	37%	28%	**30%**	**28%**
Ceftriaxone	**38%**	21%	18%	21%	16%	**16%**	10%	5%	**7%**	**3%**
Gentamicin	**10%**	13%	13%	11%	16%	**22%**	19%	16%	**26%**	**16%**
Nalidixic acid	**4%**	5%	8%	4%	6%	**5%**	6%	6%	**9%**	**5%**
Streptomycin	**50%**	50%	50%	45%	57%	**60%**	58%	52%	**57%**	**49%**
Tetracycline	**52%**	52%	51%	49%	57%	**54%**	48%	41%	**39%**	**43%**
Trimethoprim-sulfamethoxazole	**10%**	15%	15%	18%	21%	**20%**	17%	18%	**19%**	**19%**

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 previous 10 years, 5 years, and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

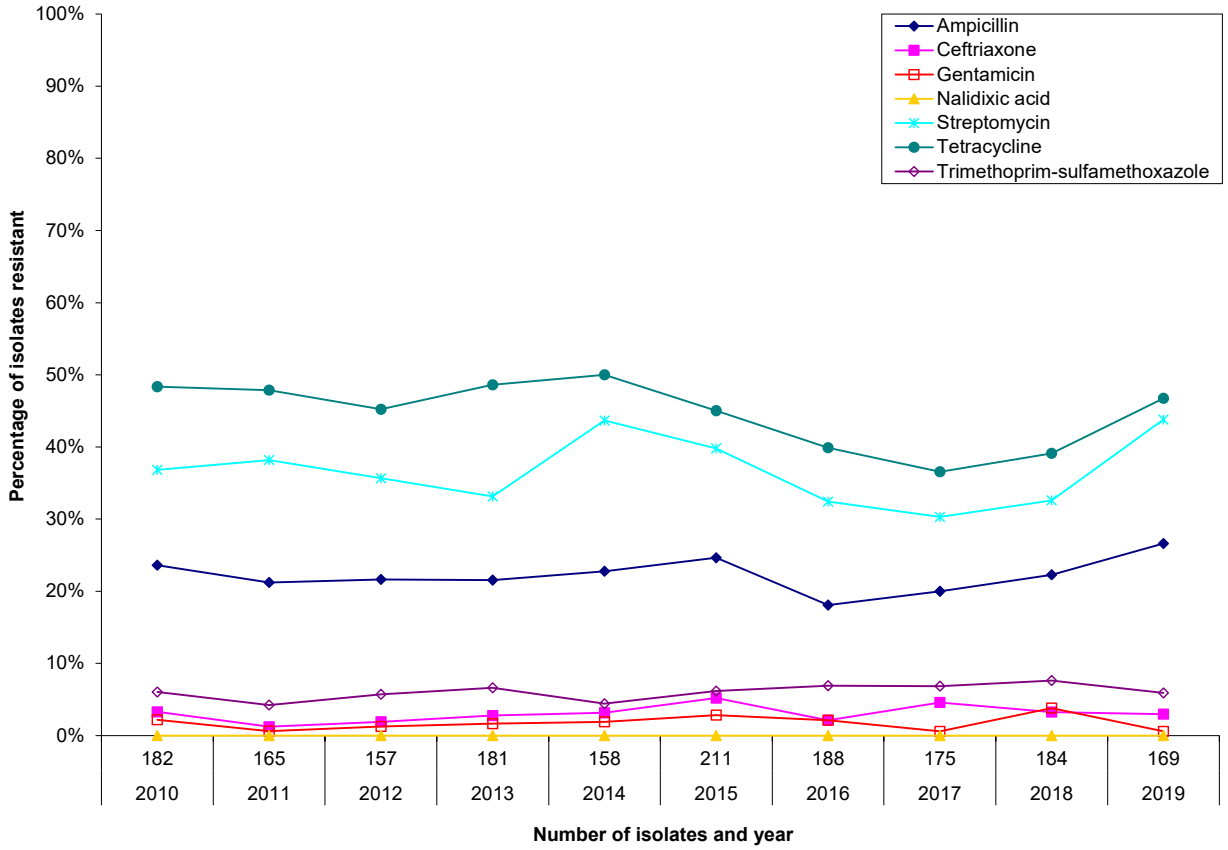
Figure 3. 22 Temporal variations in resistance of *Campylobacter* isolates from chickens, 2010 to 2019



Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of isolates	111	117	155	138	188	143	177	168	213	206
Antimicrobial										
Azithromycin	**6%**	4%	6%	5%	5%	**3%**	4%	4%	**4%**	**8%**
Ciprofloxacin	**4%**	9%	7%	14%	11%	**20%**	15%	23%	**20%**	**25%**
Gentamicin	**0%**	0%	0%	0%	0%	**0%**	0%	0%	**0%**	**0%**
Tetracycline	**47%**	39%	49%	39%	41%	**46%**	42%	41%	**39%**	**42%**

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 previous 10 years, 5 years, and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

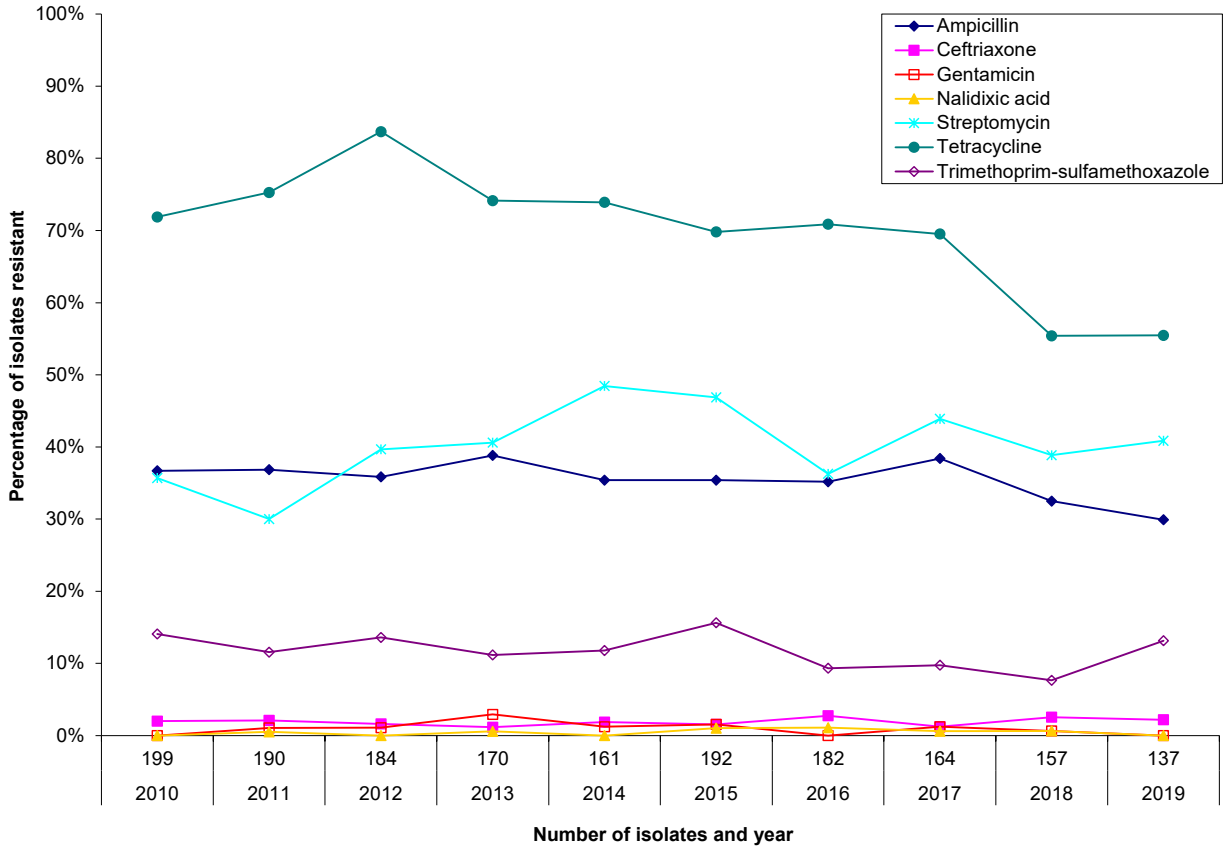
Figure 3. 23 Temporal variations in resistance of *Salmonella* isolates from pigs, 2010 to 2019



Year Number of isolates	2010 182	2011 165	2012 157	2013 181	2014 158	2015 211	2016 188	2017 175	2018 184	2019 169
Antimicrobial										
Ampicillin	**24%**	21%	22%	22%	23%	**25%**	18%	20%	**22%**	**27%**
Ceftriaxone	**3%**	1%	2%	3%	3%	**5%**	2%	5%	**3%**	**3%**
Gentamicin	**2%**	1%	1%	2%	2%	**3%**	2%	1%	**4%**	**1%**
Nalidixic acid	**0%**	0%	0%	0%	0%	**0%**	0%	0%	**0%**	**0%**
Streptomycin	**37%**	38%	36%	33%	44%	**40%**	32%	30%	**33%**	**44%**
Tetracycline	**48%**	48%	45%	49%	50%	**45%**	40%	37%	**39%**	**47%**
Trimethoprim-sulfamethoxazole	**6%**	4%	6%	7%	4%	**6%**	7%	7%	**8%**	**6%**

For the temporal analyses, the proportion (%) of isolates resistant to a specific antimicrobial over the current year has been compared to the proportion (%) of isolates resistant to the same antimicrobial during the previous 10 years, 5 years, and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

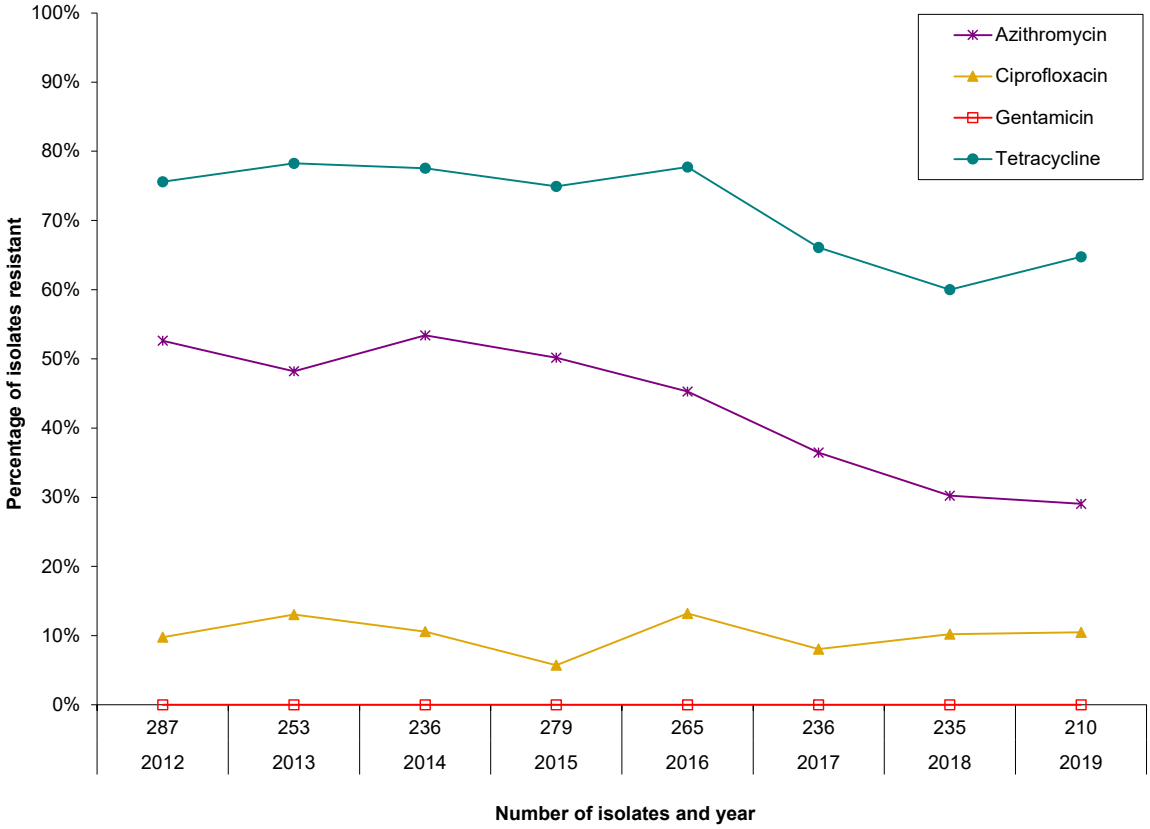
Figure 3. 24 Temporal variations in resistance of *Escherichia coli* isolates from pigs, 2010 to 2019



Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of isolates	199	190	184	170	161	192	182	164	157	137
Antimicrobial										
Ampicillin	**37%**	37%	36%	39%	35%	**35%**	35%	38%	**32%**	**30%**
Ceftriaxone	**2%**	2%	2%	1%	2%	**2%**	3%	1%	**3%**	**2%**
Gentamicin	**0%**	1%	1%	3%	1%	**2%**	0%	1%	**1%**	**0%**
Nalidixic acid	**0%**	1%	0%	1%	0%	**1%**	1%	1%	**1%**	**0%**
Streptomycin	**36%**	30%	40%	41%	48%	**47%**	36%	44%	**39%**	**41%**
Tetracycline	**72%**	75%	84%	74%	74%	**70%**	71%	70%	**55%**	**55%**
Trimethoprim-sulfamethoxazole	**14%**	12%	14%	11%	12%	**16%**	9%	10%	**8%**	**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 previous 10 years, 5 years, and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

Figure 3. 25 Temporal variations in resistance of *Campylobacter* isolates from pigs, 2012 to 2019



Year	2012	2013	2014	2015	2016	2017	2018	2019
Number of isolates	287	253	236	279	265	236	235	210
Antimicrobial								
Azithromycin	**53%**	48%	53%	**50%**	45%	36%	**30%**	**29%**
Ciprofloxacin	**10%**	13%	11%	**6%**	13%	8%	**10%**	**10%**
Gentamicin	**0%**	0%	0%	**0%**	0%	0%	**0%**	**0%**
Tetracycline	**76%**	78%	78%	**75%**	78%	66%	**60%**	**65%**

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 previous 10 years, 5 years, and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

Recovery results

Table 3. 18 Abattoir Surveillance recovery rates, 2002 to 2019

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		
	2014	**99%**	141/142			**87%**	123/142		
	2015	**98%**	149/152			**85%**	129/152		
	2016	**98%**	133/136			**76%**	104/136		
	2017	**98%**	148/151			**83%**	125/151		
	2018	**98%**	125/127			**85%**	108/127		
	2019	**98%**	119/121			**85%**	103/121		
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		
	2014	**100%**	170/170	**15%**	103/684	**27%**	187/683		
	2015	**99%**	179/181	**18%**	128/708	**20%**	143/709		
	2016	**99%**	206/208	**14%**	120/840	**21%**	177/842		
	2017	**99%**	195/196	**16%**	127/785	**21%**	168/784		
	2018	**99%**	227/229	**13%**	118/915	**24%**	215/915		
	2019	**96%**	216/225	**18%**	162/901	**23%**	208/901		

See corresponding footnotes at the end of the table.

