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# 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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# Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) 2017:

## 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
- Alberta Agriculture and Forestry
- 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.

## Broiler chickens

### Key findings

#### Mortality

- The mortality rate in the broiler flocks surveyed was similar to the previous year (median: 3%, range 1 to 9%). Mortality rate varied by marketing category: mainstream RWA/ABF (raised without antibiotics/antibiotic-free program) (4%, range: 2 to 9%), conventional (3%, range: 1 to 9%), organic (8%, 6 to 9%), and other categories such as flocks raised according to CFIA's updated methods of production claim definitions for RWA/ABF<sup>1</sup> (4%, range: 3 to 5%).

#### Chick sources

- Overall, the total number of chicks placed in the sampling unit (barn/floor/pen sampled for microbiological testing) in 2017 was similar to the previous years and comprised of 84% domestic, 15% imported and 1% from other provinces (Figure 1. 1). There were provincial/regional variations in the proportion of chicks sourced (Figure 1. 2).
- By production type category, 82% of the flocks (84% of the total bird population surveyed) sampled were classified as conventional and was fed or medicated via water or injection with any of the antimicrobials listed in Table 2.3 (i.e., excluding coccidiostats). The remaining eighteen percent of the flocks (16% of total bird population surveyed) were deemed organic and RWA/ABF mainstream program or according to the revised CFIA method of production claim.

#### Diagnosis of disease in broiler flocks

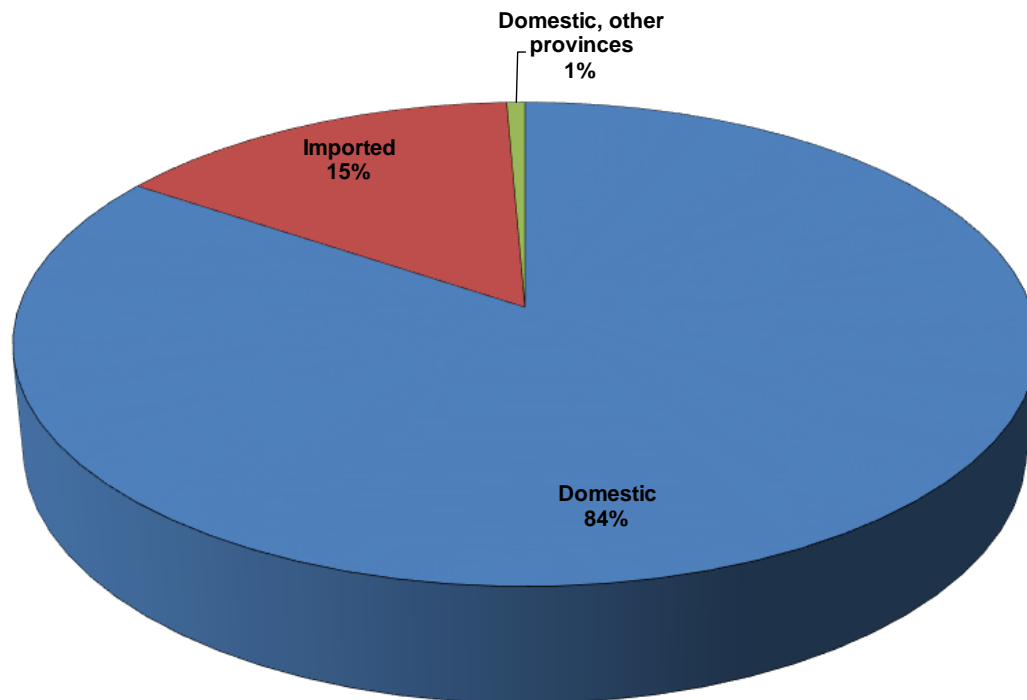
- The diagnosis of APEC (avian pathogenic *Escherichia coli*) associated diseases increased between 2016 to 2017 in British Columbia and the Prairies while it decreased in Ontario and Québec. There were no marked changes in the number of flocks diagnosed with enteric diseases (necrotic enteritis and coccidiosis) and viral diseases (Figure 1. 3 and Figure 1. 4).

<sup>1</sup> 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 2018.

## Biosecurity

- As for biosecurity practices, observance of downtime and rest period of 11 days (range: 1 to 42 days) was reported. Routine vaccination of broilers at the hatchery (79%) and on-farm (23) against common viral diseases affecting broilers in Canada and for coccidiosis (12%) were practiced by the participating producers to manage flock health.

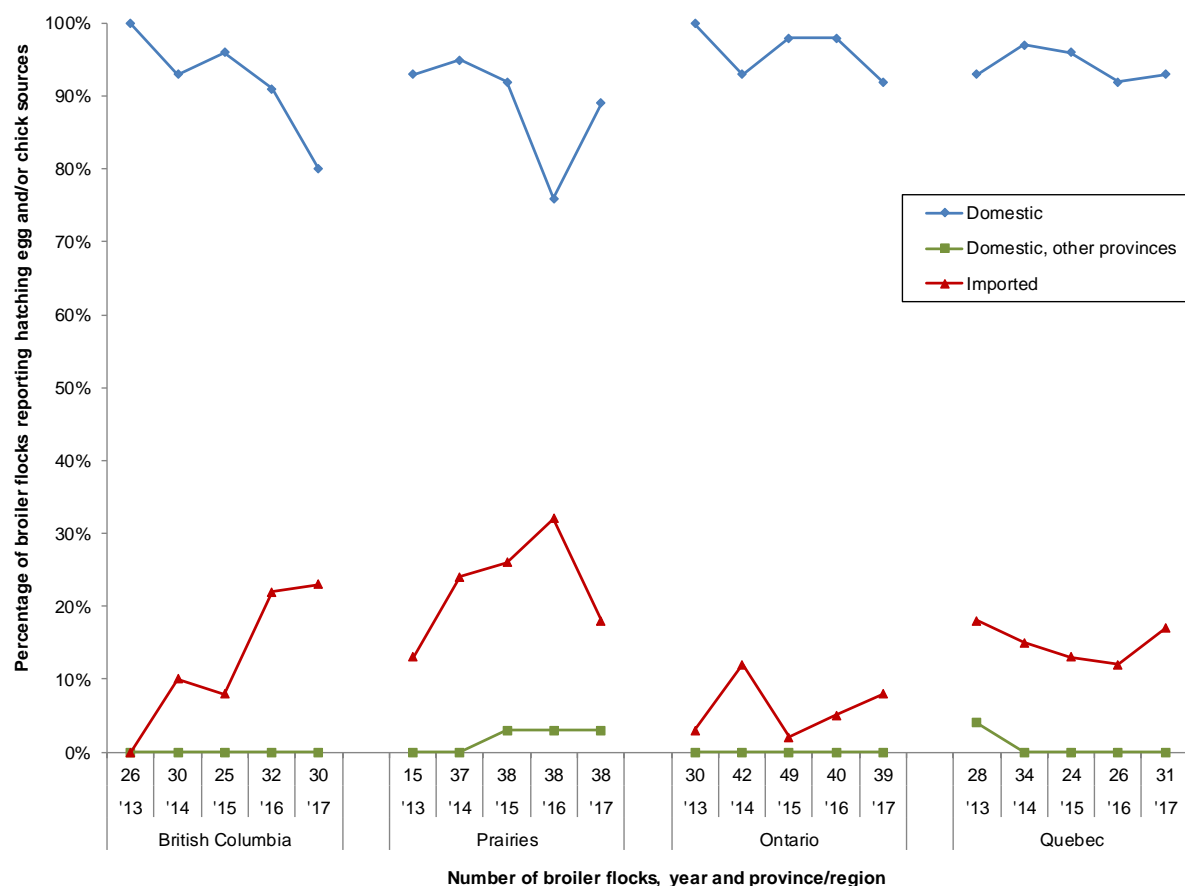
**Figure 1. 1 Relative distribution of chick sources, 2017**



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, 2013 to 2017**

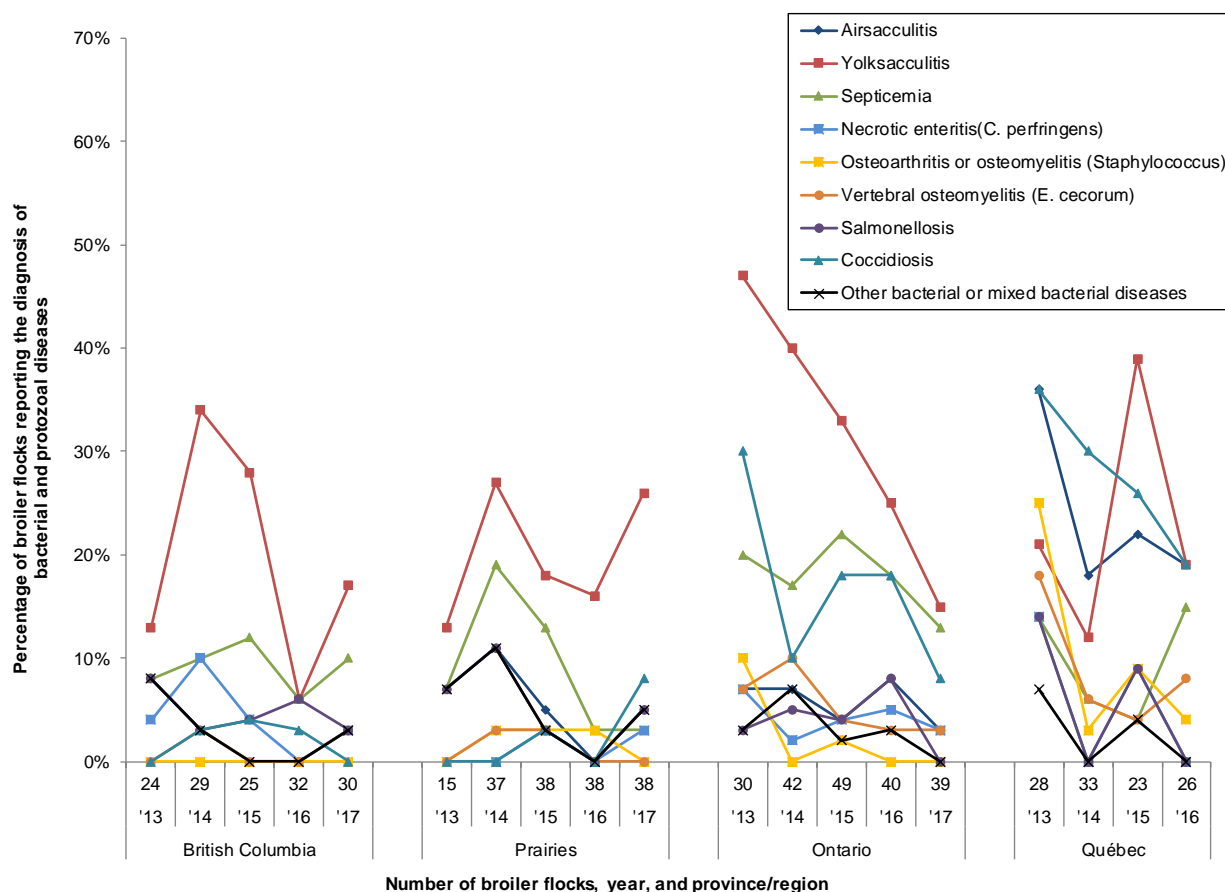
Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17
Number of flocks	26	30	25	32	30	15	37	38	38	38	30	42	49	40	39	28	34	24	26	31
hatching egg and/or chick sources																				
Domestic	100%	93%	96%	91%	80%	93%	95%	92%	76%	89%	100%	93%	98%	98%	92%	93%	97%	96%	92%	93%
Domestic, other provinces	0%	0%	0%	0%	0%	0%	0%	3%	3%	3%	0%	0%	0%	0%	0%	4%	0%	0%	0%	0%
Imported	0%	10%	8%	22%	23%	13%	24%	26%	32%	18%	3%	12%	2%	5%	8%	18%	15%	13%	12%	17%

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.

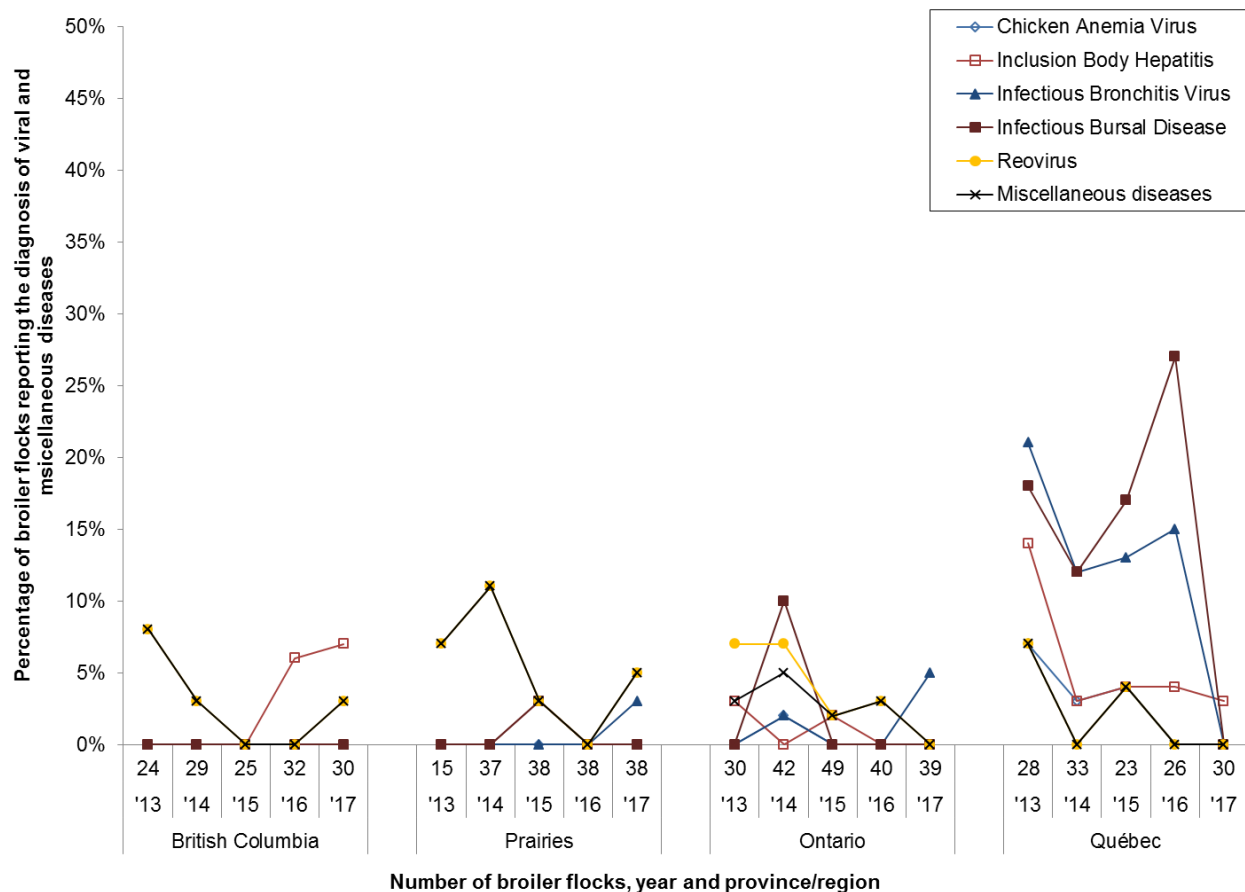
**Figure 1. 3 Percentage of broiler flocks reporting bacterial and protozoal diseases, 2013 to 2017**

Province/region	British Columbia					Prairies					Ontario					Québec				
Year	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Number of flocks	24	29	25	32	30	15	37	38	38	38	30	42	49	40	39	28	33	23	26	30
Diseases																				
Airsacculitis	8%	3%	0%	0%	3%	7%	11%	5%	0%	5%	7%	7%	4%	8%	3%	36%	18%	22%	19%	0%
Yolk sacculitis	13%	34%	28%	6%	17%	13%	27%	18%	16%	26%	47%	40%	33%	25%	15%	21%	12%	39%	19%	10%
Septicemia	8%	10%	12%	6%	10%	7%	19%	13%	3%	3%	20%	17%	22%	18%	13%	14%	6%	4%	15%	7%
Necrotic enteritis ( <i>C. perfringens</i> )	4%	10%	4%	0%	3%	0%	0%	3%	0%	3%	7%	2%	4%	5%	3%	14%	0%	9%	0%	0%
Osteoarthritis or osteomyelitis ( <i>Staphylococcus</i> )	0%	0%	0%	0%	0%	0%	3%	3%	3%	0%	10%	0%	2%	0%	0%	25%	3%	9%	4%	0%
Vertebral osteomyelitis ( <i>E. cecorum</i> )	0%	3%	0%	0%	3%	0%	3%	3%	0%	0%	7%	10%	4%	3%	3%	18%	6%	4%	8%	0%
Salmonellosis	8%	3%	4%	6%	3%	7%	11%	3%	0%	5%	3%	5%	4%	8%	0%	14%	0%	9%	0%	0%
Coccidiosis	0%	3%	4%	3%	0%	0%	0%	3%	0%	8%	30%	10%	18%	18%	8%	36%	30%	26%	19%	17%
Other bacterial or mixed bacterial diseases	8%	3%	0%	0%	3%	7%	11%	3%	0%	5%	3%	7%	2%	3%	0%	7%	0%	4%	0%	0%

Health status was considered to be positive if the questionnaire response was “Confirmed positive” or “Likely positive” plus a response to any or combination of the following: clinical sign, post-mortem or laboratory testing to confirm the diagnosis. Health status was considered to be negative if the questionnaire response was “Confirmed negative” or “Likely negative”. Data above was updated from previous year’s data where only the flocks with confirmatory diagnosis were reported.

In 2017, other bacterial diseases reported were unspecified *E. coli*-associated disease syndromes.

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, 2013 to 2017**

Province/region	British Columbia					Prairies					Ontario					Québec				
Year	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Number of flocks	24	29	25	32	30	15	37	38	38	38	30	42	49	40	39	28	33	23	26	30
Diseases																				
Chicken Anemia Virus	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	7%	3%	4%	0%	0%
Inclusion Body Hepatitis	0%	0%	0%	6%	7%	0%	0%	3%	0%	0%	3%	0%	2%	0%	0%	14%	3%	4%	4%	3%
Infectious Bronchitis Virus	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	2%	0%	0%	5%	21%	12%	13%	15%	0%
Infectious Bursal Disease	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	0%	10%	0%	0%	0%	18%	12%	17%	27%	0%
Reovirus	8%	3%	0%	0%	3%	7%	11%	3%	0%	5%	7%	7%	2%	3%	0%	7%	0%	4%	0%	0%
Miscellaneous diseases	8%	3%	0%	0%	3%	7%	11%	3%	0%	5%	3%	5%	2%	3%	0%	7%	0%	4%	0%	0%

Health status was considered to be positive if the questionnaire response was "Confirmed positive" or "Likely positive" plus a response to any or combination of the following: clinical sign, post-mortem or laboratory testing to confirm the diagnosis. Health status was considered to be negative if the questionnaire response was "Confirmed negative" or "Likely negative". Data above was updated from previous year's data where only the flocks with confirmatory diagnoses were reported.

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

# Chapter 2 Antimicrobial use in broiler chickens

## How to read this chapter

This chapter highlights the most notable antimicrobial use (AMU) findings in broiler chickens. Data are presented as antimicrobial active ingredient (summary table and frequency figures by route of administration) and antimicrobial class (quantitative AMU indicators).

## Terms and definitions apply to this chapter

- **Metric:** also known as technical unit of measurement<sup>2</sup>; 3 different AMU metrics are used throughout this chapter including 1) frequency of use (counts of flocks/herds), 2) milligrams of antimicrobials consumed by the flocks/herds or total quantity (mg) of active ingredients distributed for sale and, 3) number (n) of defined daily doses in animals (DDDvet) using Canadian (CA) standards (nDDDvetCA).
- **Indicator:** is defined as "a metric quantifying use of antimicrobials, usually expressed in relation to a denominator representing the population (at risk)"<sup>3,4</sup>.
- **Dose:** is the recommended or veterinarian-prescribed milligrams of active ingredient administered per kilogram of the animal treated; dose information is indicated in the product label and are available from 2 Canadian references<sup>5,6</sup> or expert opinion<sup>7</sup>.
- **Defined Daily Dose in animals (DDDvet) using Canadian (CA) doses (DDDvetCA):** the DDDvetCA standard is the average of all unique treatment and prevention label doses in milligrams per kg animal per day (unit: mg/kg per day). These are assigned by species. The DDDvetCA standards are listed in the Appendix of the CIPARS 2016 Annual Report<sup>8</sup>. These were developed using an approach similar to

<sup>2</sup> Collineau L, Belloc C, Stärk KD, Hémonic A, Postma M, Dewulf J, and Chauvin C. 2017. Guidance on the Selection of Appropriate Indicators for Quantification of Antimicrobial Use in Humans and Animals. Zoonoses Public Health, 64: 165-184.

<sup>3</sup> Collineau L, Belloc C, Stärk KD, Hémonic A, Postma M, Dewulf J, and Chauvin C. 2017. Guidance on the Selection of Appropriate Indicators for Quantification of Antimicrobial Use in Humans and Animals. Zoonoses Public Health, 64: 165-184.

<sup>4</sup> AACTING Consortium. Guidelines for collection, analysis and reporting of farm-level antimicrobial use, in the scope of antimicrobial stewardship. VERSION 1\_2018-03-21. Available at: <http://www.aacting.org/guidelines/>. Accessed March, 2018.

<sup>5</sup> Compendium of Veterinary Products. Available at: <https://bam.cvpsservice.com/>. Accessed March, 2018.

<sup>6</sup> Compendium of Medicating Ingredients Brochure. Available at: <http://www.inspection.gc.ca/animals/feeds/medicating-ingredients/eng/1300212600464/1320602461227>. Accessed March 2018.

<sup>7</sup> Canadian Association of Poultry Veterinarians. CgFARAD. Available at: <https://www.capv-acva.ca/cgfarad>. Accessed March, 2018.

<sup>8</sup> Government of Canada. Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) 2016 Annual Report. Public Health Agency of Canada, Guelph, Ontario, 2018. Available at: [http://publications.gc.ca/collections/collection\\_2018/aspc-phac/HP2-4-2016-eng.pdf](http://publications.gc.ca/collections/collection_2018/aspc-phac/HP2-4-2016-eng.pdf). Accessed January 2019.

