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Canada

2017

CIPARS

Canadian Integrated Program for Antimicrobial Resistance Surveillance

Turkeys

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

Également disponible en français sous le titre :

Programme intégré canadien de surveillance de la résistance aux antimicrobiens (PICRA) de 2017 : Dindons

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This publication can be made available in alternative formats upon request.

Publication date: April 2022

Cat.: HP2-4/2017E-6-PDF

ISBN: 978-0-660-42481-1

Pub.: 210737

Suggested Citation:

Government of Canada. Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) 2017: Turkeys. Public Health Agency of Canada, Guelph, Ontario, 2022.

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Turkeys

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Acknowledgements

We are grateful for the sentinel veterinarians and the producers who participated in Farm Surveillance by providing data and enabling collection of samples for bacterial culture.
We would like to acknowledge the following organizations for their contribution to the CIPARS Farm Surveillance – turkey component:

- Turkey Farmers of Canada
- British Columbia Turkey Farmers
- Turkey Farmers of Ontario
- Les Éleveurs de volailles du Québec (ÉVQ)
- Canadian Hatcheries Federation
- Canadian Poultry and Egg Processors Council
- Ontario Ministry of Agriculture, Food and Rural Affairs
- Canadian Poultry Research Council

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 turkeys. These are relevant to antimicrobial use and antimicrobial resistance.

Key findings

Mortality

- The median mortality rate in the one grow-out cycle of turkey flocks surveyed was 6% (range: 1 to 33%) and varies by production type: ABF/RWA (antibiotic-free program/raised without antibiotics) (6%, 2 to 10%), organic (3%) and conventional (6%, 1 to 33%).

Turkey poult sources

- Overall, 73% of poults placed in 2017 were domestically sourced (hatchery located in province were the birds are raised), with 5% of birds reportedly sourced from other provinces (other than the province where the birds are raised) and 23% of poults were imported from the USA (Figure 1. 1).

Diagnosis of diseases in turkey flocks

- As in the previous year, diseases associated with avian pathogenic *Esherichicia coli* were diagnosed (15 cases) but the diagnosis of enteric diseases (necrotic enteritis and coccidiosis) and viral diseases was relatively uncommon.

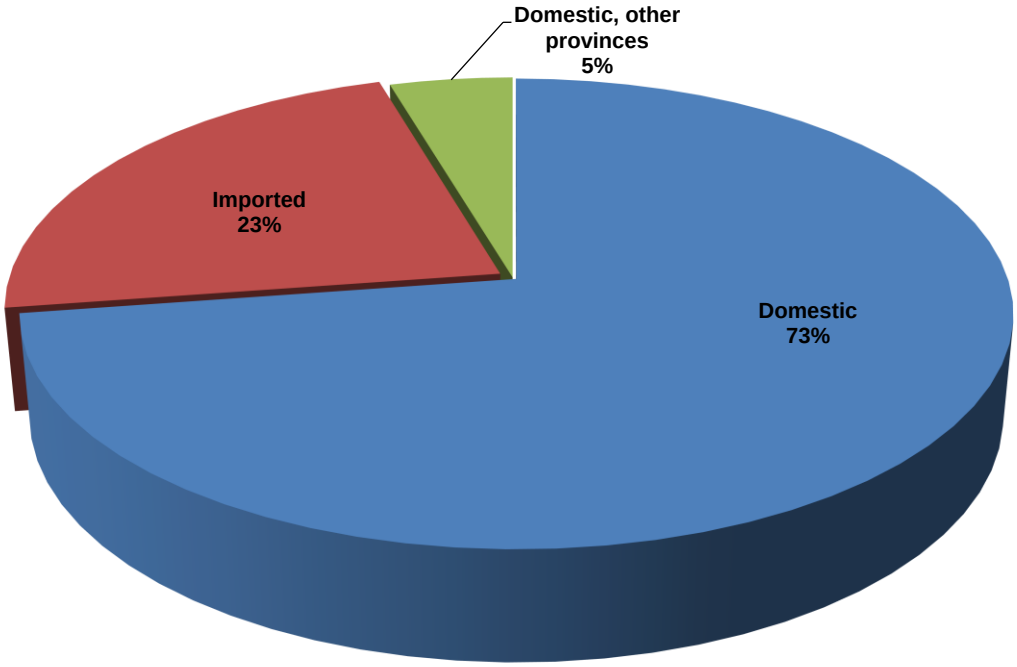
Biosecurity

- As for biosecurity practices, producers implemented a median downtime/rest period between flock cycles of 14 days (range: 1 to 240 days).

Zootechnical additives, vaccines, and deworming

- Fifty eight percent (43/74 flocks) of producers reported that their flocks were vaccinated with at least one viral/bacterial agent. Coccidiosis vaccine was administered to ABF/RWA flocks (19%). Between 2016 and 2017, flocks vaccinated with *E. coli* markedly increased from 1% to 14%.

Figure 1. 1 Relative distribution of turkey poult sources, 2017



Domestic = hatching eggs originated and/or poults hatched from hatcheries located in the province where the birds were raised.
Domestic, other provinces = hatching eggs originated and/or poults hatched from hatcheries located in provinces other than the province where the birds were raised.
Imported = hatching eggs/poults were sourced by the importing hatchery from the United States or other countries; there were hatching eggs from domestic breeders hatched in United States hatcheries and then delivered/reared in Canadian turkey farms.

Chapter 2 Antimicrobial use in turkeys

How to read this chapter

This chapter highlights the most notable antimicrobial use (AMU) findings in turkeys. 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[1]; 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)"[2,3].
- **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[4,5] or expert opinion[6].
- **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[7]. These were developed using an approach similar to

[1] 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.
[2] 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.
[3] 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 26, 2018.
[4] Compendium of Veterinary Products. Available at: https://bam.cvpservice.com/. Accessed March 26, 2018.
[5] Compendium of Medicating Ingredients Brochure.Available: http://www.inspection.gc.ca/animals/feeds/medicating-ingredients/eng/1300212600464/1320602461227. Accessed March 26, 2018.
[6] Canadian Association of Poultry Veterinarians. CgFARAD. Available at: https://www.capv-acva.ca/cgfarad. Accessed March 26, 2018
[7] 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. Accessed January 2019.

ESVAC's DDDvet assignment with some exceptions[8]. Details of the development of the standards are outlined in the CIPARS 2016 Annual Report methods chapter[9].

- **Number of Defined Daily Doses (nDDDvetCA) in animals using Canadian standards (nDDDvetCA):** 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"[10], is a denominator that accounts for the inter-species variations in live animal biomass and duration of the grow-out or observation period[11]. 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; presented for the first time in this report.

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

[8] 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.

[9] 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. Accessed January 2019.

[10] 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.

[11] 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[12], is also suggested for the reporting of farm-level data[13]. Table 2. 1 briefly describes the technical units of measurement and indicators used in this chapter. Detailed methodology are 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 turkeys. 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 (turkeys: Table 2. 3 and Table 2. 4.

To harmonize with other international surveillance programs[14,15] the figures and tables do not include the coccidiostats. These antimicrobial agents are described in a separate subsection.

[12] 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. Accessed March 2018.

[13] 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. Accessed March 2018.

[14] ESVAC. Sales of veterinary antimicrobial agents in 20 European countries in 2015. Trends from 2010 to 2015. Seventh ESVAC Report.

