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2019

CIPARS

Canadian Integrated Program for Antimicrobial Resistance Surveillance

Broiler Chickens

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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Broiler Chickens

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- Alberta Chicken Producers
- British Columbia Chicken Marketing Board
- Canadian Hatcheries Federation
- Canadian Poultry and Egg Processors Council
- Chicken Farmers of Canada
- Chicken Farmers of Ontario
- CIPARS Farm Broiler Chicken Industry Antimicrobial Use/Resistance Working Group
- Les Éleveurs de volailles du Québec
- Saskatchewan Agriculture

Chapter 1 Animal Health Status and Farm Information

The data presented in this section pertains to pertinent farm-level animal health status and CIPARS sentinel farm information for broiler chickens. These are relevant to antimicrobial use and antimicrobial resistance.

Key findings

Mortality, barn-level percentages by production type

- The median barn-level mortality in the broiler flocks surveyed was similar to 2018 (n = 147 flocks; 4% median; range: 1 to 14%). The percentage of barn mortality varied by production type:
    - Antibiotic free or raised without antimicrobials-mainstream programs (ABF/RWA)[1] (n = 16; 5%; 2 to 8%).
    - Conventional (n = 117; 4%; 0.4 to 13%).
    - Other categories such as flocks raised according to CFIA's updated methods of production claim definitions for RWA/ABF[2] (n = 14; 5%; 2 to 4%).

Chick sources

- Overall, the total number of chicks placed in the sampling unit (barn/floor/pen sampled for microbiological testing) in 2019 comprised of 90% domestic, 9% imported and 1% from other provinces (Figure 1. 1). There were provincial/regional variations in chick origin (sourced domestically, other provinces and internationally) (Figure 1. 2).

Diagnosis of disease in broiler flocks[3]

- The diagnosis of APEC (avian pathogenic *Escherichia coli)* associated diseases increased between 2018 and 2019: airsacculitis/respiratory diseases increased from 6% to 11%, yolksaccultis from 23% to 29%, and septicemia from 14% to 21%. The increase was noted in 3 provinces (British Columbia, Ontario, and Québec).
- Between 2018 and 2019, the diagnosis of necrotic enteritis decreased from 8% to 5% while the diagnosis of coccidiosis increased from 13% to 16% (Figure 1. 3).
- The diagnoses of viral diseases remained relatively stable except in Québec where there is a great deal of variation (Figure 1. 4).

Biosecurity

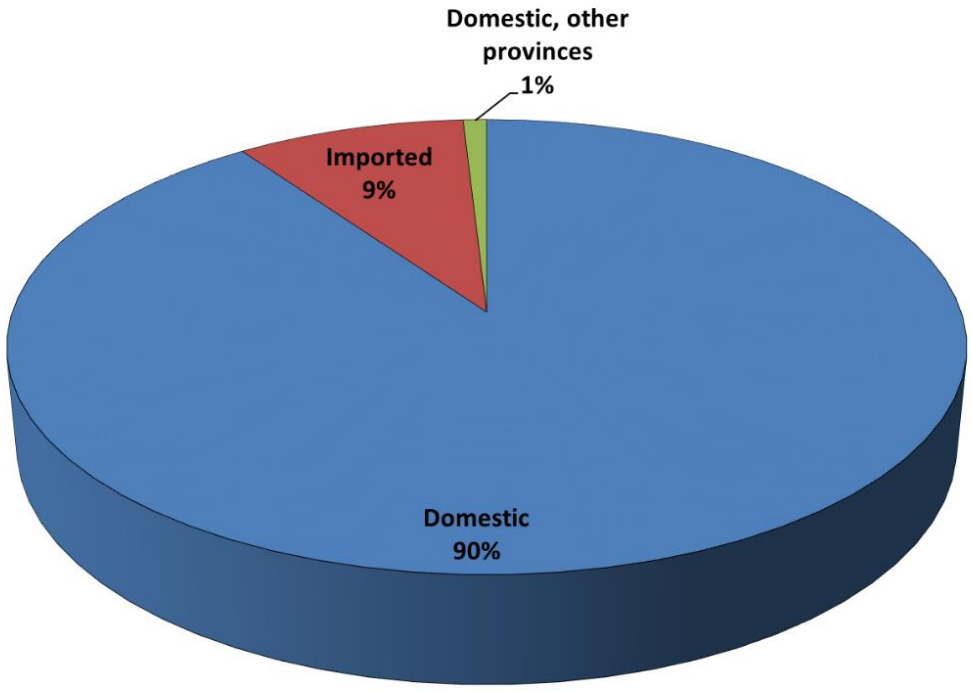
- As for biosecurity practices, downtime and rest period documented was 15 days mean (range: 0 to 42 days).

[1] Not treated with any antimicrobials including ionophores and chemical coccidiostats.
[2] CFIA. Chapter Method of Production Claims. Method of Production Claims for Meat, Poultry and Fish Products. Available at: http://inspection.gc.ca/food/labelling/food-labelling-for-industry/method-of-production-claims/eng/1389379565794/1389380926083?chap=7. Accessed June 2019.
[3] Please note that all reported diseases were included in the analysis regardless of the diagnostic tool used (any or all of clinical, post mortem and laboratory testing).

Vaccinations

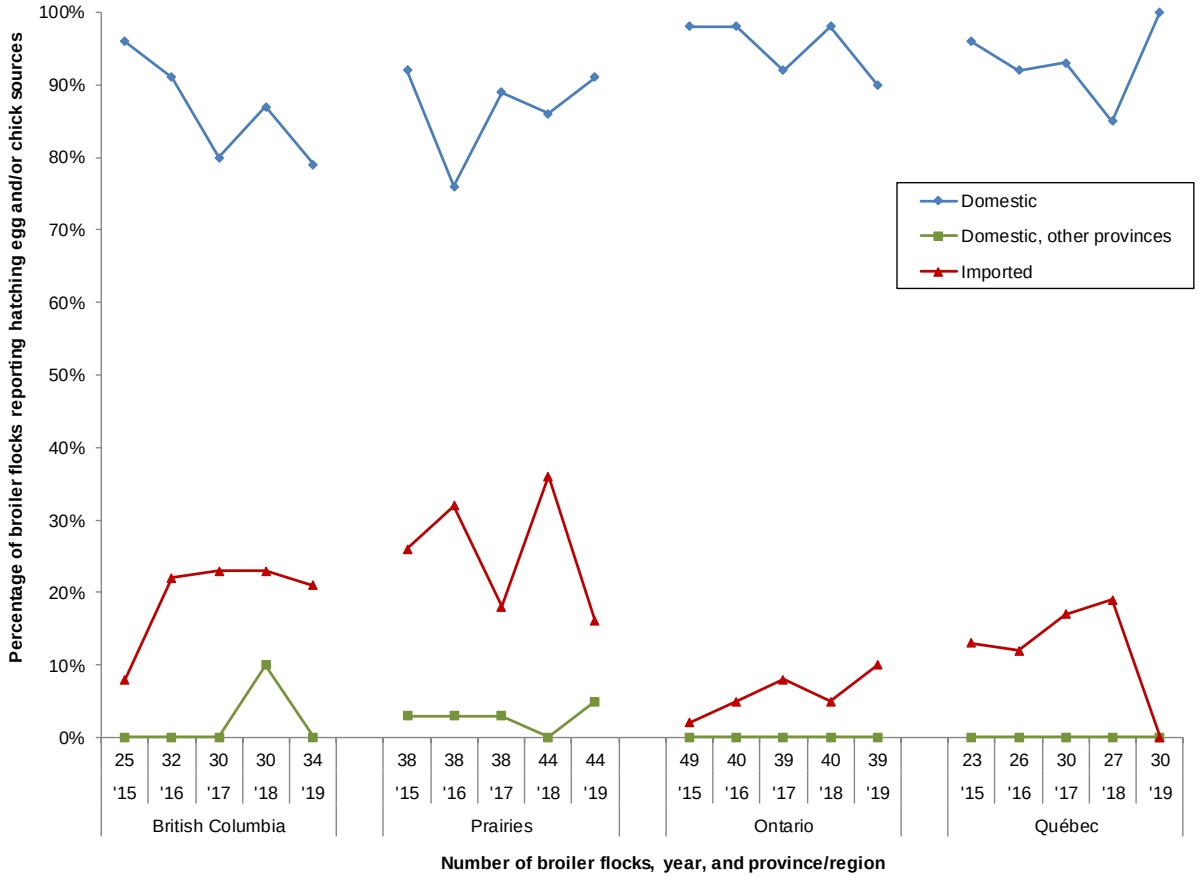
- Routine vaccination of broilers at the hatchery (93% of flocks) and on-farm (36% of flocks) against common viral, bacterial and protozoal pathogens affecting broilers in Canada were practiced by the participating producers to manage flock health. Notably, coccidiosis vaccination decreased (combined hatchery and on-farm application) from 18% in 2018 to 12% in 2019.

Figure 1. 1 Relative distribution of chick sources, 2019



Domestic chicks = 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.

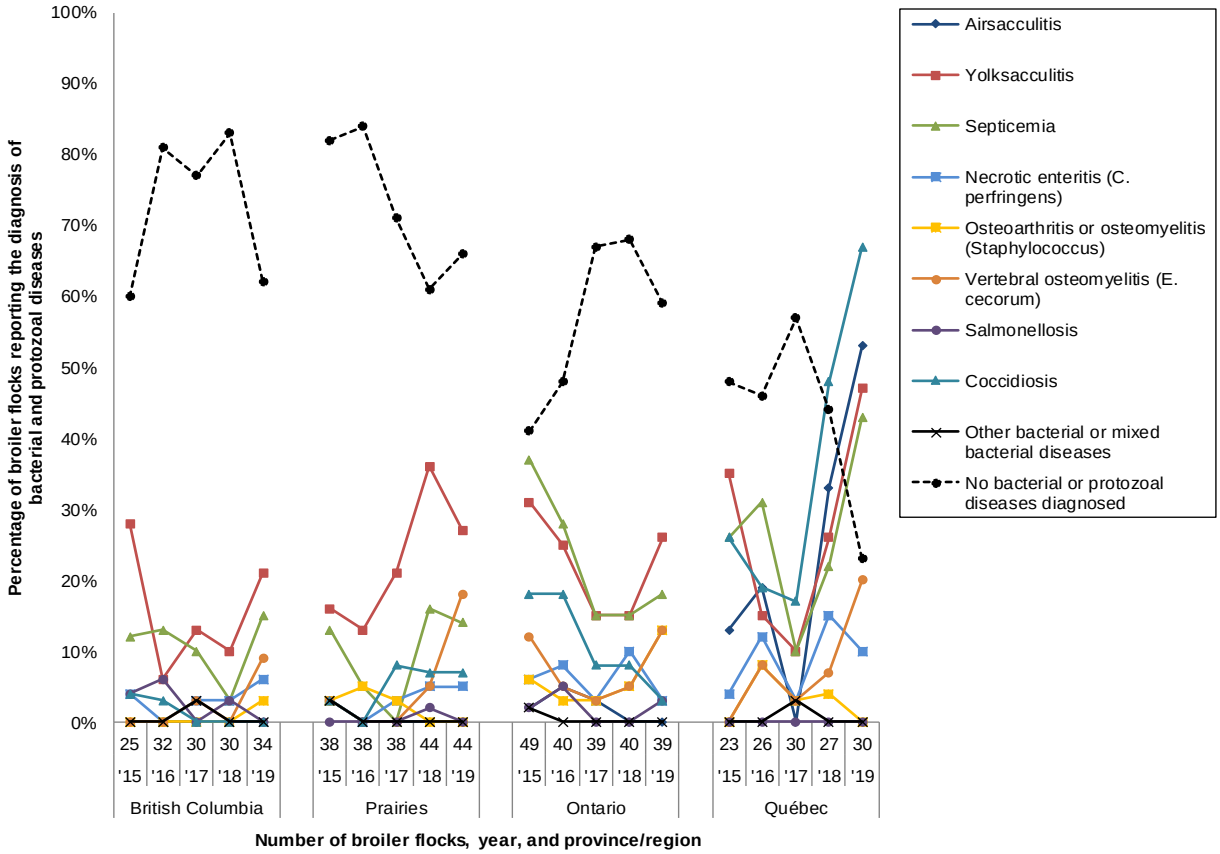
Figure 1. 2 Sources of hatching eggs and/or chicks placed in the barn sampled, 2015 to 2019



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 chicks = 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.