ESVAC's DDDvet assignment with some exceptions<sup>9</sup>. Details of the development of the standards are outlined in the CIPARS 2016 Annual Report methods chapter<sup>10</sup>.

- **Number of Defined Daily Doses (nDDDvetCA) in animals using Canadian standards (DDDvetCA):** is the total milligrams consumed by the flock/herd adjusted by the DDDvetCA standard. This metric is used in the 2 dose-based indicators presented in this report, nDDDvetCA/1,000 animal-days at risk and nDDDvetCA/PCU.
- **Population correction unit (PCU):** also known as animal biomass, is the total of all animals in the surveyed flock/herd (minus half of the mortalities) adjusted by the ESVAC standard body weight (e.g., 1 kg for broilers, 6.5 kg for turkeys, and 65 kg for grower-finisher pigs). For the national distribution data, this pertains to the number of livestock and/or slaughtered animals in each species/production stage adjusted by the ESVAC and Canadian standard body weight (please see methods chapter for details)
- **Animal-days at risk:** also known as "standard-animals at risk"<sup>11</sup>, is a denominator that accounts for the inter-species variations in live animal biomass and duration of the grow-out or observation period<sup>12</sup>. The "animal" component was calculated as above (i.e., total animals in the surveyed flock/herd minus half the mortality rate multiplied by the ESVAC standard body weight) adjusted by the average days at risk or lifespan of the animal (e.g., broiler chickens = 34 days, grower-finisher pigs = 114 days, turkeys = 90 days). The average days at risk vary from year to year due to changes in production practices and other factors (e.g., diseases, genetics).

## Quantitative data of the Farm Surveillance component

The quantitative component of the farm data is presented by route of administration (for broilers and turkeys only) and overall use using the following indicators:

- milligrams/PCU
- nDDDvetCA/1,000 animal-days at risk
- nDDDvetCA/PCU

The AMU indicators nDDDvetCA/1,000 animal-days at risk and nDDDvetCA/PCU are used to better describe sample survey type of data where only a predetermined number of flocks/herds are surveyed each year, the animal population (flock/herd size) varies from year to year, and data is collected for a specified timeframe (i.e., only 1 production cycle or grow-out period per year). The mg/PCU, an indicator used in reporting quantities of antimicrobials

<sup>9</sup> ESVAC. Principles on assignment of defined daily dose for animals (DDDvet) and defined course dose for animals (DCDvet). Available at: [http://www.ema.europa.eu/docs/en\\_GB/document\\_library/Scientific\\_guideline/2015/06/WC500188890.pdf](http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2015/06/WC500188890.pdf).

<sup>10</sup> Government of Canada. Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) 2016 Annual Report. Public Health Agency of Canada, Guelph, Ontario, 2018. Available at: [http://publications.gc.ca/collections/collection\\_2018/aspc-phac/HP2-4-2016-eng.pdf](http://publications.gc.ca/collections/collection_2018/aspc-phac/HP2-4-2016-eng.pdf). Accessed January 2019.

<sup>11</sup> DANMAP. DANMAP 2016. Use of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from food animals, food and humans in Denmark. Available at: <https://www.danmap.org/~media/Projekt%20sites/Danmap/DANMAP%20reports/DANMAP%20%202015/DANMAP%202015.ashx>. Accessed March 2018.

<sup>12</sup> DANMAP. DANMAP 2016. Use of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from food animals, food and humans in Denmark. Available at: <https://www.danmap.org/~media/Projekt%20sites/Danmap/DANMAP%20reports/DANMAP%20%202015/DANMAP%202015.ashx>. Accessed March 2018.

distributed for sale at the national level<sup>13</sup>, is also suggested for the reporting of farm-level data<sup>14</sup>. Table 2. 1 briefly describes the technical units of measurement and indicators used in this chapter. Detailed methodology is found in Chapter 5: Design and methods of the 2016 CIPARS Annual Report. We caution our readers that the scale (vertical axis) varies depending on the indicator, animal species or route of administration; for example, in the broiler chicken and turkey sectors, the mg/PCU values for antimicrobials administered via water and injection were generally lower than the antimicrobials administered via feed.

Summary antimicrobial use data are presented in Table 2. 2, Table 2. 3, and Table 2. 4 for broiler chickens. In this chapter, the data are presented by:

- **Antimicrobial (active ingredient):** counts of flocks that used a specific antimicrobial active ingredient or did not use any antimicrobials; these are shown in the frequency figures and in the year-specific summary tables.
- **Antimicrobial class:** aggregated antimicrobial active ingredient data shown in the quantitative sections for each route of administration (feed, water, injection, if data are available) and the combined routes (for broiler chickens and turkeys only). The use indicators described on the next page, Table 2. 1, are presented by antimicrobial class).
- **Total antimicrobials used:** annual aggregated antimicrobial class data shown in the summary tables (broiler chickens: Table 2. 3 and Table 2. 4).

To harmonize with other international surveillance programs<sup>15,16</sup> the figures and tables do not include the coccidiostats. These antimicrobial agents are described in a separate subsection.

<sup>13</sup> ESVAC. Sales of veterinary antimicrobial agents in 20 European countries in 2015. Trends from 2010 to 2015. Seventh ESVAC Report. Available at: [http://www.ema.europa.eu/docs/en\\_GB/document\\_library/Report/2017/10/WC500236750.pdf](http://www.ema.europa.eu/docs/en_GB/document_library/Report/2017/10/WC500236750.pdf). Accessed March 2018.

<sup>14</sup> EMA, 2018. Guidance on collection and provision of national data on antimicrobial use by animal species/categories. EMA/489035/2016. Available at: [http://www.ema.europa.eu/docs/en\\_GB/document\\_library/Scientific\\_guideline/2017/03/WC500224492.pdf](http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2017/03/WC500224492.pdf). Accessed March 2018.

<sup>15</sup> ESVAC. Sales of veterinary antimicrobial agents in 20 European countries in 2015. Trends from 2010 to 2015. Seventh ESVAC Report.

<sup>16</sup> DANMAP. Available at: <https://www.danmap.org/~media/Projekt%20sites/Danmap/DANMAP%20reports/DANMAP%20%202015/DANMAP%202015.ashx>. Accessed March 2018.

**Table 2. 1 Antimicrobial technical units of measurement and indicators used in this chapter**

Indicator	Numerator	Denominator
<b>Frequency of use</b>	Number of flocks/herd exposed	Total flocks/herds sampled
$\text{Percentage of flocks exposed/treated} = \frac{\text{Number of flocks or herds exposed}}{\text{Total flocks or herds sampled}} \times 100$		
<b>Frequency of rations</b>	Number of medicated or unmedicated rations	Total number of rations
$\text{Percentage of rations medicated} = \frac{\text{Number of rations medicated}}{\text{Total rations fed}} \times 100$		
<b>kg (distribution data)</b>	Antimicrobials (kg) distributed by CAHI member companies for use in production and companion animal in Canada	N/A
$\text{Kilograms distributed in production animals} + \text{companion animals}$		
<b>Population correction unit (mg/PCU), distribution data</b>	Total population multiplied by the standard weight of animals at time of treatment	N/A
$\text{Total population} \times \text{std. weight of animals in kg at time of treatment}$		
<b>mg/population correction unit (mg/PCU), distribution data</b>	Total quantity of antimicrobials distributed for sale by CAHI member companies (mg)	Biomass: total population, adjusted by the standard animal weights (kg) at treatment (see Chapter 5: Design and methods)
$\text{mg/PCU} = \frac{\text{Antimicrobials distributed (mg)}}{\text{PCU (kg)}}$		
<b>mg/population correction unit (mg/PCU), farm data</b>	Total quantity of antimicrobials consumed by the surveyed animals for one grow-out period in mg	Population correction unit or Biomass: total population minus half of the mortality rate, adjusted by the standard weight of broiler (1 kg), pig (65 kg) or turkey (6.5 kg)
$\text{mg/PCU} = \frac{\text{Feed (mg)} + \text{water (mg)} + \text{injection (mg)}}{\text{PCU (total animals} \times \text{std. weight in kg)}}$		
<b>nDDVetCA/1,000 animal-days at risk</b>	Total quantity of antimicrobials consumed by the surveyed flock/herd in mg adjusted for defined daily dose in animals using Canadian standard (mg/DDVetCA <sub>mg/kg/day</sub> ) <sup>a</sup>	Total number of animals minus half of the mortality rate multiplied by the weight of the animal and the average days at risk <sup>b</sup>
Final step: value multiplied by 1,000		
$\text{nDDVetCA/1,000 animal days at risk} = \left( \frac{\text{Total milligrams/DDVetCA}_{\text{mg/kg/day}}}{\text{Total animals} \times \text{std. weight in kg} \times \text{average days at risk}} \right) \times 1,000$		
<b>nDDVetCA/population correction unit</b>	Total quantity of antimicrobials consumed by the surveyed flock/herd in mg adjusted for defined daily dose in animals using Canadian standard (mg/DDVetCA <sub>mg/kg/day</sub> ) <sup>a</sup>	Population correction unit or Biomass: total population minus half of the mortality rate, adjusted by the standard animal weight of broiler (1 kg), pig (65 kg) or turkey (6.5 kg)
$\text{nDDVetCA/PCU} = \frac{\text{Total milligrams/DDVetCA}_{\text{mg/kg/day}}}{(\text{Total animals} \times \text{std. weight in kg})}$		

CAHI = Canadian Animal Health Institute. N/A = not applicable.

For detailed and step-by-step calculations, please refer to Chapter 5: Design and methods of the 2016 CIPARS Annual Report.

<sup>a</sup> DDDvetCA standard is in mg/kg per day; please refer to the species-specific standards in Table A. 1 and Table A. 2 of Chapter 5: Design and methods of the 2016 CIPARS Annual Report.

<sup>b</sup> Average days at risk is year-specific (e.g., broiler chickens = 34 days, grower-finisher pigs = 114 days, turkeys = 90 days).

## Farm Surveillance in broiler chickens

### Key findings

#### Administration in feed

- Antimicrobials administered via feed represented the greatest route of administration/exposure in terms of frequency and quantity (Table 2. 3, Figure 2. 1, Figure 2. 2, Figure 2. 3, Figure 2. 4, and Figure 2. 5). The top 3 most frequently used antimicrobial classes in terms of mg/PCU were bacitracins, streptogramins and orthosomycins. These antimicrobial classes plus all the other antimicrobial classes used via feed (except trimethoprim-sulfonamide) were reportedly used for the prevention of necrotic enteritis.
- Overall, the quantity of antimicrobials decreased marginally between 2016 and 2017 by 2% in terms of mg/PCU (Figure 2. 1), nDDDvetCA/1,000 broiler chicken-days at risk by 8% (Figure 2. 3) and nDDDvetCA/PCU by 7% (Figure 2. 4). There were provincial/regional variations noted (Table 2. 4) as a result of a change in the quantity of antimicrobials administered via feed; Québec had the greatest magnitude of decrease (Figure 2. 7, Figure 2. 8, and Figure 2. 9).

#### Administration in water

- As in the previous years, the proportion of producers that reported the use of antimicrobials via water was relatively low at 7% (Figure 2. 10) and there were no marked differences in frequency observed between the provinces/regions (Figure 2. 11). The total quantity of antimicrobials used via this route contributed to only 6% of the total quantity of antimicrobials in terms of mg/PCU (Figure 2. 2).

#### Administration *in ovo* or subcutaneous injection

- Twenty seven percent (37/138) of broiler producers reported that the chicks delivered to their barn were medicated at the hatchery. This reported use of antimicrobials at the hatchery is up by 4% from the previous year (Figure 2. 15); the quantity of antimicrobials contributed to less than 1% of the overall use in terms of mg/PCU. Lincomycin-spectinomycin (20%) and gentamicin (6%) were the antimicrobials administered at the hatchery for the prevention of diseases associated with avian pathogenic *E. coli* such as yolk sac infection and septicemia. The reported frequency of lincomycin-spectinomycin use in 2017 was significantly higher in Québec (68%) compared to the other provinces/regions sampled (3 to 8%) (Figure 2. 16).
- For three consecutive years (2015 to 2017), there were no producers that reported the use of Veterinary Drugs Directorate's Category I antimicrobials by any route of administration (Table 2. 3, Figure 2. 5, Figure 2. 11, and Figure 2. 15).

#### Ionophores, chemical coccidiostats and other antiprotozoal agents

- Coccidiostats used for the prevention of coccidiosis (*Eimeria* spp.), contributed to 58% of the total quantity of antimicrobials used in broilers in 2017. Overall, 76% of the flocks used ionophores and 39% used chemical coccidiostats (Figure 2. 20); the

proportion of flocks using specific coccidiostats varied by province/region (Figure 2. 21 and Figure 2. 22). Salinomycin, narasin-nicarbazin and monensin were the top 3 most frequently used coccidiostats (Figure 2. 20).

## Summary of antimicrobials used by routes of administration

**Table 2. 2 Number of broiler flocks with reported antimicrobial use by route of administration, 2017**

Antimicrobial use	Route of administration			
	Any route <sup>a</sup> n (%)	<i>In ovo</i> /subcutaneous n (%)	Feed n (%)	Water n (%)
Any antimicrobial use	112 (81)	37 (27)	112 (82)	11 (8)
No antimicrobial use <sup>b</sup>	26 (19)	101 (73)	25 (18)	126 (92)
<b>Total flocks</b>	<b>138 (100)</b>	<b>138 (100)</b>	<b>137 (100)</b>	<b>137 (100)</b>

<sup>a</sup> 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.

<sup>b</sup> These were flocks not medicated with any of the antimicrobials listed in Table 2. 3 (next page).

**Table 2. 3 Frequency and quantity of antimicrobial use in broiler chickens, 2017**

Quantity of antimicrobial active ingredient <sup>c</sup>								
Route of administration	Antimicrobial	Flocks n (%)	Ration n (%)	Days exposed median (min. ; max.) <sup>a</sup>	Level of drug median (min. ; max.) <sup>b</sup>	mg/PCU	nDDDvetCA/ 1,000 Broiler chicken-days at risk	nDDDvetCA/ PCU
Feed		g/tonne						
II	Tylosin	6 (4)	11 (2)	8 (6 ; 14)	22 (22 ; 22)	1	1	0.04
	Penicillin G procaine	13 (9)	24 (5)	7 (3 ; 14)	55 (31 ; 110)	5	27	0.92
	Virginiamycin	34 (25)	89 (18)	9 (1 ; 30)	22 (11 ; 44)	13	128	4.38
	Trimethoprim sulfadiazine	7 (5)	7 (1)	10 (3 ; 14)	300 (200 ; 300)	14	61	2.09
III	Bacitracin	73 (53)	192 (38)	9 (2 ; 17)	55 (55 ; 110)	77	224	7.65
	Oxytetracycline	1 (1)	1 (< 1)	10 (10 ; 10)	440 (440 ; 440)	2	4	0.13
IV	Bambermycin	5 (4)	15 (3)	8 (1 ; 11)	2 (2 ; 2)	0.1		
N/A	Avilamycin	37 (27)	67 (13)	8 (2 ; 16)	20 (15 ; 30)	8	79	2.69
No AMU in feed		25 (18)	98 (19)					
Total feed, medicated		112 (82)	406 (81)			120	523	17.89
Water		Treatment (n)			g/Liter			
II	Amoxicillin	1 (1)	1	5 (5 ; 5)	0.1 (0.1 ; 0.1)	0.4	1	0.03
	Penicillin	1 (1)	1	4 (4 ; 4)	0.2 (0.2 ; 0.2)	2.9	2.0	0.07
	Penicillin-streptomycin	5 (4)	5	5 (4 ; 5)	0.1 (0.1 ; 0.1)	0.6	2	0.05
III	Sulfamethazine	2 (1)	2	6 (6 ; 6)	1.0 (1.0 ; 1.0)	3	0.3	0.01
	Tetracycline	1 (1)	1	4 (4 ; 4)	0.1 (0.1 ; 0.1)	0.1	0.1	0.00
	Tetracycline-neomycin	1 (1)	1	5 (5 ; 5)	0.2 (0.2 ; 0.2)	0.3	0.4	0.01
No AMU in water		126 (92)						
Total water, medicated		11 (8)	17			7	5.4	0.18
Injection		mg/egg or chick						
II	Gentamicin	8 (6)			0.2	0.01	0.03	0.001
	Lincomycin-spectinomycin	27 (20)			0.75	0.1	0.5	0.02
No AMU via injection		101 (73)						
Total injection		37 (27)				0.2	0.5	0.02
All routes <sup>d</sup>		112 (81)				127	529	18.09

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). ESVAC = European Surveillance of Veterinary Antimicrobial Consumption. 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<sub>drug</sub>/kg<sub>animal</sub>/day); please refer to the species-specific standards in Table A. 1 of Chapter 5: Design and methods of the 2016 CIPARS Annual Report.

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

nDDDvetCA/PCU = number of DDDvetCA/population correction unit.

For detailed indicator description, please refer to Table 2. 1.

<sup>a</sup> Days exposed are by ration (not full grow-out) or 1 course of water treatment.

<sup>b</sup> Level of drug is in grams/tonne of feed or grams/liter drinking water. In water, "grams" is the inclusion rate multiplied by the concentration of the drug in that product. In chicks or hatching eggs, level of drug is in milligrams per chick or hatching egg, as reported by the veterinarian/producer.

<sup>c</sup> Total quantity of antimicrobials were calculated based on standard feed or water consumed (feed and water were estimated based on breed standards).

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

**Table 2. 4 Production, biomass and quantity of antimicrobials use by province/region, 2013 to 2017**

Province/ region	Year	Number of flocks	Pre-harvest weight mean (kg)	Age sampled mean (days)	Active ingredient (mg)	Broiler weights (kg) <sup>a</sup>	mg/PCU		nDDDvetCA/1,000 broiler chicken- days at risk		nDDDvetCA/PCU	
							Total	% change <sup>b</sup>	Total	% change <sup>b</sup>	Total	% change <sup>b</sup>
British Columbia	2013	24	1.9	33	54,512,352	522,525	104		484		16	
	2014	29	1.9	33	67,656,030	650,756	104	0	380	-22	12	-22
	2015	25	2.0	33	54,790,215	592,652	92	-11	403	6	14	9
	2016	32	2.0	33	73,658,806	765,987	96	4	493	22	16	21
	2017	30	2.0	34	71,972,475	732,417	98	2	431	-13	15	-9
Prairies	2013	15	1.7	33	58,620,413	453,936	129		482		16	
	2014	37	1.9	34	153,638,071	910,594	169	31	448	-7	15	-6
	2015	38	1.9	34	95,991,943	746,106	129	-24	424	-5	14	-6
	2016	38	1.9	34	137,573,040	857,215	160	25	606	43	20	41
	2017	38	1.9	34	123,628,913	790,810	156	-3	561	-7	19	-6
Ontario	2013	30	2.4	38	132,530,015	740,183	179		688		26	
	2014	42	2.2	36	172,669,256	999,661	173	-4	630	-8	22	-14
	2015	49	2.4	38	228,313,087	1,204,851	189	10	679	8	25	13
	2016	40	2.2	36	111,982,379	884,702	127	-33	603	-11	21	-15
	2017	39	2.3	36	140,688,575	987,244	142	13	613	2	22	3
Québec	2013	28	1.9	33	81,361,944	581,995	139		635		21	
	2014	33	2.0	33	110,529,348	739,406	149	7	594	-6	20	-6
	2015	23	1.8	33	69,394,742	491,834	140	-6	470	-21	15	-22
	2016	26	1.9	33	73,168,534	544,595	134	-5	599	28	19	27
	2017	30	1.9	32	71,134,309	702,314	101	-25	470	-21	15	-22
National <sup>c</sup>	2013	99	2.0	34	326,491,338	2,298,639	142		591		20	
	2014	143	2.0	34	503,883,579	3,300,417	153	7	524	-11	18	-13
	2015	136	2.1	35	447,695,719	3,035,442	147	-3	535	2	19	5
	2016	136	2.0	34	395,928,412	3,052,498	130	-12	576	8	19	5
	2017	138	2.0	34	407,235,868	3,212,784	127	-2	529	-8	18	-7

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 ( $\text{mg}_{\text{drug}}/\text{kg}_{\text{animal}}/\text{day}$ ); please refer to the species-specific standards in Table A. 1 of Chapter 5: Design and methods of the 2016 CIPARS Annual Report.

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

nDDDvetCA/PCU = number of DDDvetCA/population correction unit.

For detailed indicator description, please refer to Table 2. 1.

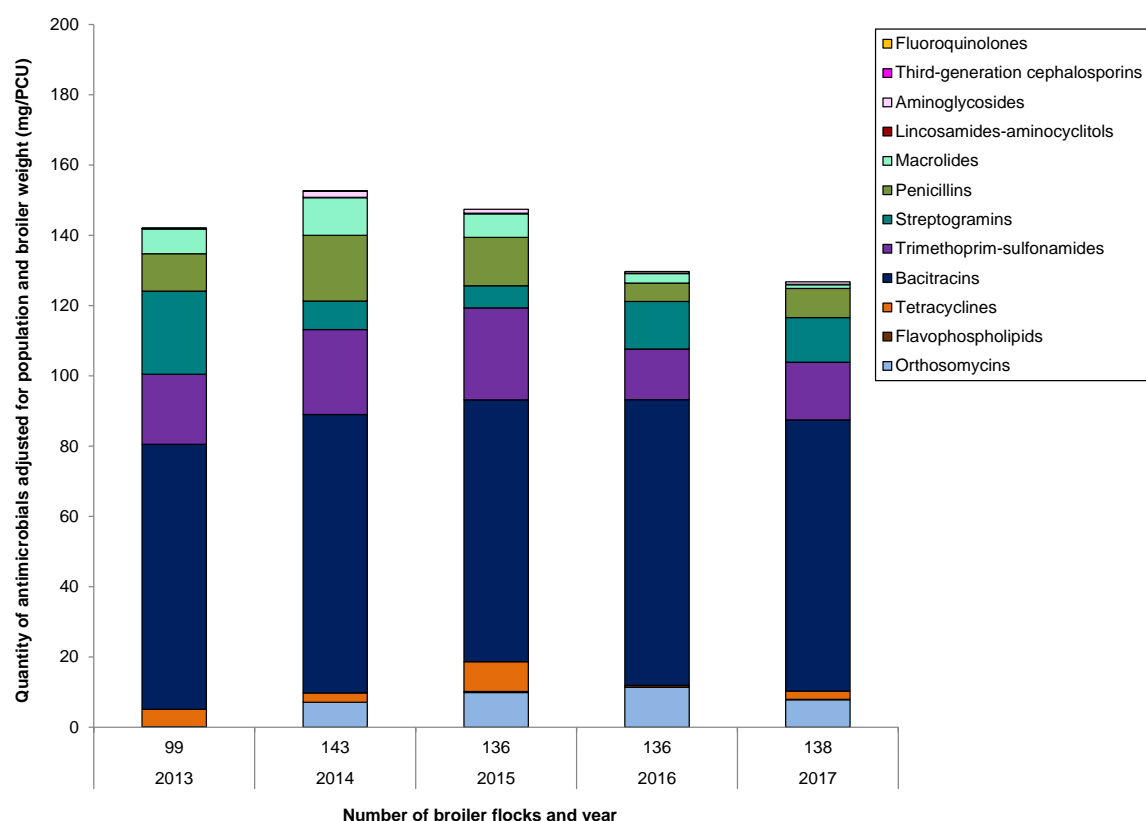
The Prairies is a region including the provinces of Alberta and Saskatchewan.