[15] 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
Frequency of use	Number of flocks/herd exposed	Total flocks/herds sampled
$Percentage\ of\ flocks\ exposed/treated = \frac{Number\ of\ flocks\ or\ herds\ exposed}{Total\ flocks\ or\ herds\ sampled} \times 100$		
Frequency of rations	Number of medicated or unmedicated rations	Total number of rations
$Percentage\ of\ rations\ medicated = \frac{Number\ of\ rations\ medicated}{Total\ rations\ fed} \times 100$		
kg (distribution data)	Antimicrobials (kg) distributed by CAHI member companies for use in production and comparnion animal in Canada	N/A
$Kilograms\ distributed\ in\ production\ animals\ +\ companion\ animals$		
Population correction unit (mg/PCU), distribution data data	Total population multiplied by the standard weight of animals at time of treatment	N/A
$Total\ population\ \times std.\ weight\ of\ animals\ in\ kg\ at\ time\ of\ treatment$		
mg/population correction unit (mg/PCU), distribution data	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)
$mg/_{PCU} = \frac{Antimicrobials\ distributed\ (mg)}{PCU\ (kg)}$		
mg/population correction unit (mg/PCU), farm data	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)
$mg/_{PCU} = \frac{Feed\ (mg) + water\ (mg) + injection\ (mg)}{PCU\ (total\ animals\ \times std.\ weight\ in\ kg)}$		
nDDDvetCA/1,000 animal-days at risk	Total quantity of antimicrobials consumed by the surveyed flock/herd in mg adjusted for defined daily dose in animals using Canadian standard (mg/DDDvetCA$_{mg/kg/day}$)[a]	Total number of animals minus half of the mortality rate multiplied by the weight of the animal and the average days at risk[b]
Final step: value multiplied by 1,000		
$nDDDvetCA/_{1{,}000\ animal\ days\ at\ risk} = \left(\frac{Total\ milligrams/_{DDDvetCA_{mg/kg/day}}}{Total\ animals \times std.\ weight\ in\ kg \times average\ days\ at\ risk}\right) \times 1{,}000$		
nDDDvetCA/population correction unit	Total quantity of antimicrobials consumed by the surveyed flock/herd in mg adjusted for defined daily dose in animals using Canadian standard (mg/DDDvetCA$_{mg/kg/day}$)[a]	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)
$nDDDvetCA/_{PCU} = \frac{Total\ milligrams/DDDvetCA_{mg/kg/day}}{(Total\ animals \times std.\ weight\ in\ kg)}$		

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.

[a] 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.

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

Farm Surveillance in turkeys

Key findings

Administration in feed

- Antimicrobials administered via feed represented the greatest route of administration/exposure in terms of frequency (80%, 59/74 flocks) (Table 2. 2) and quantity (Table 2. 3 and Figure 2. 1). The top 3 most frequently used antimicrobial classes in terms of mg/PCU were bacitracins, streptogramins, and trimethoprim-sulfonamides. These were reportedly used for the prevention of necrotic enteritis (bacitracin, streptogramins) and the treatment of diseases associated with avian pathogenic *E. coli* such as yolksacculitis, septicemia and airsacculitis.
- Overall, the quantity of antimicrobials marginally increased between 2016 and 2017 in terms of mg/PCU by 4%, nDDDvetCA/1,000 turkey-days at risk by 4% and nDDDvetCA/PCU by 5% (Table 2. 4). There were provincial variations noted in all the antimicrobial use indicators used (Table 2. 3), largely as a result of change in the quantity of antimicrobials administered via feed; British Columbia increased while Ontario and Québec decreased (Figure 2. 2, Figure 2. 3, and Figure 2. 4).

Administration in water

- As in the previous year, the proportion of producers that reported the use of antimicrobial via water was relatively small (14%). The quantity of antimicrobials used via this route contributed to less than 1 % of the total quantity of antimicrobials in terms of mg/PCU (Figure 2. 2).
- One turkey producer reported the use of enrofloxacin (British Columbia), a fluoroquinolone class of antimicrobial belonging to Veterinary Drugs Directorate's Category I antimicrobials. The flock was reportedly treated for septicemia and respiratory infection. This is the only reported use of VDD Category I antimicrobial in the sentinel flocks surveyed between 2016 and 2017.

Administration *in ovo* or subcutaneous injection

- Seventy percent (51/74) of turkey producers reported that the poults delivered to their barn were medicated at the hatchery (Table 2. 3). The proportion of flocks medicated decreased by 9%. Gentamicin, administered by injection, was the drug of choice for the prevention of neonatal diseases such as avian pathogenic *E. coli* (APEC) at the hatchery level (Figure 2. 9).

Ionophores, chemical coccidiostats and other antiprotozoal agents

- Coccidiostats, used for the prevention of coccidiosis (*Eimeria* spp.), contributed to 65% of the total antimicrobials used in turkeys. Overall, 72% of the flocks used ionophores and 4% used chemical coccidiostats. The ionophores lasalocid and monensin were the most frequently used coccidiostats.

Summary of antimicrobials used by routes of administration

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

Antimicrobial use	Route of administration			
	Any route[a] n (%)	*In ovo*/subcutaneous n (%)	Feed n (%)	Water n (%)
Any antimicrobial use	59 (80)	52 (72)	59 (80)	10 (14)
No antimicrobial use[b]	15 (20)	20 (28)	15 (20)	64 (86)
Total flocks	**74 (100)**	**72 (100)**	**74 (100)**	**74 (100)**

[a] Flocks with reported use of an antimicrobial class by feed, water, *in ovo*/subcutaneous, or any combination of these routes are included in each count.
[b] These were flocks that were not medicated with any of the antimicrobials listed in Table 2.3 (next page).

Table 2. 3 Frequency and quantity of antimicrobial use in turkeys, 2017

Route of administration	Antimicrobial	Flocks n (%)	Ration n (%)	Days exposed median (min. ; max.)[a]	Level of drug median (min. ; max.)[b]	Quantity of antimicrobial active ingredient[c]		
						mg/PCU	nDDDvetCA/ 1,000 turkey-days at risk	nDDDvetCA/ PCU
Feed					g/tonne			
II	Tylosin	4 (5)	12 (3)	14 (7 ; 21)	22 (22 ; 88)	7	3	0.3
	Penicillin G procaine	1 (1)	1 (< 1)	14 (14 ; 14)	110 (110 ; 110)	0	0	0.004
	Virginiamycin	27 (36)	102 (24)	14 (6 ; 42)	22 (22 ; 22)	13	52	5
	Trimethoprim-sulfadiazine	7 (9)	8 (2)	11 (7 ; 21)	250 200; 300)	8	13	1
III	Bacitracin	28 (38)	116 (27)	14 (3 ; 28)	55 (55 ; 110)	33	38	3
	Chlortetracycline	2 (3)	2 (< 1)	9 (4 ; 14)	330 (220 ; 440)	1	0	0.04
IV	Bambermycin	12 (16)	36 (9)	18 (7 ; 53)	2 (2 ; 4)	1		
No AMU in feed		15 (20)	32 (137)					
Total feed, medicated		**59 (80)**	**285 (68)**			**62**	**107**	**9**
Water			**Treatment (n)**		g/Liter			
I	Enrofloxacin	1 (1)	1	5 (5 ; 5)	< 0.1	0.001	0.01	0.001
II	Amoxicillin	1 (1)	1	5 (5 ; 5)	0.14 (0.14 ; 0.14)	0.1	0.2	0.02
	Penicillin	4 (5)	4	5 (5 ; 5)	0.13 (0.13 ; 0.13)	0.0	0.9	0.07
	Penicillin-streptomycin	1 (1)	1	6 (3 ; 6)	0.18 (0.18 ; 0.55)	0.6	0.0	0.001
III	Neomycin	1 (1)	1	5 (5 ; 5)	0.11 (0.11 ; 0.11)	0.0	0.2	0.01
	Sulfaquinoxaline	2 (3)	2	5 (3 ; 6)	0.29 (0.29 ; 0.29)	0.2	0.1	0.01
	Sulfaquinoxaline-pyrimethamine	1 (1)	1	4 (4 ; 4)	0.05 (0.05 ; 0.05	0.0	0.0	0.003
No AMU in water		64 (86)						
Total water, medicated		**10 (14)**	**11**			**0.9**	**1.4**	**0.12**
Injection					mg/egg or poult			
II	Gentamicin	52 (72)			1	0.1	0.1	0.01
No AMU via injection		20 (28)						
Total injection		**52 (72)**				**0.1**	**0.1**	**0.01**
All routes[d]		**59 (80)**				**63**	**108**	**9**

See corresponding footnotes on next page.

Table 2. 3 Frequency and quantity of antimicrobial use summary, 2017

Roman numerals I to IV indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate. 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 turkeys.
mg/PCU = milligrams/population correction unit.
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligrams per kilogram turkey (mg_{drug}/kg_{animal}/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 turkey-days at risk = number of DDDvetCA/1,000 turkey-days at risk.
nDDDvetCA/PCU = number of DDDvetCA/population correction unit.
For detailed indicator description, please refer to **Error! Reference source not found.**.

[a] Days exposed are by ration (not full grow-out) or 1 course of water treatment.

[b] 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 poults or hatching eggs, level of drug is in milligrams per poult or hatching egg, as reported by the veterinarian/producer.

[c] Total quantity of antimicrobials were calculated based on standard feed or water consumed (feed and water were estimated based on breed standards).