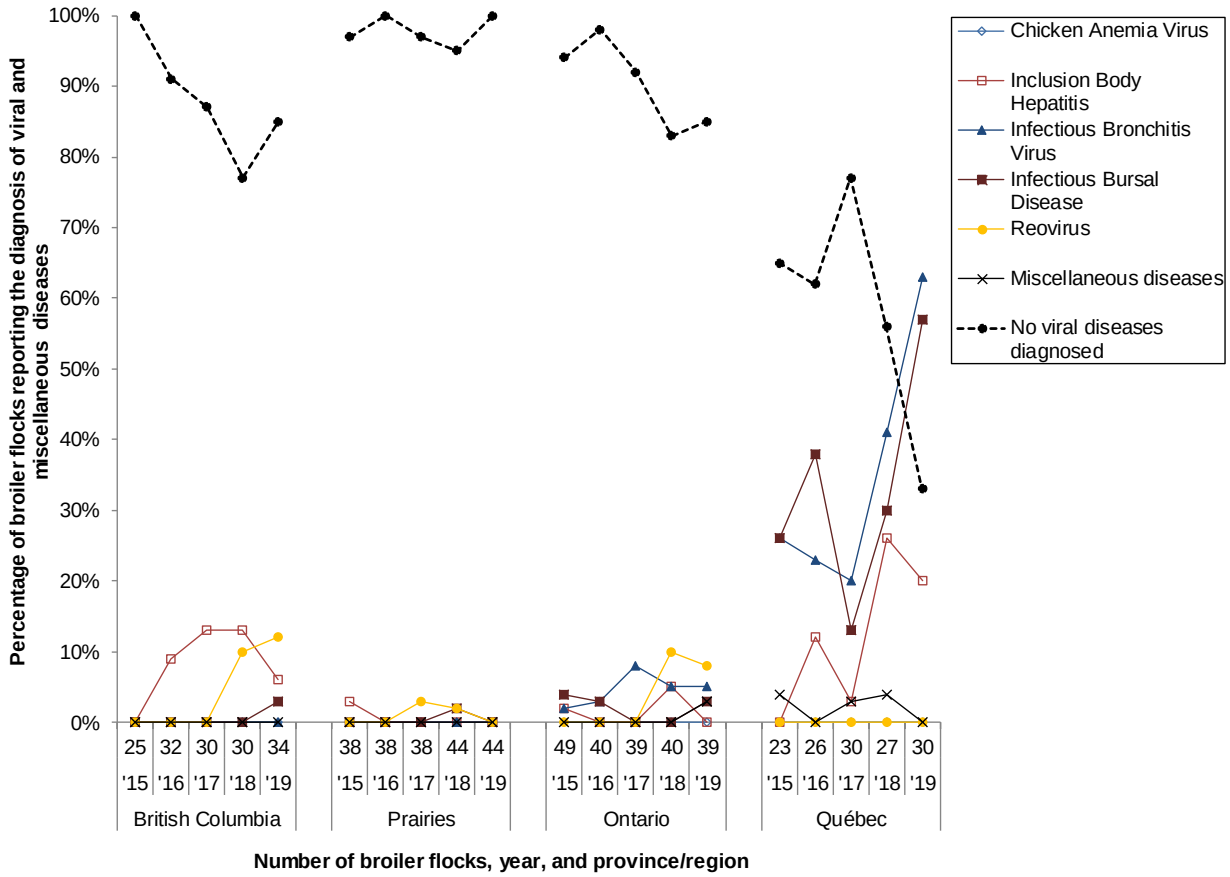
Figure 1. 3 Percentage of broiler flocks reporting the diagnosis of bacterial and protozoal diseases, 2015 to 2019



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, 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.

Chapter 2 Antimicrobial Use

DATA CORRECTIONS IN THE 2019 REPORT: Please note that quantitative estimates presented in the tables and figures slightly varied from previous reports due to further validations of our data with the veterinarians on dose/inclusion rates of antimicrobial active ingredients and corrections to flock inventories (birds at risk) and pre-harvest sampling age (days at risk). It is also important to note that in preparation for our interactive data display and for consistency and harmonization with our antimicrobial resistance data, 10 flocks with partial data (has chick placement but no pre-harvest data) sampled between 2013 and 2017 were excluded from the analysis. The changes in quantity of use have not impacted the national and regional temporal variations.

Key findings

- There were 11 antimicrobial active ingredients (AAIs) used in 2019, down from 17 AAIs in 2018.
- The quantity of antimicrobials increased substantially between 2018 and 2019 by 15% in terms of mg/PCU (Figure 2. 1 and Textbox 2. 1). Regionally, mg/PCU increased in Ontario and Québec by 46% and 17%, respectively while it decreased by 6% and 2% in British Columbia and the Prairies, respectively (Table 2. 3).
- nDDDvetCA/1,000 broiler chicken-days at risk decreased between 2018 and 2019 by 8% (Figure 2. 3 and Textbox 2. 1). Regionally, this indicator increased by 12% and 2% in Ontario and Québec, respectively, while it substantially decreased in British Columbia by 39% and decreased in the Prairies by 8% (Table 2. 3).
- Feed was still the major route for the delivery of antimicrobials. In 2019, 86% of the antimicrobials were delivered through feed which decreased from 95% in 2018. The proportion of antimicrobials administered via water increased (14%) from 2018 (5%). A small proportion was administered via injection (0.01%, 3 flocks).
- Overall, the frequency and quantity of Veterinary Drugs Directorate's (VDD) Category II antimicrobials decreased in 2019. The VDD Category II used in 2019 comprised of classes administered via feed such as streptogramins (1 mg/PCU) and trimethoprim-sulfonamides (16 mg/PCU), and those administered via water such as penicillins (18 mg/PCU), aminoglycosides (1 mg/PCU), and tetracyclines (less than 1 mg/PCU). Except for streptogramins, all VDD Category II antimicrobials used in feed and water were for disease treatment.
- VDD's Category III antimicrobial, bacitracins, significantly increased in terms of frequency (48% to 61%) and quantity (65 to 98 mg/PCU, 52% change) between 2018 and 2019. This class was used for disease prevention (necrotic enteritis).

- Avilamycin, an orthosomycin was another antimicrobial (uncategorized medically-important antimicrobial[4]) used for disease prevention (necrotic enteritis) with minimal increase in frequency (15% to 20%) and quantity (6 to 8 mg/PCU) between 2018 and 2019.
- Frequency and quantity of use via injections decreased (3 flocks reporting lincomycin-spectinomycin).
- VDD's Categories II and III classes comprised of 38% of all antimicrobial quantity in milligrams (Figure 2. 16). The remaining 62% comprised of non-medically important antimicrobials belonging to ionophores (43%) and chemical coccidiostats (19%). Temporal trends in coccidiostats used are summarized in Figure 2. 17, Figure 2. 18, and Figure 2. 19.

[4] 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.

Indicators explained

Textbox 2. 1 Weight-based and dose-based indicators explained

The AACTING consortium (https://aacting.org/) defines an indicator as "a metric (e.g., mg active ingredient or total number of defined daily doses) usually expressed in relation to a denominator representing the population (at risk)". This denominator is what we could call ➡ **the "scaling factor".**

Weight-based indicator: the milligrams per population correction unit (mg/PCU) indicator adjusts the milligrams of an active ingredient by the size of flock population multiplied by the average weight at treatment (broiler chicken = 1 kg).

Dose-based indicator: **1)** the milligrams of an active ingredient are adjusted by the defined daily dose (DDD) standard for animals using Canadian standard (DDDvetCA), this is the average daily dose expressed in milligrams per kilogram broiler chicken per day (mg/kg/day). **2)** the number of DDDvetCA (nDDDvetCA) is adjusted by the population size, standard or average weight (1 kg), and days at risk (this is the length of the cycle, meaning that each day during the growing period, the birds are at risk of being treated). The final step multiplies the value by 1,000*.

Example (with actual values):

In 2018, flock **A** in barn **A** was treated with **virginiamycin** (active ingredient) in feed:

$$\Rightarrow \frac{2{,}927{,}361 \text{ mg virginiamycin}}{40{,}000 \text{ broilers x } 1 \text{ kg}} = 73 \ {}^{\text{mg}}/_{\text{PCU}}$$

This antimicrobial has a DDDvetCA of **2.9 mg/kg/day**, the growing period is 35 days.

$$\Rightarrow \frac{2{,}927{,}361 \text{ mg virginiamycin} \ / \ 2.9_{\text{mg/kg/day}}}{40{,}000 \text{ broilers} \times 1 \text{ kg} \times 35 \text{ days}} \times 1{,}000 = 721 \ {}^{\text{nDDDvetCA}}/_{\text{1,000 br. chicken days at risk}}$$

In 2019, flock **B** in barn **A** was treated with **bacitracin** (active ingredient) in feed:

$$\Rightarrow \frac{7{,}764{,}965 \text{ mg bacitracin}}{40{,}000 \text{ broilers x } 1 \text{ kg}} = 194 \ {}^{\text{mg}}/_{\text{PCU}}$$

This antimicrobial has a DDDvetCA of **10 mg/kg/day**, the growing period is 35 days.

$$\Rightarrow \frac{7{,}764{,}965 \text{ mg bacitracin} \ / \ 10_{\text{mg/kg/day}}}{40{,}000 \text{ broilers} \times 1 \text{ kg} \times 35 \text{ days}} \times 1{,}000 = 549 \ {}^{\text{nDDDvetCA}}/_{\text{1,000 br. chicken days at risk}}$$

Why do we see fluctuation between indicators over time?

- **Flock B**: because bacitracin has **higher** inclusion rate in feed (thus **higher** mg/PCU) and has **higher** DDDvetCA, the resulting nDDDvetCA/1,000 broiler chicken-days at risk would be **lower**.
- **Flock A**: for virginiamycin, a streptogramin, which has a **lower** inclusion rate in feed (thus **lower** mg/PCU) and has a **lower** DDDvetCA, the resulting nDDDvetCA/1,000 turkey-days at risk is **higher**.
- **Between flock A and flock B:** variations are observed when antimicrobials are also administered in **water** and other antimicrobials are used in addition to the routine necrotic enteritis program.
- **Not only the quantity of antimicrobials can impact the annual data:** also the antimicrobials that constitute the overall use for that year (vary in inclusion rates, dose, and route of administration). Please consult the **CIPARS 2017 Design and Methods** for more details as well as this publication: https://www.frontiersin.org/articles/10.3389/fvets.2019.00220/full.

*There are many variations of this formula, for example, the TI_{100} (Treatment Incidence, interpreted as the percentage of time an animal of a standard or average weight is treated during the growing period with an antimicrobial).

Medically important antimicrobials[5] and others[6]

Summary of antimicrobials used by routes of administration

Table 2. 1 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* or 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. 2 (next page).

[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

[6] Others are flavophospholipids or antimicrobial classes belonging to Veterinary Drugs Directorate Category IV other than ionophores.

Table 2. 2 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**

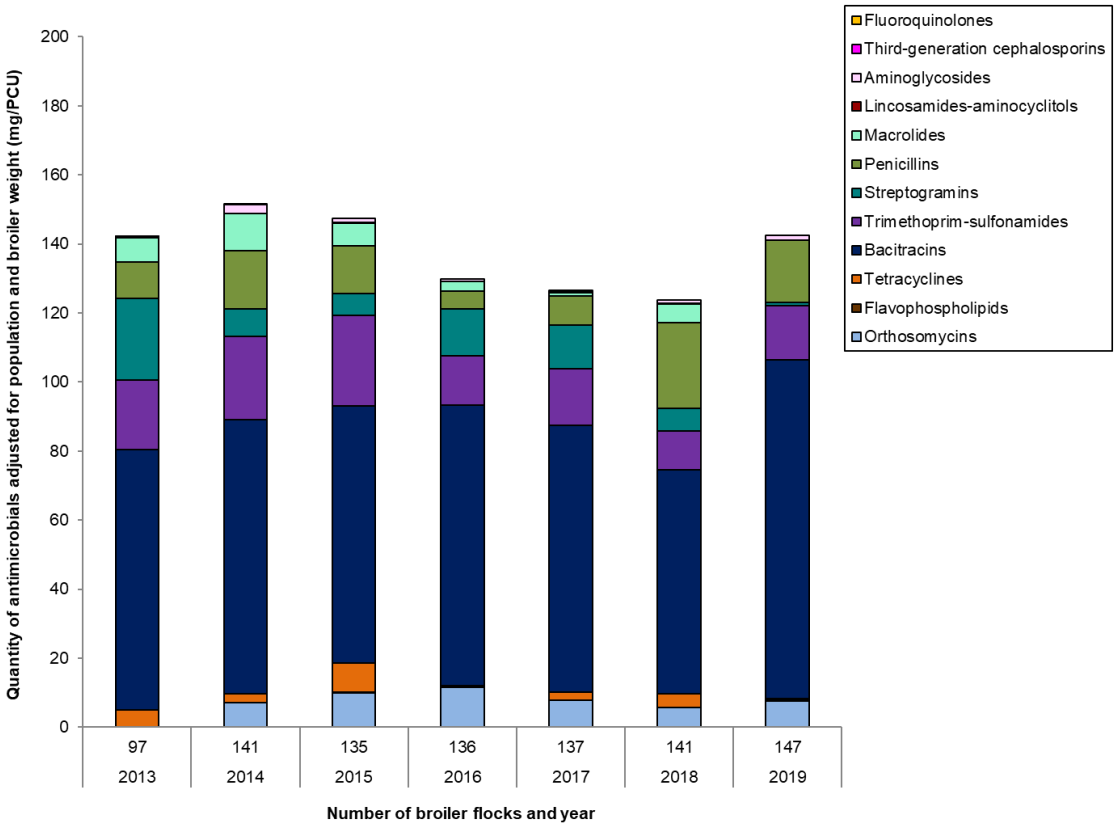
Roman numerals II to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification available at the time of writing of this report). AMU = antimicrobial use.
Combination antimicrobials include the values for both antimicrobial 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, 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.
[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. 3 Production, biomass and quantity of antimicrobials use 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

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, 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.
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.