<sup>a</sup> Population correction unit (PCU) or biomass, European weight (total flock population x ESVAC standard weight of 1 kg bird).

<sup>b</sup> Percent change =  $[(\text{current surveillance year} - \text{previous surveillance year})/\text{previous surveillance year}] \times 100$ .

<sup>c</sup> 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 2017**



Year	2013	2014	2015	2016	2017
Number of flocks	99	143	136	136	138
<b>Antimicrobial class</b>					
I Fluoroquinolones	< 0.1	0	0	0	0
I Third-generation cephalosporins	< 0.1	< 0.1	0	0	0
Aminoglycosides	< 0.1	2	1	0.5	1
Lincosamides-aminocyclitols	0.1	0.1	0.2	0.1	0.1
II Macrolides	7	11	7	3	1
II Penicillins	11	19	14	5	8
Streptogramins	24	8	6	14	13
Trimethoprim and sulfonamides	20	24	26	14	16
III Bacitracins	75	79	74	82	77
III Tetracyclines	5	3	8	0	2
IV Flavophospholipids	0.2	0	0.3	< 0.1	0.1
N/A Orthosomycins	0	7	10	11	8
<b>Total</b>	<b>142</b>	<b>153</b>	<b>147</b>	<b>130</b>	<b>127</b>

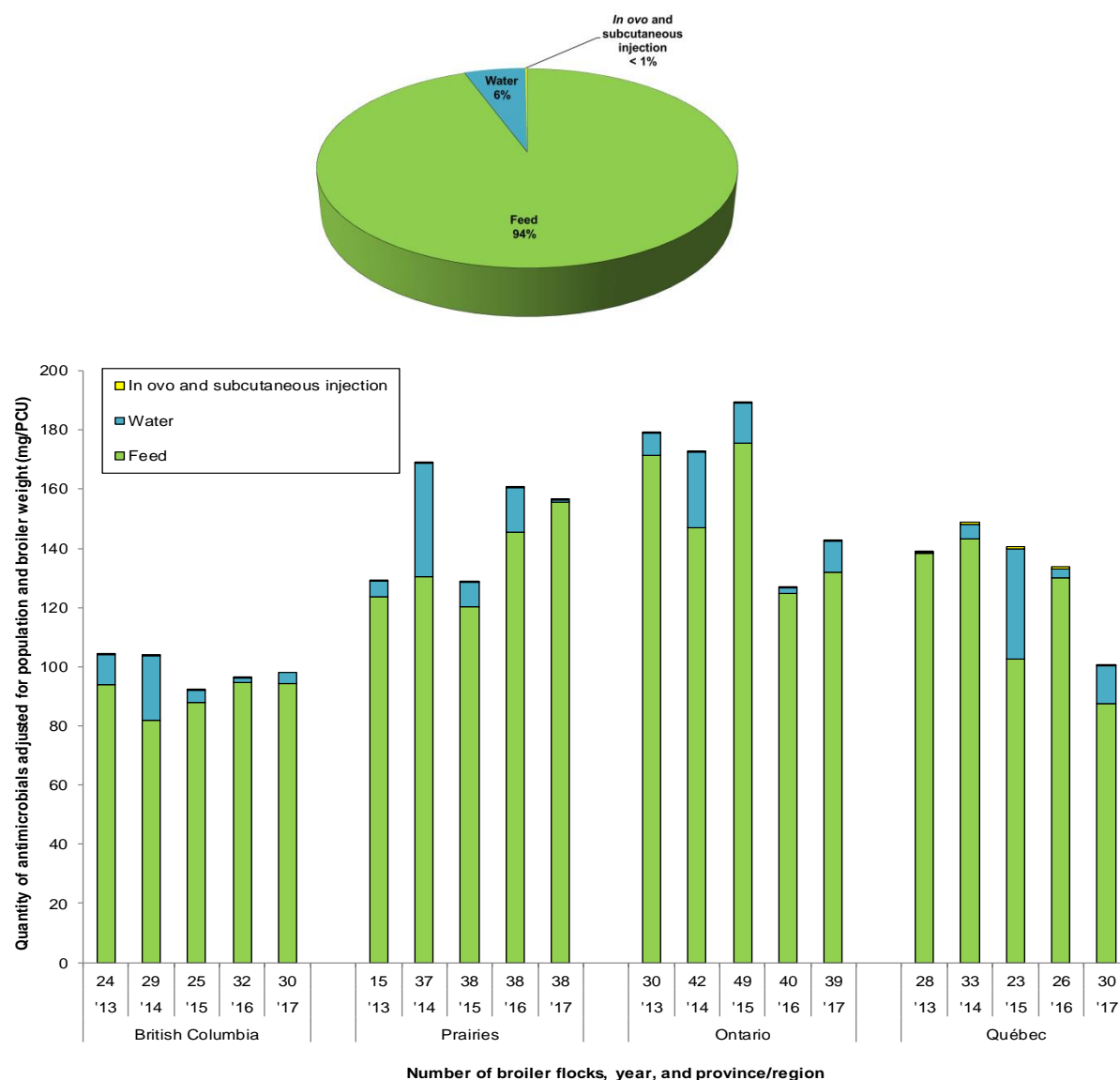
Roman numerals I to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification available at the time of writing of this report).

Flavophospholipids intended for growth promotion and had lower dosing than prevention or treatment dosing was not included in the estimates.

mg/PCU = milligrams/population correction unit.

For detailed indicator description, please refer to Table 2. 1.

**Figure 2. 2 Quantity of antimicrobials, adjusted for population and broiler weight (mg/PCU), in 2017 and by province/region, 2013 to 2017**



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17
Number of flocks	24	29	25	32	30	15	37	38	38	38	30	42	49	40	39	28	33	23	26	30
Route of administration																				
Feed	94	82	88	95	94	123	130	120	146	156	171	147	176	125	132	138	143	103	130	88
Water	10	22	4	1	4	5	38	8	15	0	8	26	13	2	10	1	5	37	3	13
In ovo and subcutaneous injection	0.1	0.1	0.3	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.2	0.0	0.0	0.6	0.6	0.6	0.7	0.5
Total	104	104	92	96	98	129	169	129	160	156	179	173	189	127	142	139	149	140	134	101

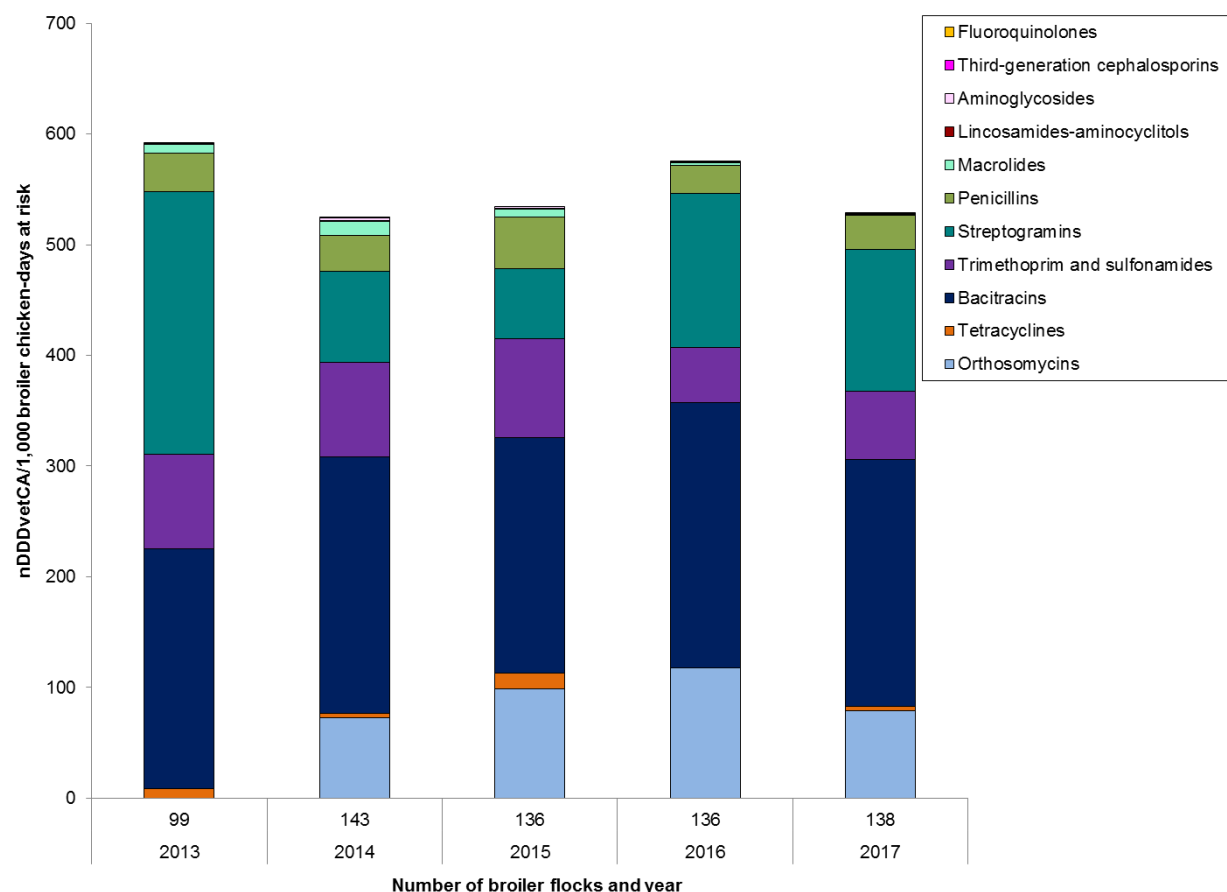
Ionophores, chemical coccidiostats and flavophospholipids used in feed and antiprotozoals used in water (e.g., pyrimethamine, a diaminopyrimidine) were excluded in the estimates above.

mg/PCU = milligrams/population correction unit.

For detailed indicator description, please refer to Table 2. 1.

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 2017**



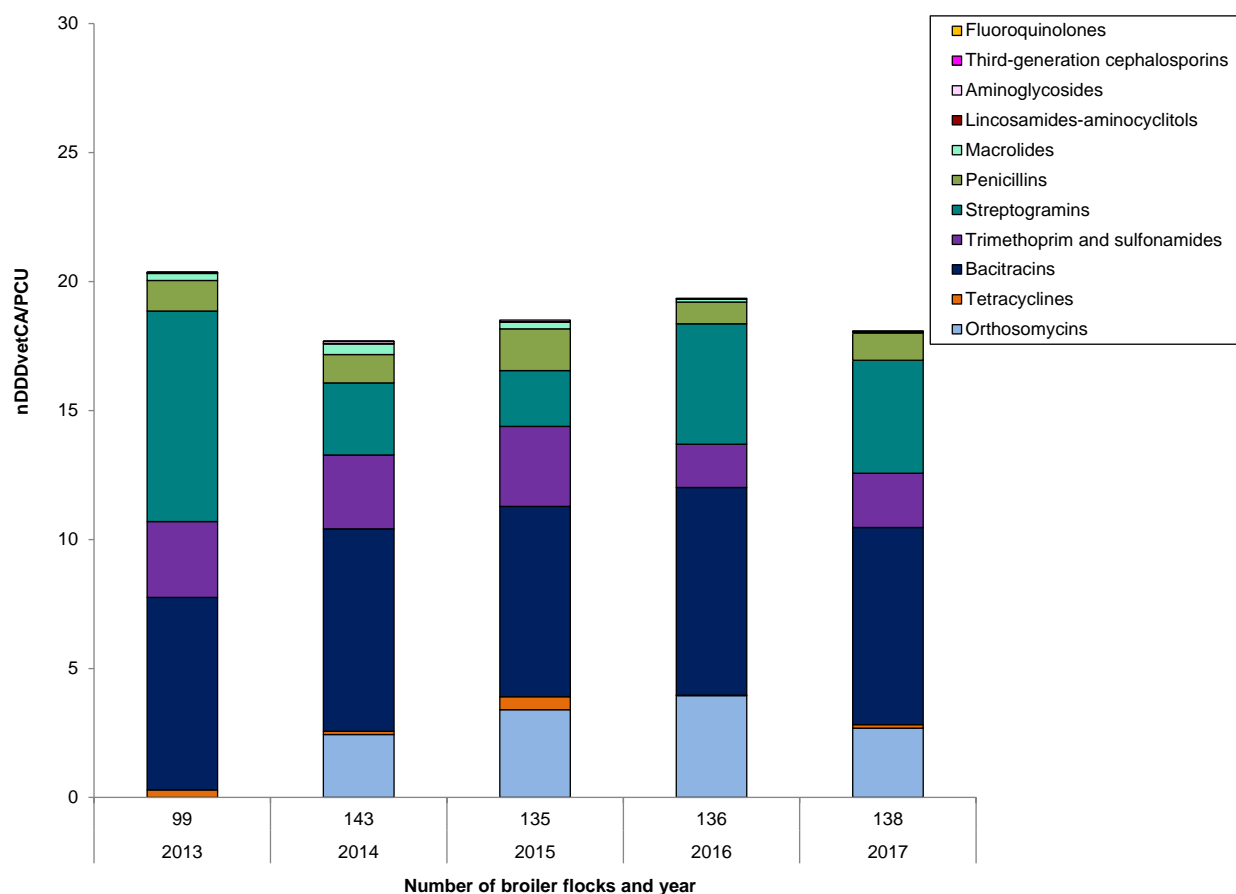
Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. N/A = not applicable (no classification at the time of writing of this report).

DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram broiler weight per day ( $\text{mg}_{\text{drug}}/\text{kg}_{\text{animal}}/\text{day}$ ); please refer to Table A. 1 of Chapter 5: Design and methods of the 2016 CIPARS Annual Report 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 description, please refer to Table 2. 1.

**Figure 2. 4 Number of Canadian Defined Daily Doses for animals per population correction unit (nDDDvetCA/PCU) for all routes of administration, 2013 to 2017**



Year	2013	2014	2015	2016	2017
Number of flocks	99	143	136	138	138
<b>Antimicrobial class</b>					
I Fluoroquinolones	< 0.1	0	0	0	0
I Third-generation cephalosporins	< 0.1	< 0.1	0	0	0
Aminoglycosides	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Lincosamides-aminocyclitols	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
II Macrolides	0.3	0.4	0.3	0.1	< 0.1
II Penicillins	1.2	1.1	1.6	0.8	1.0
II Streptogramins	8.2	2.8	2.2	4.7	4.4
Trimethoprim and sulfonamides	2.9	2.9	3.1	1.7	2.1
III Bacitracins	7.5	7.8	7.4	8.1	7.6
III Tetracyclines	0.3	0.1	0.5	< 0.1	0.1
N/A Orthosomycins	0.0	2.4	3.4	3.9	2.7
<b>Total</b>	<b>20.4</b>	<b>17.7</b>	<b>18.5</b>	<b>19.4</b>	<b>18.1</b>

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).

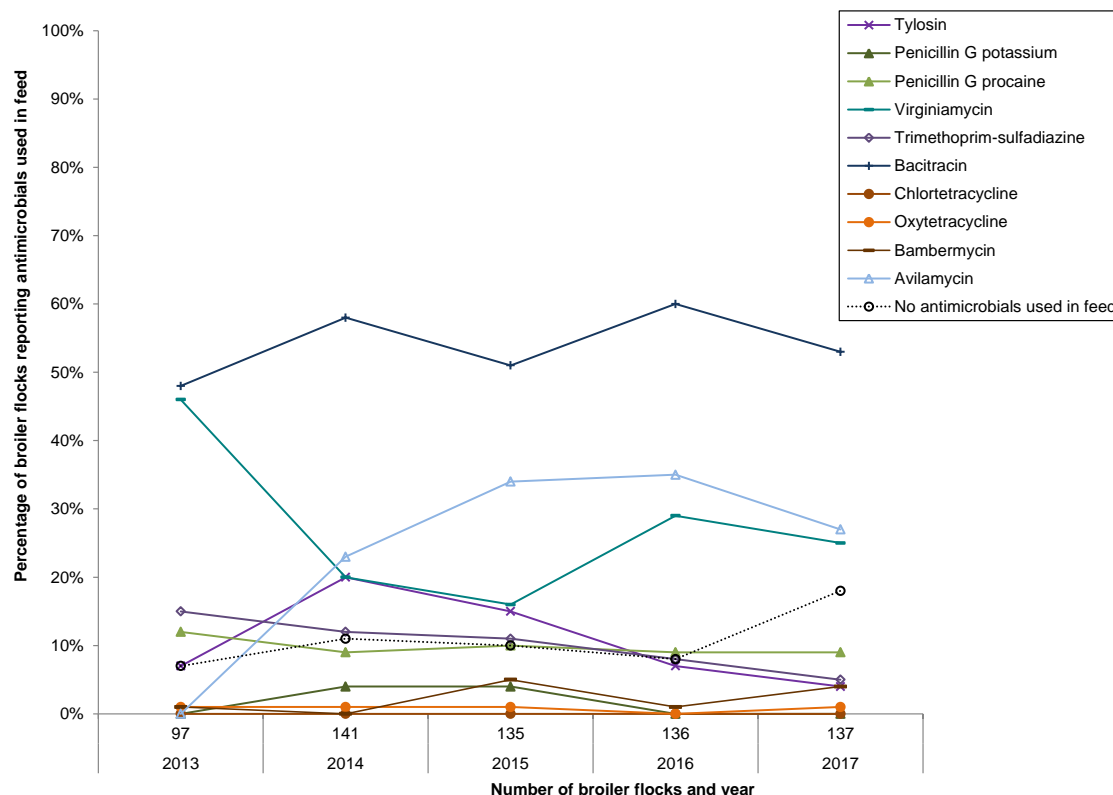
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram broiler weight per day ( $\text{mg}_{\text{drug}}/\text{kg}_{\text{animal}}/\text{day}$ ); please refer to Table A. 1 of Chapter 5: Design and methods of the 2016 CIPARS Annual Report for the list of standards.

nDDDvetCA/PCU = number of DDDvetCA/population correction unit.

For detailed indicator description, please refer to Table 2. 1.

## Antimicrobial use in feed by frequency

**Figure 2. 5 Percentage of broiler flocks reporting antimicrobial use in feed, 2013 to 2017**



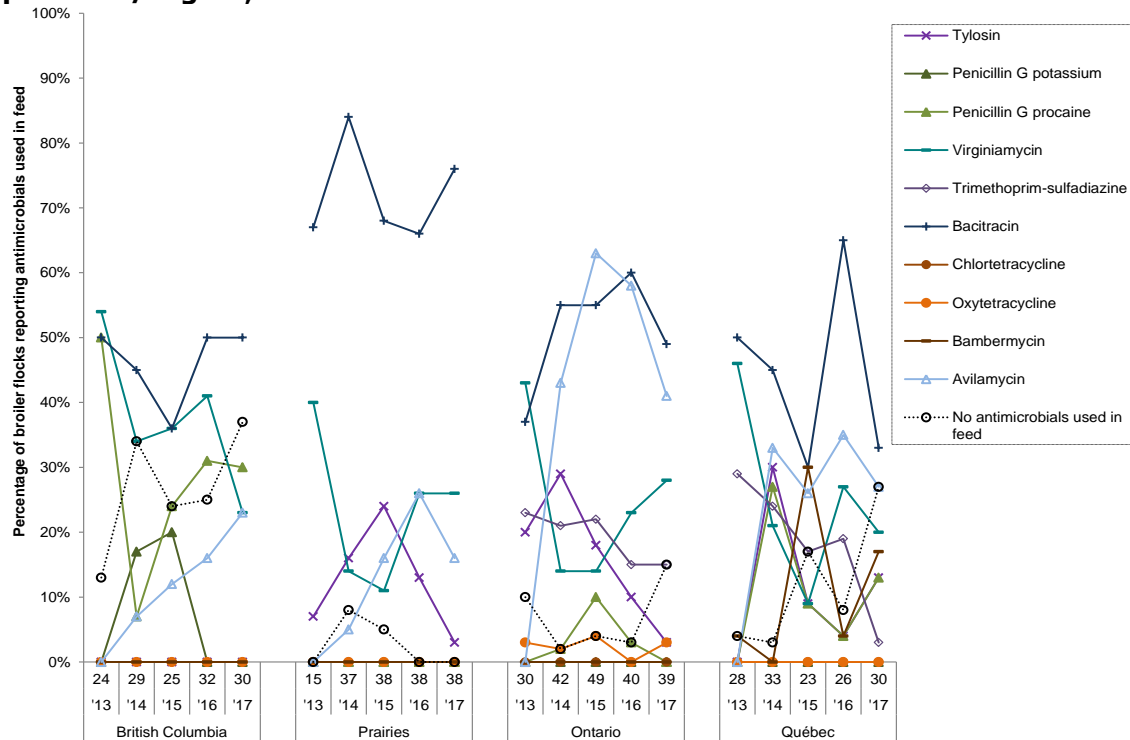
Year	2013	2014	2015	2016	2017
Number of flocks	97	141	135	136	137
<b>Antimicrobial</b>					
I Tylosin	7%	20%	15%	7%	4%
II Penicillin G potassium	0%	4%	4%	0%	0%
II Penicillin G procaine	12%	9%	10%	9%	9%
II Virginiamycin	46%	20%	16%	29%	25%
II Trimethoprim-sulfadiazine	15%	12%	11%	8%	5%
III Bacitracin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

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" pertains to flocks that did not use any of the antimicrobial classes included in this figure (Categories II to IV and avilamycin).