Table 3. 18 Abattoir Surveillance recovery rates, 2002 to 2019 (continued)

Animal species	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted						
		Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*
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	
	2014	**99%**	161/162	**49%**	158/325	**73%**	237/325	
	2015	**98%**	192/195	**55%**	211/385	**72%**	279/385	
	2016	**99%**	182/184	**51%**	188/367	**72%**	265/366	
	2017	**98%**	164/167	**52%**	175/336	**71%**	237/336	
	2018	**97%**	157/162	**57%**	184/324	**73%**	235/324	
	2019	**100%**	137/137	**61%**	169/276	**76%**	210/276	

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 a 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

Multiclass resistance

Table 3. 19 Number of antimicrobial classes in resistance patterns of *Salmonella* from feedlot cattle, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Alberta																				
Heidelberg	7 (53.8)				1	6		7	7	7	7	6		7	4		7	1	6	7
Uganda	2 (15.4)	2																		
Dublin	1 (7.7)	1																		
Muenster	1 (7.7)	1																		
Rubislaw	1 (7.7)	1																		
Tennessee	1 (7.7)	1																		
Total	**13 (100)**	**6**			**1**	**6**		**7**	**7**	**7**	**7**	**6**		**7**	**4**		**7**	**1**	**6**	**7**
Ontario																				
Orion	5 (38.5)		4	1				1												5
Agona	2 (15.4)	1	1																	1
Give	2 (15.4)	2																		
Mbandaka	2 (15.4)	2																		
Oranienburg	2 (15.4)	2																		
Total	**13 (100)**	**7**	**5**	**1**				**1**												**6**
National																				
Heidelberg	7 (26.9)				1	6		7	7	7	7	6		7	4		7	1	6	7
Orion	5 (19.2)		4	1				1												5
Agona	2 (7.7)	1	1																	1
Give	2 (7.7)	2																		
Mbandaka	2 (7.7)	2																		
Oranienburg	2 (7.7)	2																		
Uganda	2 (7.7)	2																		
Dublin	1 (3.8)	1																		
Muenster	1 (3.8)	1																		
Rubislaw	1 (3.8)	1																		
Tennessee	1 (3.8)	1																		
Total	**26 (100)**	**13**	**5**	**1**	**1**	**6**		**8**	**7**	**7**	**7**	**6**		**7**	**4**		**7**	**1**	**6**	**13**

Antimicrobial abbreviations are defined in the Appendix.

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

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

Table 3. 20 Number of antimicrobial classes in resistance patterns of *Escherichia coli* from feedlot cattle, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Alberta	293 (80.7)	139	90	47	17			58	17		1			51	2		17		1	142
Saskatchewan	20 (5.5)	8	5	5	2			7	3					3			2			12
Ontario	50 (13.8)	28	16	5	1			5	1					5			1			22
National	**363 (100)**	**175**	**111**	**57**	**20**			**70**	**21**		**1**			**59**	**2**		**20**		**1**	**176**

Antimicrobial abbreviations are defined in the Appendix.

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

Table 3. 21 Number of antimicrobial classes in resistance patterns of *Campylobacter* from feedlot cattle, 2019

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	Lincosamides	Macrolides		Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	CLI	AZM	ERY	FLR	CIP	NAL	TET
Alberta														
Campylobacter coli	77 (70.0)	11	23	20	15	8	1	28	28	28		23	23	61
Campylobacter jejuni	33 (30.0)	5	22	2	4							6	6	26
Total	**110 (100)**	**16**	**45**	**22**	**19**	**8**	**1**	**28**	**28**	**28**		**29**	**29**	**87**
Saskatchewan														
Campylobacter coli	6 (54.5)		3		2	1		1	1	1		3	3	6
Campylobacter jejuni	5 (45.5)		4		1							1	1	5
Total	**11 (100)**		**7**		**3**	**1**		**1**	**1**	**1**		**4**	**4**	**11**
Ontario														
Campylobacter coli	38 (92.7)	4	15	7	12			7	7	7		12	12	31
Campylobacter jejuni	3 (7.3)	3												
Total	**41 (100)**	**7**	**15**	**7**	**12**			**7**	**7**	**7**		**12**	**12**	**31**
National														
Campylobacter coli	121 (74.7)	15	41	27	29	9	1	36	36	36		38	38	98
Campylobacter jejuni	41 (25.3)	8	26	2	5							7	7	31
Total	**162 (100)**	**23**	**67**	**29**	**34**	**9**	**1**	**36**	**36**	**36**		**45**	**45**	**129**

Antimicrobial abbreviations are defined in the Appendix.

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

Table 3. 22 Number of antimicrobial classes in resistance patterns of *Salmonella* from chickens pre-harvest, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia																				
Enteritidis	28 (27.5)	28																		
Johannesburg	18 (17.6)	16	1	1			1	1						1					1	
Kentucky	52 (51.0)	5	7	39	1			45	10	10	10	7							1	40
Mbandaka	2 (2.0)	2																		
Less common serovars	2 (2.0)	1	1					1												
Total	**102 (100)**	**52**	**9**	**40**	**1**		**1**	**47**	**10**	**10**	**10**	**7**		**1**					**2**	**40**
Prairies																				
Kentucky	14 (25.5)		5	9				9	9	9	9	9								9
Hadar	10 (18.2)			10				10												10
Braenderup	8 (14.5)	8																		
Enteritidis	5 (9.1)	5																		
Schwarzengrund	4 (7.3)	4																		
8,20:i:-	2 (3.6)			2				2	2	2	2	1								2
Typhimurium	2 (3.6)			1	1			2	1					2			1			1
Worthington	2 (3.6)	2																		
Less common serovars	8 (14.5)	5	1	2				2	2	1	1	1								2
Total	**55 (100)**	**24**	**6**	**24**	**1**			**25**	**14**	**12**	**12**	**11**		**2**			**1**			**24**
Ontario																				
Kentucky	28 (43.8)		1	27				27												28
Typhimurium	13 (20.3)			13				2	2	2	2	2		13						13
Liverpool	12 (18.8)	8	4					3												1
Mbandaka	4 (6.3)		3	1				1						4	4					
4,[5],12:i:-	3 (4.7)			3			1	2						3						3
Less common serovars	4 (6.3)	3	1																	1
Total	**64 (100)**	**11**	**9**	**44**			**1**	**35**	**2**	**2**	**2**	**2**		**20**	**4**					**46**
Québec																				
Kentucky	63 (67.7)	2		61				61												61
Enteritidis	13 (14.0)	13																		
Heidelberg	7 (7.5)	7																		
Hadar	3 (3.2)	1		2				2												2
Oranienburg	3 (3.2)	3																		
Less common serovars	4 (4.3)	2		2				2						2						2
Total	**93 (100)**	**28**		**65**				**65**						**2**						**65**
National																				
Kentucky	157 (50.0)	7	13	136	1			142	19	19	19	16							1	138
Enteritidis	46 (14.6)	46																		
Johannesburg	18 (5.7)	16	1	1			1	1						1					1	
Typhimurium	15 (4.8)			14	1			4	3	2	2	2		15			1			14
Hadar	13 (4.1)	1		12				12												12
Liverpool	12 (3.8)	8	4					3												1
Braenderup	8 (2.5)	8																		
Heidelberg	7 (2.2)	7																		
Mbandaka	6 (1.9)	2	3	1				1						4	4					
Less common serovars	32 (10.2)	20	3	9			1	9	4	3	3	2		5						10
Total	**314 (100)**	**115**	**24**	**173**	**2**		**2**	**172**	**26**	**24**	**24**	**20**		**25**	**4**		**1**		**2**	**175**

Antimicrobial abbreviations are defined in the Appendix.

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

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

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Table 3. 23 Number of antimicrobial classes in resistance patterns of *Escherichia coli* from chickens at pre-harvest, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia	131 (22.9)	46	24	32	29		26	52	56	20	20	19		39	6		2	1	23	48
Prairies	173 (30.3)	73	38	49	13		23	54	39	10	11	11		39	3	1	5	1	11	60
Ontario	149 (26.1)	56	34	41	18		21	48	43	4	8	4		46	23		5		8	55
Québec	118 (20.7)	19	14	66	19		28	75	44	4	4	3		76	52		9		3	61
National	**571 (100)**	**194**	**110**	**188**	**79**		**98**	**229**	**182**	**38**	**42**	**37**		**200**	**84**	**1**	**21**	**2**	**45**	**224**

Antimicrobial abbreviations are defined in the Appendix.

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

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Table 3. 24 Number of antimicrobial classes in resistance patterns of *Campylobacter* from chickens at pre-harvest, 2019

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	Lincosamides	Macrolides		Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	CLI	AZM	ERY	FLR	CIP	NAL	TET
British Columbia														
Campylobacter coli	6 (13.3)	2	4									4	4	
Campylobacter jejuni	39 (86.7)	22	14	3								13	13	7
Total	**45 (100)**	**24**	**18**	**3**								**17**	**17**	**7**
Prairies														
Campylobacter jejuni	46 (100)	38	4	4								4	4	8
Total	**46 (100)**	**38**	**4**	**4**								**4**	**4**	**8**
Ontario														
Campylobacter coli	3 (9.7)	2		1				1	1	1				1
Campylobacter jejuni	28 (90.3)	12	9	7								7	7	16
Total	**31 (100)**	**14**	**9**	**8**				**1**	**1**	**1**		**7**	**7**	**17**
Québec														
Campylobacter jejuni	20 (100)	16		4								4	4	4
Total	**20 (100)**	**16**		**4**								**4**	**4**	**4**
National														
Campylobacter coli	9 (6.3)	4	4	1				1	1	1		4		1
Campylobacter jejuni	133 (93.7)	88	27	18								28		35
Total	**142 (100)**	**92**	**31**	**19**				**1**	**1**	**1**		**32**	**64**	**36**

Antimicrobial abbreviations are defined in the Appendix.

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

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Table 3. 25 Number of antimicrobial classes in resistance patterns of *Salmonella* from pigs, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Prairies																				
Typhimurium	7 (13.5)	1			4	2	2	6	6					6	2	2	6			6
Derby	6 (11.5)	2	1	2	1			3	2	2	2	2		3		1				3
4,12:d:-	5 (9.6)			5				5						5						5
Ohio	5 (9.6)	4		1				1						1						1
Worthington	4 (7.7)	2		2			2		2	2	2	2								
Agona	3 (5.7)	1	1	1				1	2											
4,12:i:-	3 (5.7)				3			3	3					3						3
Infantis	3 (5.7)	3																		
Livingstone	3 (5.7)	2			1			1	1	1	1	1		1	1		1			1
Putten	3 (5.7)	2	1					1												
Senftenberg	3 (5.7)	2	1					1												
Give	2 (3.8)	1		1				1						1	1					
Schwarzengrund	2 (3.8)			2				2						2						2
Less common serovars	3 (5.7)	2		1				1						1						
Total	**52 (100)**	**22**	**4**	**15**	**9**	**2**	**4**	**26**	**16**	**5**	**5**	**5**		**23**	**4**	**3**	**7**			**21**
Ontario																				
Typhimurium	18 (32.7)	1	2	3	12			15	11					15	2		12			16
4,[5],12:i:-	16 (29.1)	3			13		1	13	13					13						13
Derby	7 (12.7)			7				7						7						7
Infantis	3 (5.5)	1			2			2	1	1	1	1		2			2			2
Muenchen	3 (5.5)	2			1			1	1	1	1	1		1			1			1
Ohio	3 (5.5)	1			2		2	2	2					2						2
Uganda	2 (3.6)	2																		
Less common serovars	3 (5.5)	1	1	1			1	2												1
Total	**55 (100)**	**11**	**3**	**11**	**30**		**4**	**42**	**28**	**2**	**2**	**2**		**40**	**2**		**15**			**42**
Québec																				
4,[5],12:i:-	19 (32.8)	1	3		15			15	15					15						18
Typhimurium	17 (29.3)			6	11		3	16	11					15	6	2	9			13
Derby	6 (10.3)			6				6						6						6
Brandenburg	5 (8.6)	4	1						1											
Ohio	3 (5.2)	1			2			2	2	1	1	1		2		1	1			2
Schwarzengrund	3 (5.2)	2		1				1												1
Worthington	3 (5.2)		1		2		2	2						2			2			3
Less common serovars	2 (3.4)	2																		
Total	**58 (100)**	**10**	**5**	**13**	**30**		**5**	**42**	**29**	**1**	**1**	**1**		**40**	**6**	**3**	**12**			**43**
National																				
Typhimurium	42 (25.5)	2	2	9	27	2	5	37	28					36	10	4	27			35
4,[5],12:i:-	36 (21.8)	5	3		28		1	28	28					28						31
Derby	19 (11.5)	2	1	15	1			16	2	2	2	2		16						16
Ohio	11 (6.7)	6		1	4		2	5	4	1	1	1		5		1	1			5
Worthington	8 (4.8)	3	1	2	2		4	2	2	2	2	2		2			2			3
Infantis	7 (4.2)	5			2			2	1	1	1	1		2			2			2
Brandenburg	5 (3.0)	4	1						1											
4,12:d:-	5 (3.0)			5				5						5						5
Schwarzengrund	5 (3.0)	2		3				3						2						3
Less common serovars	27 (16.4)	14	4	4	5		1	12	7	2	2	2		7	2		2			6
Total	**165 (100)**	**43**	**12**	**39**	**69**	**2**	**13**	**110**	**73**	**8**	**8**	**8**		**103**	**12**	**5**	**34**			**106**

Antimicrobial abbreviations are defined in the Appendix.