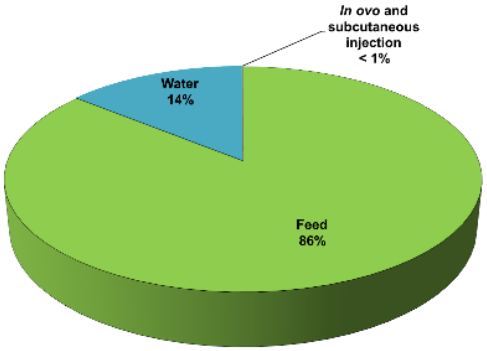
Figure 2. 1 Quantity of antimicrobial use in all routes of administration, adjusted for population and broiler weight (mg/PCU), 2013 to 2019

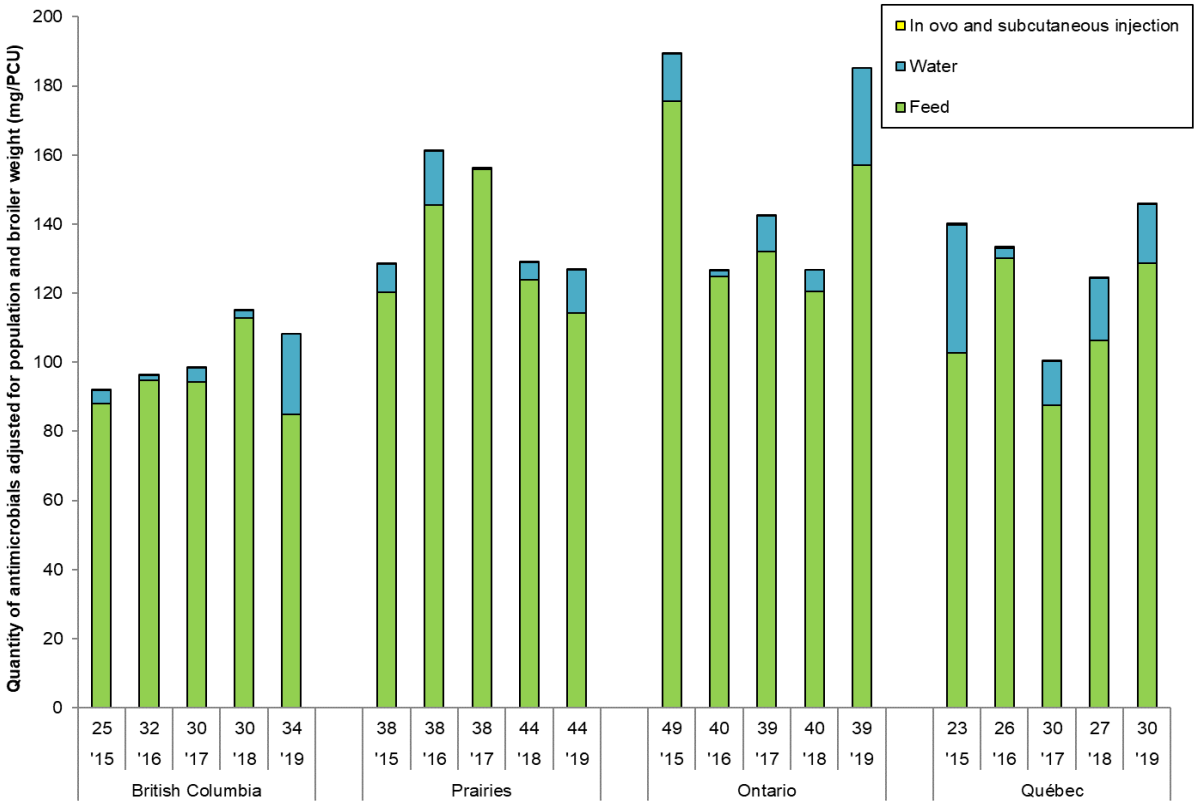


Year Number of flocks		2013 97	2014 141	2015 135	2016 136	2017 137	2018 141	2019 147
Antimicrobial class								
I	Fluoroquinolones	< 0.1	0	0	0	0	< 0.1	0
	Third-generation cephalosporins	< 0.1	< 0.1	0	0	0	0	0
II	Aminoglycosides	< 0.1	3	1	1	1	1	1
	Lincosamides-aminocyclitols	0.1	0.1	0.2	0.1	0.1	0.2	< 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. 2 Quantity of antimicrobials, adjusted for population and broiler weight (mg/PCU), in 2019 and by province/region from 2015 to 2019



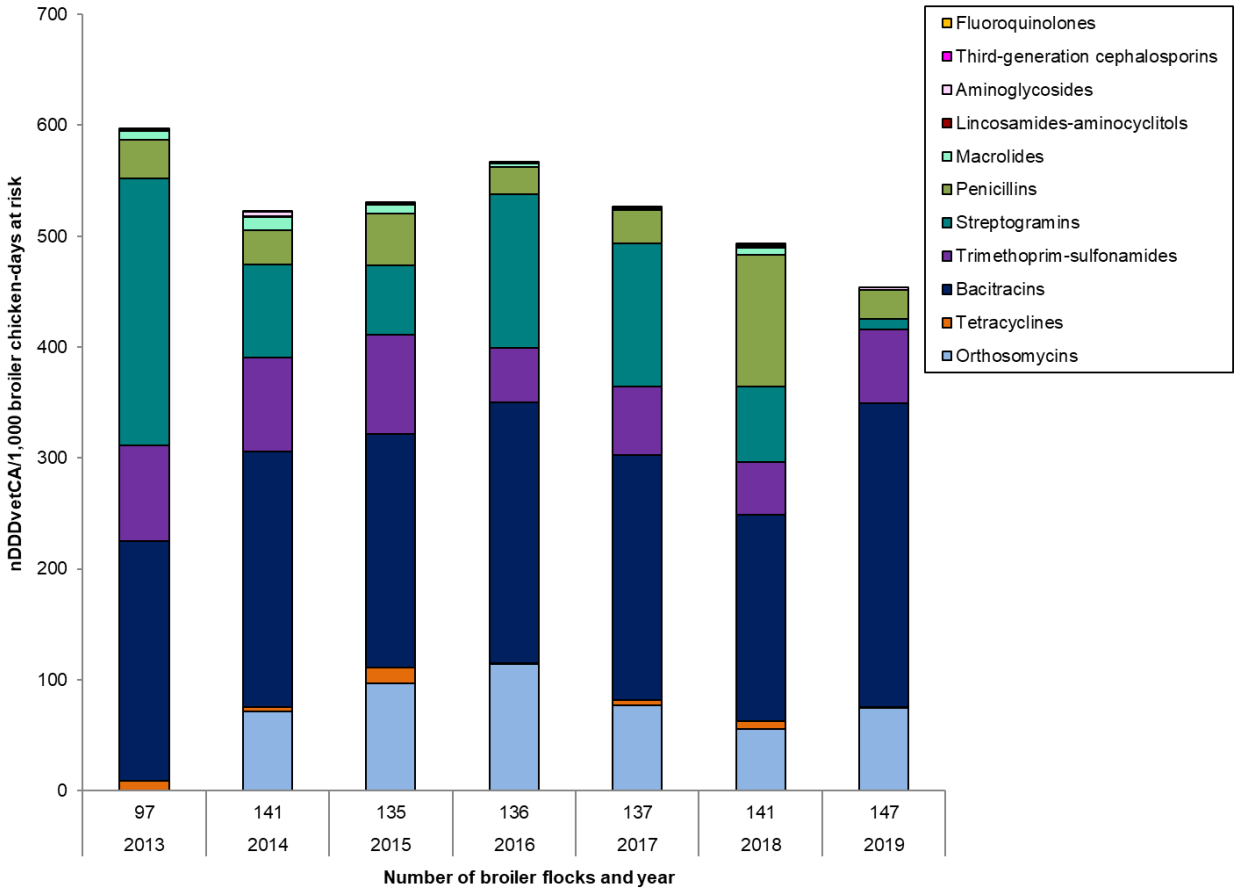


Number of broiler flocks, year, and province/region

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
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. 3 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

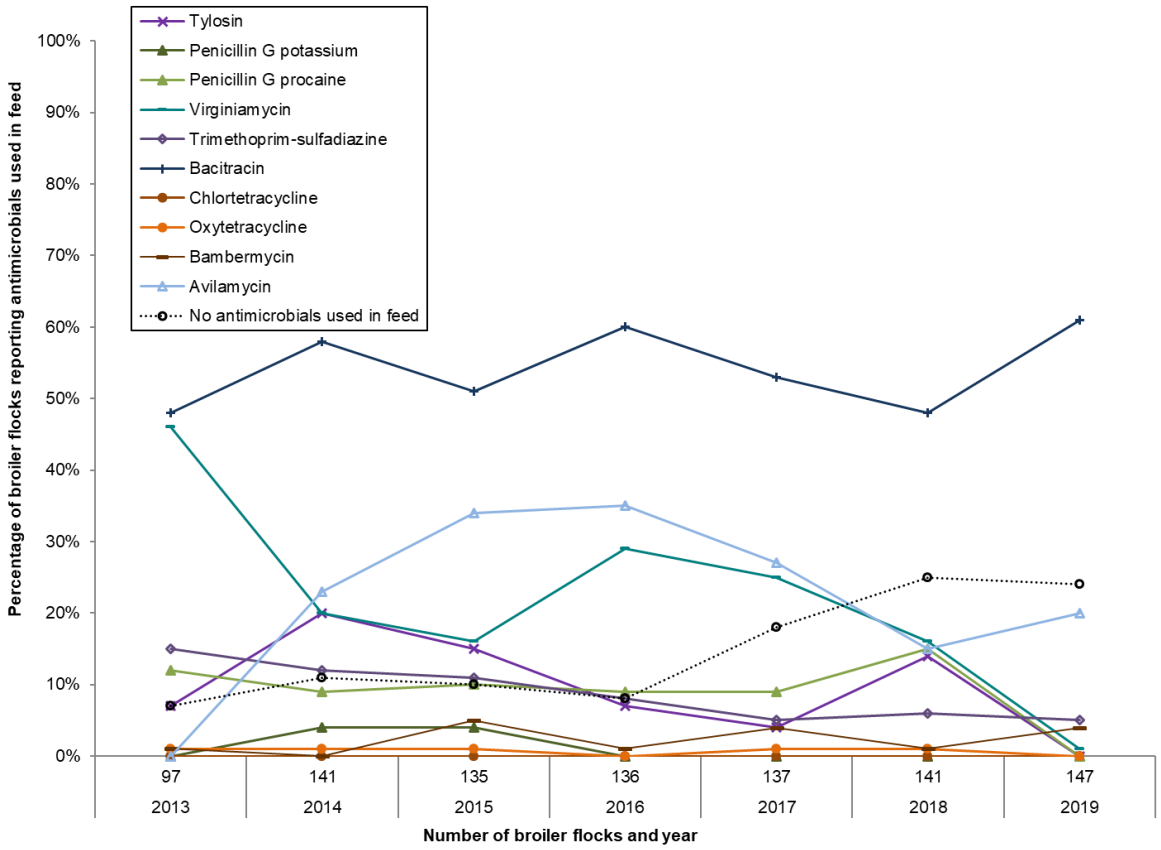


Year		2013	2014	2015	2016	2017	2018	2019
Number of flocks		97	141	135	136	137	141	147
Antimicrobial class								
I	Fluoroquinolones	< 0.1	0	0	0	0	< 0.1	0
	Third-generation cephalosporins	1	0.1	0	0	0	0	0
II	Aminoglycosides	< 0.1	3	2	1	1	1	2
	Lincosamides-aminocyclitols	1	1	1	0.7	0.8	2	0
	Macrolides	8	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 at the time of writing of this report).
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram broiler chicken 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.
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