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

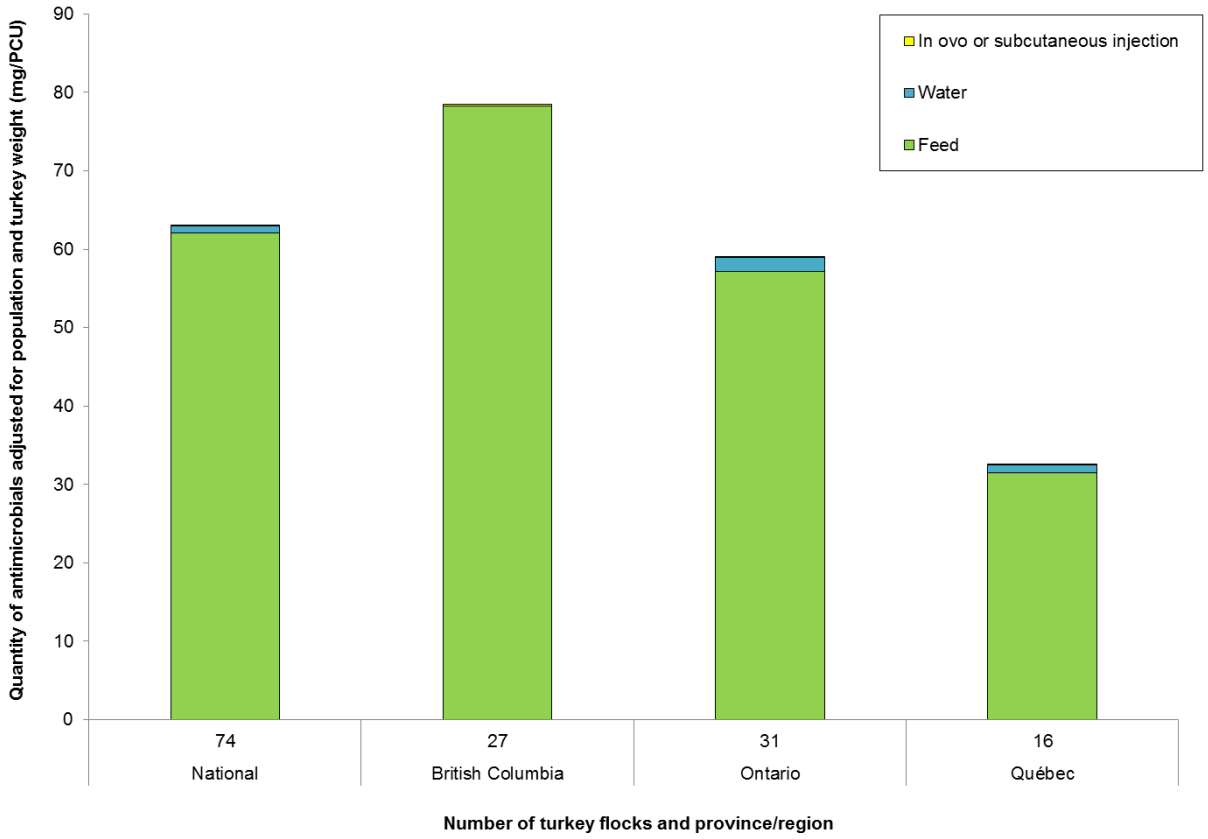
Table 2. 4 Production, biomass and quantity of antimicrobials used by province/region, 2016 to 2017

Province/ region	Year	Number of flocks	Pre-harvest weight Mean (kg)	Age sampled Mean (days)	Active ingredient (mg)	Turkey weights[a] (kg)	mg/PCU		nDDDvetCA/1,000 turkey-days at risk		nDDDvetCA/PCU	
							Total	%change[b]	Total	%change[b]	Total	%change[b]
British Columbia	2016	30	9	88	96,093,296	1,973,663	49		88		8	
	2017	27	9	89	125,474,395	1,599,299	78	61	122	39	11	46
Ontario	2016	30	10	91	102,916,844	1,170,514	88		143		12	
	2017	31	10	89	79,962,067	1,353,281	59	-33	111	-22	9	-25
Québec	2016	12	12	96	20,915,816	485,394	43		73		6	
	2017	16	11	90	20,382,878	626,239	33	-24	65	-12	5	-14
National[c]	2016	72	10	90	219,925,956	3,629,571	61		104		9	
	2017	74	10	89	225,819,340	3,578,819	63	4	108	4	9	5

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 turkey per day (mg_{drug}/kg_{animal}/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 turkey-days at risk = number of DDDvetCA/1,000 turkey-days at risk.
nDDDvetCA/PCU = number of DDDvetCA/population correction unit.
For detailed metric description, please refer to Table 2. 1.

[a] Population correction unit (PCU) or biomass, European weight (total flock population x ESVAC standard weight of 6.5 kg bird).
[b] Percent change = [(current surveillance year – previous surveillance year)/previous surveillance year] x 100.
[c] Includes only the provinces/regions surveyed and combines the quantity of antimicrobials used in feed, water and injection excluding coccidiostats, antiprotozoals and flavophospholipids.

Figure 2. 1 Quantity of antimicrobial use in all routes of administration, adjusted for population and turkey weight (mg/PCU), 2017

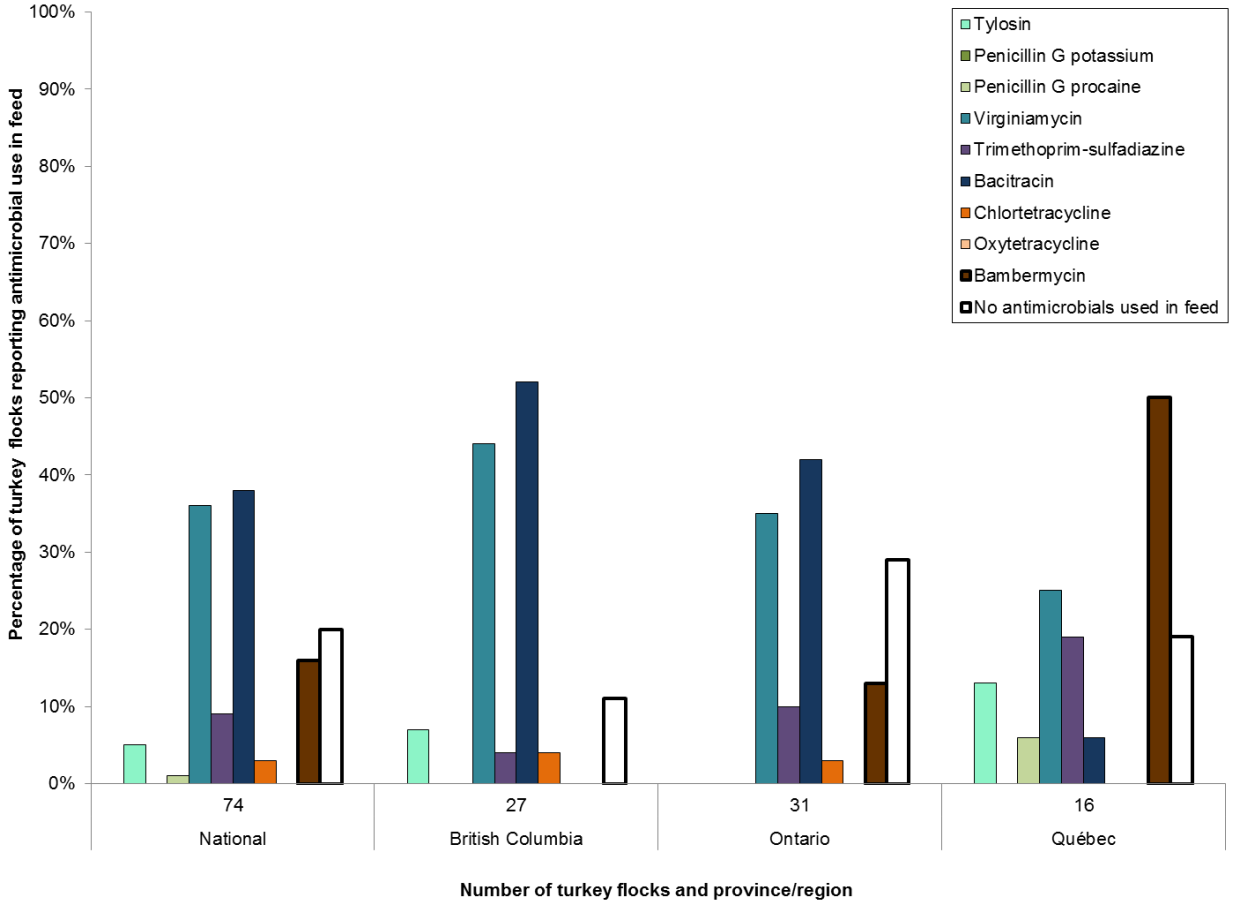


Province/region	National		British Columbia		Ontario		Québec	
Year	2016	2017	2016	2017	2016	2017	2016	2017
Number of flocks	72	74	30	27	30	31	12	16
Route of administration								
Feed	59.8	62.1	48.1	78.3	86.6	57	43.0	31.5
Water	0.6	0.86	0.4	0.01	1	2	0	0.9
In ovo/subcutaneous injections	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	60.6	63.1	49	78.5	87.9	59.1	43.1	32.5

mg/PCU = milligrams/population correction unit .
For detailed indicator description, please refer to Table 2. 1.
Data in figure pertains to the current year and data in table includes all years.