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

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

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Table 3. 26 Number of antimicrobial classes in resistance patterns of *Escherichia coli* from pigs, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Prairies	272 (43.3)	83	65	104	20			100	79	12	13	12		63	20		20		2	143
Ontario	189 (30.1)	23	56	78	32		1	80	60					78	24		24			151
Québec	167 (26.6)	35	44	62	25	1	4	60	40	1	2	1		65	34	1	20		1	114
National	**628 (100)**	**141**	**165**	**244**	**77**	**1**	**5**	**240**	**179**	**13**	**15**	**13**		**206**	**78**	**1**	**64**		**3**	**408**

Antimicrobial abbreviations are defined in the Appendix.

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

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Table 3. 27 Number of antimicrobial classes in resistance patterns of *Campylobacter* from pigs, 2019

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	Lincosamides	Macrolides		Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	CLI	AZM	ERY	FLR	CIP	NAL	TET
Prairies														
Campylobacter coli	204 (100)	55	51	89	9			83	90	90		17	17	102
Total	**204 (100)**	**55**	**51**	**89**	**9**			**83**	**90**	**90**		**17**	**17**	**102**
Ontario														
Campylobacter coli	139 (100)	29	36	59	15			56	69	69		14	14	100
Total	**139 (100)**	**29**	**36**	**59**	**15**			**56**	**69**	**69**		**14**	**14**	**100**
Québec														
Campylobacter coli	104 (100)	15	42	41	6			23	34	34		19	19	77
Total	**104 (100)**	**15**	**42**	**41**	**6**			**23**	**34**	**34**		**19**	**19**	**77**
National														
Campylobacter coli	447 (100)	99	129	189	30			162	193	193		50	50	279
Total	**447 (100)**	**99**	**129**	**189**	**30**			**162**	**193**	**193**		**50**	**50**	**279**

Antimicrobial abbreviations are defined in the Appendix.

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

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Table 3. 28 Number of antimicrobial classes in resistance patterns of *Salmonella* from turkeys, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia																				
Reading	40 (46.0)	19	16	5				6	11					4				3	5	4
Uganda	26 (29.9)	16		10				10						10						10
Hadar	11 (12.6)			9	2			11	4					2						11
Agona	6 (6.9)	5		1			1	1						1						1
Less common serovars	4 (4.6)	4																		
Total	**87 (100)**	**44**	**16**	**25**	**2**		**1**	**28**	**15**					**17**				**3**	**5**	**26**
Alberta																				
Reading	14 (45.1)	2	4	1	7			8	11					8						8
Heidelberg	5 (16.1)	3	1	1			1		1											1
Schwarzengrund	4 (12.9)	1		3				3						3						3
Hadar	3 (9.7)			3				3												3
Mbandaka	3 (9.7)	3																		
Cubana	1 (3.2)	1																		
London	1 (3.2)	1																		
Total	**31 (100)**	**11**	**5**	**8**	**7**		**1**	**14**	**12**					**11**						**15**
Ontario																				
Uganda	45 (45.0)	5	1	39				40						39						39
Reading	13 (13.0)	13																		
Schwarzengrund	9 (9.0)	9																		
Muenchen	6 (6.0)	4		2				2						2						2
Senftenberg	4 (4.0)	4																		
Typhimurium	4 (4.0)	4																		
Berta	3 (3.0)	3																		
Infantis	3 (3.0)					3		3	3		3			3			3		3	3
Anatum	2 (2.0)	2																		
Hadar	2 (2.0)			2				2												2
Livingston	2 (2.0)		2																	2
Muenster	2 (2.0)	2																		
Tennessee	2 (2.0)	1	1					1												
Less common serovars	3 (3.0)	1		1	1			2	1	1	1	1		2	1		1			1
Total	**100 (100)**	**48**	**4**	**44**	**1**	**3**		**50**	**4**	**1**	**4**	**1**		**46**	**1**		**4**		**3**	**49**
Québec																				
Heidelberg	28 (33.7)	20	3	5				7	6	1	1	1								
Uganda	28 (33.7)	10		18				18						18						18
Hadar	9 (10.8)	1	1	7				7	5											7
Schwarzengrund	9 (10.8)	5		4				4						4						4
Muenchen	6 (7.2)	4		2				2						2						2
Senftenberg	2 (2.4)	2																		
Reading	1 (1.2)	1																		
Total	**83 (100)**	**43**	**4**	**36**				**38**	**11**	**1**	**1**	**1**		**24**						**31**
National																				
Uganda	99 (32.9)	31	1	67				68						67						67
Reading	68 (22.6)	35	20	6	7			14	22					12				3	5	12
Heidelberg	33 (11.0)	23	4	6			1	7	7	1	1	1								1
Hadar	25 (8.3)	1	1	21	2			23	9					2						23
Schwarzengrund	22 (7.3)	15		7				7						7						7
Muenchen	12 (4.0)	8		4				4						4						4
Seftenberg	7 (2.3)	7																		
Less common serovars	35 (11.6)	26	3	2	1	3	1	7	4	1	4	1		6	1		4		3	7
Total	**301 (100)**	**146**	**29**	**113**	**10**	**3**	**2**	**130**	**42**	**2**	**5**	**2**		**98**	**1**		**4**	**3**	**8**	**121**

Antimicrobial abbreviations are defined in the Appendix.

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

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

Table 3. 29 Number of antimicrobial classes in resistance patterns of *Escherichia coli* from turkeys, 2019

Province	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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia	124 (31.5)	36	28	45	15		19	54	34	2	2	3		27	7		5		3	71
Alberta	40 (10.2)	4	12	16	8		4	18	21	4	3	3		11	2		1		2	32
Ontario	118 (30.0)	35	28	41	14		10	41	26					33	11		6	1	2	72
Québec	111 (28.2)	34	20	46	11		9	39	33	1	1	1		31	20		2		1	66
National	**393 (100)**	**109**	**88**	**148**	**48**		**42**	**152**	**114**	**7**	**6**	**7**		**102**	**40**		**14**	**1**	**8**	**241**

Antimicrobial abbreviations are defined in the Appendix.

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

Table 3. 30 Number of antimicrobial classes in resistance patterns of *Campylobacter* from turkeys, 2019

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	Lincosamides	Macrolides		Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	CLI	AZM	ERY	FLR	CIP	NAL	TET
British Columbia														
Campylobacter coli	29 (33.7)	2	13	14								23	22	18
Campylobacter jejuni	57 (66.3)	24	15	18								28	28	23
Total	**86 (100)**	**26**	**28**	**32**								**51**	**50**	**41**
Alberta														
Campylobacter coli	8 (40.0)	8												
Campylobacter jejuni	12 (60.0)	12												
Total	**20 (100)**	**20**												
Ontario														
Campylobacter coli	14 (25.5)	11	2	1				1	1	1				2
Campylobacter jejuni	32 (58.1)	12	15	5								5	5	20
Campylobacter spp.	9 (16.4)	1	8									8	8	
Total	**55 (100)**	**24**	**25**	**6**				**1**	**1**	**1**		**13**	**13**	**22**
Québec														
Campylobacter coli	9 (16.9)		1	8				8	9	9				
Campylobacter jejuni	44 (83.0)	15	15	14								14	14	29
Total	**53 (100)**	**15**	**16**	**22**				**8**	**9**	**9**		**14**	**14**	**29**
National														
Campylobacter coli	60 (28.0)	21	16	23				9	10	10		23	22	20
Campylobacter jejuni	145 (67.8)	63	45	37								47	47	72
Campylobacter spp.	9 (4.2)	1	8									8	8	
Total	**214 (100)**	**85**	**69**	**60**				**9**	**10**	**10**		**78**	**77**	**92**

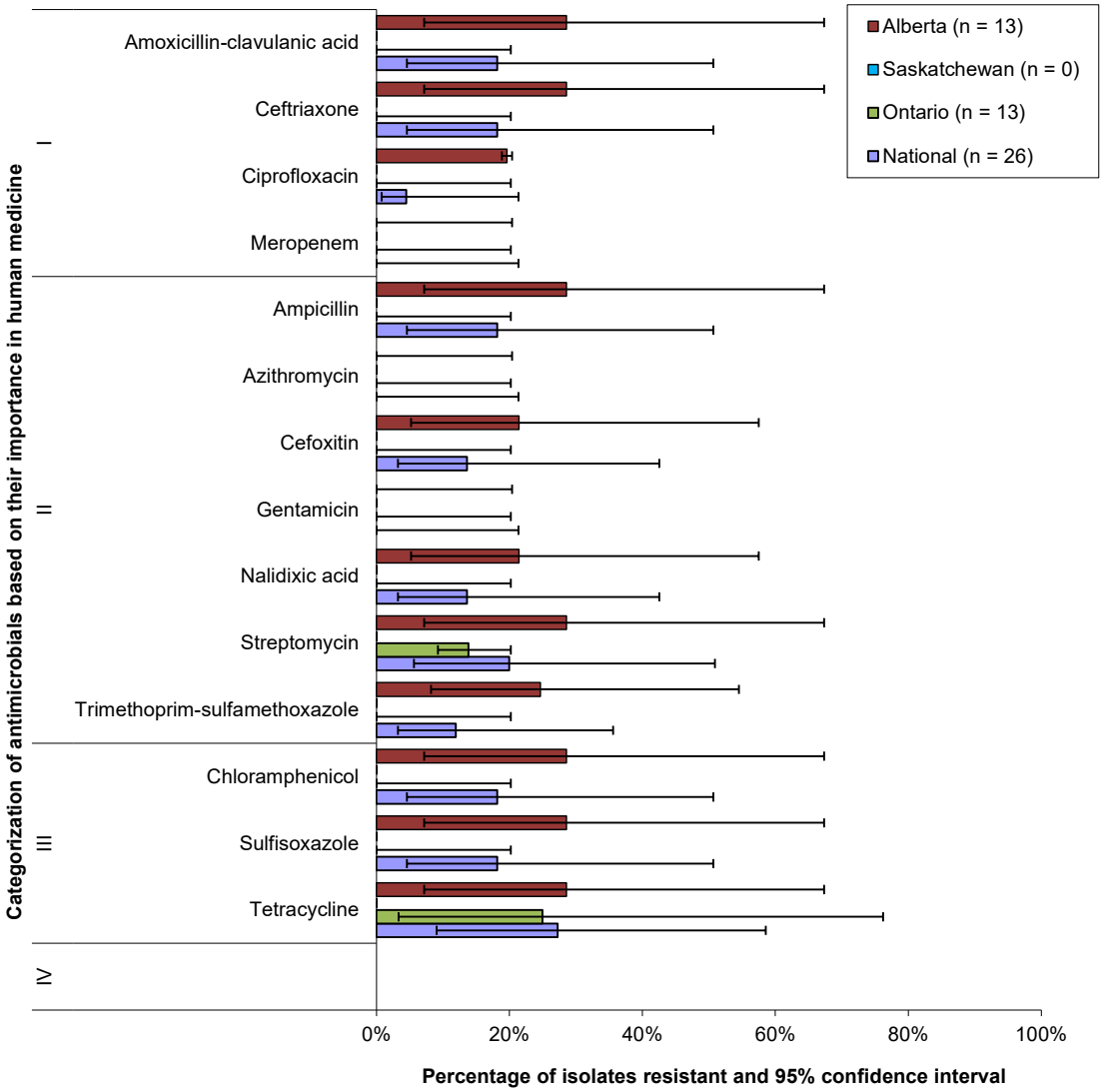
Antimicrobial abbreviations are defined in the Appendix.