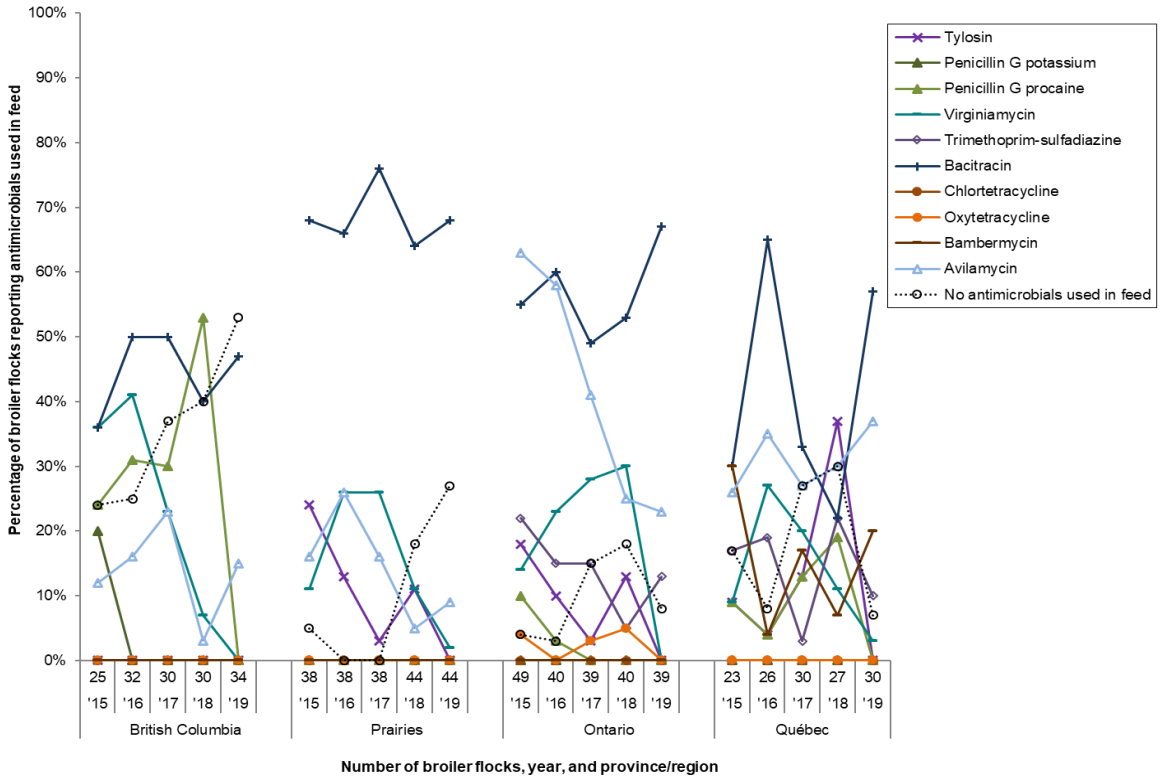
Figure 2. 4 Percentage of broiler flocks reporting antimicrobial use in feed, 2013 to 2019



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. 5 Percentage of broiler flocks reporting antimicrobials used in feed, by province/region, 2015 to 2019

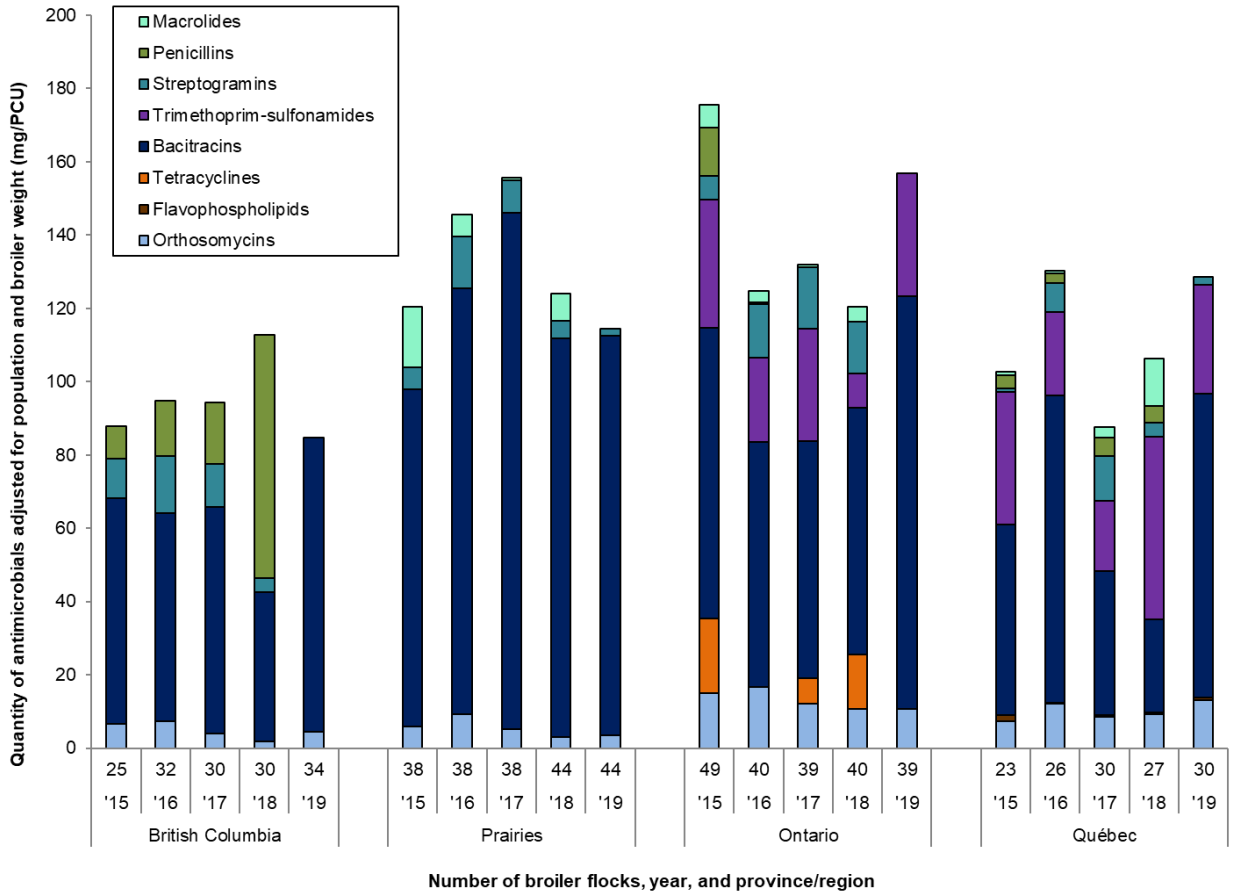


Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks	25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Antimicrobial																				
Tylosin	**0%**	0%	0%	**0%**	**0%**	**24%**	13%	3%	**11%**	**0%**	**18%**	10%	3%	**13%**	**0%**	**9%**	4%	13%	**37%**	**0%**
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%**
Virginiamycin	**36%**	41%	23%	**7%**	**0%**	**11%**	26%	26%	**11%**	**2%**	**14%**	23%	28%	**30%**	**0%**	**9%**	27%	20%	**11%**	**3%**
Trimethoprim-sulfadiazine	**0%**	0%	0%	**0%**	**0%**	**0%**	0%	0%	**0%**	**0%**	**22%**	15%	15%	**5%**	**13%**	**17%**	19%	3%	**22%**	**10%**
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%**
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%**
NA 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 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/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

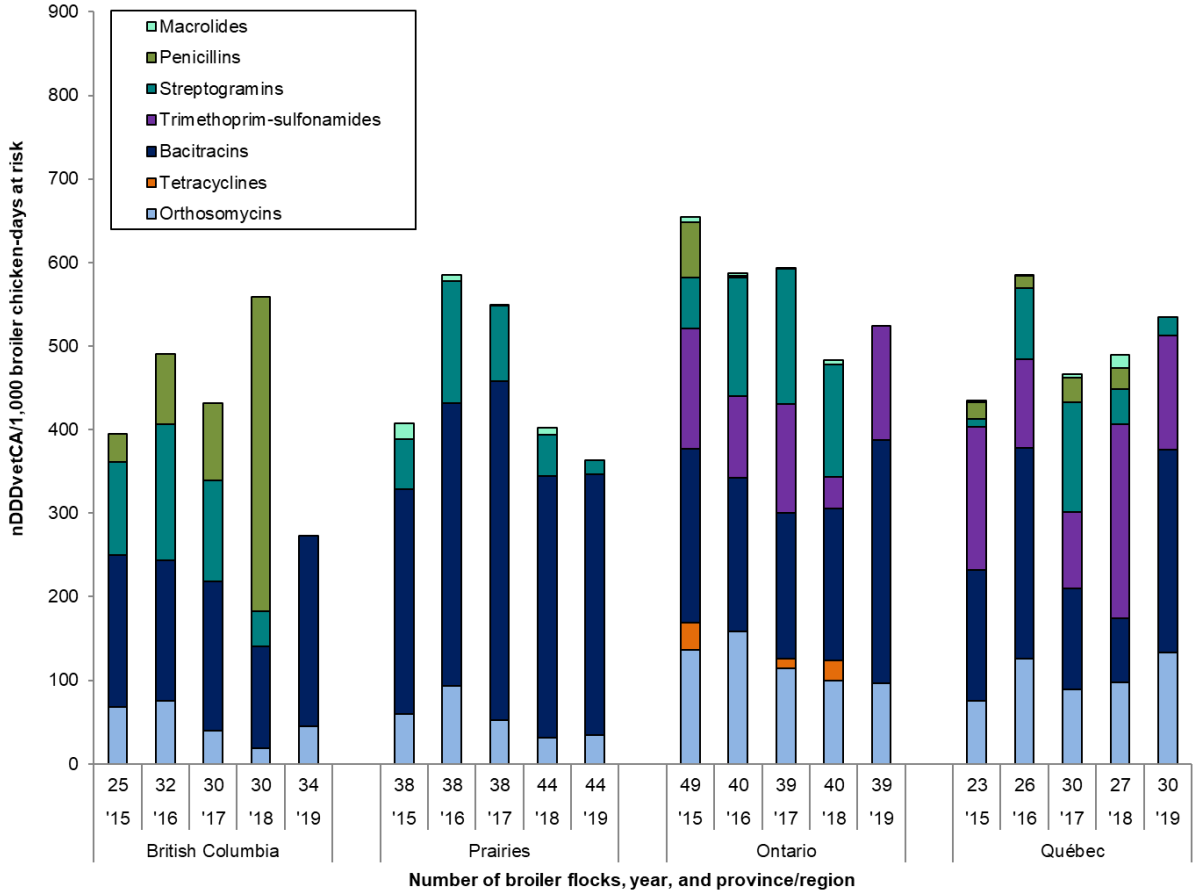
Figure 2. 6 Quantity of antimicrobials used in feed adjusted for population and broiler weight (mg/PCU), by province/region, 2015 to 2019



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

Figure 2. 7 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

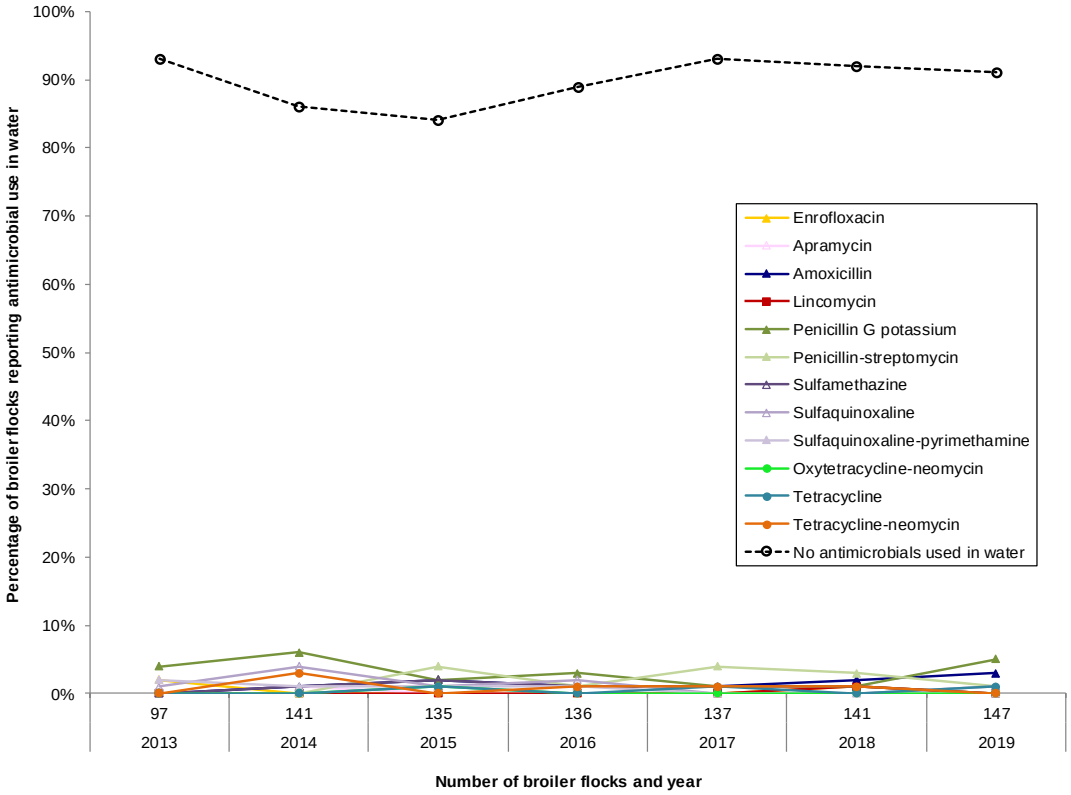


Province/region		British Columbia					Prairies					Ontario					Québec				
Year		'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks		25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Antimicrobial class																					
II	Macrolides	0	0	0	0	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 available at the time of writing of this report).
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram broiler chicken 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.
The Prairies is a region including the provinces of Alberta and Saskatchewan.