Antimicrobial use in feed by frequency

Figure 2. 2 Percentage of turkey flocks reporting antimicrobial use in feed, 2017

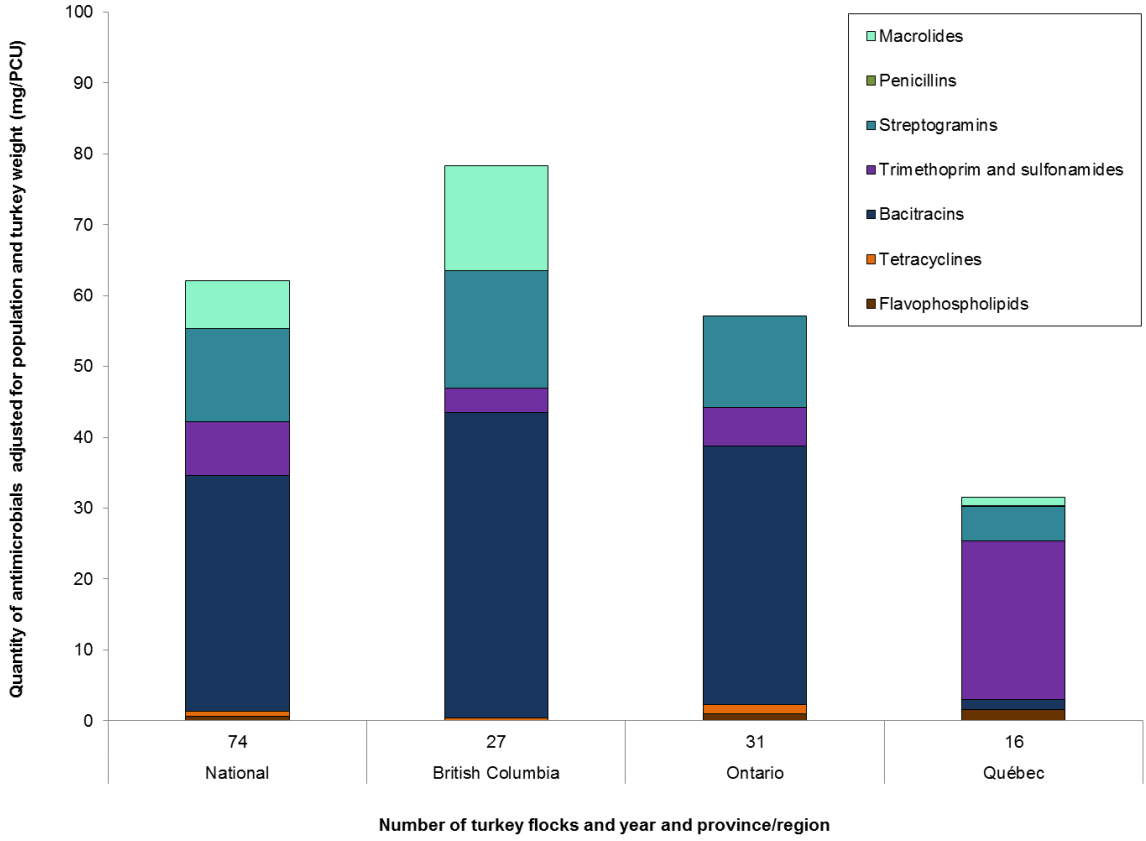


Province/region		National		British Columbia		Ontario		Québec	
Year		2016	2017	2016	2017	2016	2017	2016	2017
Number of flocks		72	74	30	27	30	31	12	16
Antimicrobials									
II	Tylosin	7%	5%	0%	7%	7%	0%	25%	13%
II	Penicillin G potassium	0%	0%	0%	0%	0%	0%	0%	0%
II	Penicillin G procaine	7%	1%	3%	0%	0%	0%	33%	6%
II	Virginiamycin	38%	36%	33%	44%	40%	35%	42%	25%
II	Trimethoprim-sulfadiazine	6%	9%	0%	4%	10%	10%	8%	19%
III	Bacitracin	36%	38%	57%	52%	30%	42%	0%	6%
III	Chlortetracycline	3%	3%	0%	4%	7%	3%	0%	0%
III	Oxytetracycline	3%	0%	0%	0%	0%	0%	17%	0%
IV	Bambermycin	4%	16%	0%	0%	10%	13%	0%	50%
	No antimicrobials used in feed	19%	20%	13%	11%	23%	29%	25%	19%

Roman numerals II to IV 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.
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 excluding coccidiostats).

Antimicrobial use in feed by quantitative indicators

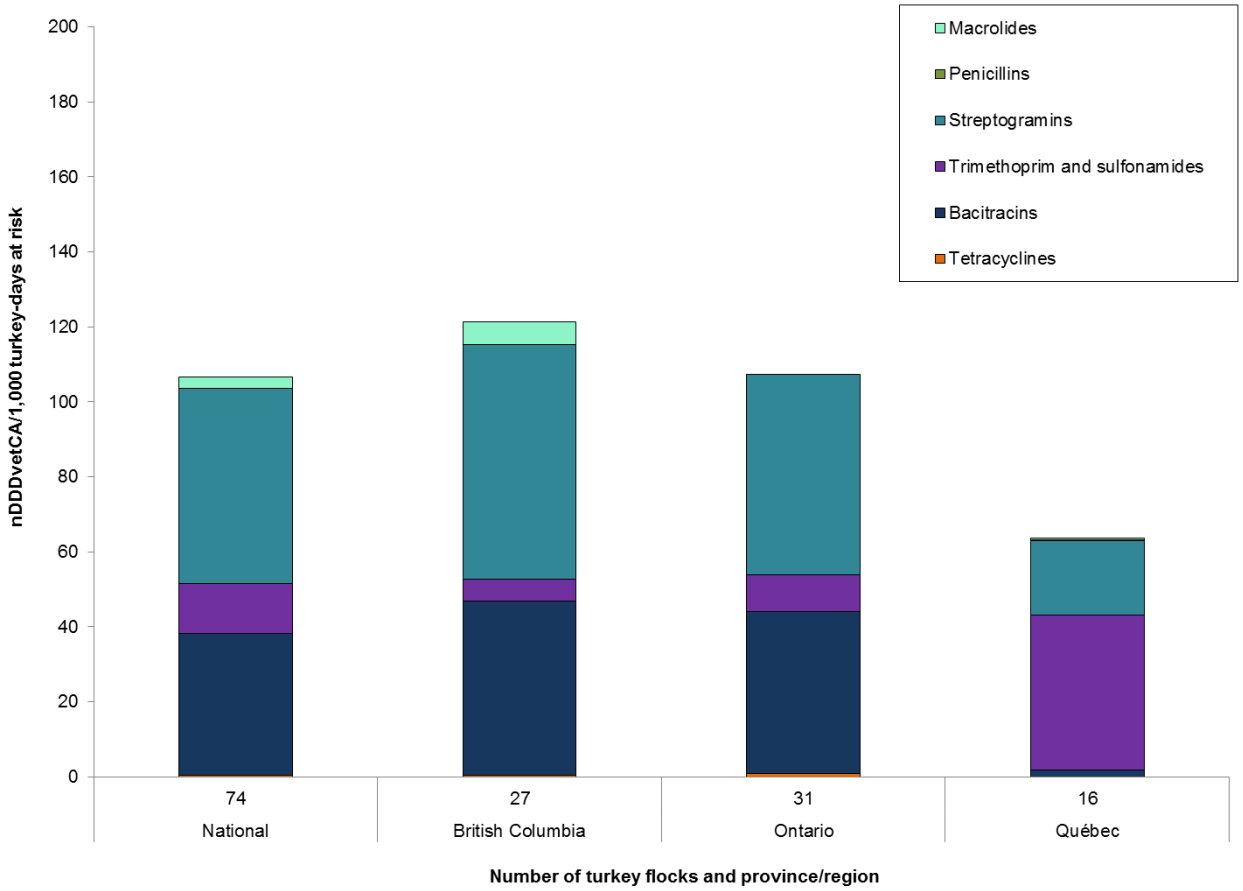
Figure 2. 3 Quantity of antimicrobial use in feed adjusted for population and turkey weight (mg/PCU), 2017