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

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

Temporal antimicrobial resistance summary

Figure 3. 26 Resistance of *Salmonella* isolates from feedlot cattle, 2019

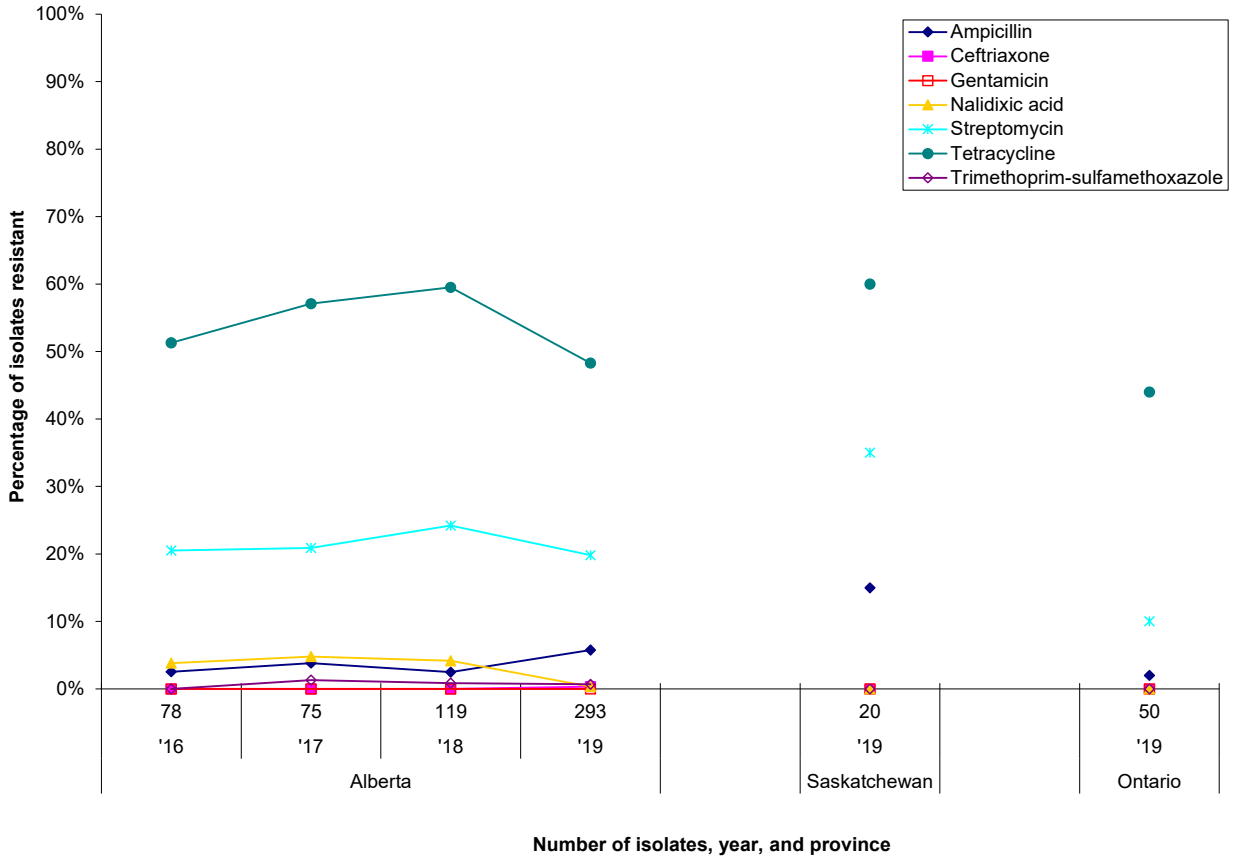


Province/region Number of isolates	Alberta 13	Saskatchewan 0	Ontario 13	National 26
Antimicrobial				
Ampicillin	29%	0%	0%	18%
Ceftriaxone	29%	0%	0%	18%
Gentamicin	0%	0%	0%	0%
Nalidixic acid	21%	0%	0%	14%
Streptomycin	29%	0%	14%	20%
Tetracycline	29%	0%	25%	27%
Trimethoprim-sulfamethoxazole	25%	0%	0%	12%

Twenty samples were collected in Saskatchewan; however, there were 0 isolates recovered.

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per feedlot.

Figure 3. 27 Temporal variations in resistance of *Escherichia coli* isolates from feedlot cattle, 2016 to 2019

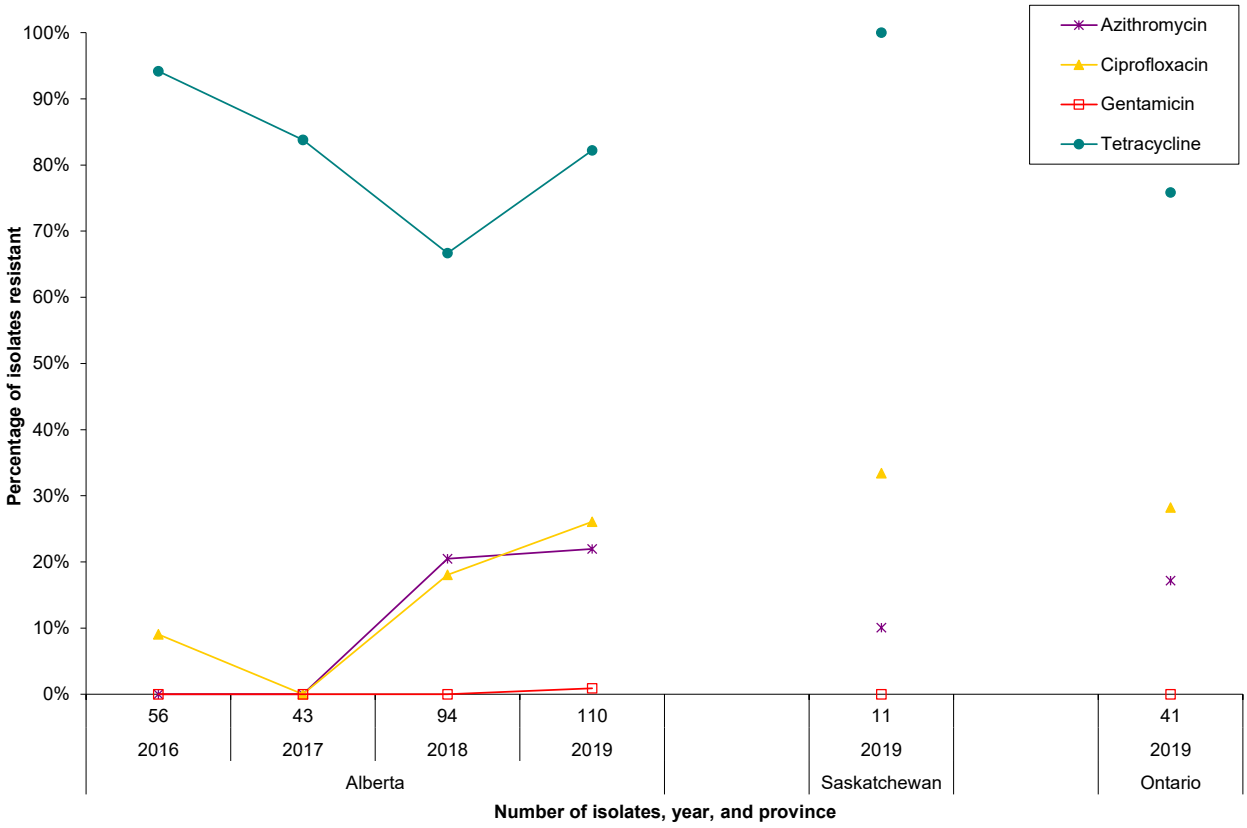


Province/region	Alberta				Saskatchewan	Ontario
Year	2016	2017	2018	2019	2019	2019
Number of isolates	78	75	119	293	20	50
Antimicrobial						
Ampicillin	**3%**	4%	**2%**	**6%**	15%	2%
Ceftriaxone	**0%**	0%	**0%**	**0%**	0%	0%
Gentamicin	**0%**	0%	**0%**	**0%**	0%	0%
Nalidixic acid	**4%**	5%	**4%**	**0%**	0%	0%
Streptomycin	**21%**	21%	**24%**	**20%**	35%	10%
Tetracycline	**51%**	57%	**60%**	**48%**	60%	44%
Trimethoprim-sulfamethoxazole	**0%**	1%	**1%**	**1%**	0%	0%

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per feedlot.

For the temporal analyses by province, 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 year of surveillance and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

Figure 3. 28 Temporal variations in resistance of *Campylobacter* isolates from feedlot cattle, 2016 to 2019

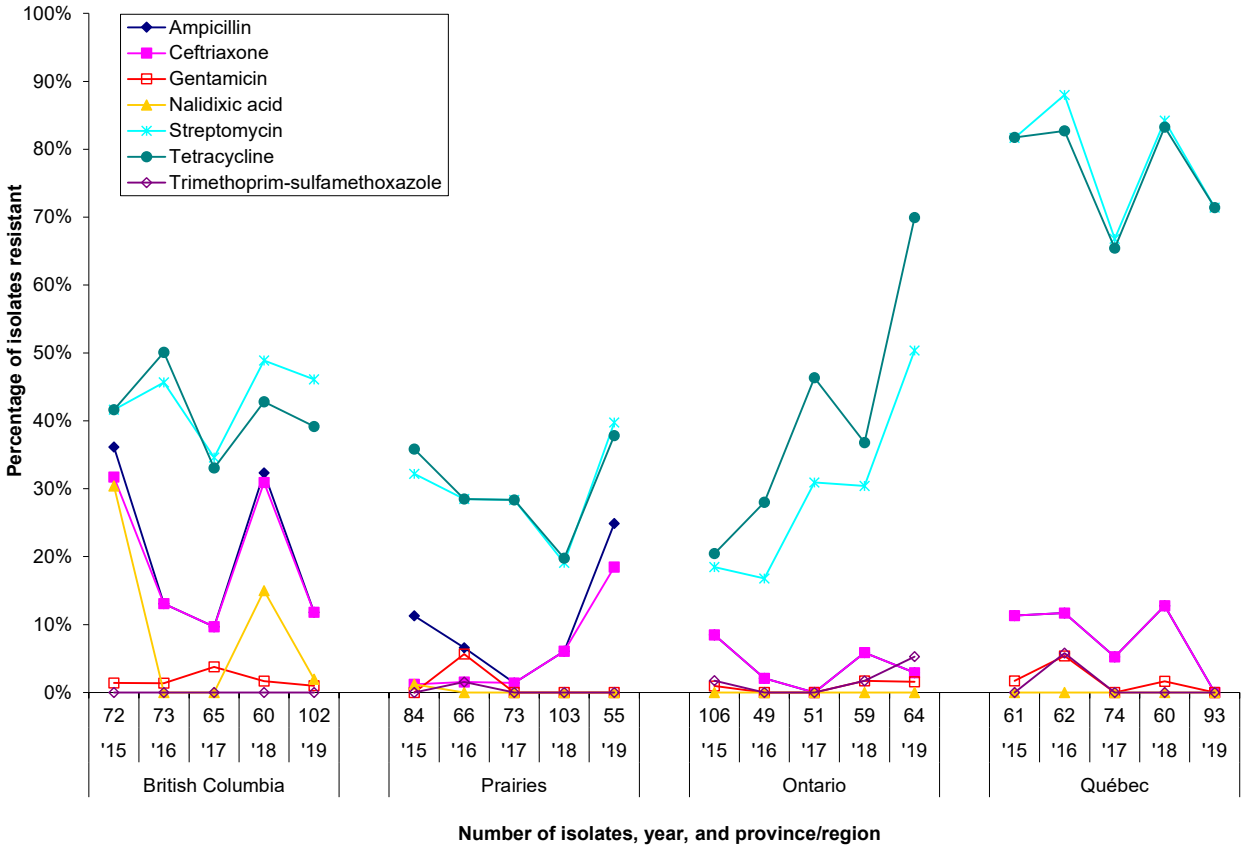


Province / region	Alberta				Saskatchewan	Ontario
Year	2016	2017	2018	2019	2019	2019
Number of isolates	56	43	94	110	11	41
Antimicrobial						
Azithromycin	**0%**	0%	**20%**	**22%**	10%	17%
Ciprofloxacin	**9%**	0%	**18%**	**26%**	33%	28%
Gentamicin	**0%**	0%	**0%**	**1%**	0%	0%
Tetracycline	**94%**	84%	**67%**	**82%**	100%	76%

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per feedlot.

For the temporal analyses by province, 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 year of surveillance and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given antimicrobial.