Antimicrobial use in water by frequency

Figure 2. 8 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%**

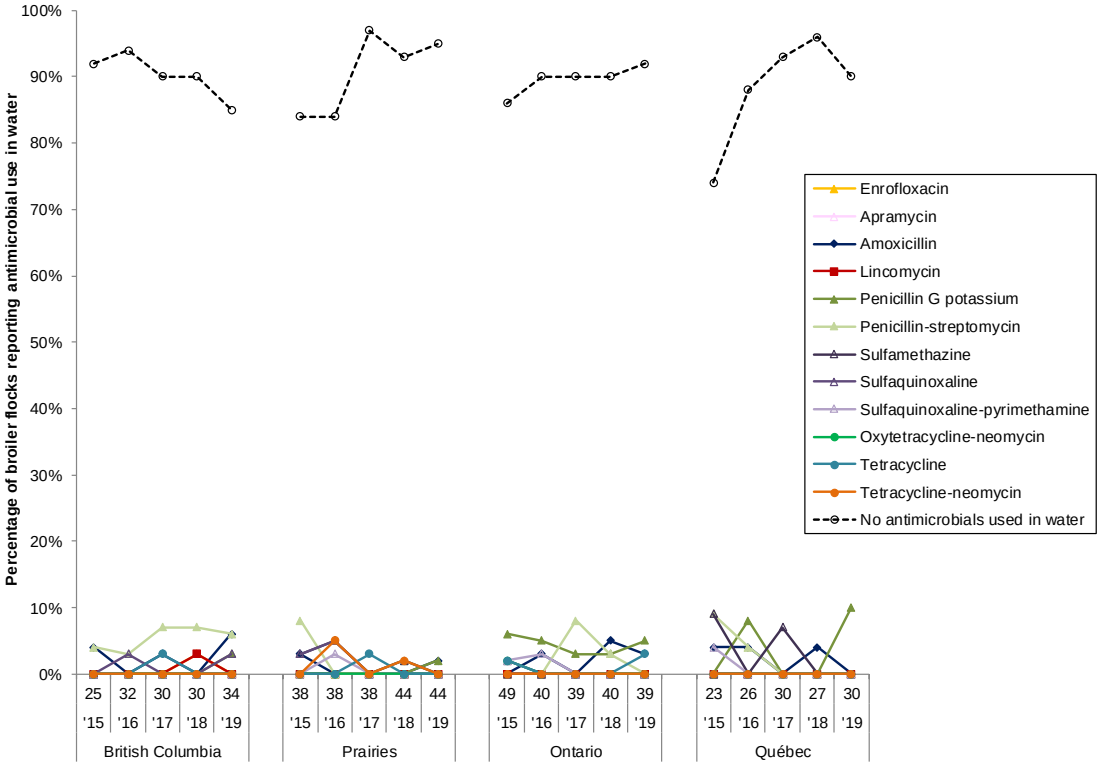
Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

Numbers per column may not add up to 100% as some flocks may have used an antimicrobial more than once or used multiple antimicrobials throughout the grow-out 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 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. 9 Percentage of broiler flocks reporting antimicrobial use in water, 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																					
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 may have used an antimicrobial more than once or used multiple antimicrobials throughout the grow-out period.

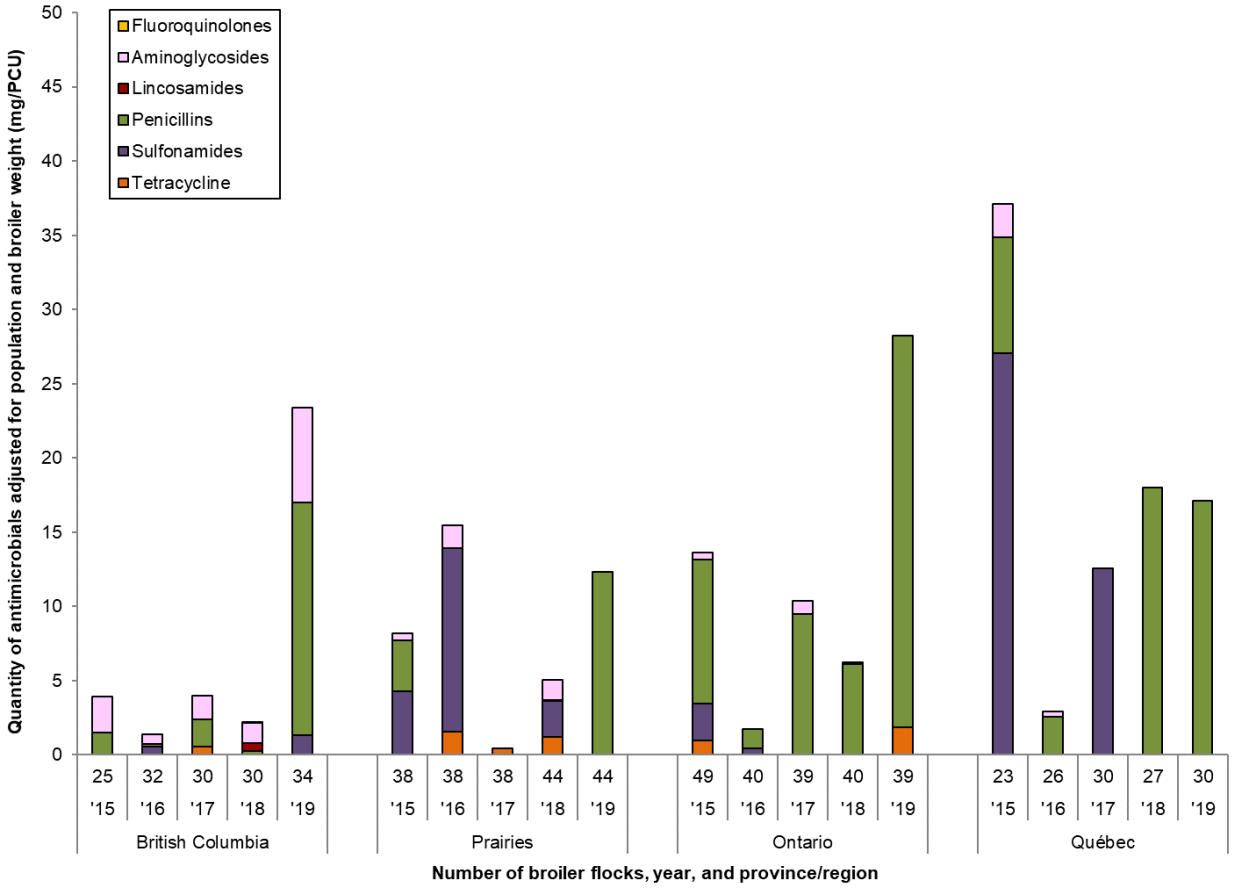
For the temporal analyses within province/region, the proportion (%) of flocks using a specific antimicrobial in the current year has been compared to the proportion (%) of flocks using the same antimicrobial in the previous 5 years and the previous surveillance year (grey areas). The presence of blue 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 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

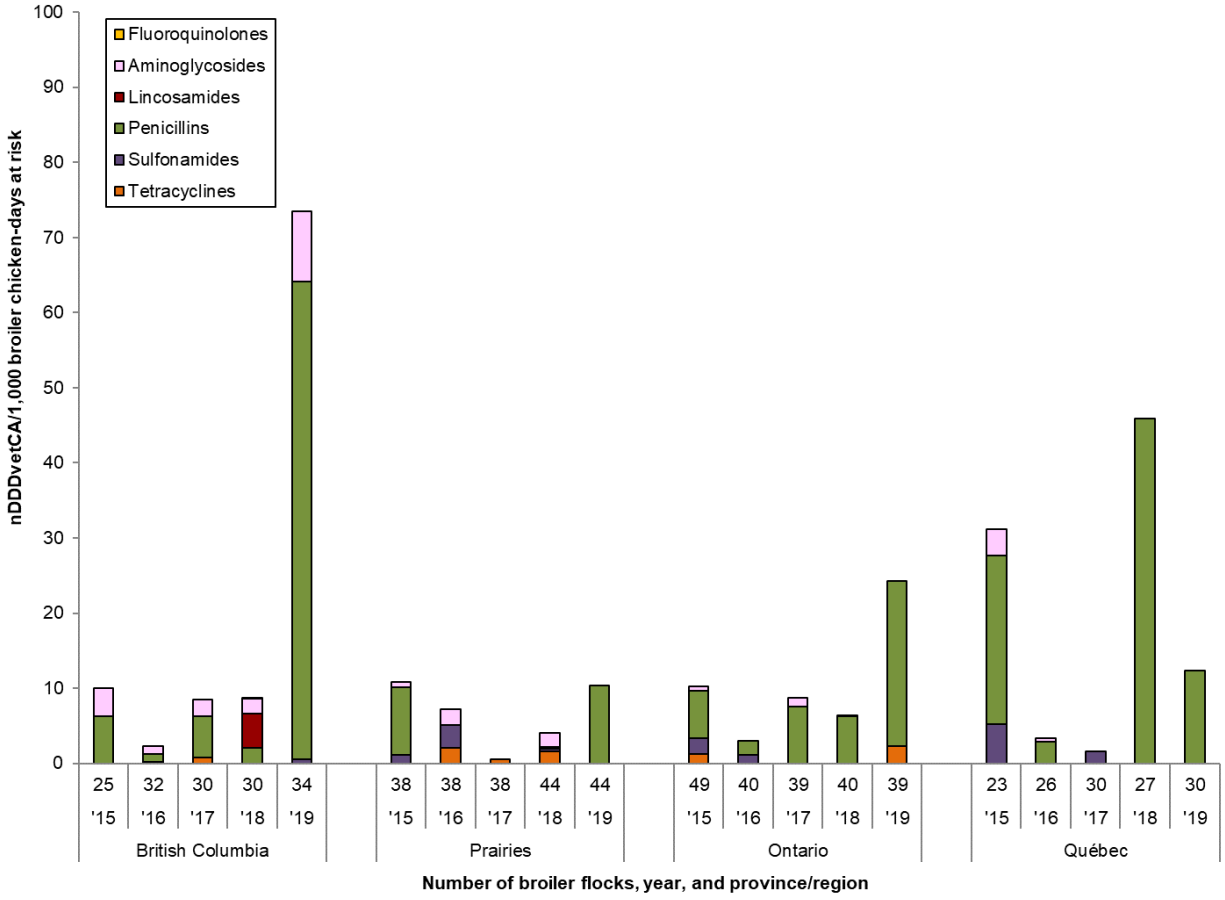
Figure 2. 10 Quantity of antimicrobials used in water adjusted for population and broiler weight (mg/PCU), by province/region, 2015 to 2019



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

Figure 2. 11 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

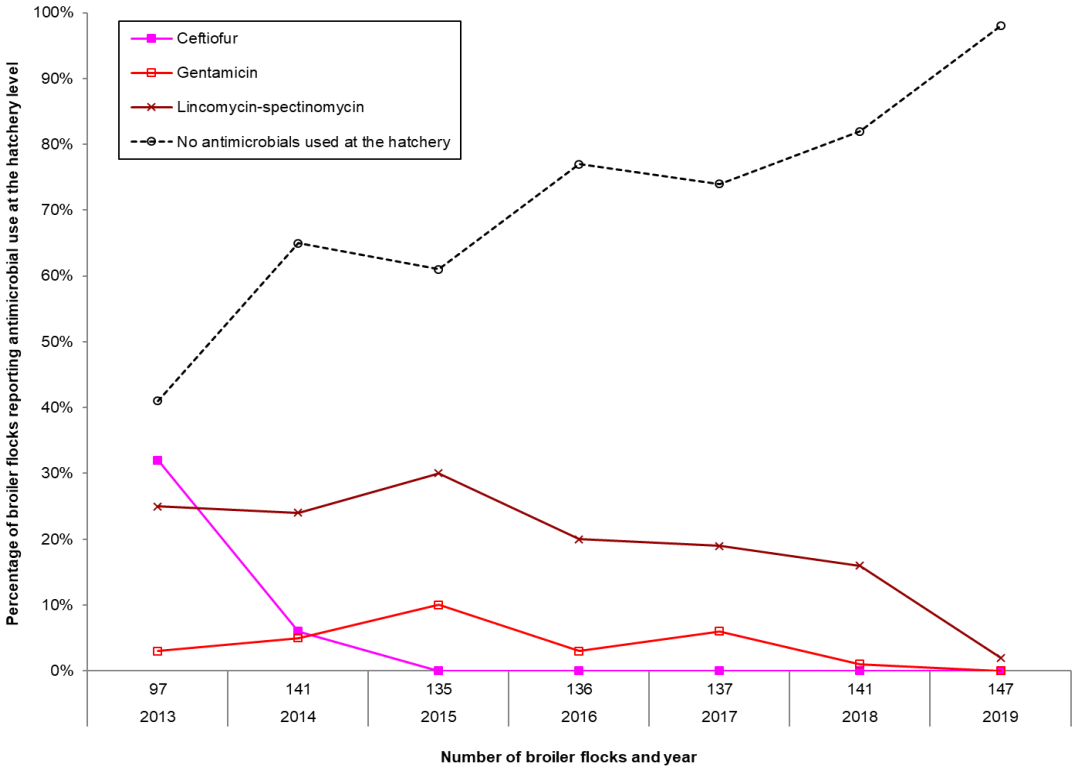


Province/region		British Columbia					Prairies					Ontario					Québec				
Year		'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks		25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Antimicrobial class																					
I	Fluoroquinolones	0	0	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 chicken 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.
The Prairies is a region including the provinces of Alberta and Saskatchewan.