Province/region		National		British Columbia		Ontario		Québec	
Year		2016	2017	2016	2017	2016	2017	2016	2017
Number of flocks		72	74	30	27	30	31	12	16
Antimicrobial class									
II	Macrolides	2.6	6.8	0.0	14.8	2.1	0	14.1	1.2
II	Penicillins	0.5	0.02	0.4	0	0	0	2.2	0.1
II	Streptogramins	12.0	13.2	10.9	16.6	14.2	13.0	11.3	4.8
II	Trimethoprim and sulfonamides	2.3	7.6	0	3.5	4.9	5.4	5.4	22.4
III	Bacitracins	37.3	33.3	36.8	43.0	53.7	36.5	0	1.4
III	Tetracyclines	5.0	0.6	0	0.4	11.2	1.2	10.1	0
IV	Flavophospholipids	0.1	0.7	0	0	0.4	1.0	0	1.5
Total		59.8	62.1	48.1	78.3	86.6	57.2	43.0	31.5

Roman numerals II to IV 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.

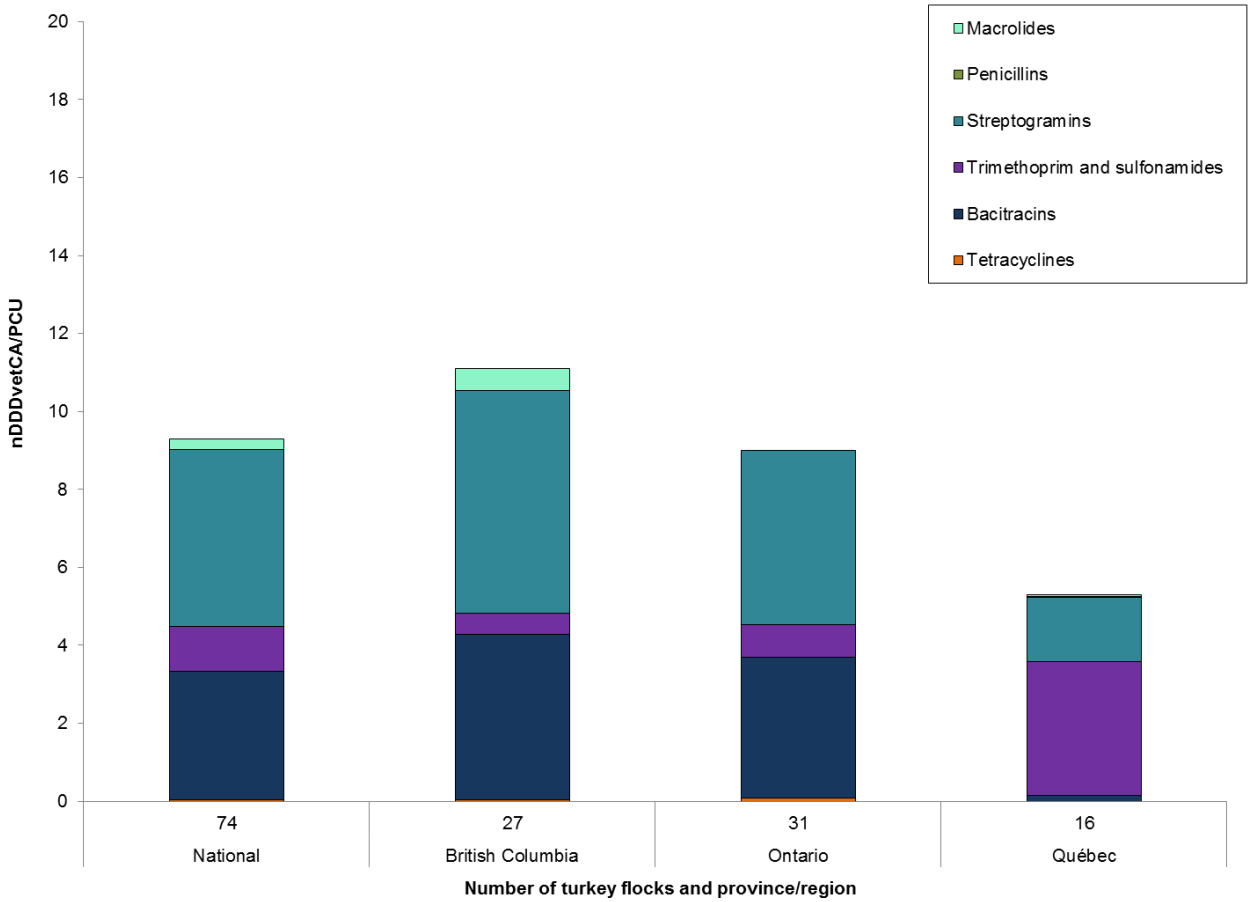
Figure 2. 4 Number of Canadian Defined Daily Doses for animals per 1,000 turkey-days at risk (nDDDvetCA/1,000 turkey-days at risk) for antimicrobials administered in feed, 2017



Province/region		National		British Columbia		Ontario		Québec	
Year		2016	2017	2016	2017	2016	2017	2016	2017
Number of flocks		72	74	30	27	30	31	12	16
Antimicrobial class									
II	Macrolides	1.1	3.0	0.0	6.2	0.9	0	6.3	0.6
II	Penicillins	1.1	0.05	0.9	0	0	0	4.7	0.3
II	Streptogramins	47.9	52.1	43.5	62.4	56.4	53.4	45.3	19.9
II	Trimethoprim and sulfonamides	5.4	13.3	0	5.9	12.7	9.9	9.6	41.3
III	Bacitracins	42.6	37.8	42.0	46.6	61.2	43.1	0	1.7
III	Tetracyclines	3.4	0.4	0	0.3	7.7	0.9	7.0	0
Total		101.6	106.7	86	121	138.9	107.4	73	63.8

Roman numerals II to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram turkey weight per day (mg_{drug}/kg_{animal}/day); please refer to Table A. 1 of Chapter 5: Design and methods of the 2016 CIPARS Annual Report for the list of standards.
nDDDvetCA/1,000 turkey-days at risk = number of DDDvetCA/1,000 turkey-days at risk.
For detailed indicator description, please refer to Table 2. 1.

Figure 2. 5 Number of Canadian Defined Daily Doses for animals per population correction unit (nDDDvetCA/PCU) for antimicrobials administered in feed, 2017