Figure 3. 29 Temporal variations in resistance of *Salmonella* isolates from chickens at pre-harvest, 2015 to 2019



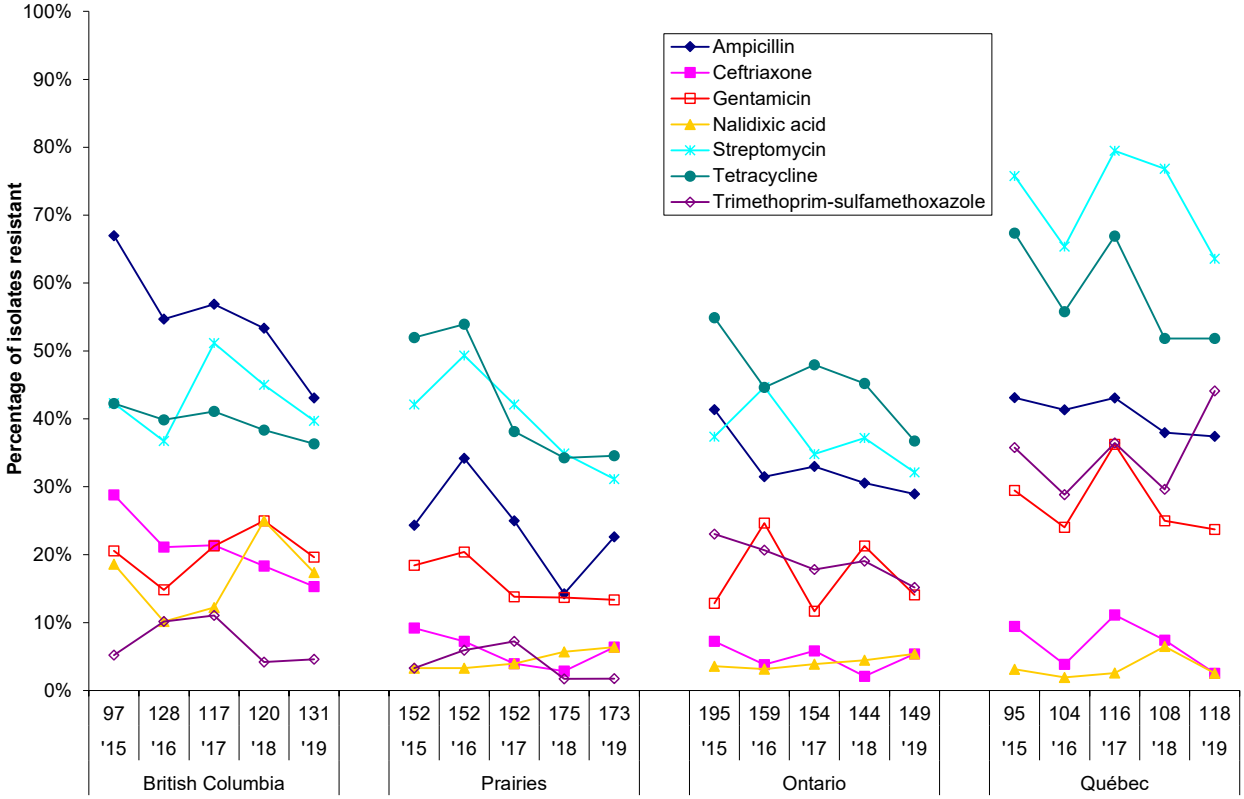
Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of isolates	72	73	65	60	102	84	66	73	103	55	106	49	51	59	64	61	62	74	60	93
Antimicrobial																				
Ampicillin	**36%**	13%	10%	**32%**	**12%**	**11%**	7%	1%	**6%**	**25%**	**8%**	2%	0%	**6%**	**3%**	**11%**	12%	5%	**13%**	**0%**
Ceftriaxone	**32%**	13%	10%	**31%**	**12%**	**1%**	2%	1%	**6%**	**18%**	**8%**	2%	0%	**6%**	**3%**	**11%**	12%	5%	**13%**	**0%**
Gentamicin	**1%**	1%	4%	**2%**	**1%**	**0%**	6%	0%	**0%**	**0%**	**1%**	0%	0%	**2%**	**2%**	**2%**	5%	0%	**2%**	**0%**
Nalidixic acid	**30%**	0%	0%	**15%**	**2%**	**1%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
Streptomycin	**42%**	46%	35%	**49%**	**46%**	**32%**	28%	28%	**19%**	**40%**	**18%**	17%	31%	**30%**	**50%**	**82%**	88%	67%	**84%**	**71%**
Tetracycline	**42%**	50%	33%	**43%**	**39%**	**36%**	28%	28%	**20%**	**38%**	**20%**	28%	46%	**37%**	**70%**	**82%**	83%	65%	**83%**	**71%**
Trimethoprim-sulfamethoxazole	**0%**	0%	0%	**0%**	**0%**	**0%**	2%	0%	**0%**	**0%**	**2%**	0%	0%	**2%**	**5%**	**0%**	6%	0%	**0%**	**0%**

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per flock.

For the temporal analyses within 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 previous 5 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Figure 3. 30 Temporal variations in resistance of *Escherichia coli* isolates from chickens at pre-harvest, 2015 to 2019



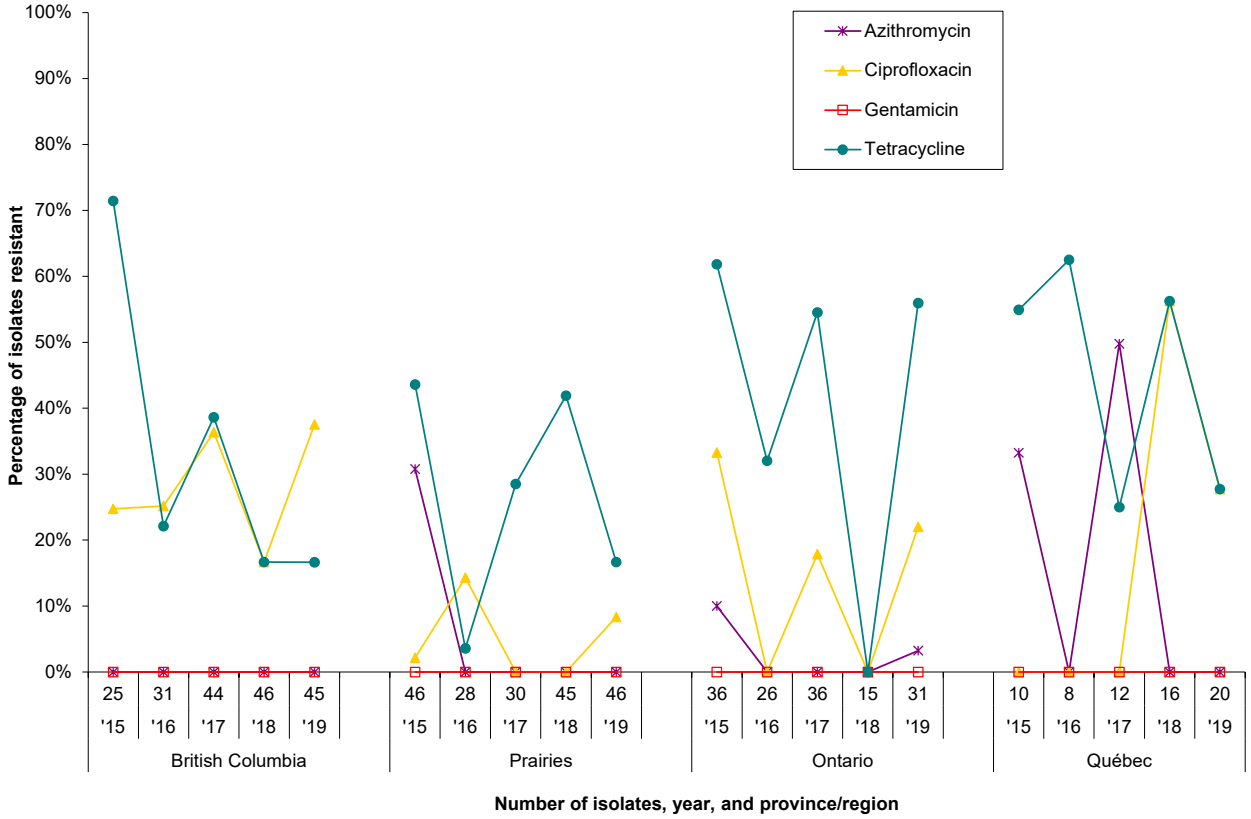
Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of isolates	97	128	117	120	131	152	152	152	175	173	195	159	154	144	149	95	104	116	108	118
Antimicrobial																				
Ampicillin	**67%**	55%	57%	**53%**	**43%**	**24%**	34%	25%	**14%**	**23%**	**41%**	31%	33%	**31%**	**29%**	**43%**	41%	43%	**38%**	**37%**
Ceftriaxone	**29%**	21%	21%	**18%**	**15%**	**9%**	7%	4%	**3%**	**6%**	**7%**	4%	6%	**2%**	**5%**	**9%**	4%	11%	**7%**	**3%**
Gentamicin	**21%**	15%	21%	**25%**	**20%**	**18%**	20%	14%	**14%**	**13%**	**13%**	25%	12%	**21%**	**14%**	**29%**	24%	36%	**25%**	**24%**
Nalidixic acid	**19%**	10%	12%	**25%**	**17%**	**3%**	3%	4%	**6%**	**6%**	**4%**	3%	4%	**4%**	**5%**	**3%**	2%	3%	**6%**	**3%**
Streptomycin	**42%**	37%	51%	**45%**	**40%**	**42%**	49%	42%	**35%**	**31%**	**37%**	45%	35%	**37%**	**32%**	**76%**	65%	79%	**77%**	**64%**
Tetracycline	**42%**	40%	41%	**38%**	**36%**	**52%**	54%	38%	**34%**	**35%**	**55%**	45%	48%	**45%**	**37%**	**67%**	56%	67%	**52%**	**52%**
Trimethoprim-sulfamethoxazole	**5%**	10%	11%	**4%**	**5%**	**3%**	6%	7%	**2%**	**2%**	**23%**	21%	18%	**19%**	**15%**	**36%**	29%	36%	**30%**	**44%**

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per flock.

For the temporal analyses within 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 previous 5 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Figure 3. 31 Temporal variations in resistance of *Campylobacter* isolates from chickens at pre-harvest, 2015 to 2019



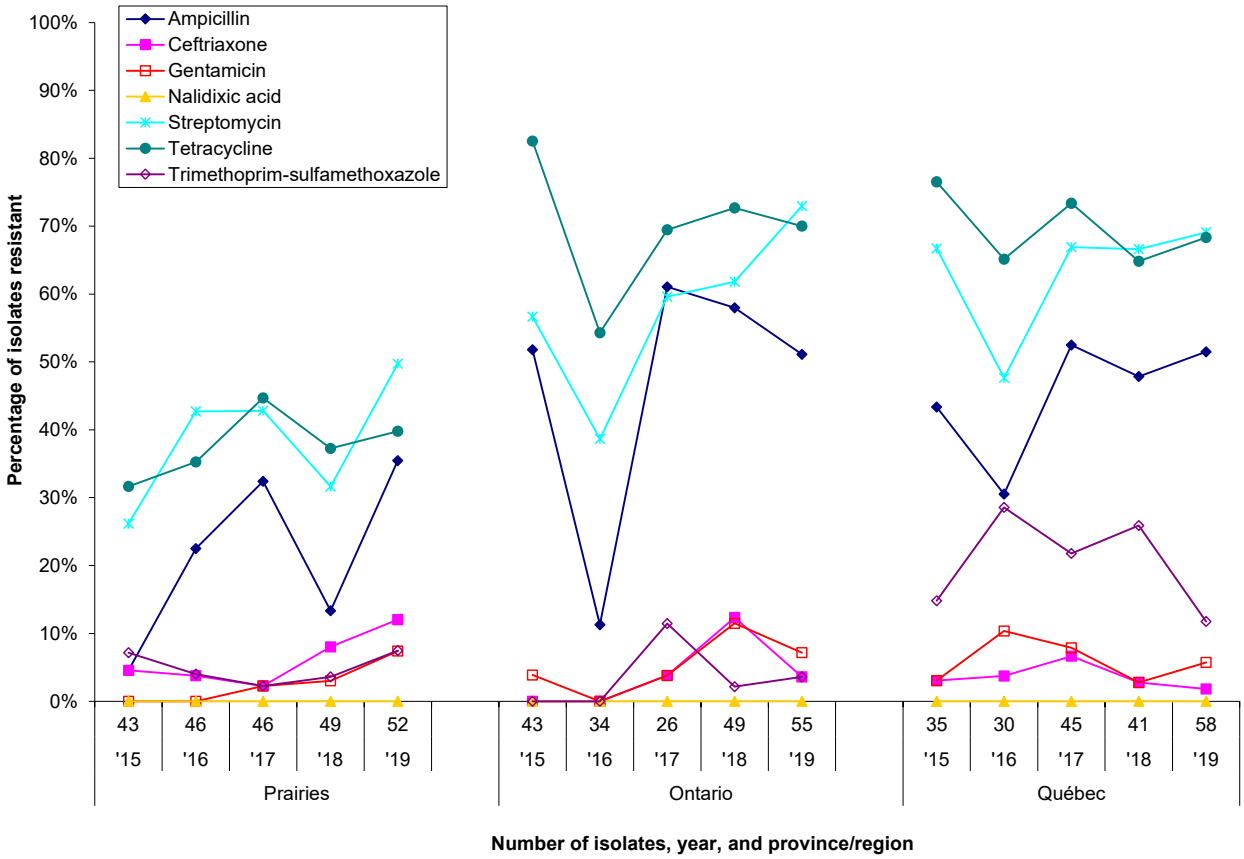
Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of isolates	25	31	44	46	45	46	28	30	45	46	36	26	36	15	31	10	8	12	16	20
Antimicrobial																				
Azithromycin	0%	0%	0%	**0%**	**0%**	**31%**	0%	0%	**0%**	**0%**	**10%**	0%	0%	**0%**	**3%**	**33%**	0%	50%	**0%**	**0%**
Ciprofloxacin	**25%**	25%	36%	**17%**	**38%**	**2%**	14%	0%	**0%**	**8%**	**33%**	0%	18%	**0%**	**22%**	**0%**	0%	0%	**56%**	**28%**
Gentamicin	0%	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
Tetracycline	71%	22%	39%	**17%**	**17%**	**44%**	4%	29%	**42%**	**17%**	**62%**	32%	55%	**0%**	**56%**	**55%**	63%	25%	**56%**	**28%**

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per flock.

For the temporal analyses within 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 previous 5 years and the preceding surveillance year (grey areas). The presence of blue areas indicates significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

The Prairies is a region including the provinces of Alberta and Saskatchewan.