**Figure 2. 6 Percentage of broiler flocks reporting antimicrobials used in feed by province/region, 2013 to 2017****Number of broiler flocks, year and province/region**

Province/region	British Columbia					Prairies					Ontario					Québec					
Year	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	
Number of flocks	24	29	25	32	30	15	37	38	38	38	30	42	49	40	39	28	33	23	26	30	
Antimicrobial																					
II	Tylosin	0%	0%	0%	0%	0%	7%	16%	24%	13%	3%	20%	29%	18%	10%	3%	0%	30%	9%	4%	13%
	Penicillin G potassium	0%	17%	20%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Penicillin G procaine	50%	7%	24%	31%	30%	0%	0%	0%	0%	0%	0%	2%	10%	3%	0%	0%	27%	9%	4%	13%
	Virginiamycin	54%	34%	36%	41%	23%	40%	14%	11%	26%	26%	43%	14%	14%	23%	28%	46%	21%	9%	27%	20%
	Trimethoprim-sulfadiazine	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	23%	21%	22%	15%	15%	29%	24%	17%	19%	3%
III	Bacitracin	50%	45%	36%	50%	50%	67%	84%	68%	66%	76%	37%	55%	55%	60%	49%	50%	45%	30%	65%	33%
	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%	3%	2%	4%	0%	3%	0%	0%	0%	0%	0%
IV	Bambermycin	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%	30%	4%	17%
NA	Avilamycin	0%	7%	12%	16%	23%	0%	5%	16%	26%	16%	0%	43%	63%	58%	41%	0%	33%	26%	35%	27%
No antimicrobials used in feed																					
	13%	34%	24%	25%	37%	0%	8%	5%	0%	0%	10%	2%	4%	3%	15%	4%	3%	17%	8%	27%	

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).

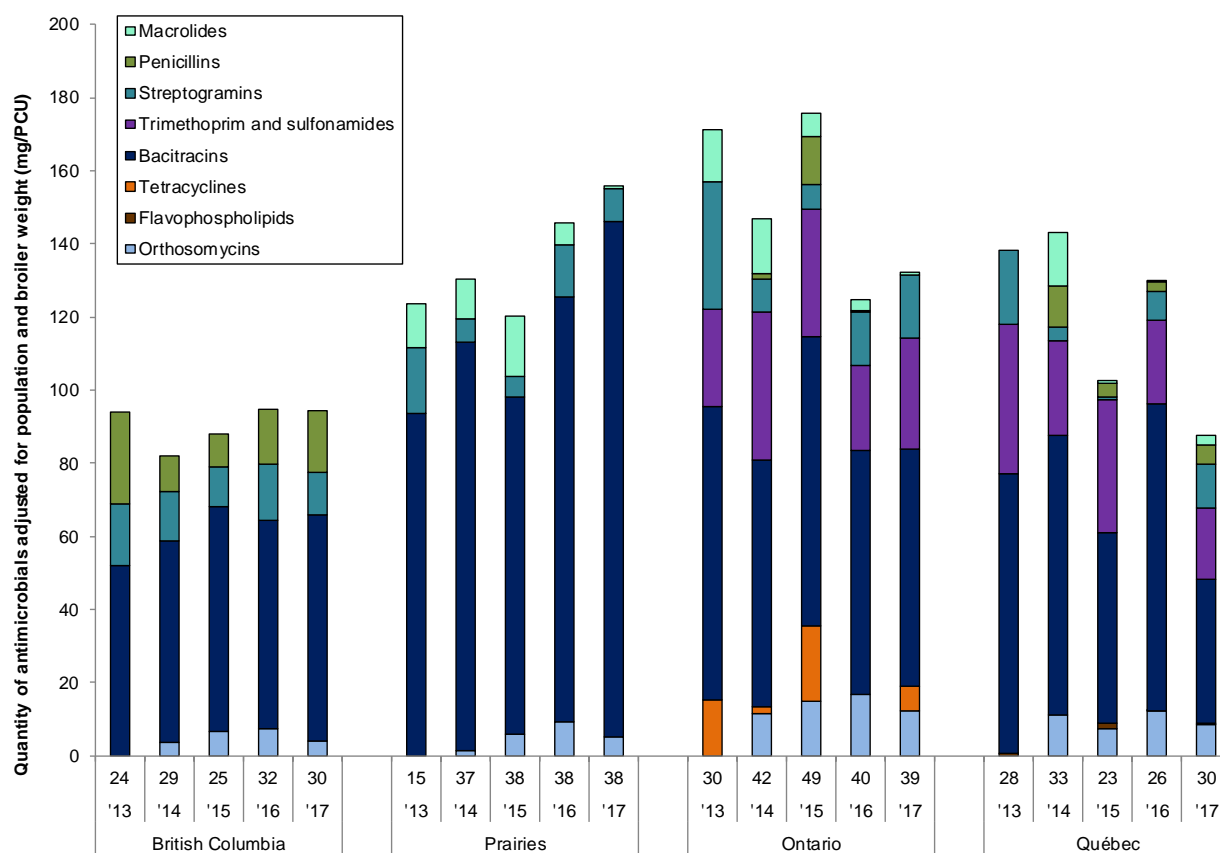
Numbers per column may not add up to 100% as some flocks may have used an antimicrobial more than once or used multiple antimicrobials throughout the grow-out period.

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 first 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 (2017 surveillance year; Québec-referent province) indicates significant temporal and provincial/regional 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 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. 7 Quantity of antimicrobials used in feed adjusted for population and broiler weight (mg/PCU), 2013 to 2017**

Province/region	British Columbia					Prairies					Ontario					Québec				
Year	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Number of flocks	24	29	25	32	30	15	37	38	38	38	30	42	49	40	39	28	33	23	26	30
Antimicrobial class																				
II Macrolides	0	0	0	0	0	12	11	16	6	1	14	15	6	3	1	0	15	1	1	3
II Penicillins	25	10	9	15	17	0	0	0	0	0	0	2	13	0	0	0	11	3	2	5
II Streptogramins	17	13	11	15	12	18	7	6	14	9	35	9	7	15	17	20	4	1	8	12
II Trimethoprim and sulfonamides	0	0	0	0	0	0	0	0	0	0	27	40	35	23	31	41	26	36	23	19
III Bacitracins	52	55	61	57	63	93	111	92	117	141	80	68	79	67	65	76	76	52	84	39
III Tetracyclines	0	0	0	0	0	0	0	0	0	0	15	2	20	0	7	0	0	0	0	0
IV Flavophospholipids	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	1
N/A Orthosomycins	0	4	7	7	4	0	1	6	9	5	0	11	15	17	12	0	11	7	12	8
<b>Total</b>	<b>94</b>	<b>82</b>	<b>88</b>	<b>95</b>	<b>96</b>	<b>123</b>	<b>130</b>	<b>120</b>	<b>146</b>	<b>156</b>	<b>171</b>	<b>147</b>	<b>175</b>	<b>125</b>	<b>132</b>	<b>138</b>	<b>143</b>	<b>103</b>	<b>130</b>	<b>88</b>

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).

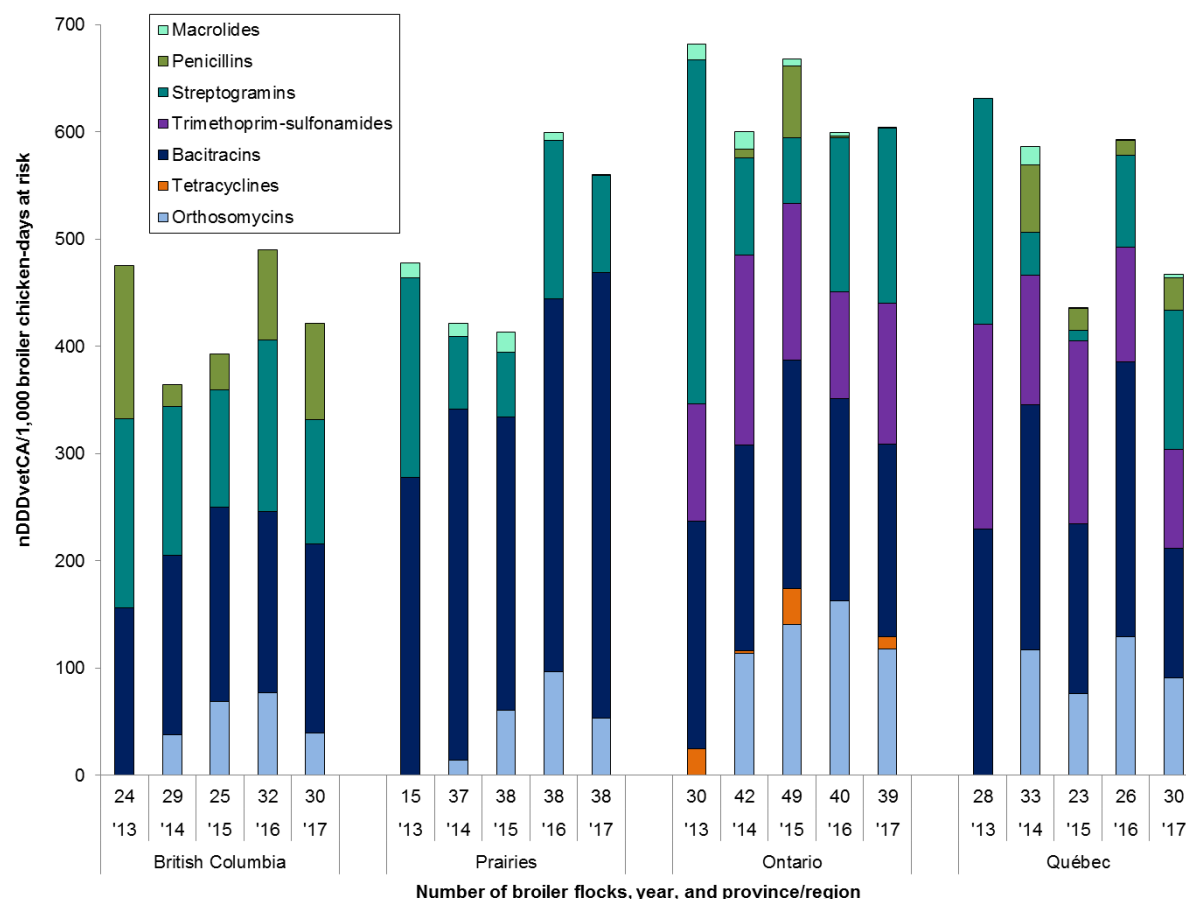
Flavophospholipids intended for growth promotion and had lower dosing than prevention or treatment dosing was not included in the estimates.

mg/PCU = milligrams/population correction unit.

For detailed indicator description, please refer to Table 2. 1.

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

**Figure 2. 8 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, 2013 to 2017**



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17
Number of flocks	24	29	25	32	30	15	37	38	38	38	30	42	49	40	39	28	33	23	26	30
Antimicrobial class																				
Macrolides	0	0	0	0	0	14	12	19	7	1	15	17	7	4	1	0	17	1	1	3
Penicillins	142	20	33	84	90	0	0	0	0	0	0	8	66	2	0	0	62	20	14	30
Streptogramins	177	139	109	161	116	186	68	60	148	91	321	91	62	143	163	211	41	10	86	130
Trimethoprim and sulfonamides	0	0	0	0	0	0	0	0	0	0	109	177	146	100	132	191	120	171	107	92
Bacitracins	156	167	182	169	176	278	327	273	348	415	212	192	213	188	179	230	229	158	257	121
Tetracyclines	0	0	0	0	0	0	0	0	0	0	25	3	33	0	12	0	0	0	0	0
N/A Orthosomycins	0	38	68	77	40	0	14	61	96	53	0	113	141	163	118	0	117	77	129	91
<b>Total</b>	<b>475</b>	<b>365</b>	<b>393</b>	<b>490</b>	<b>422</b>	<b>478</b>	<b>421</b>	<b>413</b>	<b>599</b>	<b>560</b>	<b>682</b>	<b>601</b>	<b>668</b>	<b>600</b>	<b>604</b>	<b>632</b>	<b>586</b>	<b>436</b>	<b>593</b>	<b>467</b>

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).

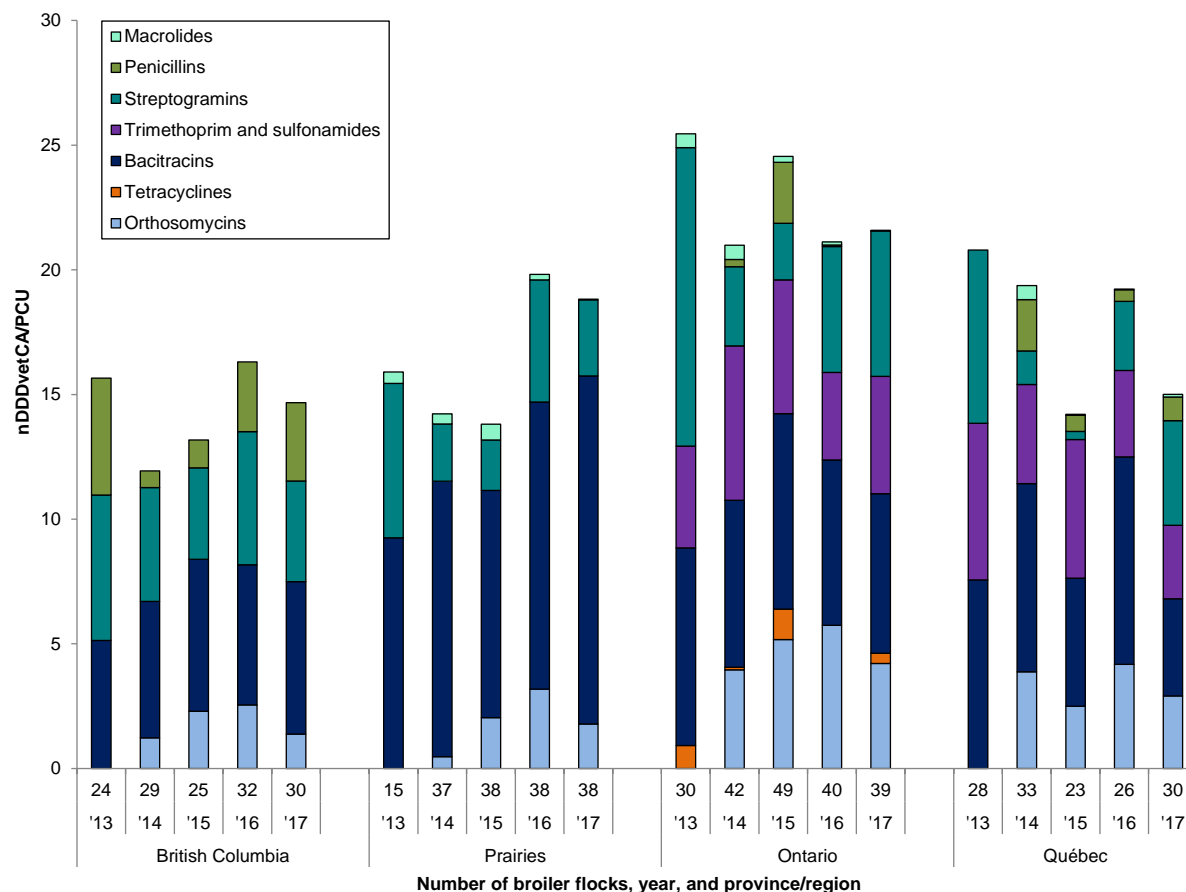
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram broiler weight per day ( $\text{mg}_{\text{drug}}/\text{kg}_{\text{animal}}/\text{day}$ ); please refer to Table A. 1 of Chapter 5: Design and methods of the 2016 CIPARS Annual Report for the list of standards.

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

For detailed indicator description, please refer to Table 2. 1.

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

**Figure 2. 9 Number of Canadian Defined Daily Doses for animals per population correction unit (nDDDvetCA/PCU) for antimicrobials administered in feed, 2013 to 2017**



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17
Number of flocks	24	29	25	32	30	15	37	38	38	38	30	42	49	40	39	28	33	23	26	30
Antimicrobial class																				
Macrolides	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0
Penicillins	5	1	1	3	3	0	0	0	0	0	0	0	2	0	0	0	2	1	0	1
Streptogramins	6	5	4	5	4	6	2	2	5	3	12	3	2	5	6	7	1	0	3	4
Trimethoprim and sulfonamides	0	0	0	0	0	0	0	0	0	0	4	6	5	4	5	6	4	6	3	3
Bacitracins	5	5	6	6	6	9	11	9	12	14	8	7	8	7	6	8	8	5	8	4
Tetracyclines	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
N/A Orthosomycins	0	1	2	3	1	0	0	2	3	2	0	4	5	6	4	0	4	2	4	3
Total	16	12	13	16	15	16	14	14	20	19	25	21	25	21	22	21	19	14	19	15

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).

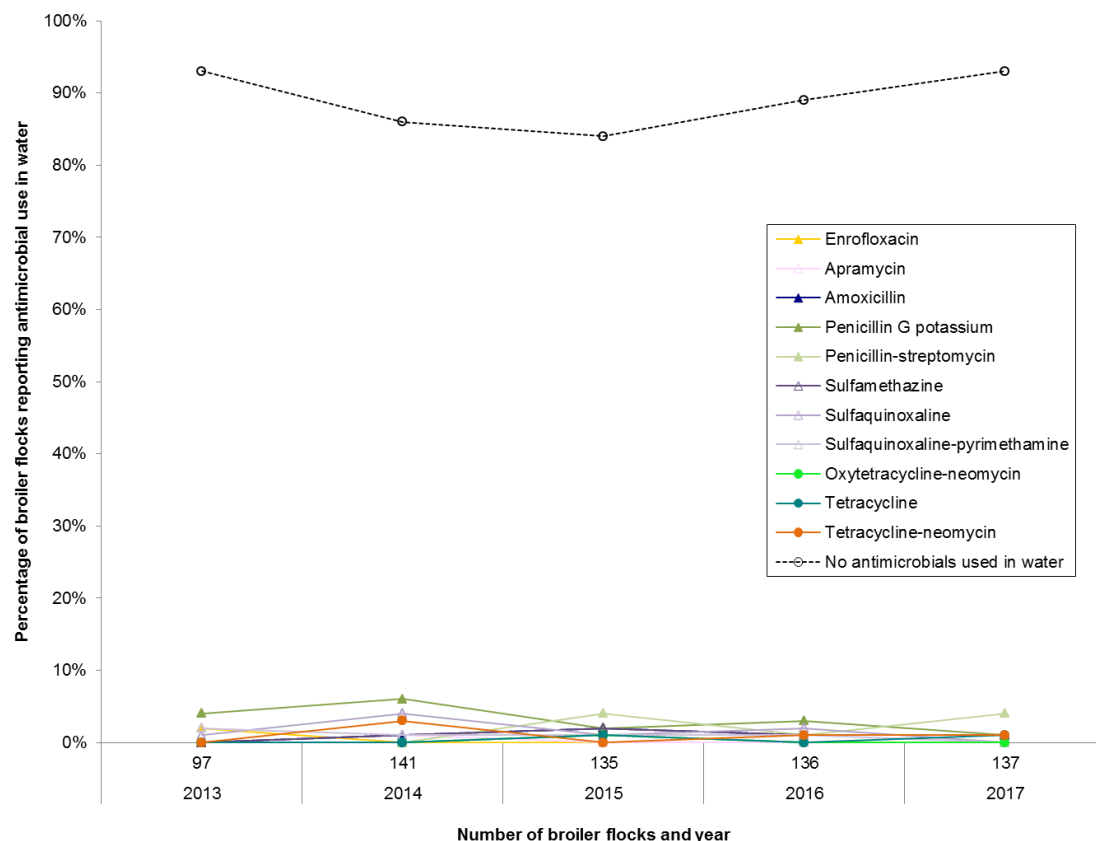
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram broiler weight per day ( $\text{mg}_{\text{drug}}/\text{kg}_{\text{animal}}/\text{day}$ ); please refer to Table A. 1 of Chapter 5: Design and methods of the 2016 CIPARS Annual Report for the list of standards.

nDDDvetCA/PCU = number of DDDvetCA/population correction unit.

For detailed indicator description, please refer to Table 2. 1.

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

## Antimicrobial use in water by frequency

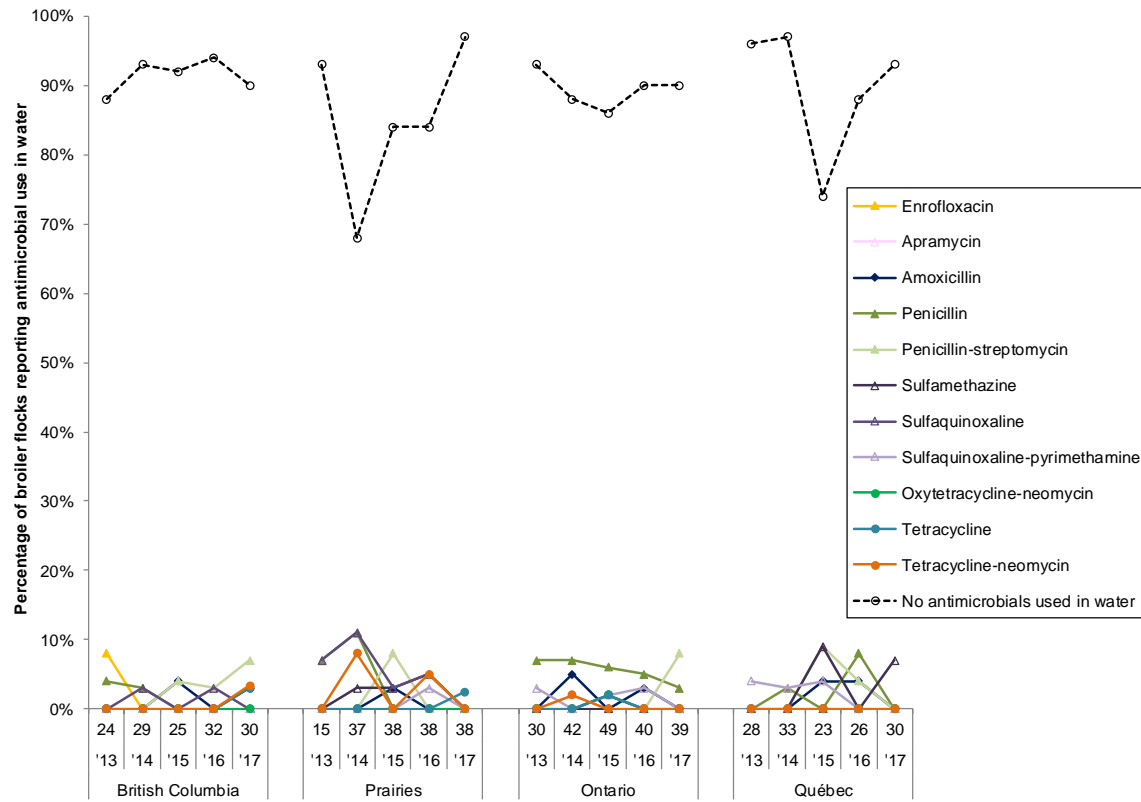
**Figure 2. 10 Percentage of broiler flocks reporting antimicrobial use in water, 2013 to 2017**

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

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.