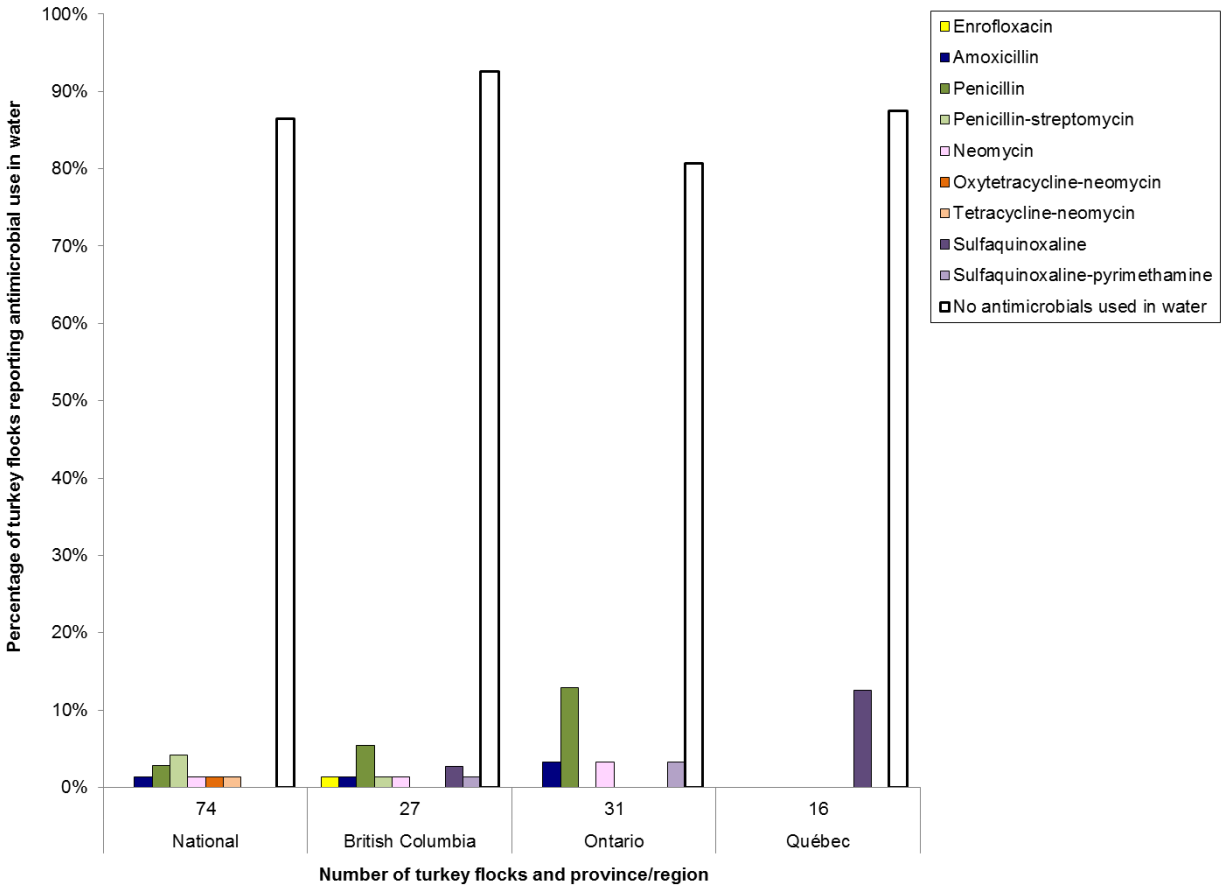


Province/region		National		British Columbia		Ontario		Québec	
Year		2016	2017	2016	2017	2016	2017	2016	2017
Number of flocks		72	74	30	27	30	31	12	16
Antimicrobial class									
II	Macrolides	0.1	0.3	0.0	0.6	0.1	0	0.5	0.0
II	Penicillins	0.1	0.00	0.1	0	0	0	0.4	0.0
II	Streptogramins	4.2	4.5	3.8	5.7	4.9	4.5	3.9	1.7
II	Trimethoprim and sulfonamides	0.5	1.2	0	0.5	1.1	0.8	0.8	3.4
III	Bacitracins	3.7	3.3	3.6	4.3	5.3	3.6	0	0.1
III	Tetracyclines	0.3	0.0	0	0.02	0.7	0.1	0.6	0
Total		8.8	9.3	7	11	12.1	9.0	6	5.3

Roman numerals II to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram turkey weight per day (mg_{drug}/kg_{animal}/day); please refer to 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 water by frequency

Figure 2. 6 Percentage of turkey flocks reporting antimicrobial use in water, 2017



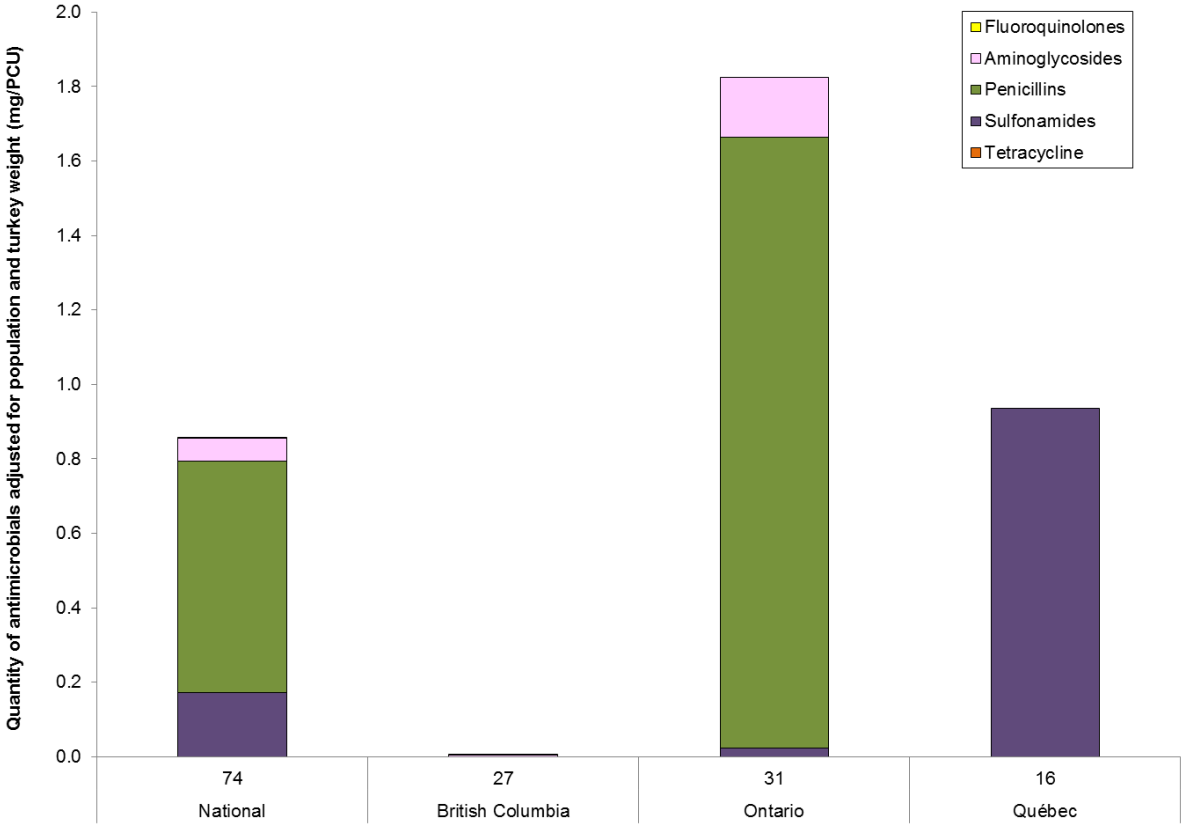
Province/Region	National		British Columbia		Ontario		Québec	
Year	2016	2017	2016	2017	2016	2017	2016	2017
Number of flocks	72	74	30	27	30	31	12	16
Antimicrobial								
I Enrofloxacin	0%	1%	0%	4%	0%	0%	0%	0%
II Amoxicillin	1%	1%	0%	0%	3%	3%	0%	0%
II Penicillin	3%	5%	0%	0%	7%	13%	0%	0%
II Penicillin-streptomycin	4%	1%	10%	4%	0%	0%	0%	0%
III Neomycin	1%	1%	0%	0%	3%	3%	0%	0%
III Oxytetracycline-neomycin	1%	0%	3%	0%	0%	0%	0%	0%
III Tetracycline-neomycin	1%	0%	0%	0%	3%	0%	0%	0%
III Sulfaquinoxaline	0%	3%	0%	0%	0%	0%	0%	13%
III Sulfaquinoxaline-pyrimethamine	0%	1%	0%	0%	0%	3%	0%	0%
No antimicrobials used in water	86%	93%	87%	93%	87%	81%	100%	88%