Figure 3. 32 Temporal variations in resistance of *Salmonella* isolates from pigs, 2015 to 2019



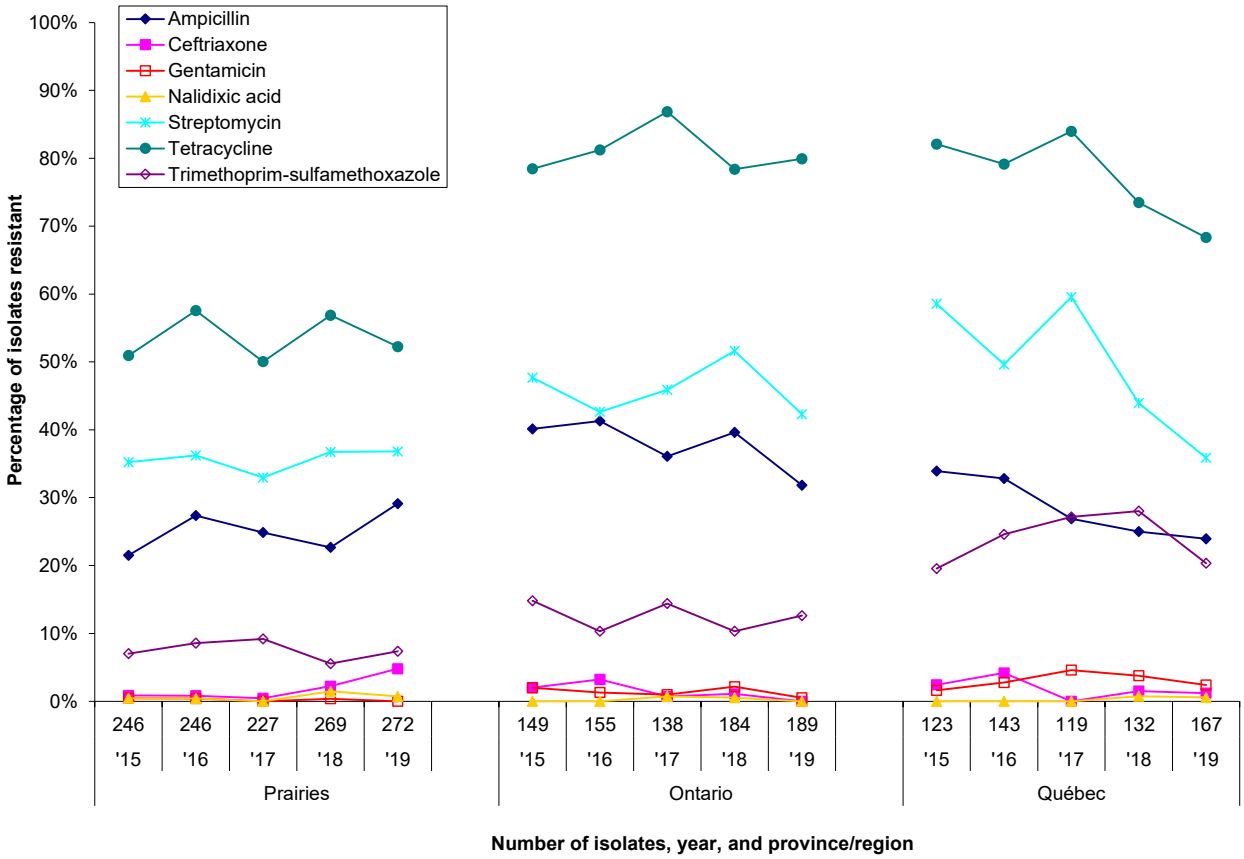
Province/region	Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of isolates	43	46	46	49	52	43	34	26	49	55	35	30	45	41	58
Antimicrobial															
Ampicillin	**5%**	23%	32%	**13%**	**35%**	**52%**	11%	61%	**58%**	**51%**	**43%**	31%	52%	**48%**	**51%**
Cefriaxone	**5%**	4%	2%	**8%**	**12%**	**0%**	0%	4%	**12%**	**4%**	**3%**	4%	7%	**3%**	**2%**
Gentamicin	**0%**	0%	2%	**3%**	**7%**	**4%**	0%	4%	**11%**	**7%**	**3%**	10%	8%	**3%**	**6%**
Nalidixic acid	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**
Streptomycin	**26%**	43%	43%	**32%**	**50%**	**57%**	39%	60%	**62%**	**73%**	**67%**	48%	67%	**67%**	**69%**
Tetracycline	**32%**	35%	45%	**37%**	**40%**	**83%**	54%	69%	**73%**	**70%**	**77%**	65%	73%	**65%**	**68%**
Trimethoprim-sulfamethoxazole	**7%**	4%	2%	**4%**	**7%**	**0%**	0%	11%	**2%**	**4%**	**15%**	29%	22%	**26%**	**12%**

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per herd.

For the temporal analyses within 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 previous 5 years and the preceding surveillance year (grey areas). The presence of blue areas indicate significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 3. 33 Temporal variations in resistance of *Escherichia coli* isolates from pigs, 2015 to 2019



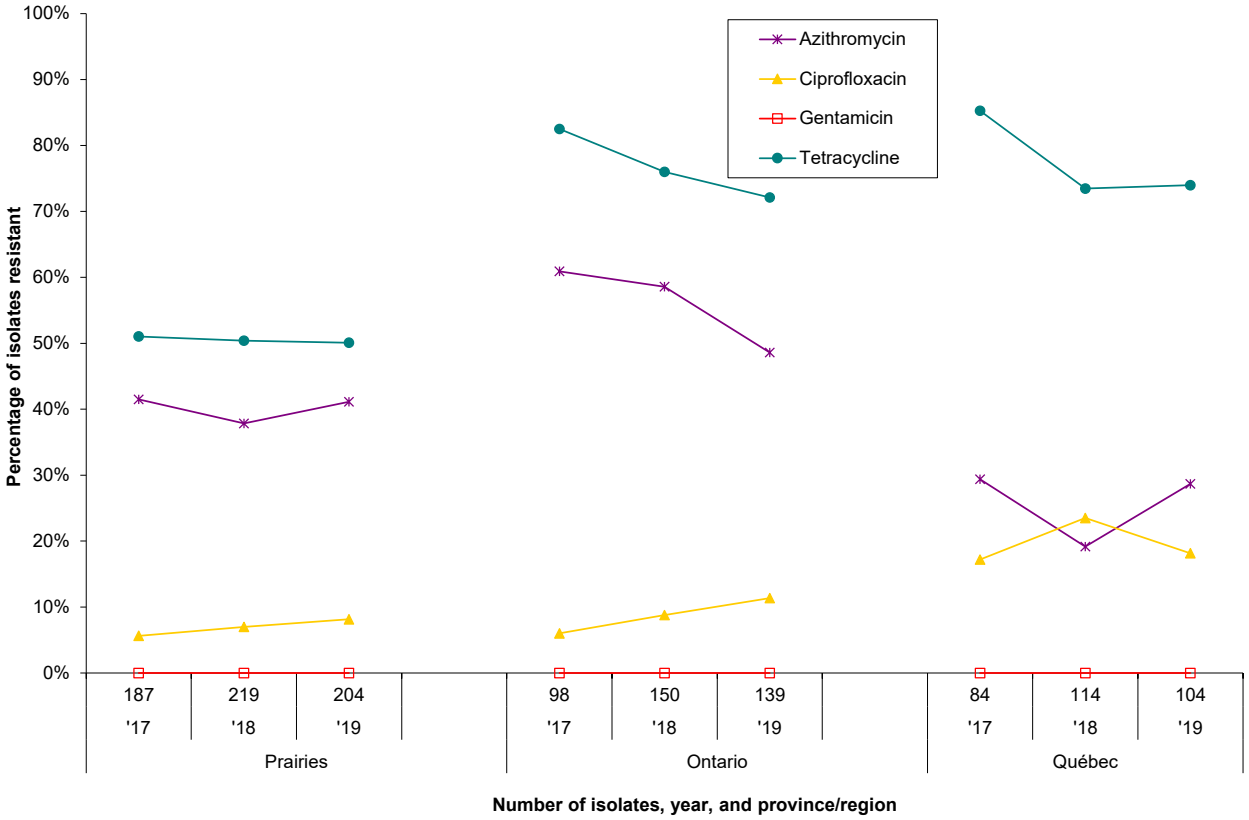
Province/region	Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of isolates	228	246	227	269	272	149	155	138	184	189	123	143	119	132	167
Antimicrobial															
Ampicillin	**22%**	27%	25%	**23%**	**29%**	**40%**	41%	36%	**40%**	**32%**	**34%**	33%	27%	**25%**	**24%**
Cefriaxone	**1%**	1%	0%	**2%**	**5%**	**2%**	3%	1%	**1%**	**0%**	**2%**	4%	0%	**2%**	**1%**
Gentamicin	**0%**	0%	0%	**0%**	**0%**	**2%**	1%	1%	**2%**	**1%**	**2%**	3%	5%	**4%**	**2%**
Nalidixic acid	**0%**	0%	0%	**1%**	**1%**	**0%**	0%	1%	**1%**	**0%**	**0%**	0%	0%	**1%**	**1%**
Streptomycin	**35%**	36%	33%	**37%**	**37%**	**48%**	43%	46%	**52%**	**42%**	**59%**	50%	60%	**44%**	**36%**
Tetracycline	**51%**	58%	50%	**57%**	**52%**	**78%**	81%	87%	**78%**	**80%**	**82%**	79%	84%	**73%**	**68%**
Trimethoprim-sulfamethoxazole	**7%**	9%	9%	**6%**	**7%**	**15%**	10%	14%	**10%**	**13%**	**20%**	25%	27%	**28%**	**20%**

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per herd.

For the temporal analyses within 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 previous 5 years and the preceding surveillance year (grey areas). The presence of blue areas indicate significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 3. 34 Temporal variations in resistance of *Campylobacter* isolates from pigs, 2017 to 2019



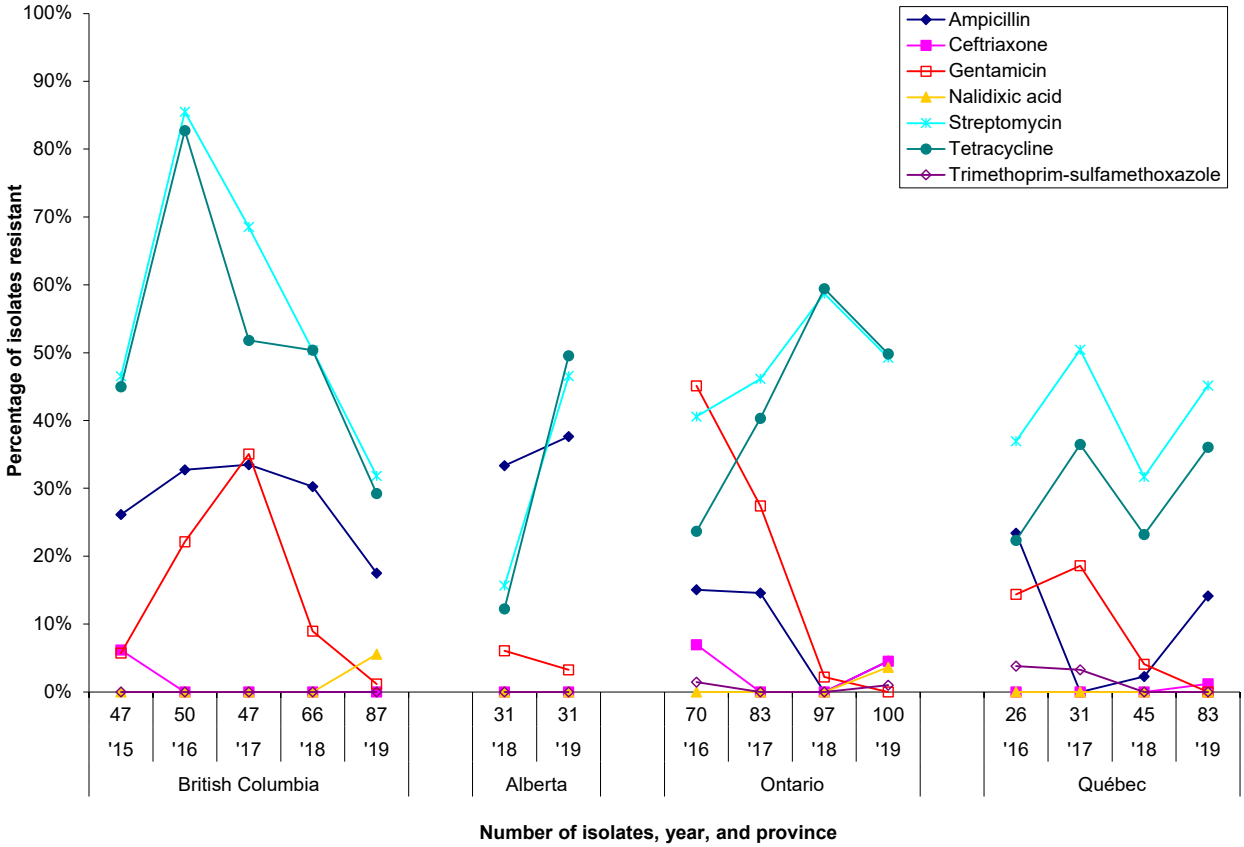
Province/region	Prairies			Ontario			Québec		
Year	'17	'18	'19	'17	'18	'19	'17	'18	'19
Number of isolates	187	219	204	98	150	139	84	114	104
Antimicrobial									
Azithromycin	41%	38%	41%	61%	59%	49%	29%	19%	29%
Ciprofloxacin	6%	7%	8%	6%	9%	11%	17%	24%	18%
Gentamicin	0%	0%	0%	0%	0%	0%	0%	0%	0%
Tetracycline	51%	50%	50%	82%	76%	72%	85%	73%	74%

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per herd.