**Figure 2. 11 Percentage of broiler flocks reporting antimicrobial use in water, 2013 to 2017**

Number of broiler flocks, year, and province/region																					
Province/region		British Columbia					Prairies					Ontario					Québec				
Year		2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Number of flocks		24	29	25	32	30	15	37	38	38	38	30	42	49	40	39	28	33	23	26	30
Antimicrobial																					
I	Enrofloxacin	8%	0%	0%	0%	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%	2%	0%	0%	0%	0%	0%	0%	0%	0%
II	Amoxicillin	0%	0%	4%	0%	3%	0%	0%	3%	0%	0%	0%	5%	0%	3%	0%	0%	0%	4%	4%	0%
	Penicillin G potassium	4%	3%	0%	0%	0%	7%	11%	0%	0%	0%	7%	7%	6%	5%	3%	0%	3%	0%	8%	0%
	Penicillin-streptomycin	0%	0%	4%	3%	7%	0%	0%	8%	0%	0%	0%	0%	0%	0%	8%	0%	0%	9%	4%	0%
III	Sulfamethazine	0%	0%	0%	0%	0%	0%	3%	3%	5%	0%	0%	0%	0%	0%	0%	0%	0%	9%	0%	7%
	Sulfaquinoxaline	0%	3%	0%	3%	0%	7%	11%	3%	5%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%
	Sulfaquinoxaline-pyrimethamine	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	3%	0%	2%	3%	0%	4%	3%	4%	0%	0%
	Oxytetracycline-neomycin	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%
	Tetracycline	0%	0%	0%	0%	3%	0%	0%	0%	0%	3%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%
	Tetracycline-neomycin	0%	0%	0%	0%	3%	0%	8%	0%	5%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%
No antimicrobials used in water		88%	93%	92%	94%	90%	93%	68%	84%	84%	97%	93%	88%	86%	90%	90%	96%	97%	74%	88%	93%

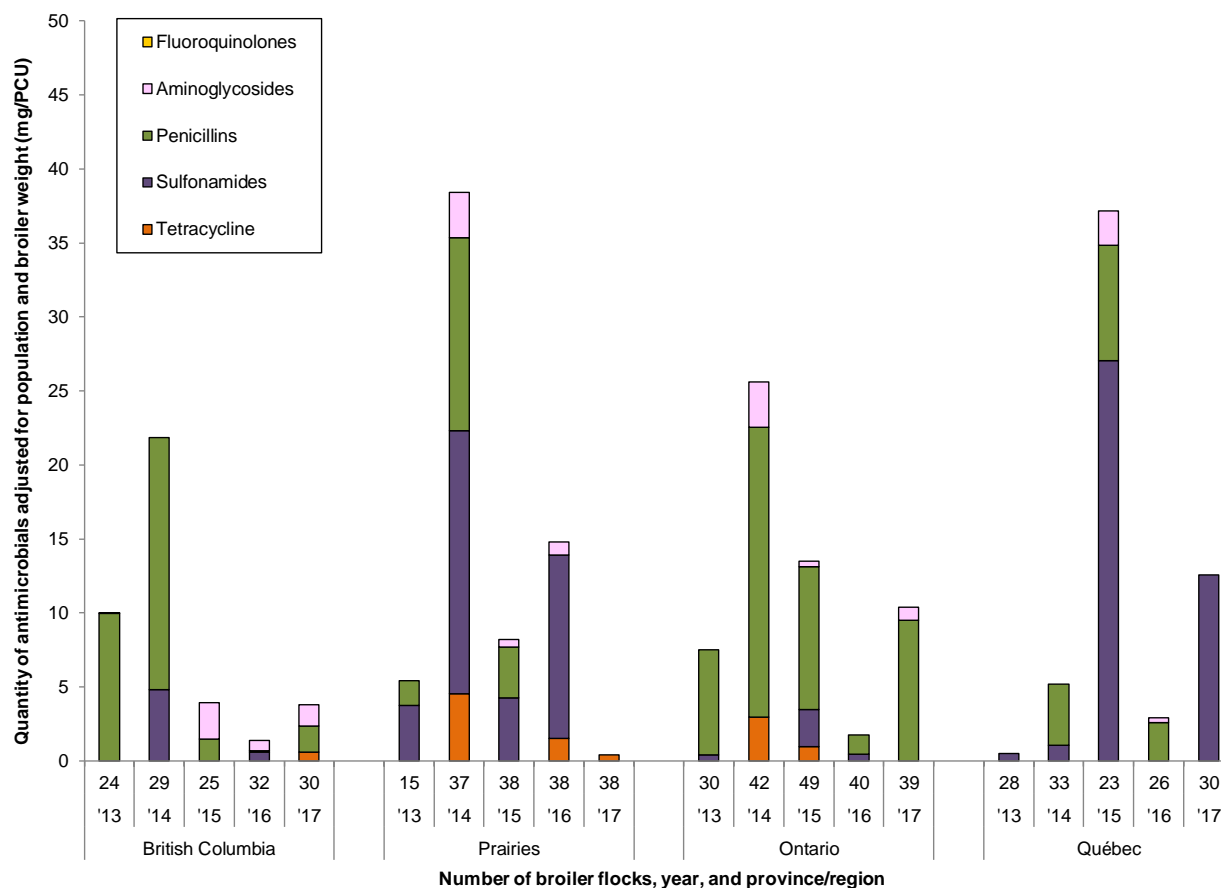
Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

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 first 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 (2017 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 and Saskatchewan.

## Antimicrobials use in water by quantitative indicators

**Figure 2. 12 Quantity of antimicrobials used in water adjusted for population and broiler weight (mg/PCU), 2013 to 2017**

Province/region	British Columbia					Prairies					Ontario					Québec				
Year	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Number of flocks	24	29	25	32	30	15	37	38	38	38	30	42	49	40	39	28	33	23	26	30
Antimicrobial class																				
I Fluoroquinolones	<0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
II Aminoglycosides	0	0	2	1	1	0	3	1	1	0	0	3	0	0	1	0	0	2	0.3	0
III Penicillins	10	17	1	0.1	1.8	2	13	3	0	0	7	20	10	1.3	9.5	0	4	8	2.6	0
Sulfonamides	0	5	0	1	0	4	18	4	12	0	0	0	2	0	0	1	1	27	0	13
Tetracyclines	0	0	0	0	1	0	5	0	2	0	0	3	1	0	0	0	0	0	0	0
Total	10	22	4	1	4	5	38	8	15	0	8	26	13	2	10	1	5	37	3	13

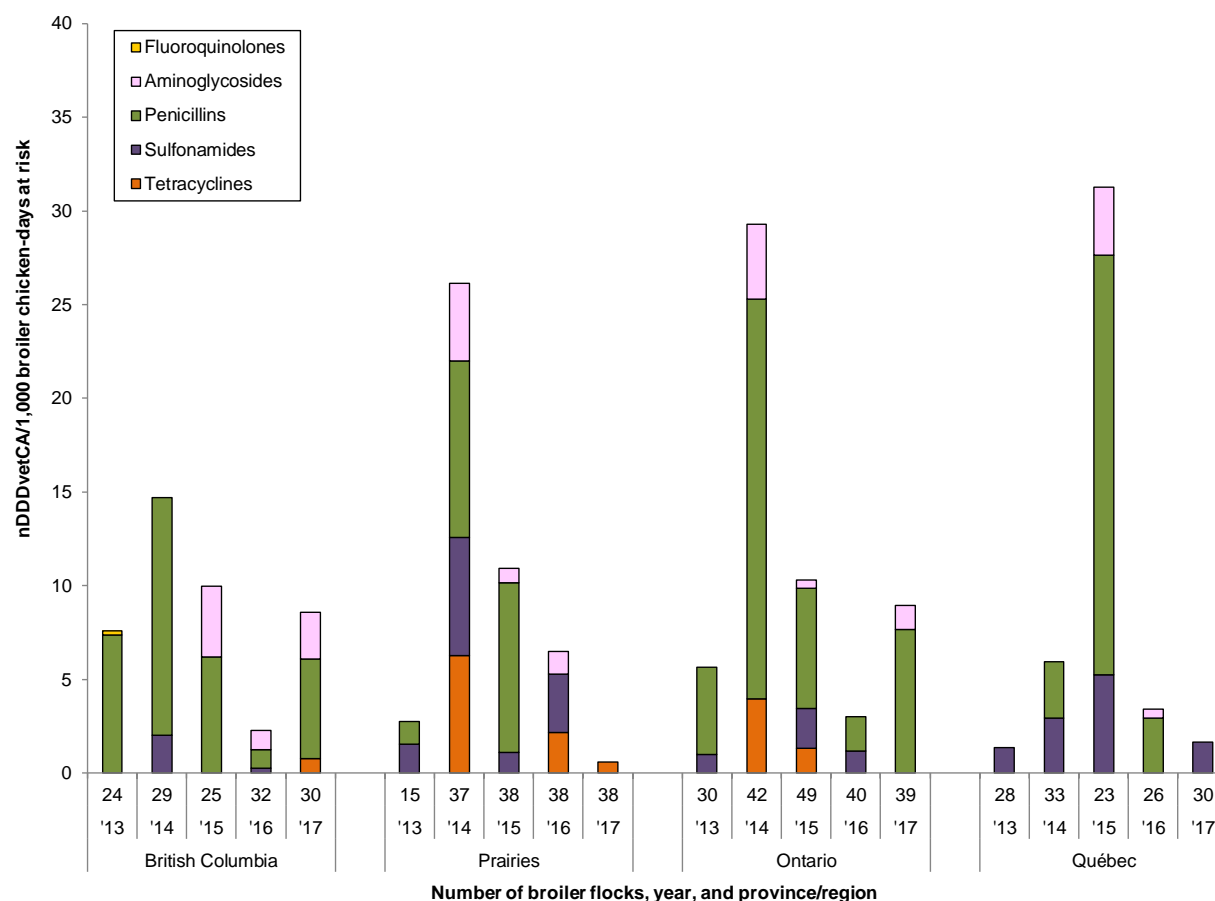
Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

mg/PCU = milligrams/population correction unit.

For detailed indicator description, please refer to Table 2. 1.

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

**Figure 2. 13 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, 2013 to 2017**



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Number of flocks	24	29	25	32	30	15	37	38	38	38	30	42	49	40	39	28	33	23	26	30
Antimicrobial class																				
I Fluoroquinolones	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
II Aminoglycosides	0	0	4	1	2	0	4	1	1	0	0	4	0.4	0	1	0	0	4	0.5	0
Penicillins	7	13	6	1	5	1	9	9	0	0	5	21	6	2	8	0	3	22	3	0
III Sulfonamides	0	2	0	0.2	0	2	6	1	3	0	1	0	2	1	0	1	3	5	0	2
Tetracyclines	0	0	0	0	1	0	6	0	2	1	0	4	1	0	0	0	0	0	0	0
Total	8	15	10	2	8	3	26	11	6	1	6	29	10	3	9	1	6	31	3	2

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

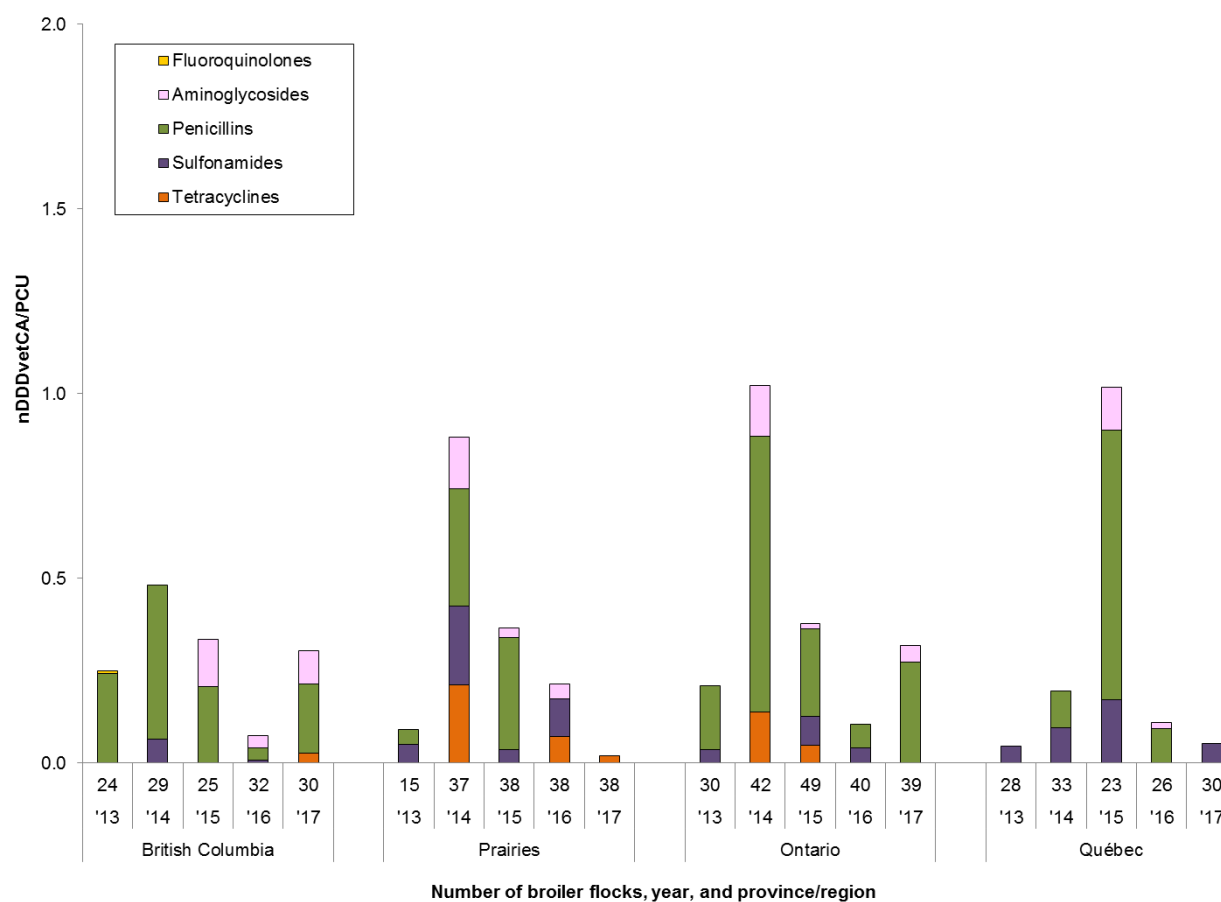
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram broiler weight per day ( $\text{mg}_{\text{drug}}/\text{kg}_{\text{animal}}/\text{day}$ ); please refer to Table A. 1 of Chapter 5: Design and methods of the 2016 CIPARS Annual Report for the list of standards.

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

For detailed indicator description, please refer to Table 2. 1.

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

**Figure 2. 14 Number of Canadian Defined Daily Doses for animals per population correction unit (nDDDvetCA/PCU) for antimicrobials administered in water, 2013 to 2017**



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Number of flocks	24	29	25	32	30	15	37	38	38	38	30	42	49	40	39	28	33	23	26	30
Antimicrobial class																				
I Fluoroquinolones	<0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
II Aminoglycosides	0	0	0.1	<0.1	0.1	0	0.1	<0.1	<0.1	0	0	0.1	<0.1	0	<0.1	0	0	0.1	<0.1	0
Penicillins	0.2	0.4	0.2	0.0	0.2	0.0	0.3	0.3	0	0	0.2	0.7	0.2	0.1	0.3	0	0.1	0.7	0.1	0
III Sulfonamides	0	0.1	0	<0.1	0	0.1	0.2	<0.1	0.1	0	<0.1	0	0.1	<0.1	0	<0.1	0.1	0.2	0	0.1
Tetracyclines	0	0	0	0	<0.1	0	0.2	0	0.1	<0.1	0	0.1	<0.1	0	0	0	0	0	0	0
Total	0.2	0.5	0.3	0.1	0.3	0.1	0.9	0.4	0.2	0.0	0.2	1.0	0.4	0.1	0.3	0.0	0.2	1.0	0.1	0.1

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 ( $\text{mg}_{\text{drug}}/\text{kg}_{\text{animal}}/\text{day}$ ); please refer to Table A. 1 of Chapter 5: Design and methods of the 2016 CIPARS Annual Report for the list of standards.

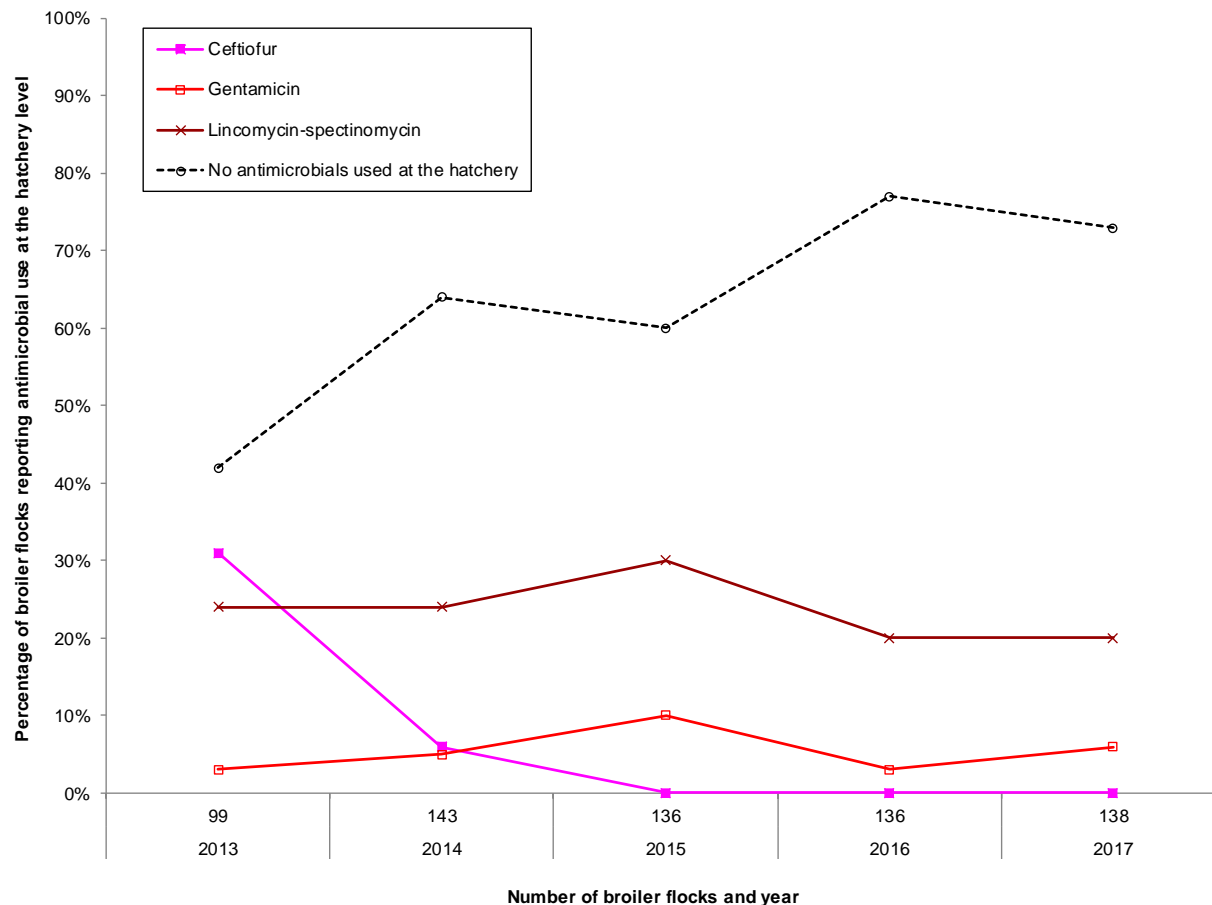
nDDDvetCA/PCU = number of DDDvetCA/population correction unit.

For detailed indicator description, please refer to Table 2. 1.