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

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

Antimicrobial use in water by quantitative indicators

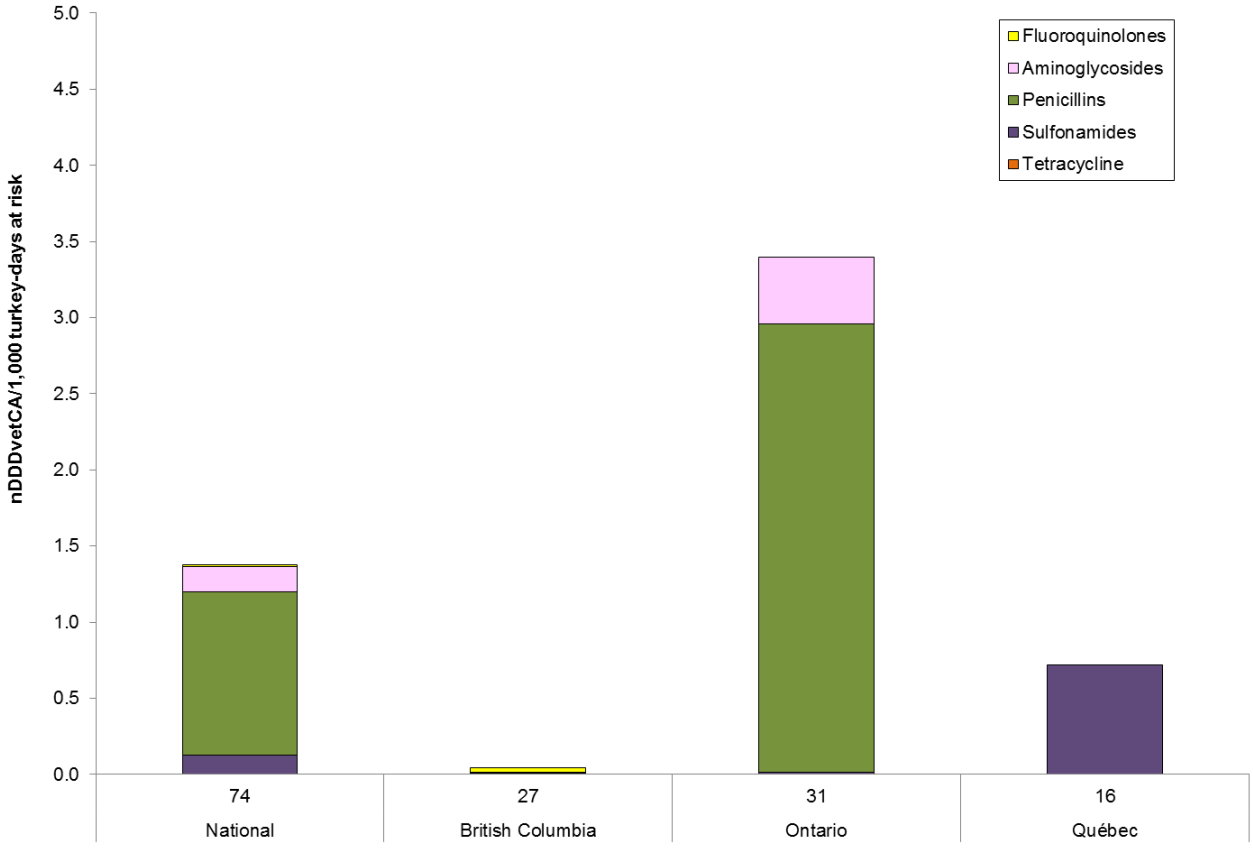
Figure 2. 7 Quantity of antimicrobial use in water adjusted for population and turkey weight (mg/PCU), 2017



Province/Region	National		British Columbia		Ontario		Québec	
Year	2016	2017	2016	2017	2016	2017	2016	2017
Number of flocks	72	74	30	27	30	31	12	16
Antimicrobial class								
I Fluoroquinolones	0	0.001	0	0.003	0	0	0	0
II Aminoglycosides	0.24	0.06	0.23	0.003	0.34	0.16	0	0
II Penicillins	0.29	0.62	0.02	0.001	0.85	1.64	0	0
III Sulfonamides	0	0.17	0	0	0	0.02	0	0.94
III Tetracycline	0.10	0	0.15	0	0.04	0	0	0
Total	0.62	0.86	0.41	0.01	1.23	1.82	0	0.94

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.

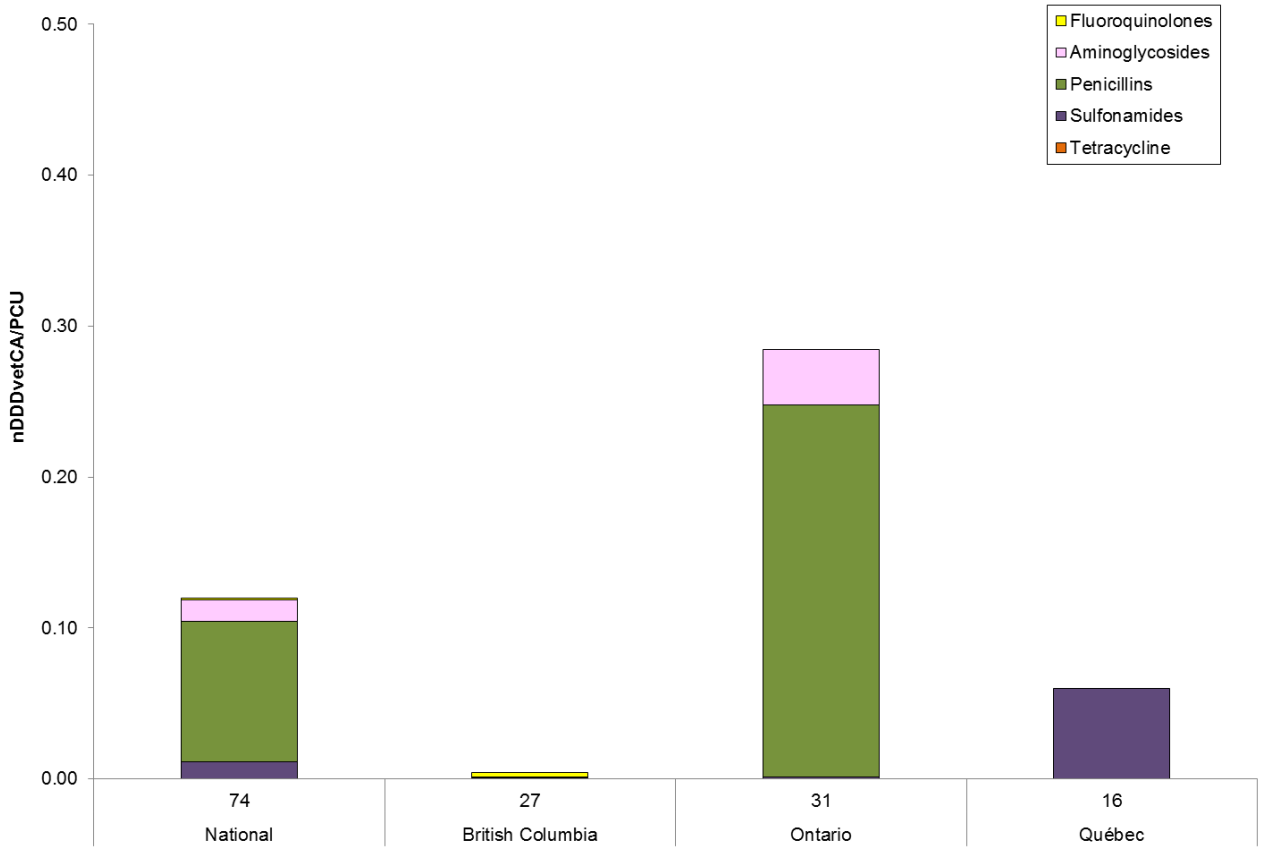
Figure 2. 8 Number of Canadian Defined Daily Doses for animals per 1,000 turkey-days at risk (nDDDvetCA/1,000 turkey-days at risk) for antimicrobials administered in water, 2017



Province/Region	National		British Columbia		Ontario		Québec	
Year	2016	2017	2016	2017	2016	2017	2016	2017
Number of flocks	72	74	30	27	30	31	12	16
Antimicrobial class								
I Fluoroquinolones	0	0.014	0	0.030	0	0	0	0
II Aminoglycosides	0.55	0.16	0.47	0.007	0.91	0.44	0	0
II Penicillins	1.02	1.07	0.31	0.007	2.63	2.94	0	0
III Sulfonamides	0	0.13	0	0	0	0.02	0	0.72
III Tetracycline	0.19	0	0.28	0	0.11	0	0	0
Total	1.76	1.38	1.06	0.04	3.65	3.40	0	0.72

Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram turkey weight per day (mg_{drug}/kg_{animal}/day); please refer to Table A. 1 of Chapter 5: Design and methods of the 2016 CIPARS Annual Report for the list of standards.
nDDDvetCA/1,000 turkey-days at risk = number of DDDvetCA/1,000 turkey-days at risk.
For detailed indicator description, please refer to Table 2. 1