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 surveillance year and the preceding surveillance year (grey areas). The presence of blue areas indicate significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

The Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Figure 3. 35 Temporal variations in resistance of *Salmonella* isolates from turkeys at pre-harvest, 2015 to 2019

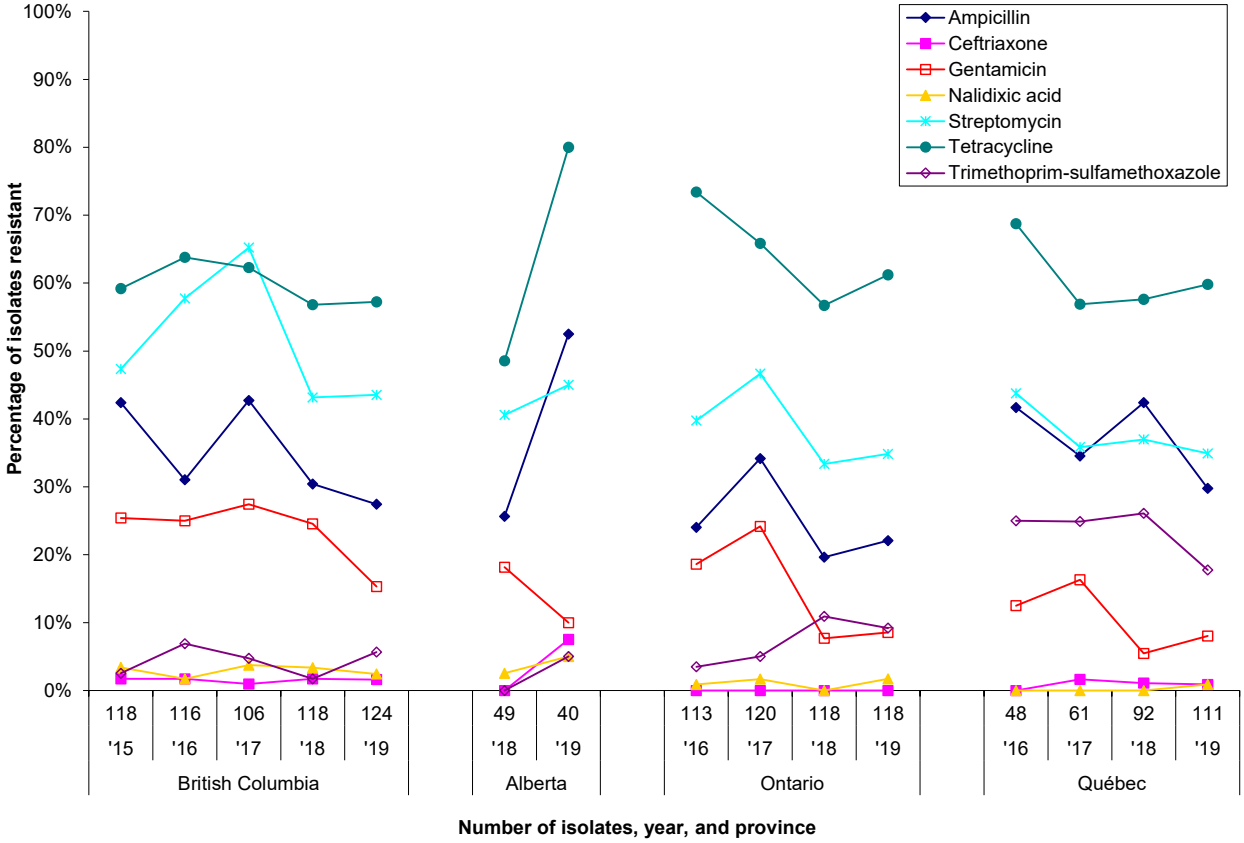


Province	British Columbia					Alberta		Ontario				Québec			
Year	'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of isolates	47	50	47	66	87	31	31	70	83	97	100	26	31	45	'20
Antimicrobial															
Ampicillin	**26%**	33%	33%	**30%**	**17%**	**33%**	**38%**	**15%**	15%	**0%**	**5%**	**23%**	0%	**2%**	**14%**
Ceftriaxone	**6%**	0%	0%	**0%**	**0%**	**0%**	**0%**	**7%**	0%	**0%**	**5%**	**0%**	0%	**0%**	**1%**
Gentamicin	**6%**	22%	35%	**9%**	**1%**	**6%**	**3%**	**45%**	27%	**2%**	**0%**	**14%**	19%	**4%**	**0%**
Nalidixic acid	**0%**	0%	0%	**0%**	**6%**	**0%**	**0%**	**0%**	0%	**0%**	**4%**	**0%**	0%	**0%**	**0%**
Streptomycin	**47%**	86%	69%	**50%**	**32%**	**16%**	**47%**	**41%**	46%	**59%**	**49%**	**37%**	50%	**32%**	**45%**
Tetracycline	**45%**	83%	52%	**50%**	**29%**	**12%**	**50%**	**24%**	40%	**59%**	**50%**	**22%**	36%	**23%**	**36%**
Trimethoprim-sulfamethoxazole	**0%**	0%	0%	**0%**	**0%**	**0%**	**0%**	**1%**	0%	**0%**	**1%**	**4%**	3%	**0%**	**0%**

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per flock.

For the temporal analyses by province, 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 previous 5 years, or the first surveillance year, and the preceding surveillance year (grey areas). The presence of blue areas indicate significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

Figure 3. 36 Temporal variations in resistance of *Escherichia coli* isolates from turkeys at pre-harvest, 2015 to 2019

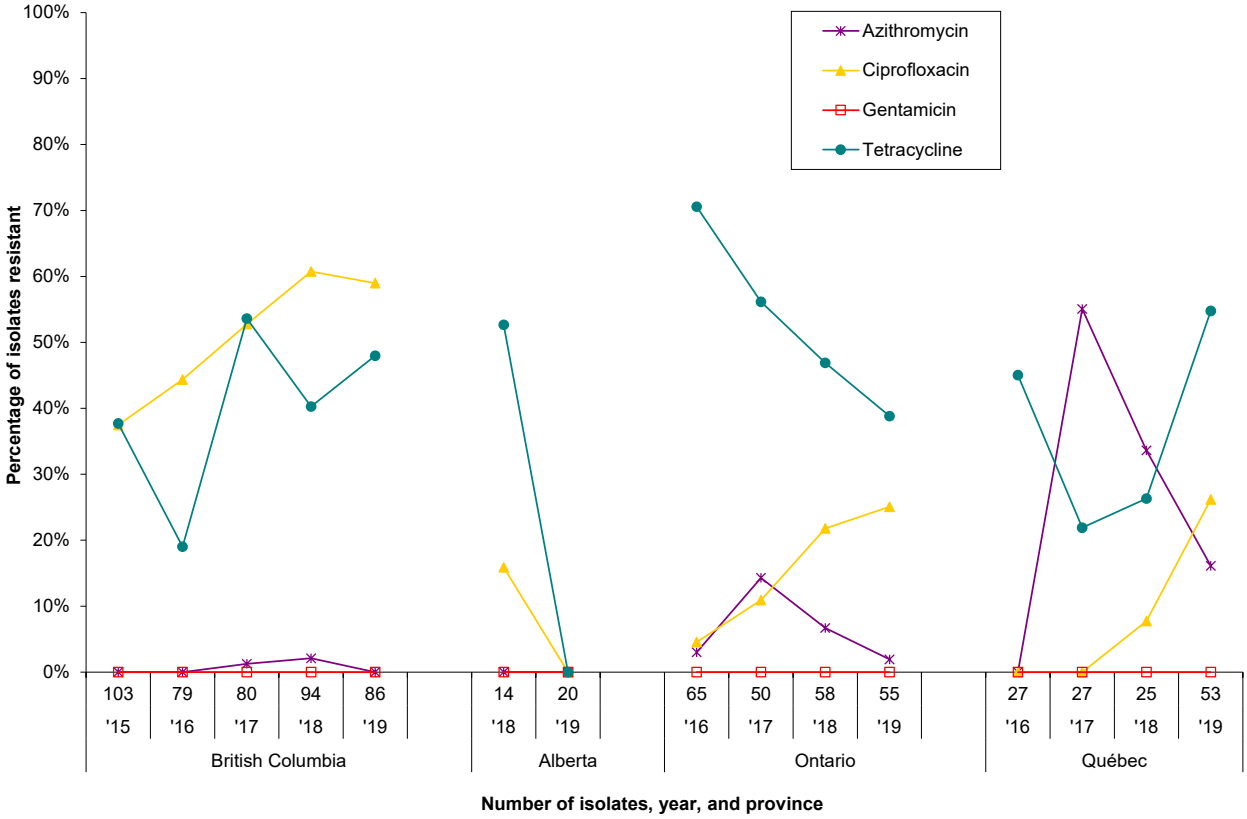


Province	British Columbia					Alberta		Ontario				Québec			
Year	'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of isolates	118	116	106	118	124	49	40	113	120	118	118	48	61	92	111
Antimicrobial															
Ampicillin	**42%**	31%	43%	**30%**	**27%**	**26%**	**52%**	**24%**	34%	**20%**	**22%**	**42%**	35%	**42%**	**30%**
Ceftriaxone	**2%**	2%	1%	**2%**	**2%**	**0%**	**8%**	**0%**	0%	**0%**	**0%**	**0%**	2%	**1%**	**1%**
Gentamicin	**25%**	25%	27%	**25%**	**15%**	**18%**	**10%**	**19%**	24%	**8%**	**9%**	**12%**	16%	**5%**	**8%**
Nalidixic acid	**3%**	2%	4%	**3%**	**2%**	**3%**	**5%**	**1%**	2%	**0%**	**2%**	**0%**	0%	**0%**	**1%**
Streptomycin	**47%**	58%	65%	**43%**	**44%**	**41%**	**45%**	**40%**	47%	**33%**	**35%**	**44%**	36%	**37%**	**35%**
Tetracycline	**59%**	64%	62%	**57%**	**57%**	**49%**	**80%**	**73%**	66%	**57%**	**61%**	**69%**	57%	**58%**	**60%**
Trimethoprim-sulfamethoxazole	**3%**	7%	5%	**2%**	**6%**	**0%**	**5%**	**4%**	5%	**11%**	**9%**	**25%**	25%	**26%**	**18%**

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per flock.

For the temporal analyses by province, 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 previous 5 years, or the first surveillance year, and the preceding surveillance year (grey areas). The presence of blue areas indicate significant differences ($P \leq 0.05$) for a given province/region and antimicrobial.

Figure 3. 37 Temporal variations in resistance of *Campylobacter* isolates from turkeys at pre-harvest, 2015 to 2019



Province	British Columbia					Alberta		Ontario				Québec			
Year	'15	'16	'17	'18	'19	'18	'19	'16	'17	'18	'19	'16	'17	'18	'19
Number of isolates	103	79	80	94	86	14	20	65	50	58	55	27	27	25	53
Antimicrobial															
Azithromycin	**0%**	0%	1%	**2%**	**0%**	**0%**	**0%**	**3%**	14%	**7%**	**2%**	**0%**	55%	**34%**	**16%**
Ciprofloxacin	**37%**	44%	53%	**61%**	**59%**	**16%**	**0%**	**5%**	11%	**22%**	**25%**	**0%**	0%	**8%**	**26%**
Gentamicin	**0%**	0%	0%	**0%**	**0%**	**0%**	**0%**	**0%**	0%	**0%**	**0%**	**0%**	0%	**0%**	**0%**
Tetracycline	**38%**	19%	54%	**40%**	**48%**	**53%**	**0%**	**71%**	56%	**47%**	**39%**	**45%**	22%	**26%**	**55%**

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per flock.

For the temporal analyses by province, 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 previous 5 years, or the first surveillance year, and the preceding surveillance year (grey areas). The presence of blue areas indicate significant differences ($P \leq 0.05$) for a given province and antimicrobial.

Recovery results

Table 3. 31 Farm Surveillance recovery rates in feedlot cattle, 2016 to 2019

Animal species	Province/region	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted							
			Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*	
Feedlot cattle	Alberta	2016	**100%**	78/78	**4%**	3/78	**72%**	56/78		
		2017	**99%**	75/76	**1%**	1/76	**57%**	43/76		
		2018	**97%**	119/123	**2%**	2/123	**76%**	94/123		
		2019	**99%**	293/296	**4%**	13/296	**37%**	110/296		
	Saskatchewan	2019	**100%**	20/20	**0%**	0/20	**55%**	11/20		
	Ontario	2019	**100%**	50/50	**26%**	13/50	**82%**	41/50		
	National	2019	**99%**	363/366	**7%**	26/366	**44%**	162/366		

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 3. 32 Farm Surveillance recovery rates in chickens, 2013 to 2019

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 (Chick placement)	British Columbia	2013	**72%**	43/60	**28%**	17/60				
		2014	**71%**	57/80	**23%**	18/80				
		2015	**74%**	37/50	**16%**	8/50				
		2016	**68%**	58/85	**12%**	10/85				
		2017	**84%**	59/70	**30%**	21/70				
		2018								
		2019								
	Prairies	2013	**89%**	31/35	**29%**	10/35				
		2014	**82%**	46/56	**13%**	7/56				
		2015	**80%**	44/55	**20%**	11/55				
		2016	**73%**	40/55	**15%**	8/55				
		2017	**87%**	48/55	**22%**	12/55				
		2018								
		2019								
	Ontario	2013	**85%**	64/75	**17%**	13/75				
		2014	**87%**	65/75	**3%**	2/75				
		2015	**88%**	66/75	**9%**	7/75				
		2016	**93%**	70/75	**3%**	2/75				
		2017	**87%**	65/75	**8%**	6/75				
		2018								
		2019								
	Québec	2013	**82%**	53/65	**17%**	11/65				
		2014	**83%**	66/80	**11%**	9/80				
		2015	**87%**	39/45	**27%**	12/45				
		2016	**74%**	52/70	**21%**	15/70				
		2017	**76%**	65/85	**18%**	15/85				
		2018								
		2019								
	National	2013	**81%**	191/235	**22%**	51/235				
		2014	**80%**	234/291	**12%**	36/291				
		2015	**83%**	186/225	**17%**	38/225				
		2016	**77%**	220/285	**12%**	35/285				
		2017	**83%**	237/285	**19%**	54/285				
		2018								
		2019								

See corresponding footnotes at the end of the table.