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

## Antimicrobial use *in ovo* or subcutaneous injection by frequency

**Figure 2. 15 Percentage of broiler flocks reporting antimicrobial use *in ovo* or subcutaneous injection at the hatchery level, 2013 to 2017**



Year	2013	2014	2015	2016	2017
Number of flocks	99	143	136	136	138
Antimicrobial					
I Cefiofur	31%	6%	0%	0%	0%
II Gentamicin	3%	5%	10%	3%	6%
II Lincomycin-spectinomycin	24%	24%	30%	20%	20%
No antimicrobials used at the hatchery	42%	64%	60%	77%	73%

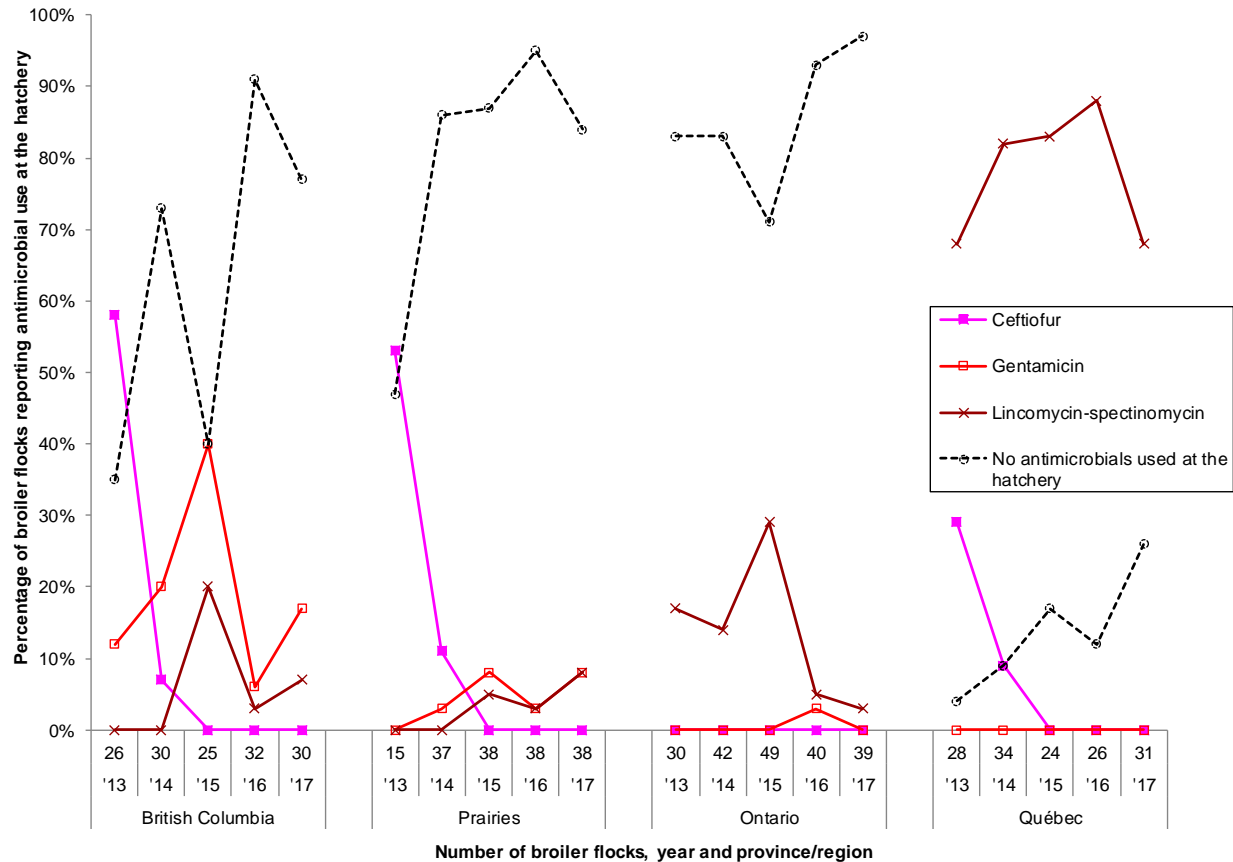
Roman numerals I to II indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.

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.

**Figure 2. 16 Percentage of broiler flocks reporting antimicrobial use *in ovo* or subcutaneous injection at the hatchery level by province/region, 2013 to 2017**



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Number of flocks	26	30	25	32	30	15	37	38	38	38	30	42	49	40	39	28	34	24	26	31
Antimicrobial																				
I Ceftiofur	58%	7%	0%	0%	0%	53%	11%	0%	0%	0%	0%	0%	0%	0%	0%	29%	9%	0%	0%	0%
Gentamicin	12%	20%	40%	6%	17%	0%	3%	8%	3%	8%	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%
II Lincomycin-spectinomycin	0%	0%	20%	3%	7%	0%	0%	5%	3%	8%	17%	14%	29%	5%	3%	68%	82%	83%	88%	68%
No antimicrobials used at the hatchery	35%	73%	40%	91%	77%	47%	86%	87%	95%	84%	83%	83%	71%	93%	97%	4%	9%	17%	12%	26%

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.

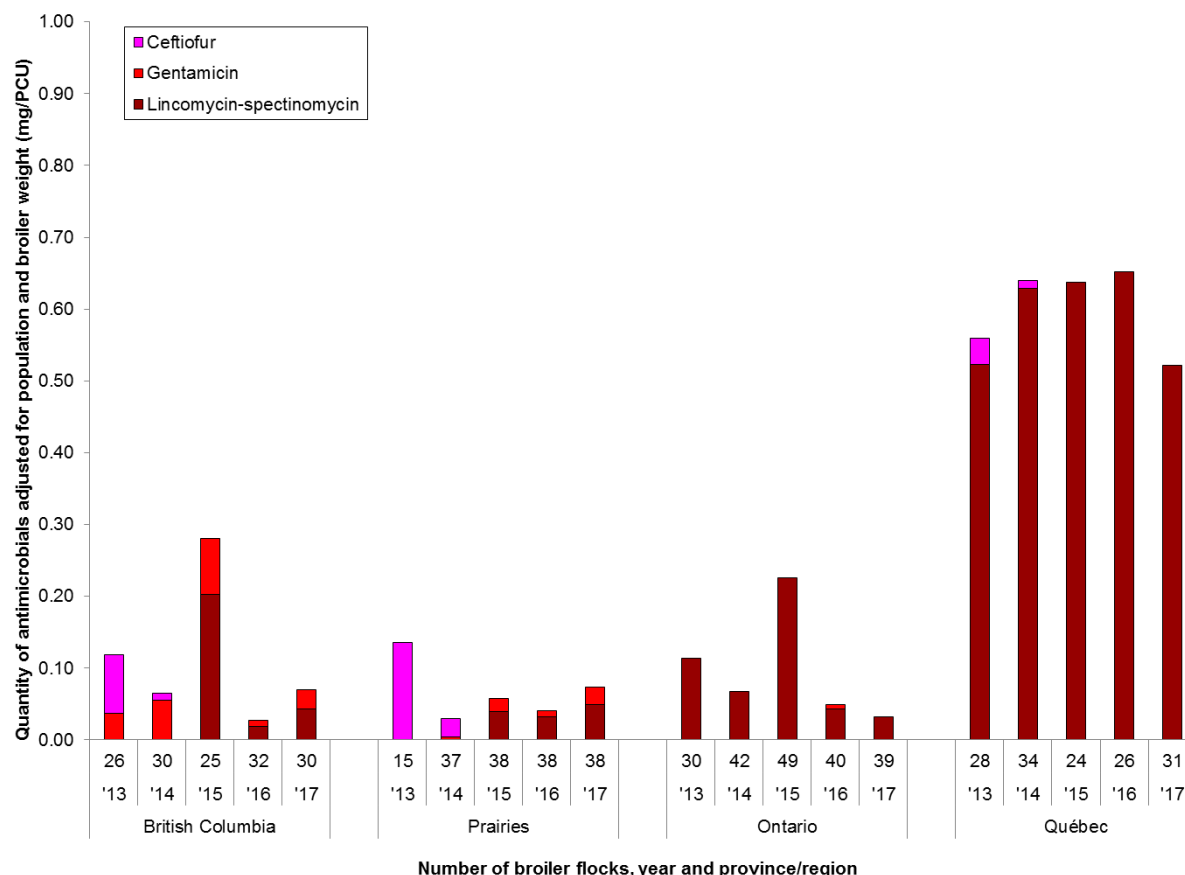
Data represent flocks medicated at the hatchery at day 18 of incubation or upon hatch.

For the temporal analyses, the proportion (%) of flocks using antimicrobial over the current year has been compared to the proportion (%) of flocks using the same antimicrobial during the first 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 presence of purple areas (2017 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 and Saskatchewan.

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

**Figure 2. 17 Quantity of antimicrobial use *in ovo* or subcutaneous injection, adjusted for population and broiler weight (mg/PCU), 2013 to 2017**



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Number of flocks	26	30	25	32	30	15	37	38	38	38	30	42	49	40	39	28	34	24	26	31
Antimicrobial																				
I Ceftiofur	0.08	0.01	0	0	0	0.14	0.03	0	0	0	0	0	0	0	0	0.04	0.01	0	0	0
II Gentamicin	0.04	0.06	0.08	0.01	0.03	0	0	0.02	0.01	0.02	0	0	0	0.01	0	0	0	0	0	0
Lincomycin-spectinomycin	0	0	0.20	0.02	0.04	0	0	0.04	0.03	0.05	0.11	0.07	0.23	0.04	0.03	0.52	0.63	0.64	0.65	0.52
Total	0.12	0.1	0.28	0.03	0.07	0.14	0.03	0.06	0.04	0.07	0.11	0.07	0.23	0.05	0.03	0.56	0.64	0.64	0.65	0.52

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

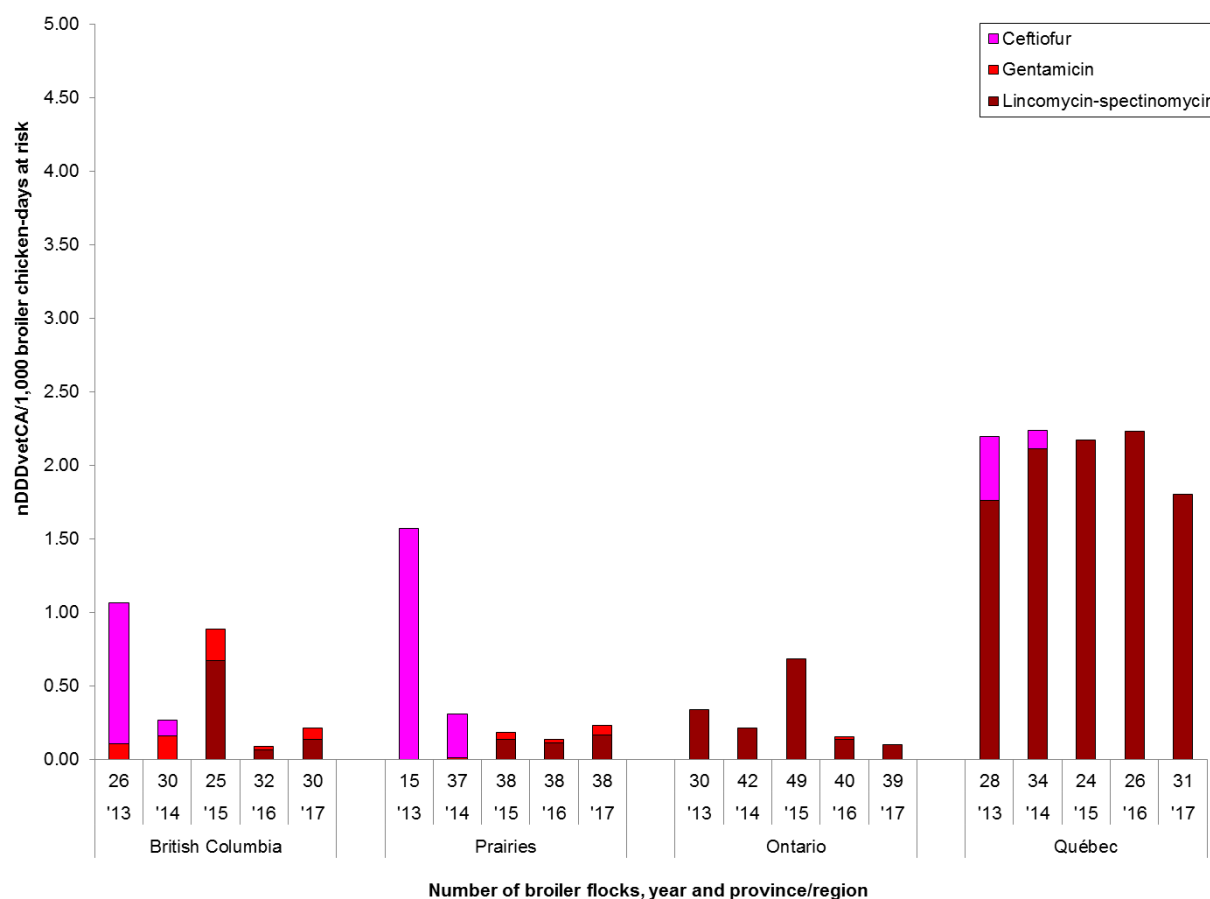
Total milligrams active ingredient was calculated using the final dose (in milligrams per hatching egg or chick) suggested by the manufacturer and expert opinion based on milligrams per body weight or residue avoidance information.

mg/PCU = milligrams/population correction unit

For detailed indicator description, please refer to Table 2. 1.

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

**Figure 2. 18 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, 2013 to 2017**



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Number of flocks	26	30	25	32	30	15	37	38	38	38	30	42	49	40	39	28	34	24	26	31
Antimicrobial																				
I Ceftiofur	0.96	0.11	0	0	0	1.57	0.30	0	0	0	0	0	0	0	0	0.43	0.13	0	0	0
II Gentamicin	0.10	0.16	0.21	0.02	0.07	0	0.01	0.05	0.03	0.07	0	0	0	0.01	0	0	0	0	0	0
Lincomycin-spectinomycin	0	0	0.67	0.06	0.14	0	0	0.13	0.11	0.16	0	0	0.68	0.14	0.10	1.76	2.11	2.17	2.23	1.80
Total	1.06	0.27	0.88	0.09	0.21	1.57	0.31	0.18	0.13	0.23	0.34	0.21	0.68	0.15	0.10	2.19	2.24	2.17	2.23	1.80

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

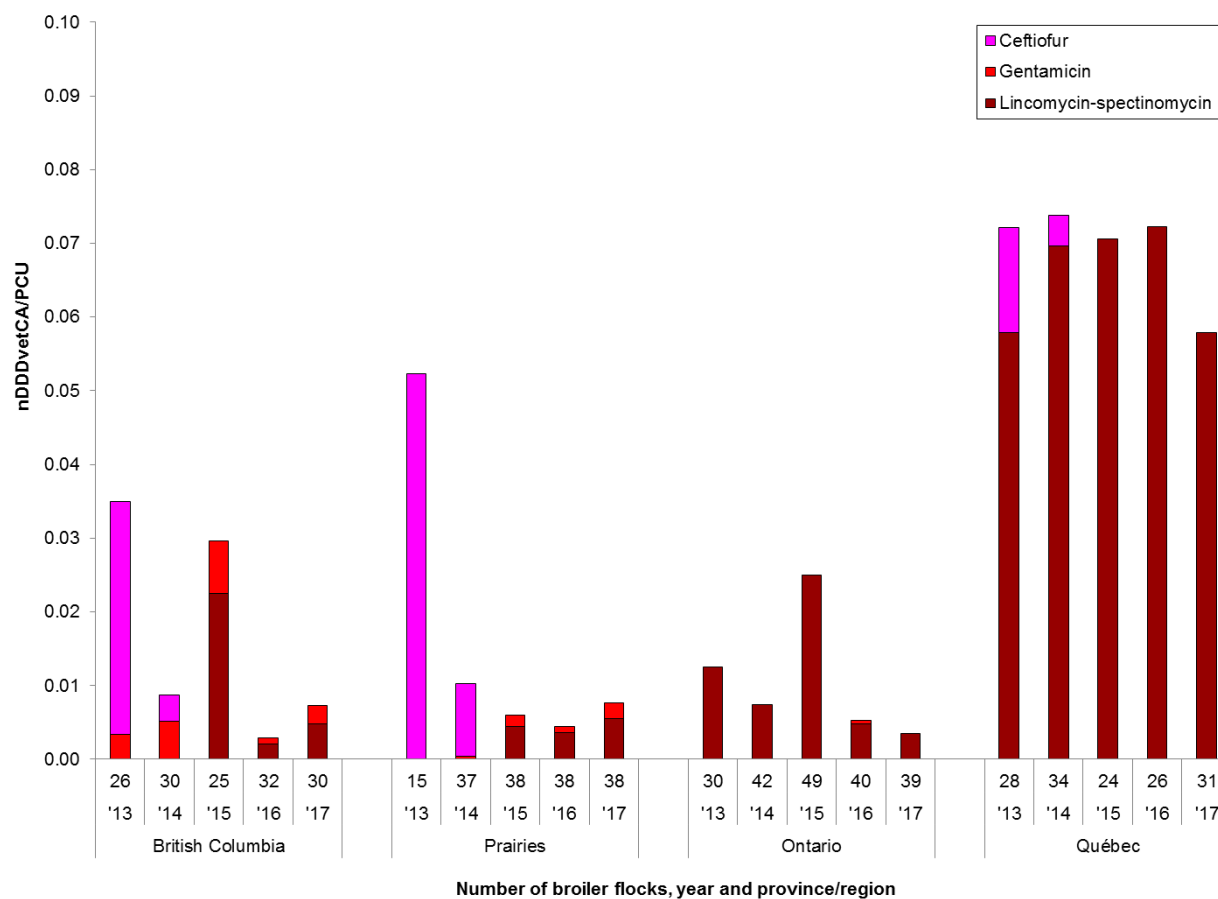
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram broiler weight per day ( $\text{mg}_{\text{drug}}/\text{kg}_{\text{animal}}/\text{day}$ ); please refer to Table A. 1 of Chapter 5: Design and methods of the 2016 CIPARS Annual Report for the list of standards.

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

For detailed indicator description, please refer to Table 2. 1.

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

**Figure 2. 19 Number of Canadian Defined Daily Doses for animals per population correction unit (nDDDvetCA/PCU) for antimicrobials administered *in ovo* or subcutaneous injection, 2013 to 2017**



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Number of flocks	26	30	25	32	30	15	37	38	38	38	30	42	49	40	39	28	34	24	26	31
Antimicrobial																				
I Ceftiofur	0.032	0.004	0	0	0	0.052	0.010	0	0	0	0	0	0	0	0	0.014	0.004	0	0	0
II Gentamicin	0.003	0.005	0.007	0.001	0.002	0	0	0.002	0.001	0.002	0	0	0	0.001	0	0	0	0	0	0
Lincomycin-spectinomycin	0	0	0.022	0.002	0.005	0	0	0.004	0.004	0.005	0.013	0.007	0.025	0.005	0.004	0.058	0.070	0.071	0.072	0.058
Total	0.035	0.009	0.030	0.003	0.007	0.052	0.010	0.006	0.004	0.008	0.013	0.007	0.025	0.005	0.004	0.072	0.074	0.071	0.072	0.058

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 ( $\text{mg}_{\text{drug}}/\text{kg}_{\text{animal}}/\text{day}$ ); please refer to Table A. 1 of Chapter 5: Design and methods of the 2016 CIPARS Annual Report for the list of standards.

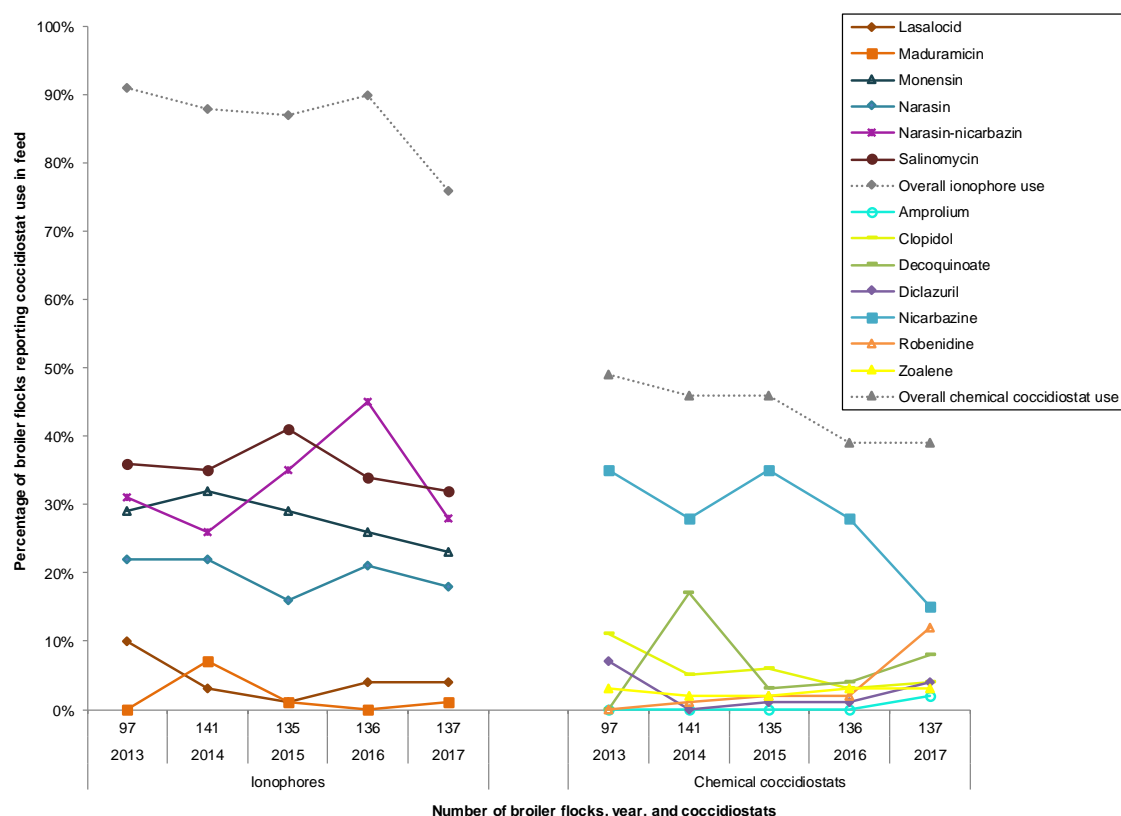
nDDDvetCA/PCU = number of DDDvetCA/population correction unit.

For detailed indicator description, please refer to Table 2. 1.