Antimicrobial use *in ovo* or subcutaneous injection by frequency

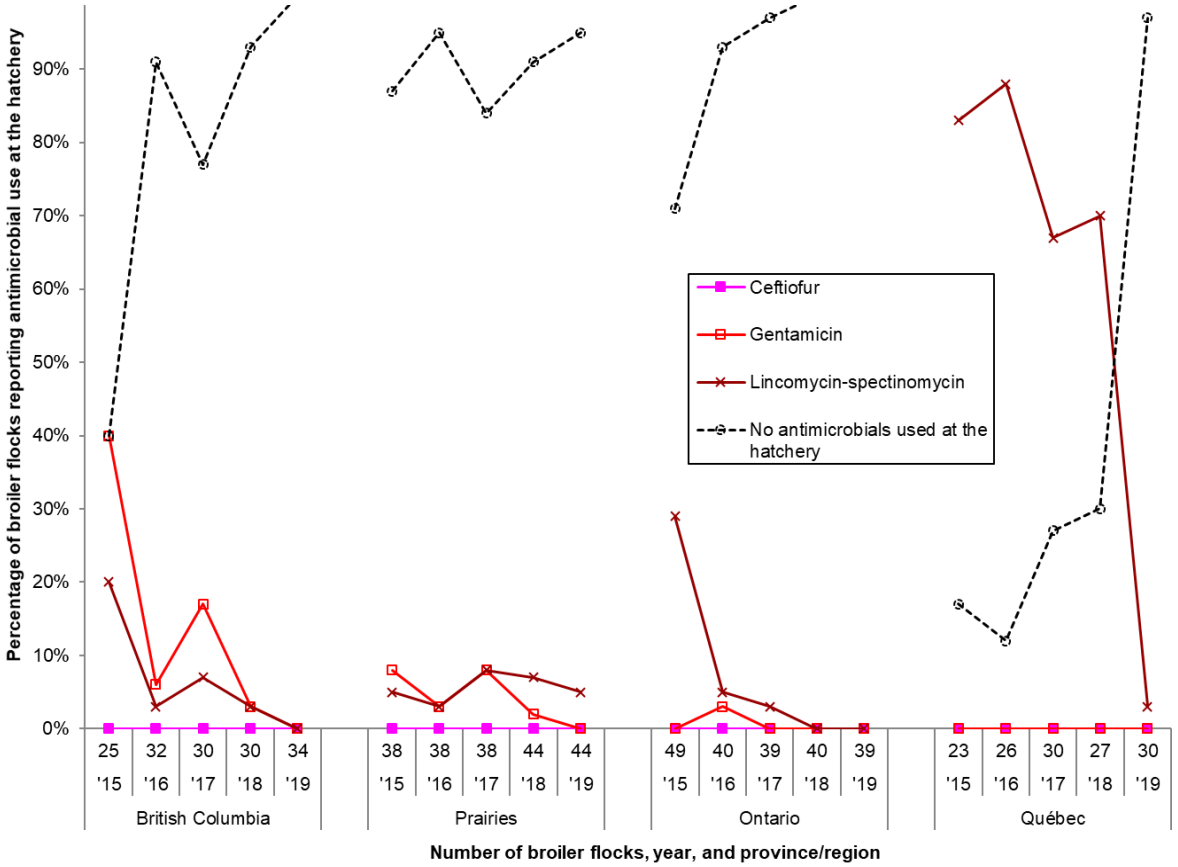
Figure 2. 12 Percentage of broiler flocks reporting antimicrobial use *in ovo* or subcutaneous injection at the hatchery level, 2013 to 2019



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. 13 Percentage of broiler flocks reporting antimicrobial use *in ovo* or subcutaneous injection at the hatchery level, by province/region, 2015 to 2019

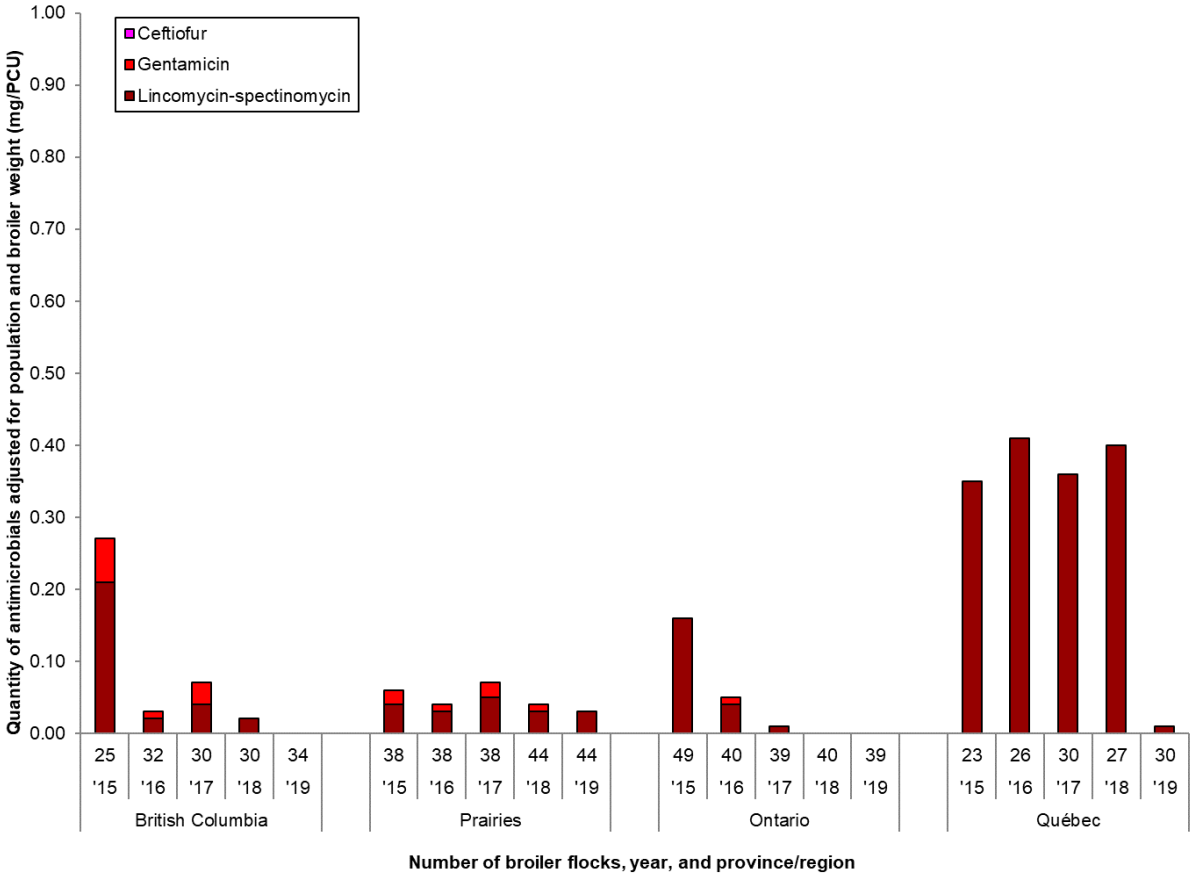


Province/region		British Columbia					Prairies					Ontario					Québec				
Year		'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks		25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Antimicrobial																					
I	Ceftiofur	**0%**	0%	0%	**0%**	**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).
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).
The Prairies is a region including the provinces of Alberta and Saskatchewan.

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

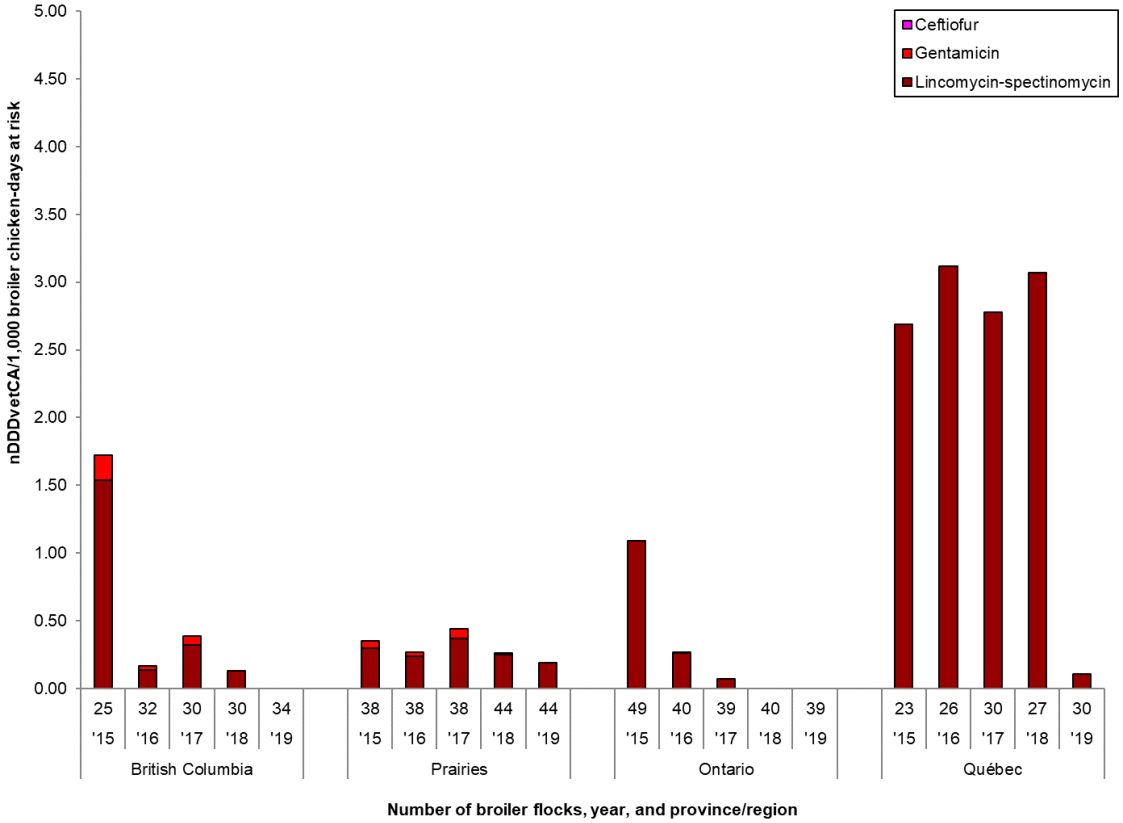
Figure 2. 14 Quantity of antimicrobial use *in ovo* or subcutaneous injection, adjusted for population and broiler weight (mg/PCU), by province/region, 2015 to 2019