Table 3. 32 Farm Surveillance recovery rates in chickens, 2013 to 2019 (continued)

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	**98%**	94/96	**71%**	68/96	**28%**	27/96		
(Pre-harvest)		2014	**100%**	116/116	**64%**	74/116	**22%**	26/116		
		2015	**97%**	97/100	**72%**	72/100	**25%**	25/100		
		2016	**100%**	128/128	**57%**	73/128	**24%**	31/128		
		2017	**98%**	117/120	**54%**	65/120	**37%**	44/120		
		2018	**100%**	120/120	**50%**	60/120	**38%**	46/120		
		2019	**96%**	131/136	**75%**	102/136	**33%**	45/136		
	Prairies	2013	**100%**	60/60	**40%**	24/60	**25%**	15/60		
		2014	**99%**	147/148	**36%**	54/148	**7%**	11/148		
		2015	**100%**	152/152	**55%**	84/152	**30%**	46/152		
		2016	**100%**	152/152	**43%**	66/152	**18%**	28/152		
		2017	**100%**	152/152	**48%**	73/152	**20%**	30/152		
		2018	**99%**	175/176	**59%**	103/176	**26%**	45/176		
		2019	**98%**	173/176	**31%**	55/176	**26%**	46/176		
	Ontario	2013	**100%**	120/120	**54%**	65/120	**17%**	20/120		
		2014	**99%**	166/168	**25%**	42/168	**21%**	35/168		
		2015	**99%**	195/196	**54%**	106/196	**18%**	36/196		
		2016	**99%**	159/160	**31%**	49/160	**16%**	26/160		
		2017	**99%**	154/156	**33%**	51/156	**23%**	36/156		
		2018	**92%**	144/156	**38%**	59/156	**10%**	15/156		
		2019	**96%**	149/156	**41%**	64/156	**20%**	31/156		
	Québec	2013	**99%**	111/112	**64%**	72/112	**17%**	19/112		
		2014	**100%**	132/132	**60%**	79/132	**16%**	21/132		
		2015	**99%**	95/96	**64%**	61/96	**10%**	10/96		
		2016	**100%**	104/104	**61%**	63/104	**8%**	8/104		
		2017	**97%**	116/120	**62%**	74/120	**10%**	12/120		
		2018	**100%**	108/108	**56%**	60/108	**15%**	16/108		
		2019	**98%**	118/120	**78%**	93/120	**17%**	20/120		
	National	2013	**99%**	385/388	**59%**	229/388	**20%**	81/388		
		2014	**99%**	561/564	**44%**	249/564	**16%**	93/564		
		2015	**99%**	539/544	**59%**	323/544	**22%**	117/544		
		2016	**99%**	543/544	**46%**	251/544	**17%**	93/544		
		2017	**98%**	539/548	**48%**	263/548	**22%**	122/548		
		2018	**98%**	547/560	**50%**	282/560	**22%**	122/560		
		2019	**97%**	571/588	**53%**	314/588	**24%**	142/588		

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 Prairies is a region including the provinces of Alberta and Saskatchewan.

Table 3. 33 Farm Surveillance recovery rates in pigs, 2006 to 2019

Animal species	Province/region	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted							
			Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*	
Pigs	Prairies	2012	**100%**	232/232	**19%**	43/232				
		2013	**98%**	224/228	**14%**	33/228				
		2014	**99%**	248/252	**16%**	40/252				
		2015	**97%**	228/234	**18%**	43/234				
		2016	**98%**	246/252	**18%**	46/252				
		2017	**97%**	227/234	**20%**	46/234	**80%**	187/234		
		2018	**98%**	269/276	**18%**	49/276	**80%**	220/276		
		2019	**96%**	272/282	**18%**	52/282	**72%**	204/282		
	Ontario	2012	**99%**	167/168	**18%**	31/168				
		2013	**100%**	168/168	**26%**	43/168				
		2014	**100%**	162/162	**41%**	67/162				
		2015	**99%**	149/150	**29%**	43/150				
		2016	**99%**	155/156	**22%**	34/156				
		2017	**100%**	138/138	**19%**	26/138	**71%**	98/138		
		2018	**99%**	184/186	**26%**	49/186	**81%**	150/186		
		2019	**99%**	189/191	**29%**	55/191	**73%**	139/191		
	Québec	2012	**100%**	120/120	**16%**	19/120				
		2013	**100%**	138/138	**17%**	23/138				
		2014	**100%**	156/156	**26%**	40/156				
		2015	**98%**	123/126	**28%**	35/126				
		2016	**99%**	143/144	**21%**	30/144				
		2017	**99%**	119/120	**38%**	45/120	**70%**	84/120		
		2018	**100%**	132/132	**31%**	41/132	**86%**	114/132		
		2019	**99%**	167/168	**35%**	58/168	**62%**	104/168		
	National	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				
		2014	**99%**	566/570	**26%**	147/570				
		2015	**98%**	500/510	**24%**	121/510				
		2016	**99%**	544/552	**20%**	110/552				
		2017	**98%**	484/492	**24%**	117/492	**75%**	369/492		
		2018	**99%**	585/594	**23%**	139/594	**82%**	484/594		
		2019	**98%**	628/641	**26%**	165/641	**70%**	447/641		

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 Prairies is a region including the provinces of Alberta, Saskatchewan, and Manitoba.

Table 3. 34 Farm Surveillance recovery rates in turkeys, 2016 to 2019

Animal species	Province	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted						
			Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*
Turkeys	British Columbia	2016	**100%**	116/116	**43%**	50/116	**68%**	79/116	
		2017	**98%**	106/108	**44%**	47/108	**75%**	80/108	
		2018	**99%**	118/119	**55%**	66/119	**79%**	94/119	
		2019	**100%**	124/124	**70%**	87/124	**70%**	87/124	
	Alberta	2018	**98%**	39/40	**78%**	31/40	**35%**	14/40	
		2019	**100%**	40/40	**78%**	31/40	**50%**	20/40	
	Ontario	2016	**97%**	113/116	**60%**	70/116	**56%**	65/116	
		2017	**100%**	120/120	**69%**	83/120	**42%**	50/120	
		2018	**98%**	118/120	**81%**	97/120	**48%**	58/120	
		2019	**98%**	118/120	**83%**	100/120	**46%**	55/120	
	Québec	2016	**100%**	48/48	**54%**	26/48	**56%**	27/48	
		2017	**95%**	61/64	**48%**	31/64	**42%**	27/64	
		2018	**100%**	92/92	**49%**	45/92	**27%**	25/92	
		2019	**97%**	111/115	**72%**	83/115	**46%**	53/115	
	National	2016	**99%**	277/280	**52%**	146/280	**61%**	171/280	
		2017	**98%**	287/292	**55%**	161/292	**54%**	157/292	
		2018	**99%**	367/371	**64%**	239/371	**51%**	191/371	
		2019	**98%**	393/399	**75%**	301/399	**54%**	215/399	

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

Multiclass resistance

Table 3. 35 Number of antimicrobial classes in resistance patterns of *Salmonella* from cattle, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Dublin	56 (50.0)	1			27	28	2	54	50	50	49	46		55	3		54	2	32	54
Typhimurium	25 (22.3)	9	2	4	10			13	12	2	2	2		14	8		9			11
4,[5],12:i:-	9 (8.0)	4			4	1	3	5	5		1			5	4	1	4	1		5
Montevideo	3 (2.7)	3																		
Uganda	3 (2.7)	2		1				1						1						1
Less common serovars	16 (14.3)	11		2	2	1		4	4	1	1	1		3	2	1	1	1	1	5
Total	**112 (100)**	**30**	**2**	**7**	**43**	**30**	**5**	**77**	**71**	**53**	**53**	**49**		**78**	**17**	**2**	**68**	**4**	**33**	**76**

Antimicrobial abbreviations are defined in the Appendix.

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

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

Table 3. 36 Number of antimicrobial classes in resistance patterns of *Salmonella* from chickens, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Enteritidis	136 (52.3)	128	8																8	
Kentucky	26 (10.0)	1	1	24				24	8	8	8	8								25
Typhimurium	21 (8.1)	16	4	1				4						1						1
Montevideo	12 (4.6)	11	1						1	1	1	1								
Infantis	11 (4.2)	10			1			1						1	1				1	1
Heidelberg	9 (3.5)	7	1	1			1	1	1	1	1	1		1						
4,[5],12:i:-	7 (2.7)	4	3					3												
Less common serovars	38 (14.6)	18	7	12	1		5	18	3	1	1	1		12	3		1			9
Total	**260 (100)**	**195**	**25**	**38**	**2**		**6**	**51**	**13**	**11**	**11**	**11**		**15**	**4**		**1**		**9**	**36**

Antimicrobial abbreviations are defined in the Appendix.

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

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

Table 3. 37 Number of antimicrobial classes in resistance patterns of *Salmonella* from pigs, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Typhimurium	135 (30.3)	19	3	13	96	4	14	97	103	5	2	3		113	45	7	98			109
4,[5],12:i:-	111 (24.9)	2	1	10	96	2	13	104	104	12	15	12		108	12	3	23	1		103
Derby	56 (12.6)	12	5	31	8			40	8					39						43
Infantis	19 (4.3)	17			2			1	1	1	1	1		2	2	1	2			2
Brandenburg	16 (3.6)	9	4	1	2		2	3	1	1	1	1		3	2	1	1			7
Agona	12 (2.7)	8		1	2	1	1	4	4	4	3	4		2	1		2	1	2	4
Mbandaka	12 (2.7)		1	6	5		4	11	5	5	5	5		11	4		3			12
Ohio	10 (2.2)	4			3	3	3	5	5	4	4	4		6	4	4	6			6
Less common serovars	74 (16.6)	21	6	25	21	1	7	38	26	9	9	9		45	23	4	15			39
Total	**445 (100)**	**92**	**20**	**87**	**235**	**11**	**44**	**303**	**257**	**41**	**40**	**39**		**329**	**93**	**20**	**150**	**2**	**2**	**325**

Antimicrobial abbreviations are defined in the Appendix.

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

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

Table 3. 38 Number of antimicrobial classes in resistance patterns of *Salmonella* from horses, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Thompson	2 (25.0)	2																		
Typhimurium	2 (25.0)	2																		
Anatum	1 (12.5)		1					1												
4,[5],12:i:-	1 (12.5)				1			1	1					1						1
Infantis	1 (12.5)	1																		
Rubislaw	1 (12.5)	1																		
Total	**8 (100)**	**6**	**1**		**1**			**2**	**1**					**1**						**1**

Antimicrobial abbreviations are defined in the Appendix.

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

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

Table 3. 39 Number of antimicrobial classes in resistance patterns of *Salmonella* from turkeys, 2019

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	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Uganda	28 (19.7)	10		17	1			18	1					18						18
Reading	12 (8.5)	6	2	3	1			4	3					4						4
Bredeney	10 (7.0)		4	6			10	6	3	3	3	3		3						3
Muenchen	10 (7.0)	8		2				2						2						2
Schwarzengrund	10 (7.0)	9		1			1	1	1	1	1	1		1						
Hadar	8 (5.6)	1		7				7	1											7
Mbandaka	7 (4.9)	4		3				3						3	1					2
Anatum	6 (4.2)		1	5			2	5	4											6
Heidelberg	6 (4.2)	2		4			4	4						4						
4,[5],12:i:-	5 (3.5)	5																		
Senftenberg	5 (3.5)	3		2				1	1					1						2
Enteritidis	4 (2.8)	4																		
Infantis	4 (2.8)	3				1		1	1		1			1	1		1		1	1
Ouakam	4 (2.8)		4				2	3												1
Typhimurium	4 (2.8)	3	1					1												
Worthington	4 (2.8)		1	3			1	3						2						4
Agona	3 (2.1)	1	1		1			2	1	1	1	1		1			1			1
Less common serovars	12 (8.5)	7	2	2	1			4						3	1		1			4
Total	**142 (100)**	**66**	**16**	**55**	**4**	**1**	**20**	**65**	**16**	**5**	**6**	**5**		**43**	**3**		**3**		**1**	**55**

Antimicrobial abbreviations are defined in the Appendix.

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

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

Appendix

Abbreviations

Canadian provinces, territories, and regions

Provinces

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

Territories

YT Yukon
NT Northwest Territories
NU Nunavut

Regions[6]

Prairies: AB, SK, MB
Maritimes: NB, NS, PE
Atlantic[7]: NB, NS, PE, NL

Antimicrobials

AMC Amoxicillin-clavulanic acid
AMP Ampicillin
AZM Azithromycin
CHL Chloramphenicol
CIP Ciprofloxacin
CLI Clindamycin
CRO Ceftriaxone
ERY Erythromycin
FLR Florfenicol
FOX Cefoxitin
GEN Gentamicin
MEM Meropenem
NAL Nalidixic acid
SSS Sulfisoxazole
STR Streptomycin
SXT Trimethoprim-sulfamethoxazole
TET Tetracycline

[6] In 2019, not all provinces are represented in each surveillance component for the Prairies and the Atlantic region.
[7] In 2019, no sampling occurred in the Atlantic region.

Other abbreviations

APP *Actinobacillus pleuropneumoniae*

PCVAD Porcine Circovirus Associated Disease

PED Porcine Epidemic Diarrhea

PRRS Porcine Reproductive and Respiratory Syndrome

TGE Transmissible gastroenteritis

VDD Veterinary Drugs Directorate, Health Canada