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

## Coccidiostat use in feed by frequency

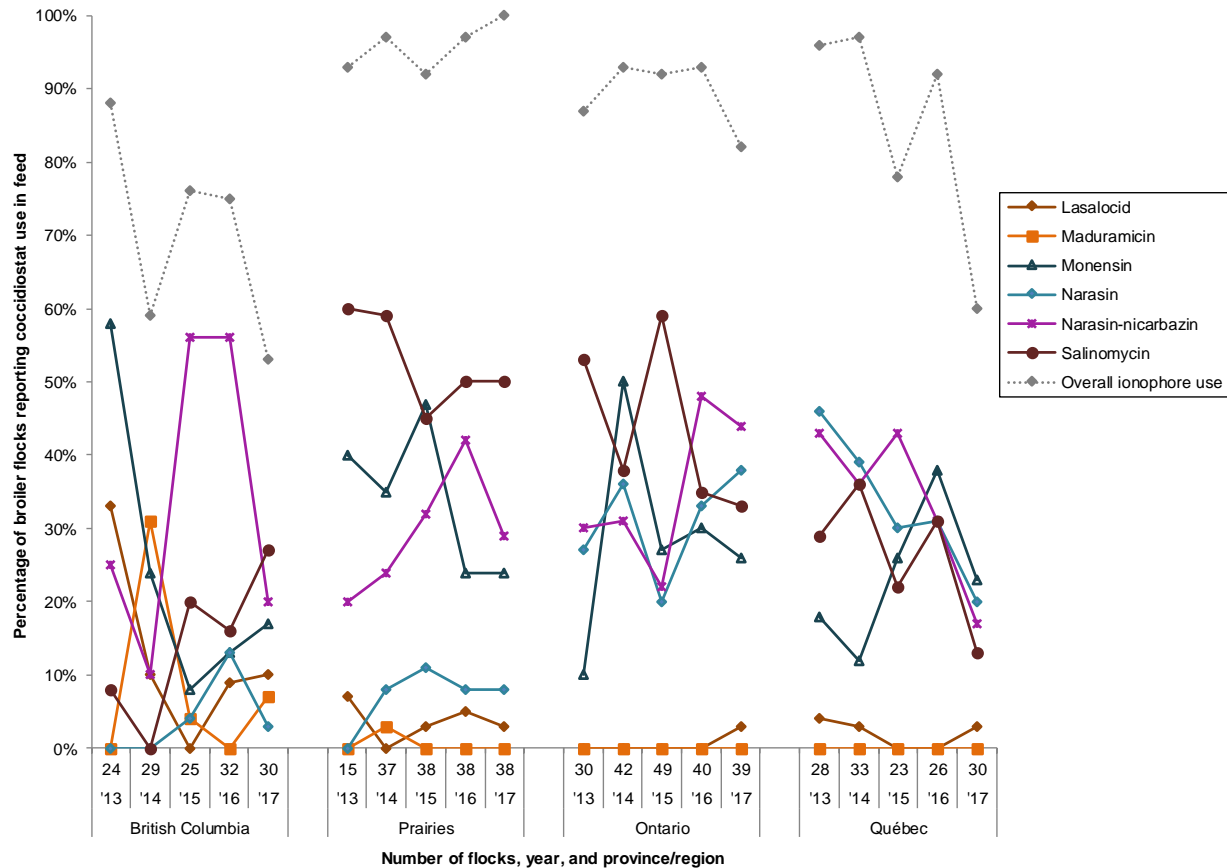
**Figure 2. 20 Percentage of broiler flocks reporting coccidiostat use in feed, 2013 to 2017**



Year	2013	2014	2015	2016	2017	
Number of flocks	97	141	135	136	137	
Coccidiostat						
IV	Lasalocid	10%	3%	1%	4%	4%
	Maduramicin	0%	7%	1%	0%	1%
	Monensin	29%	32%	29%	26%	23%
	Narasin	22%	22%	16%	21%	18%
	Narasin-nicarbazin	31%	26%	35%	45%	28%
	Salinomycin	36%	35%	41%	34%	32%
	Overall ionophore use	91%	88%	87%	90%	76%
N/A	Amprolium	0%	0%	0%	0%	2%
	Clopidol	11%	5%	6%	3%	4%
	Decoquinoate	0%	17%	3%	4%	8%
	Diclazuril	7%	0%	1%	1%	4%
	Nicarbazine	35%	28%	35%	28%	15%
	Robenidine	0%	1%	2%	2%	12%
	Zoalene	3%	2%	2%	3%	3%
Overall chemical coccidiostat use	49%	46%	46%	39%	39%	

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 first 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. 21 Percentage of broiler flocks reporting ionophore coccidiostats in feed, by province/region, 2013 to 2017**

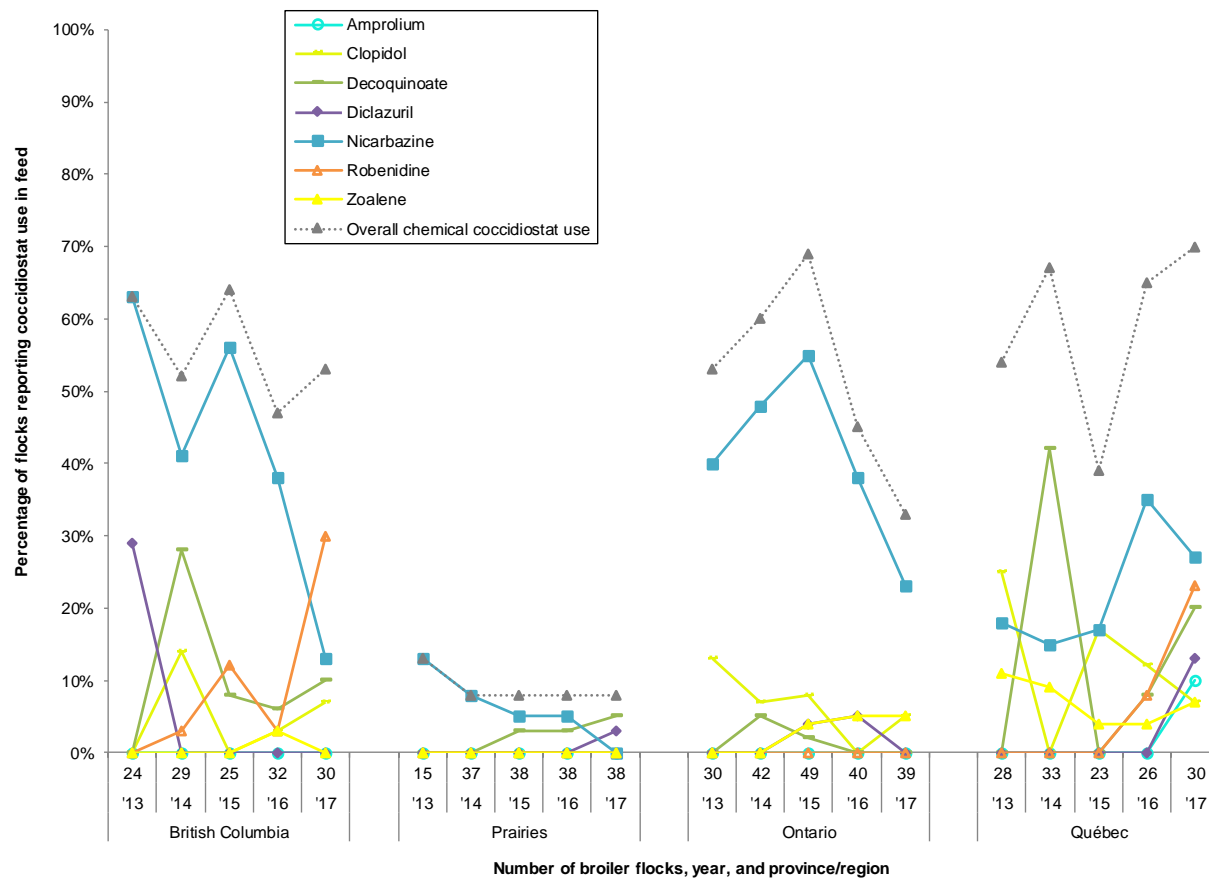
Province/region	British Columbia					Prairies					Ontario					Québec				
Year	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Number of flocks	24	29	25	32	30	15	37	38	38	38	30	42	49	40	39	28	33	23	26	30
<b>Coccidiostat</b>																				
Lasalocid	33%	10%	0%	9%	10%	7%	0%	3%	5%	3%	0%	0%	0%	0%	3%	4%	3%	0%	0%	3%
Maduramicin	0%	31%	4%	0%	7%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Monensin	58%	24%	8%	13%	17%	40%	35%	47%	24%	24%	10%	50%	27%	30%	26%	18%	12%	26%	38%	23%
Narasin	0%	0%	4%	13%	3%	0%	8%	11%	8%	8%	27%	36%	20%	33%	38%	46%	39%	30%	31%	20%
Narasin-nicarbazin	25%	10%	56%	56%	20%	20%	24%	32%	42%	29%	30%	31%	22%	48%	44%	43%	36%	43%	31%	17%
Salinomycin	8%	0%	20%	16%	27%	60%	59%	45%	50%	50%	53%	38%	59%	35%	33%	29%	36%	22%	31%	13%
<b>Overall ionophores use</b>	<b>88%</b>	<b>59%</b>	<b>76%</b>	<b>75%</b>	<b>53%</b>	<b>93%</b>	<b>97%</b>	<b>92%</b>	<b>97%</b>	<b>100%</b>	<b>87%</b>	<b>93%</b>	<b>92%</b>	<b>93%</b>	<b>82%</b>	<b>96%</b>	<b>97%</b>	<b>78%</b>	<b>92%</b>	<b>60%</b>

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 first 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 (2017 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 and Saskatchewan.

**Figure 2. 22 Percentage of broiler flocks reporting chemical coccidiostat in feed, by province/region, 2013 to 2017**



Province/region		British Columbia					Prairies					Ontario					Québec				
Year		2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Number of flocks		24	29	25	32	30	15	37	38	38	38	30	42	49	40	39	28	33	23	26	30
Coccidiostat																					
N/A	Amprolium	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	10%
	Clopidol	0%	14%	0%	3%	7%	0%	0%	0%	0%	0%	13%	7%	8%	0%	5%	25%	0%	17%	12%	7%
	Decoquinoate	0%	28%	8%	6%	10%	0%	0%	3%	3%	5%	0%	5%	2%	0%	0%	0%	42%	0%	8%	20%
	Diclazuril	29%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	4%	5%	0%	0%	0%	0%	0%	13%
	Nicarbazine	63%	41%	56%	38%	13%	13%	8%	5%	5%	0%	40%	48%	55%	38%	23%	18%	15%	17%	35%	27%
	Robenidine	0%	3%	12%	3%	30%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	8%	23%
	Zoalene	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	4%	5%	5%	11%	9%	4%	4%	7%
Overall chemical coccidiostat use		63%	52%	64%	47%	53%	13%	8%	8%	8%	8%	53%	60%	69%	45%	33%	54%	67%	39%	65%	70%

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 first 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 presence of purple areas (2017 surveillance year; Québec-referent province) indicates significant temporal and provincial/regional differences ( $P \leq 0.05$ ) for a given chemical coccidiostat. The Prairies is a region including the provinces of Alberta and Saskatchewan.

## Chapter 3 Antimicrobial resistance

### Broiler chickens

#### Key findings

##### ***Salmonella***

- At chick placement, the top 3 *Salmonella* serovars were Enteritidis, Kentucky, and Mbandaka. Provincial differences in serovar distribution were noted and for the first time since 2013, Enteritidis was isolated from all the provinces/regions sampled (Table 3. 1). One isolate (8,20:-:z6) was resistant to ceftriaxone and all other  $\beta$ -lactam antimicrobials except meropenem (Table 3. 1).
- At pre-harvest, the top 3 serovars were similar to chick placement. For 2 consecutive years, Enteritidis was detected in all provinces/regions sampled (Table 3. 3). Overall, ceftriaxone resistance decreased by 2% from the previous year and the decrease was observed in all provinces/regions sampled (Figure 3. 1 and Figure 3. 3).
- No ciprofloxacin, nalidixic acid and meropenem resistance observed in chick placement and pre-harvest isolates (Table 3. 1 and Table 3. 3).

##### ***Escherichia coli***

- At chick placement, 4 ciprofloxacin resistant isolates and 14 nalidixic acid resistant isolates were recovered (Table 3. 2). Overall, the proportion of isolates resistant to ceftriaxone decreased between 2013 to 2017 by 25% but the trends varied depending on the province/region (Figure 3. 2). Resistance to gentamicin marginally increased by 2% between 2016 and 2017 and the trend varied depending on the province/region: decreased in British Columbia by 1% and in Quebec by 5% while it increased in the Prairies by 9% and in Ontario by 2% (Figure 3. 2).
- At pre-harvest overall, 4 isolates resistant to ciprofloxacin (less than 1%) and 29 isolates resistant to nalidixic acid (5%) were recovered. Between 2016 and 2017, resistance to ceftriaxone (increased by 1%) and gentamicin (increased by 1%) was relatively stable (Figure 3. 4).
- No meropenem resistance observed in chick placement and pre-harvest isolates.

##### ***Campylobacter***

- Between 2016 and 2017, ciprofloxacin resistance increased from 25% to 36% in British Columbia. Resistant isolates were detected in Ontario (18%) but not in the Prairies and Québec (Figure 3. 5). Telithromycin (3 isolates), azithromycin (4 isolates) and erythromycin resistance was detected only in Québec (Table 3. 5).

## Multiclass resistance

**Table 3. 1 Number of antimicrobial classes in resistance patterns of *Salmonella* from chicks and barn environment at placement, 2017**

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	Phenicol	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	20 (95.2)																				
8,20:-:z6	1 (4.8)		1					1	1	1	1	1								1	
Total	21 (100)	20	1					1	1	1	1	1								1	
Prairies																					
Enteritidis	9 (75.0)																				
Kentucky	2 (16.7)		2					2												2	
Typhimurium	1 (8.3)			1				1	1					1			1			1	
Total	12 (100)	9	2	1				3	1					1			1			3	
Ontario																					
Enteritidis	3 (50.0)	3																			
Mbandaka	3 (50.0)	3																			
Total	6 (100)	6																			
Québec																					
Kentucky	9 (60.0)		9					9												9	
Enteritidis	5 (33.3)	5																			
Braenderup	1 (6.7)	1																			
Total	15 (100)	6	9					9												9	
National																					
Enteritidis	37 (68.5)	37																			
Kentucky	11 (20.4)		11					11												11	
Mbandaka	3 (5.6)	3																			
Braenderup	1 (1.9)	1																			
8,20:-:z6	1 (1.9)		1					1	1	1	1	1								1	
Typhimurium	1 (1.9)			1				1	1					1			1			1	
Total	54 (100)	41	12	1				13	2	1	1	1		1			1			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.

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

Due to the relatively small number of isolates, chick pads and environmental samples were aggregated in the table above.

**Table 3. 2 Number of antimicrobial classes in resistance patterns of *Escherichia coli* from chicks and barn environment at placement, 2017**

Sample type / 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	Phenicol	Quinolones		Tetracyclines
		0	1	2-3	4-5	6-7	GEN	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
Chick pads																				
British Columbia	38 (23.6)	11	4	12	11		12	17	15	3	5	3		14	2		1	1	6	24
Prairies	33 (20.5)	9	9	13	2		9	13	6	2	2	2		9	1			1	2	17
Ontario	44 (27.3)	13	8	16	7		17	20	12	8	9	8		15	1		3			25
Québec	46 (28.6)	16	5	13	12		19	22	19	7	7	7		21	2		2	1	1	23
National	161 (100)	49	26	54	32		57	72	52	20	23	20		59	6		6	3	9	89
Environment																				
British Columbia	21 (27.6)	4		10	7		7	15	11	4	4	4		11	3		1		2	13
Prairies	15 (19.7)	7	1	4	3		2	5	2					5	1		2		1	7
Ontario	21 (27.6)	3	5	12	1		2	6	12	3	5	3		4	1				1	14
Québec	19 (25.0)	4	2	7	5	1	3	11	10	1	1	1		12	7	1	3	1	1	11
National	76 (100)	18	8	33	16	1	14	37	35	8	10	8		32	12	1	6	1	5	45
Placement																				
British Columbia	59 (24.9)	15	4	22	18		19	32	26	7	9	7		25	5		2	1	8	37
Prairies	48 (20.2)	16	10	17	5		11	18	8	2	2	2		14	2		2	1	3	24
Ontario	65 (27.4)	16	13	28	8		19	26	24	11	14	11		19	2		3		1	39
Québec	65 (27.4)	20	7	20	17	1	22	33	29	8	8	8		33	9	1	5	2	2	34
National	237 (100)	67	34	87	48	1	71	109	87	28	33	28		91	18	1	12	4	14	134

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 *Salmonella* from broiler chickens at pre-harvest, 2017**

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	Phenicol	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																					
Kentucky	224 (36.9)		3	21				21	7	7	7	7								21	
Enteritidis	22 (33.8)		22																		
Infantis	6 (9.2)	2		4			3	4						4						4	
Mbandaka	5 (7.7)	4	1					1													
Senftenberg	4 (6.2)	4																			
Amager	2 (3.1)	2																			
Less common serovars	2 (3.1)	2																			
Total	65 (100)	36	4	25			3	26	7	7	7	7		4						25	
Prairies																					
Enteritidis	35 (48.0)	35																			
Kentucky	16 (21.9)			16				16												16	
Braenderup	5 (6.9)	4	1						1	1	1	1									
Mbandaka	5 (6.9)	5																			
Infantis	4 (5.5)	4																			
Less common serovars	8 (11.0)	7			1			1						1			1			1	
Total	73 (100)	55	1	16	1			17	1	1	1	1		1			1			17	
Ontario																					
Kentucky	21 (41.2)	1		20				20												20	
Mbandaka	7 (13.7)	7																			
Enteritidis	4 (7.8)	4																			
Liverpool	4 (7.8)	2	2																	2	
Muenchen	4 (7.8)	4																			
Braenderup	3 (5.8)	3																			
Heidelberg	2 (3.9)	2																			
Indiana	2 (3.9)	2																			
Livingstone	2 (3.9)		2																	2	
Typhimurium	2 (3.9)			2										2						2	
Total	51 (100)	25	4	22				20						2						26	
Québec																					
Kentucky	36 (48.7)	4	1	31				32	3	3	3	3								31	
Schwarzengrund	10 (13.5)			10				10						10						10	
Enteritidis	8 (10.8)	8																			
Rough:z6	5 (6.8)			5				5	1	1	1	1								5	
Braenderup	4 (5.4)	4																			
Hadar	4 (5.4)			4				4												4	
Thompson	3 (4.1)	3																			
Infantis	2 (2.7)	2																			
Less common serovars	2 (2.7)	1		1				1												1	
Total	74 (100)	22	1	51				52	4	4	4	4		10						51	
National																					
Kentucky	97 (36.9)	5	4	88				89	10	10	10	10								88	
Enteritidis	69 (26.2)	69																			
Mbandaka	17 (6.5)	16	1					1													
Braenderup	12 (4.6)	11	1						1	1	1	1									
Infantis	12 (4.6)	8		4			3	4						4						4	
Schwarzengrund	10 (3.8)			10				10						10						10	
Less common serovars	46 (17.5)	29	4	12	1			11	1	1	1	1		3			1			17	
Total	263 (100)	138	10	114	1		3	115	12	12	12	12		17			1			119	

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. 4 Number of antimicrobial classes in resistance patterns of *Escherichia coli* from broiler chickens at pre-harvest, 2017**

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	Phenicol	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	117 (21.7)	25	21	40	31		25	60	67	25	25	24		52	13		8	2	14	48
Prairies	152 (28.2)	61	23	51	17		21	64	38	6	6	9		40	11		3	1	6	58
Ontario	154 (28.6)	52	37	42	23		18	54	51	8	9	8		50	27		6		6	74
Québec	116 (21.5)	12	4	74	26		42	92	50	15	13	15		76	42		10		3	78
<b>National</b>	<b>539 (100)</b>	<b>150</b>	<b>85</b>	<b>207</b>	<b>97</b>		<b>106</b>	<b>270</b>	<b>206</b>	<b>54</b>	<b>53</b>	<b>56</b>		<b>218</b>	<b>93</b>		<b>27</b>	<b>3</b>	<b>29</b>	<b>258</b>

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. 5 Number of antimicrobial classes in resistance patterns of *Campylobacter* from chickens at pre-harvest, 2017**

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	Phenicol	Quinolones	Tetracyclines				
		0	1	2-3	4-5	6-7	GEN	TEL	CLI	AZM	ERY	FLR	CIP	NAL	TET		
British Columbia																	
<i>Campylobacter coli</i>	4 (9.1)	4												4	4		
<i>Campylobacter jejuni</i>	40 (90.9)	23	5	12									12	12		17	
Total	44 (100)	23	9	12									16	16		17	
Prairies																	
<i>Campylobacter coli</i>																	
<i>Campylobacter jejuni</i>	30 (100)	21	9													9	
Total	30 (100)	21	9													9	
Ontario																	
<i>Campylobacter coli</i>																	
<i>Campylobacter jejuni</i>	36 (100)	17	14	5									5	5		19	
Total	36 (100)	17	14	5									5	5		19	
Québec																	
<i>Campylobacter coli</i>																	
<i>Campylobacter jejuni</i>	12 (100)	4	5	3				3		1		4	4			4	
Total	12 (100)	4	5	3				3		1		4	4			4	
National																	
<i>Campylobacter coli</i>	4 (3.3)	4													4	4	
<i>Campylobacter jejuni</i>	118 (96.7)	65	33	20				3		1		4	4		17	49	
Total	122 (100)	65	37	20				3		1		4	4		21	49	

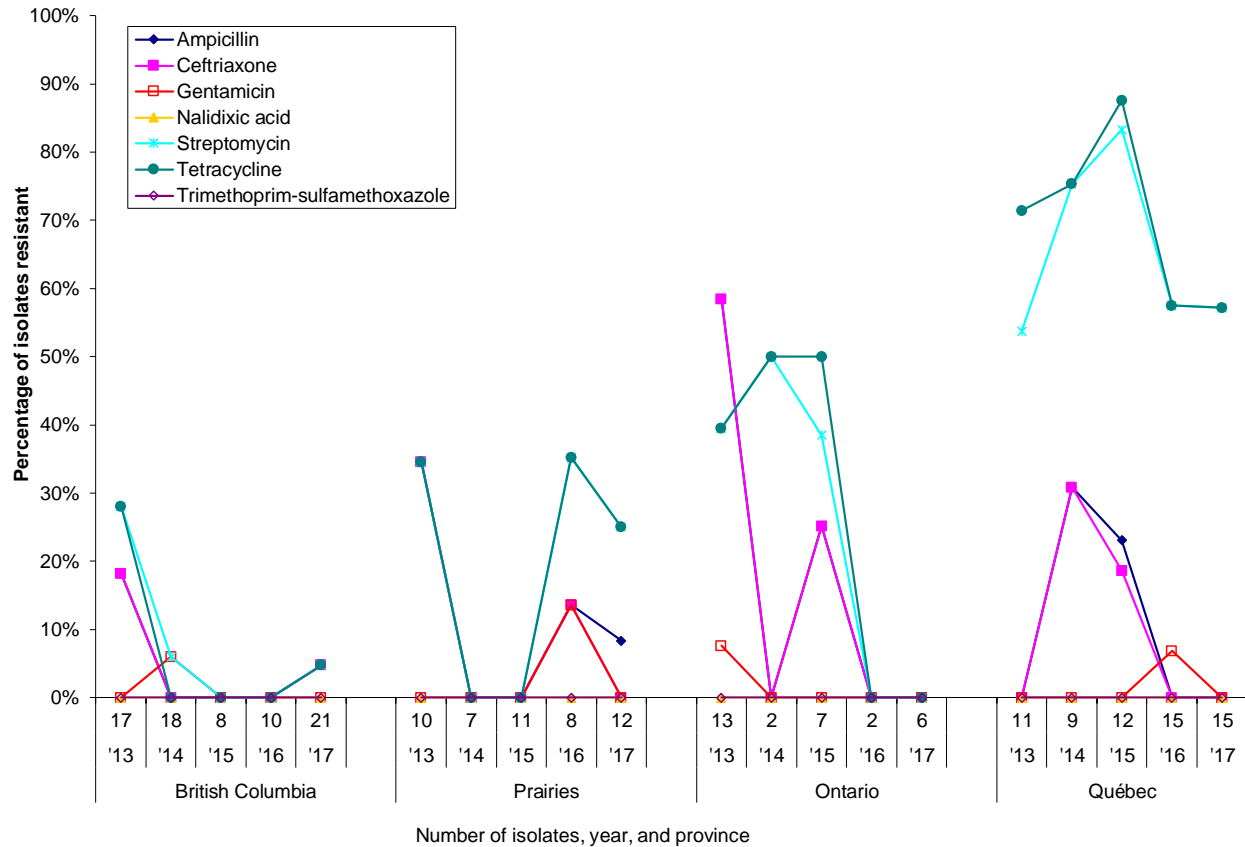
Antimicrobial abbreviations are defined in the Appendix.