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

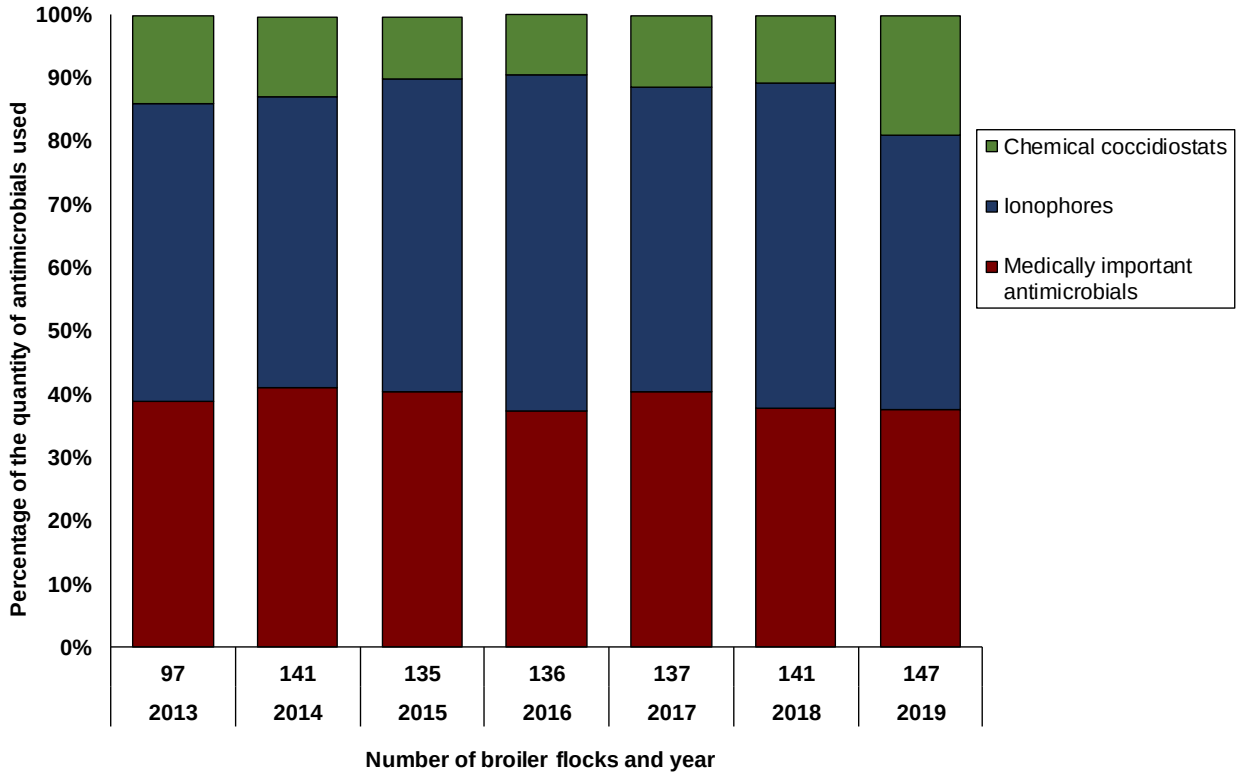


Province/region		British Columbia					Prairies					Ontario					Québec				
Year		'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks		25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Antimicrobial																					
I	Ceftiofur	0	0	0	0	0	0	0	0	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 chicken 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.
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 (2013-2017 flocks with chick placement but no pre-harvest information received).

Coccidiostats

Figure 2. 16 Percentage of the quantity (milligrams of active ingredient) of antimicrobials used in broiler chicken flocks, 2013 to 2019



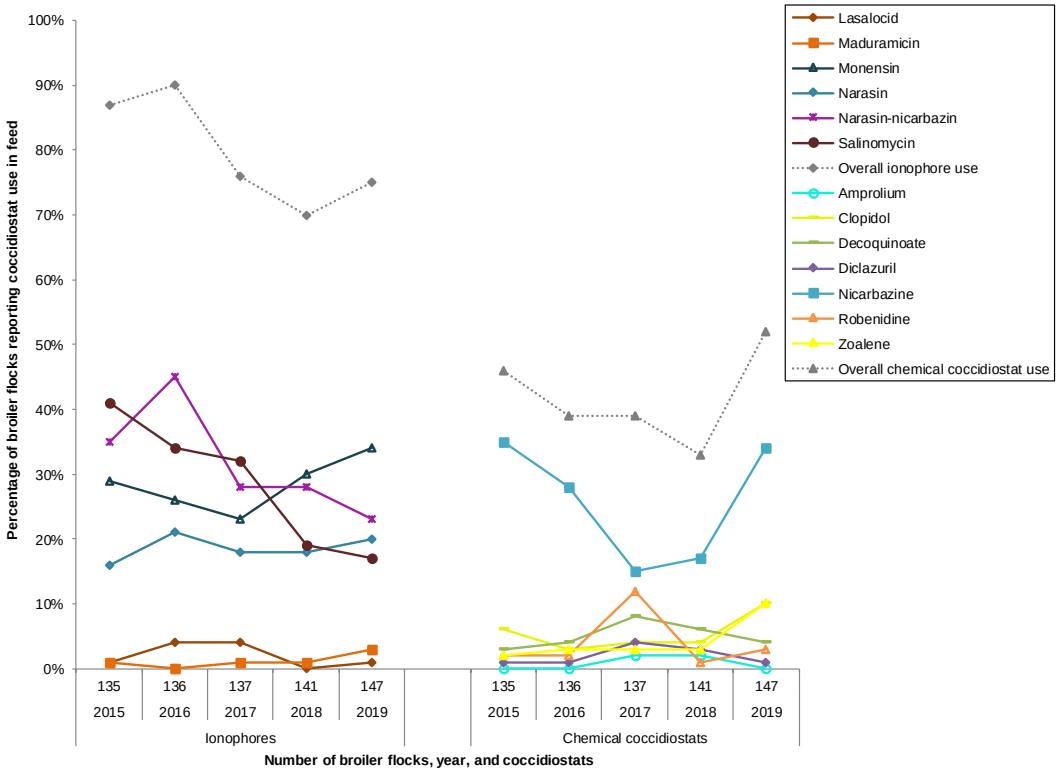
Year	2013	2014	2015	2016	2017	2018	2019
Number of flocks	97	141	135	136	137	141	147
Antimicrobial classification							
Medically important antimicrobials[1]	39%	41%	40%	37%	41%	38%	38%
Ionophores	47%	46%	49%	53%	48%	51%	43%
Chemical coccidiostats	14%	13%	10%	9%	11%	11%	19%

Quantity of antimicrobials in milligrams active ingredients.
[1] Medically-important antimicrobials are the classes reported in the previous section[7].

[7] 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.

Coccidiostat use in feed by frequency

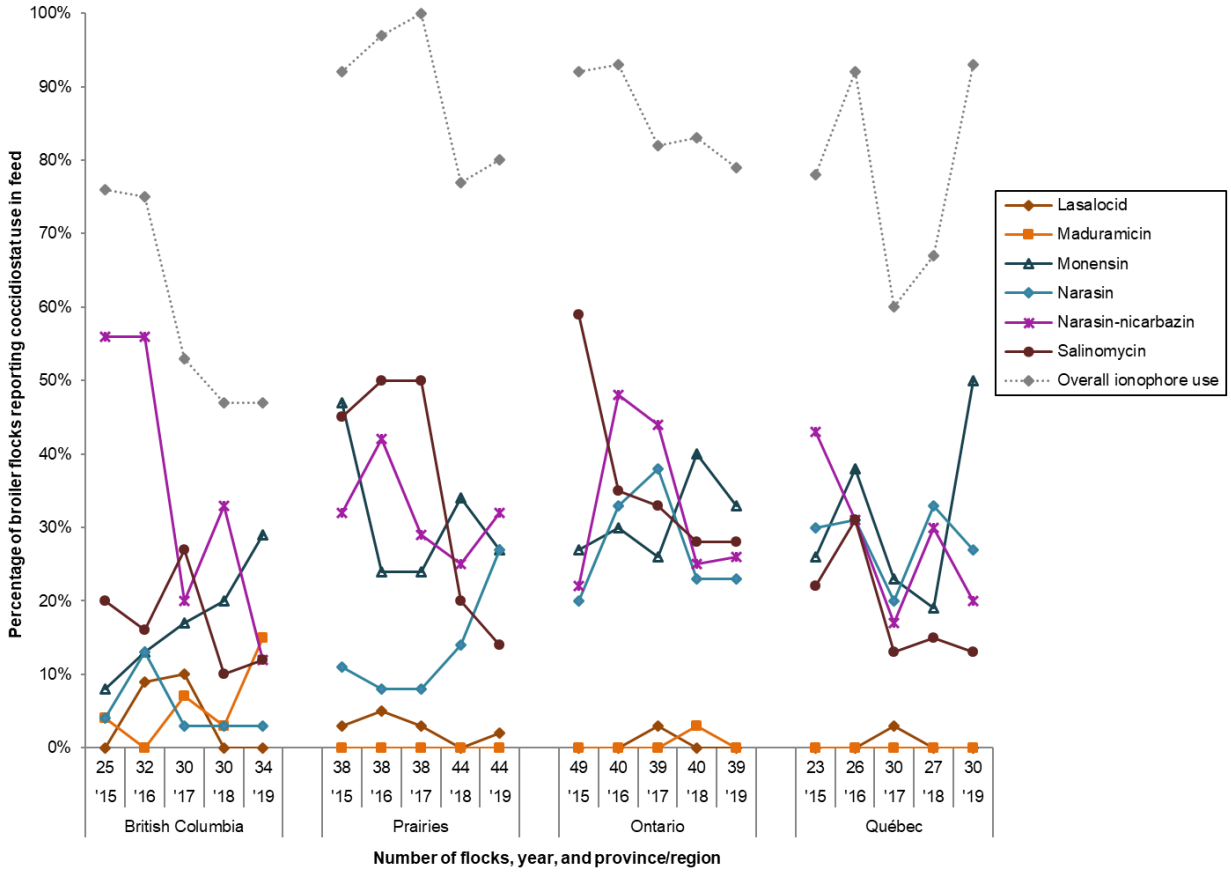
Figure 2. 17 Percentage of broiler flocks reporting coccidiostat use in feed, 2015 to 2019



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 indicate 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. 18 Percentage of broiler flocks reporting ionophore coccidiostats in feed, by province/region, 2015 to 2019

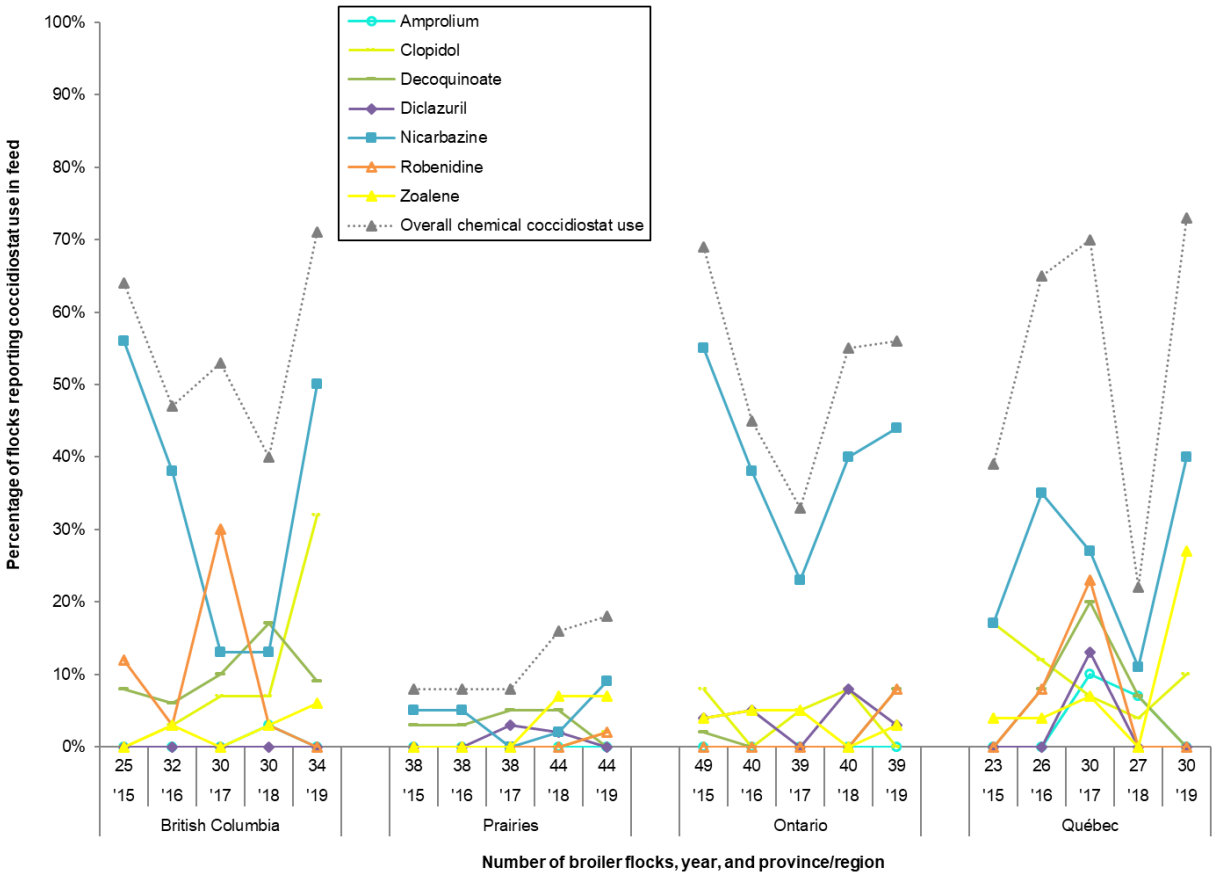


Province/region		British Columbia					Prairies					Ontario					Québec				
Year		'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19	'15	'16	'17	'18	'19
Number of flocks		25	32	30	30	34	38	38	38	44	44	49	40	39	40	39	23	26	30	27	30
Coccidiostat																					
	Lasalocid	**0%**	9%	10%	**0%**	**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%**
IV	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 indicate 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. 19 Percentage of broiler flocks reporting chemical coccidiostat 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.