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

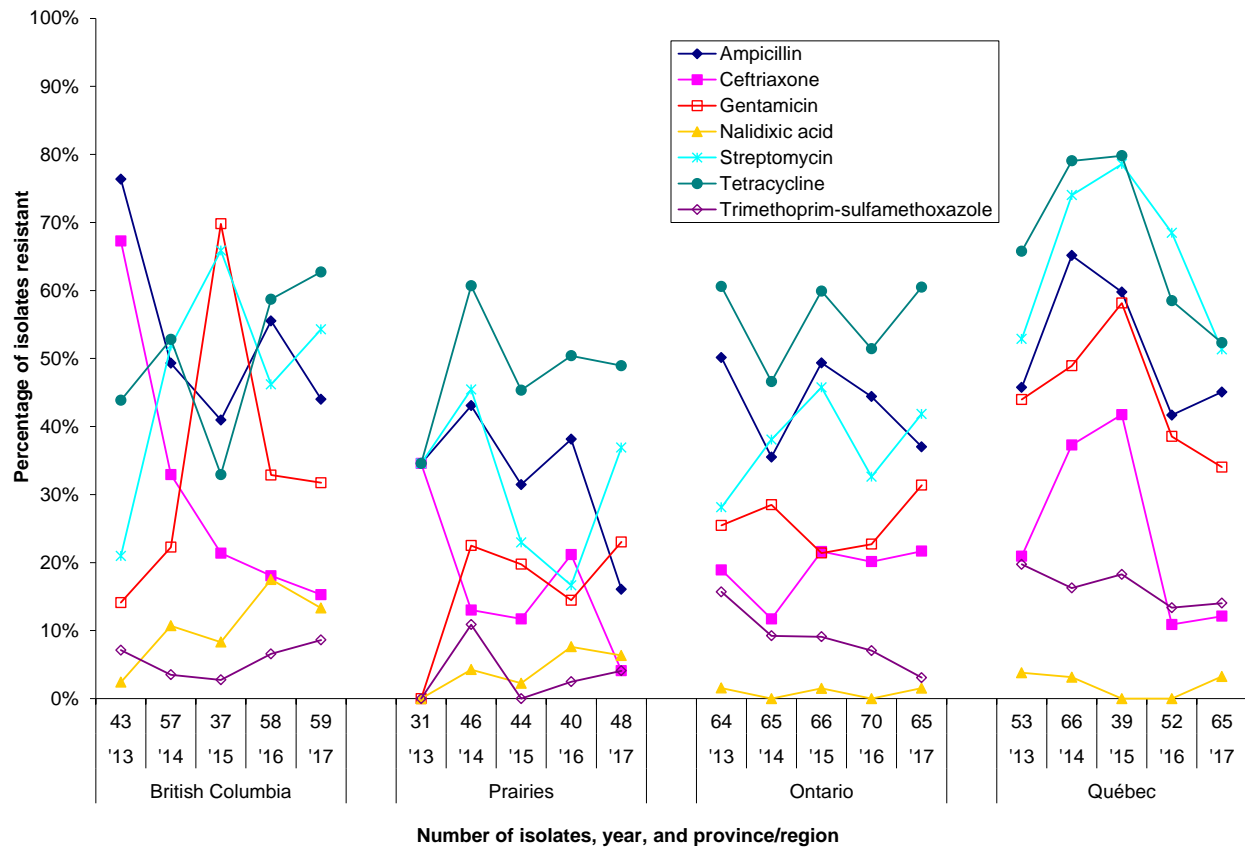
**Figure 3. 1 Temporal variations in resistance of *Salmonella* isolates from chicks and barn environment at placement, 2013 to 2017**



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17
Number of isolates	17	18	8	10	21	10	7	11	8	12	13	2	7	2	6	11	9	12	15	15
Antimicrobial																				
Ampicillin	18%	0%	0%	0%	5%	35%	0%	0%	14%	8%	58%	0%	25%	0%	0%	0%	31%	23%	0%	0%
Ceftriaxone	18%	0%	0%	0%	5%	35%	0%	0%	14%	0%	58%	0%	25%	0%	0%	0%	31%	19%	0%	0%
Gentamicin	0%	6%	0%	0%	0%	0%	0%	0%	14%	0%	8%	0%	0%	0%	0%	0%	0%	0%	7%	0%
Nalidixic acid	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Streptomycin	28%	6%	0%	0%	5%	35%	0%	0%	35%	25%	39%	50%	38%	0%	0%	54%	75%	83%	58%	57%
Tetracycline	28%	0%	0%	0%	5%	35%	0%	0%	35%	25%	39%	50%	50%	0%	0%	71%	75%	88%	58%	57%
Trimethoprim-sulfamethoxazole	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	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 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 and Saskatchewan.

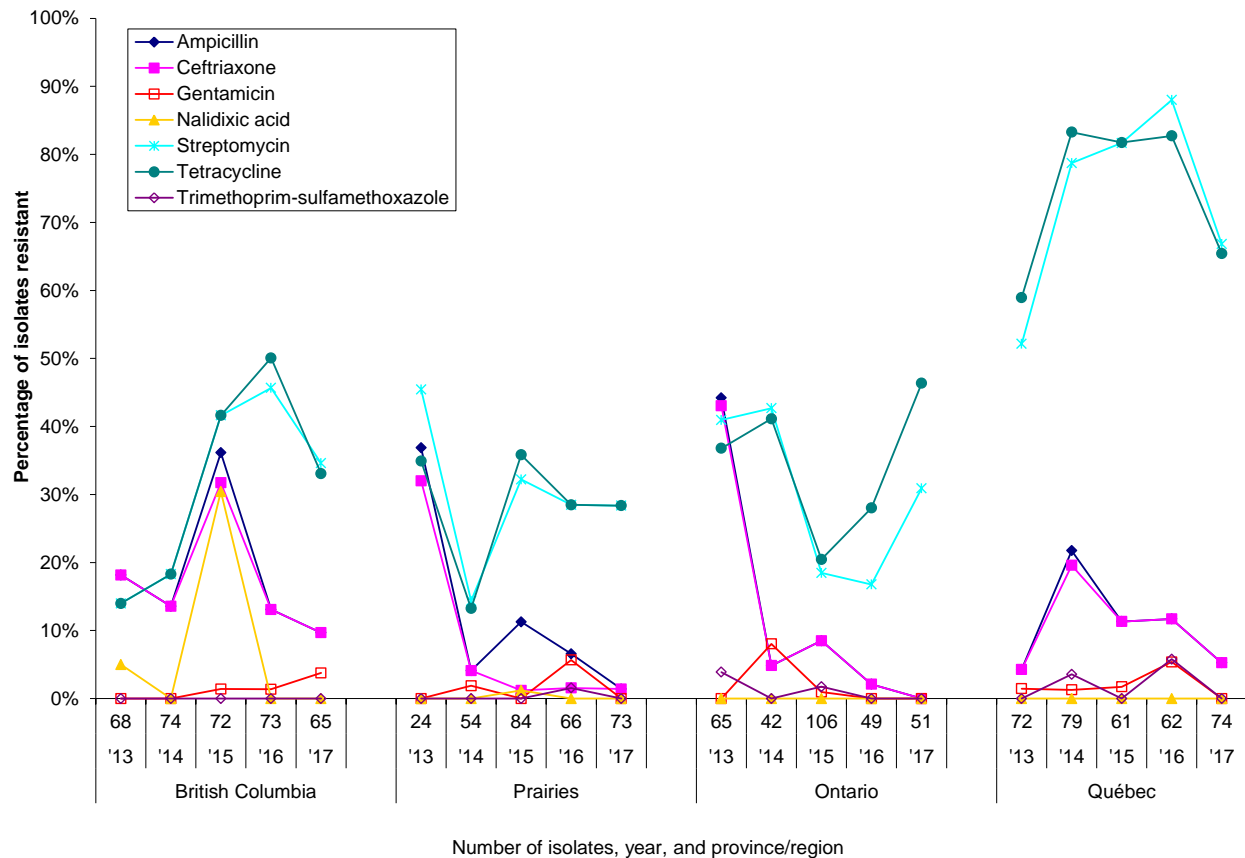
**Figure 3. 2 Temporal variations in resistance of *Escherichia coli* isolates from chicks and barn environment at placement, 2013 to 2017**



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17
Number of isolates	43	57	37	58	59	31	46	44	40	48	64	65	66	70	65	53	66	39	52	65
Antimicrobial																				
Ampicillin	76%	49%	41%	56%	44%	81%	43%	31%	38%	16%	50%	36%	49%	44%	37%	46%	65%	60%	42%	45%
Ceftriaxone	67%	33%	21%	18%	15%	68%	13%	12%	21%	4%	19%	12%	22%	20%	22%	21%	37%	42%	11%	12%
Gentamicin	14%	22%	70%	33%	32%	39%	22%	20%	14%	23%	25%	28%	21%	23%	31%	44%	49%	58%	39%	34%
Nalidixic acid	2%	11%	8%	18%	13%	7%	4%	2%	8%	6%	2%	0%	2%	0%	2%	4%	3%	0%	0%	3%
Streptomycin	21%	52%	66%	46%	54%	33%	45%	23%	17%	37%	28%	38%	46%	33%	42%	53%	74%	79%	68%	51%
Tetracycline	44%	53%	33%	59%	63%	59%	61%	45%	50%	49%	61%	47%	60%	51%	60%	66%	79%	80%	58%	52%
Trimethoprim-sulfamethoxazole	7%	3%	3%	7%	9%	6%	11%	0%	2%	4%	16%	9%	9%	7%	3%	20%	16%	18%	13%	14%

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 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.

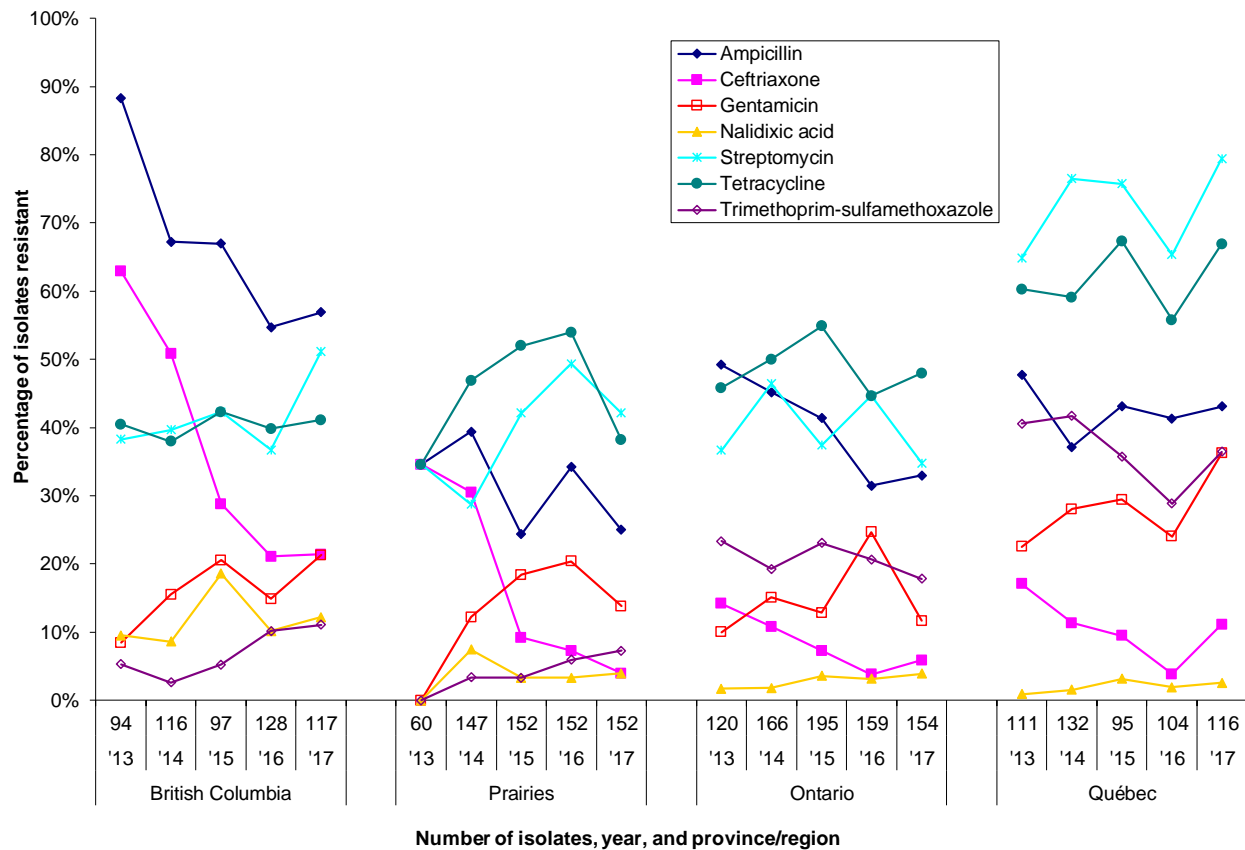
The Prairies is a region including the provinces of Alberta and Saskatchewan.

**Figure 3. 3 Temporal variations in resistance of *Salmonella* isolates from chickens at pre-harvest, 2013 to 2017**

Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17
Number of isolates	68	74	72	73	65	24	54	84	66	73	65	42	106	49	51	72	79	61	62	74
Antimicrobial																				
Ampicillin	18%	14%	36%	13%	10%	37%	4%	11%	7%	1%	44%	5%	8%	2%	0%	4%	22%	11%	12%	5%
Ceftriaxone	18%	14%	32%	13%	10%	32%	4%	1%	2%	1%	43%	5%	8%	2%	0%	4%	20%	11%	12%	5%
Gentamicin	0%	0%	1%	1%	4%	0%	2%	0%	6%	0%	0%	8%	1%	0%	0%	1%	1%	2%	5%	0%
Nalidixic acid	5%	0%	30%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Streptomycin	14%	18%	42%	46%	35%	45%	14%	32%	28%	28%	41%	43%	18%	17%	31%	52%	79%	82%	88%	67%
Tetracycline	14%	18%	42%	50%	33%	35%	13%	36%	28%	28%	37%	41%	20%	28%	46%	59%	83%	82%	83%	65%
Trimethoprim-sulfamethoxazole	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	4%	0%	2%	0%	0%	0%	4%	0%	6%	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 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 and Saskatchewan.

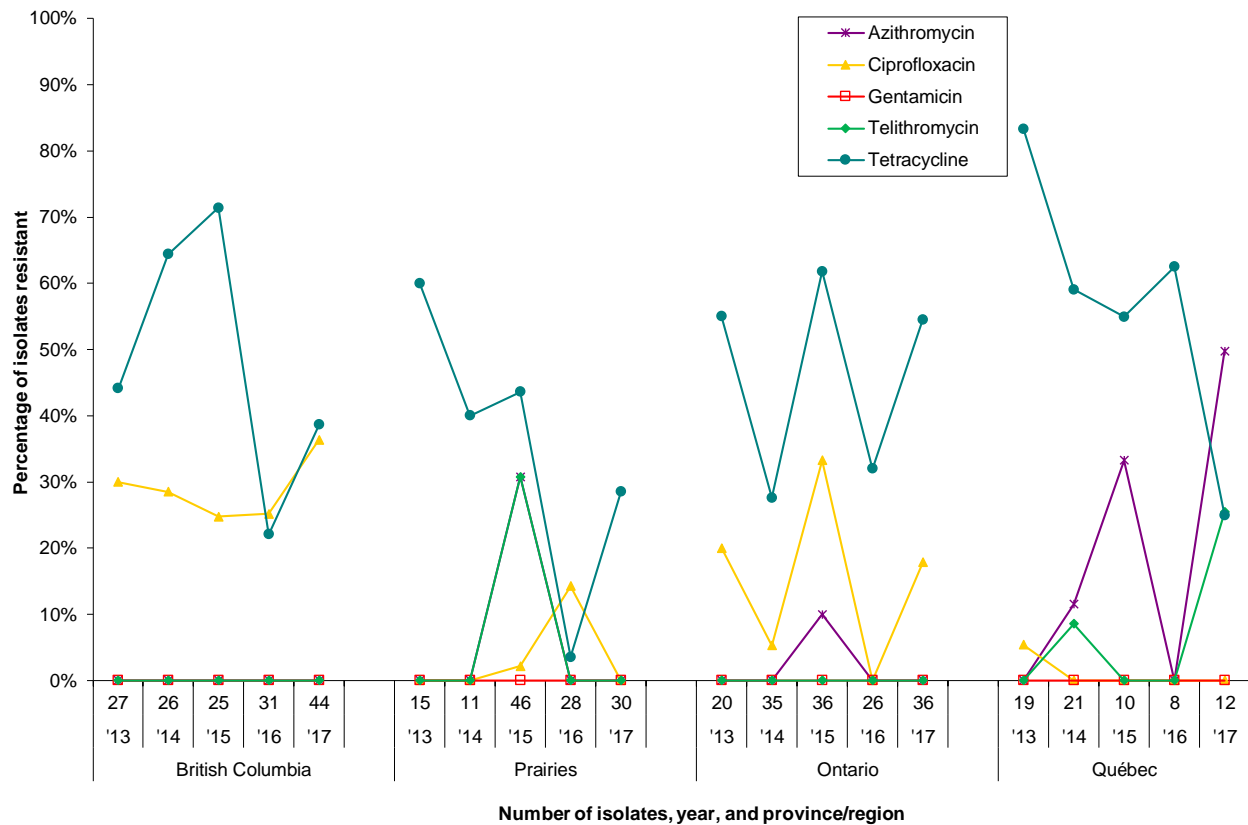
**Figure 3. 4 Temporal variations in resistance of *Escherichia coli* isolates from chickens at pre-harvest, 2013 to 2017**

Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17
Number of isolates	94	116	97	128	117	60	147	152	152	152	120	166	195	159	154	111	132	95	104	116
Antimicrobial																				
Ampicillin	88%	67%	67%	55%	57%	68%	39%	24%	34%	25%	49%	45%	41%	31%	33%	48%	37%	43%	41%	43%
Ceftriaxone	63%	51%	29%	21%	21%	47%	31%	9%	7%	4%	14%	11%	7%	4%	6%	17%	11%	9%	4%	11%
Gentamicin	8%	16%	21%	15%	21%	10%	12%	18%	20%	14%	10%	15%	13%	25%	12%	23%	28%	29%	24%	36%
Nalidixic acid	10%	9%	19%	10%	12%	8%	7%	3%	3%	4%	2%	2%	4%	3%	4%	1%	2%	3%	2%	3%
Streptomycin	38%	40%	42%	37%	51%	52%	29%	42%	49%	42%	37%	46%	37%	45%	35%	65%	77%	76%	65%	79%
Tetracycline	40%	38%	42%	40%	41%	53%	47%	52%	54%	38%	46%	50%	55%	45%	48%	60%	59%	67%	56%	67%
sulfamethoxazole	5%	3%	5%	10%	11%	7%	3%	3%	6%	7%	23%	19%	23%	21%	18%	41%	42%	36%	29%	36%

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 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 and Saskatchewan.

**Figure 3. 5 Temporal variations in resistance of *Campylobacter* isolates from chickens at pre-harvest, 2013 to 2017**



Province/region	British Columbia					Prairies					Ontario					Québec				
Year	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17	'13	'14	'15	'16	'17
Number of isolates	27	26	25	31	44	15	11	46	28	30	20	35	36	26	36	19	21	10	8	12
Antimicrobial																				
Azithromycin	0%	0%	0%	0%	0%	0%	0%	31%	0%	0%	0%	0%	10%	0%	0%	0%	12%	33%	0%	50%
Ciprofloxacin	30%	29%	25%	25%	36%	0%	0%	2%	14%	0%	20%	5%	33%	0%	18%	5%	0%	0%	0%	0%
Gentamicin	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Telithromycin	0%	0%	0%	0%	0%	0%	0%	31%	0%	0%	0%	0%	0%	0%	0%	0%	9%	0%	0%	25%
Tetracycline	44%	64%	71%	22%	39%	60%	40%	44%	4%	29%	55%	28%	62%	32%	55%	83%	59%	55%	63%	25%

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 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 and Saskatchewan.

## Recovery results

**Table 3. 6 Farm surveillance recovery rates in broiler chickens, 2013 to 2017**

Animal species	Province / region	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted					
			<i>Escherichia coli</i>		<i>Salmonella</i>		<i>Campylobacter</i>	<i>Enterococcus</i>
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		
	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		
	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	1%	6/75		
	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		
	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		
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
	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
	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	16%	36/231
	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
	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

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

### 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

#### Antimicrobials

**AMC** Amoxicillin-clavulanic acid  
**AMP** Ampicillin  
**AZM** Azithromycin  
**CHL** Chloramphenicol  
**CIP** Ciprofloxacin  
**CLI** Clindamycin  
**CRO** Ceftriaxone  
**ERY** Erythromycin  
**FLR** Florfenicol  
**FOX** Cefoxitin

#### Territories

**YT** Yukon  
**NT** Northwest Territories  
**NU** Nunavut

#### Regions

**Prairies:** AB, SK, MB  
**Maritimes:** NB, NS, PE  
**Atlantic:** NB, NS, PE, NL

**GEN** Gentamicin  
**MEM** Meropenem  
**NAL** Nalidixic acid  
**SSS** Sulfisoxazole  
**STR** Streptomycin  
**SXT** Trimethoprim-sulfamethoxazole  
**TEL** Telithromycin  
**TET** Tetracycline  
**TIO** Ceftiofur