Chapter 3 Antimicrobial Resistance

Data pertains to pre-harvest sampling. The chick placement component of the farm program was discontinued.

Key findings

Salmonella (n = 314)

- When data from all provinces were combined, the top 3 *Salmonella* serovars were Kentucky, Enteriditis, and Johannesburg. The latter serovar was detected only in British Columbia flocks (first detected in 2016 also in British Columbia). Enteritidis was detected in 3 provinces/regions sampled and no Enteritidis was detected in Ontario (Table 3. 1). Enteritidis was the top serovar detected in British Columbia. Overall, ceftriaxone resistance decreased by 5% from the previous year and the decrease was observed in British Columbia, Ontario and Québec but increased in the Prairies by 12% (Figure 3. 1).
- There were 2 nalidixic acid resistant isolates, 1 Kentucky and 1 Johannesburg isolates recovered from British Columbia (Table 3. 1).

Escherichia coli (n = 571)

- At pre-harvest, overall there were 2 isolates resistant to ciprofloxacin (less than 1%) and 45 isolates resistant to nalidixic acid (8%); 50% (23/45) of the resistant isolates were recovered from British Columbia. Between 2018 and 2019, resistance to ceftriaxone (no change) and gentamicin (decreased by 3%) was relatively stable (Figure 3. 2).
- No meropenem resistance observed among the isolates.

Campylobacter (n = 142)

Overall, between 2018 and 2019, ciprofloxacin resistance increased from 12% to 24%. In British Columbia, ciprofloxacin resistance increased from 17% to 38%; ciprofloxacin-resistant isolates were detected in all of the provinces/regions sampled (Figure 3. 3).

Multiclass resistance

Table 3. 1 Number of antimicrobial classes in resistance patterns of *Salmonella* from broiler chickens at 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.
The Prairies is a region including the provinces of Alberta and Saskatchewan.

Table 3. 2 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.

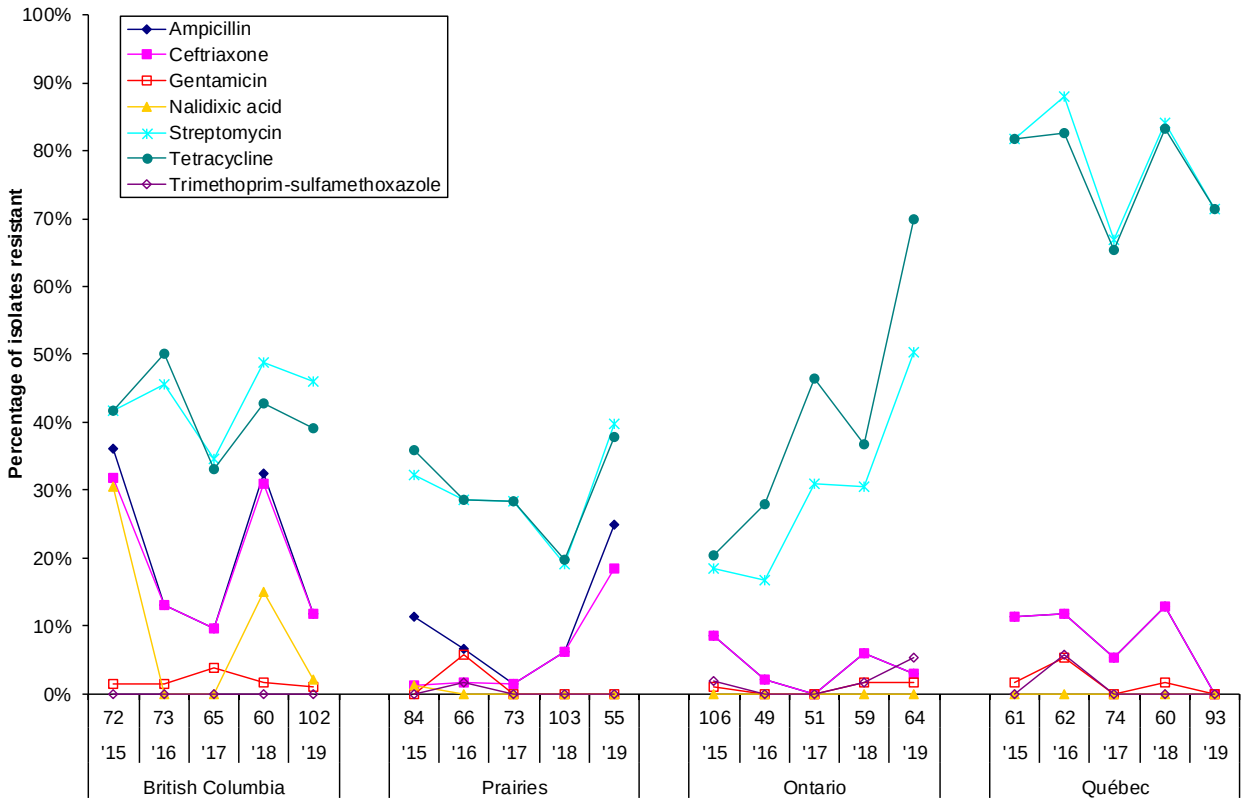
Table 3. 3 Number of antimicrobial classes in resistance patterns of *Campylobacter* from chickens at pre-harvest, 2019

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.

Temporal antimicrobial resistance summary

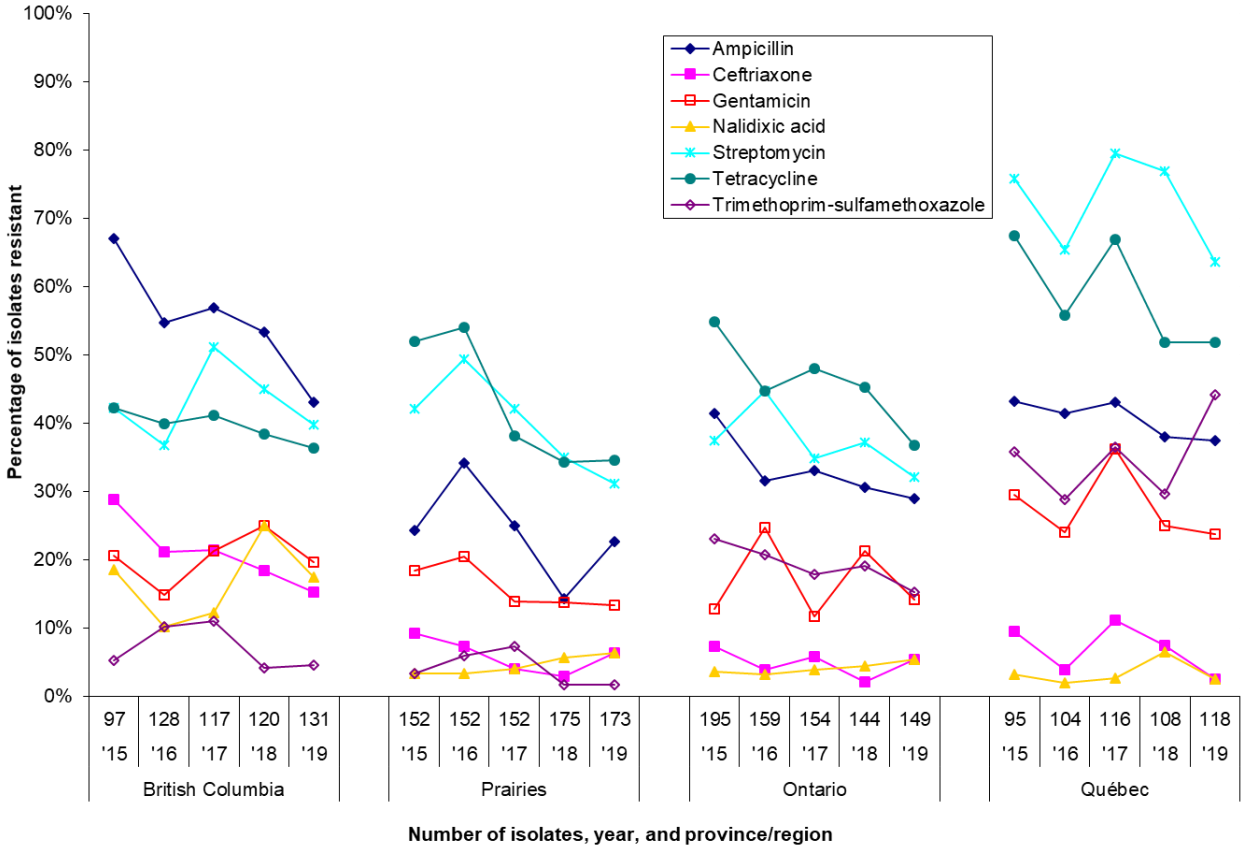
Figure 3. 1 Temporal variations in resistance of *Salmonella* isolates from chickens at pre-harvest, 2015 to 2019



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%**
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 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 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 and Saskatchewan.

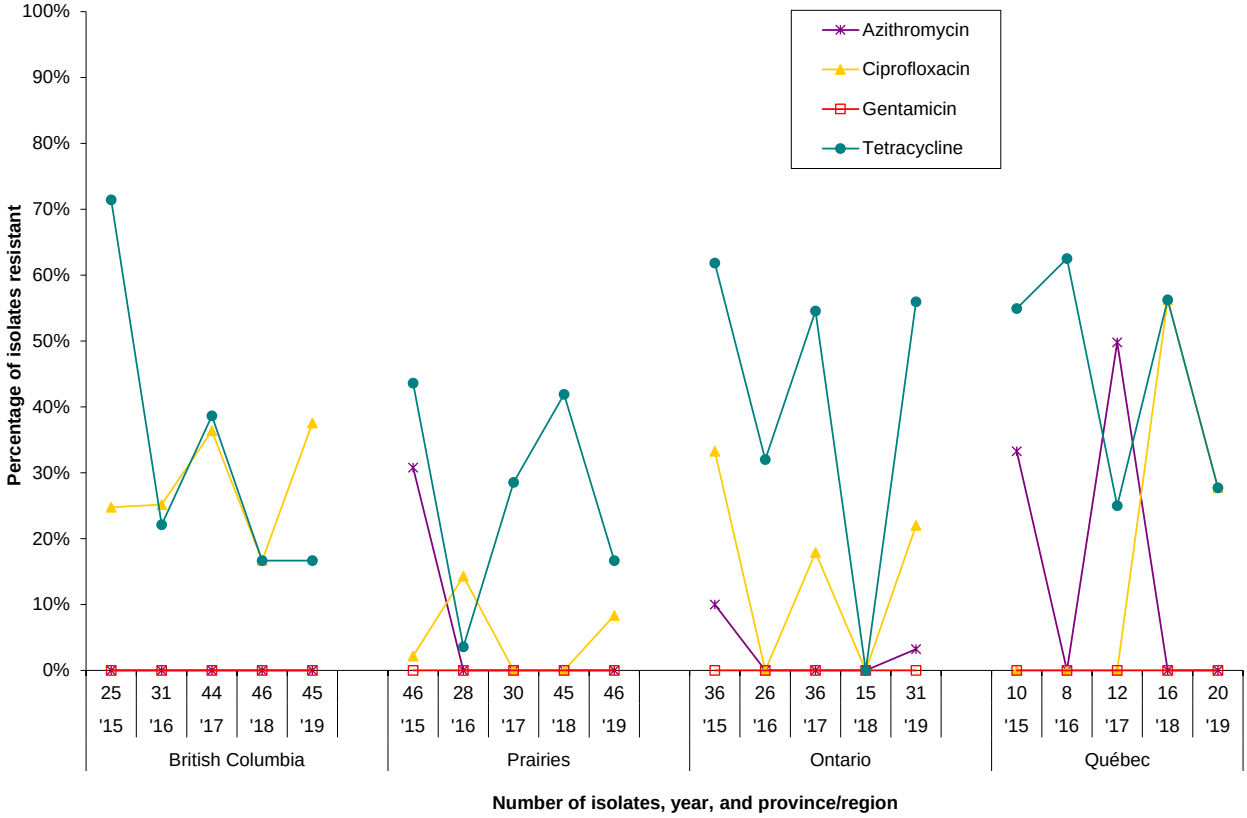
Figure 3. 2 Temporal variations in resistance of *Escherichia coli* isolates from chickens at pre-harvest, 2015 to 2019



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%**
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 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 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 and Saskatchewan.

Figure 3. 3 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 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 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 and Saskatchewan.

Recovery results

Table 3. 4 Farm surveillance recovery rates in broiler 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 (Pre-harvest)	British Columbia	2013	**98%**	94/96	**71%**	68/96	**28%**	27/96		
		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.

Appendix

Abbreviations

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
TEL Telithromycin
TET Tetracycline
TIO Ceftiofur