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

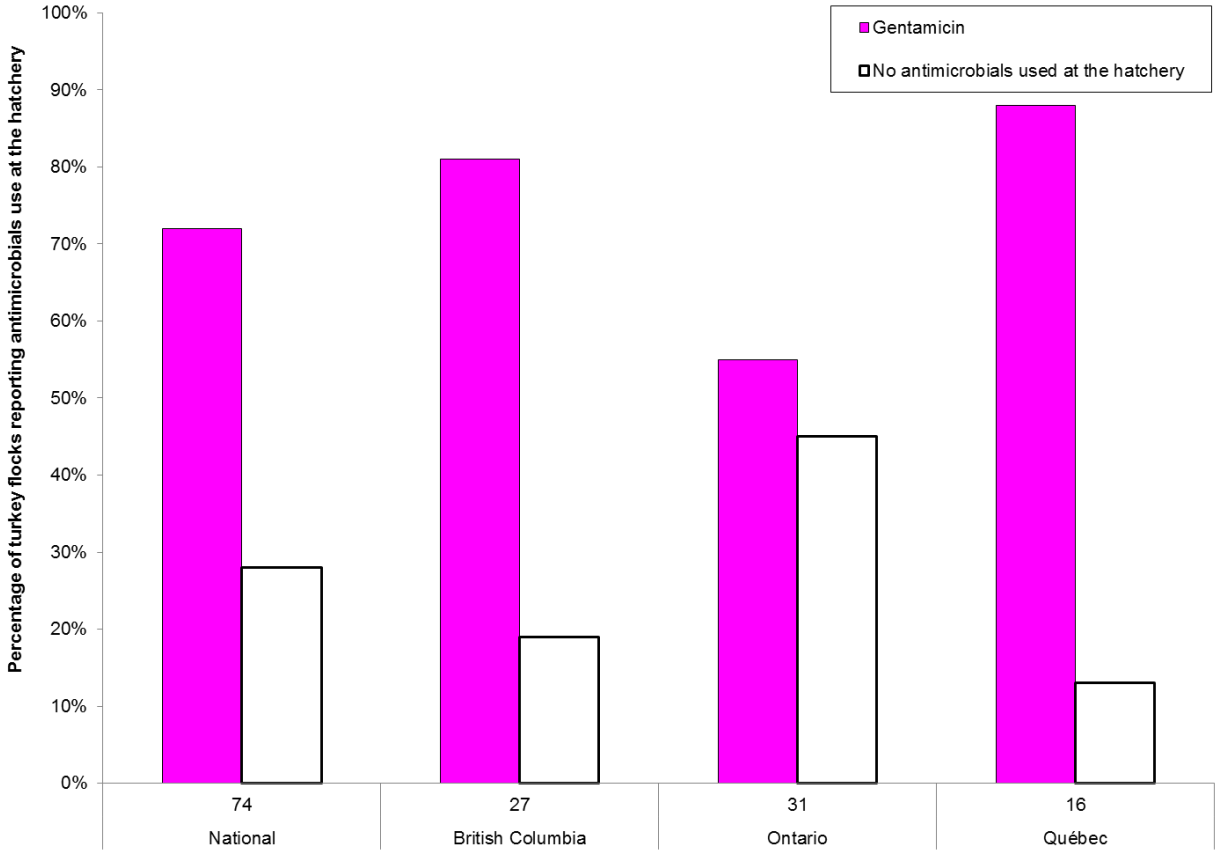


Province/Region		National		British Columbia		Ontario		Québec	
Year		2016	2017	2016	2017	2016	2017	2016	2017
Number of flocks		72	74	30	27	30	31	12	16
Antimicrobial class									
I	Fluoroquinolones	0	0.001	0	0.003	0	0	0	0
II	Aminoglycosides	0.05	0.01	0.04	0.001	0.08	0.04	0	0
	Penicillins	0.09	0.09	0.03	0.001	0.23	0.25	0	0
III	Sulfonamides	0	0.01	0	0	0	0.001	0	0.06
	Tetracycline	0.02	0	0.02	0	0.01	0	0	0
	Total	0.15	0.12	0.09	0.004	0.32	0.28	0	0.06

Roman numerals I to III indicate categories of importance to human medicine as outlined by the Veterinary Drugs Directorate.
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram turkey weight per day (mg_{drug}/kg_{animal}/day); please refer to 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.

Antimicrobials use *in ovo* or subcutaneous injection by frequency

Figure 2. 10 Percentage of turkey flocks reporting antimicrobials use *in ovo* or subcutaneous injection, 2017

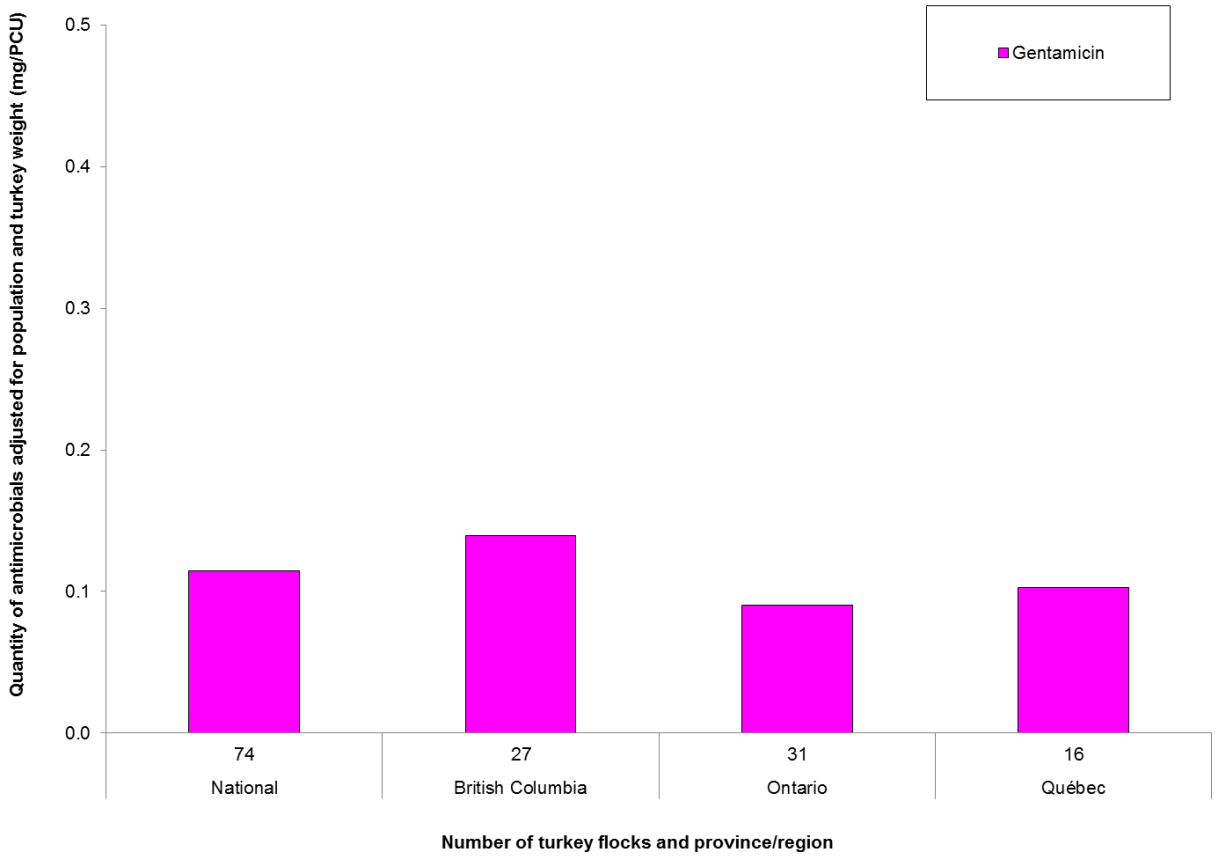


Province/Region	National		British Columbia		Ontario		Québec	
Year	2016	2017	2016	2017	2016	2017	2016	2017
Number of flocks	72	74	30	27	30	31	12	16
Antimicrobial								
II Gentamicin	81%	72%	83%	81%	77%	55%	83%	88%
No antimicrobials used at the hatchery	19%	28%	17%	19%	23%	45%	17%	13%

Roman numeral II indicates category of importance to human medicine as outlined by the Veterinary Drugs Directorate.
Data represent flocks medicated at the hatchery at day 18 of incubation or upon hatch.

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

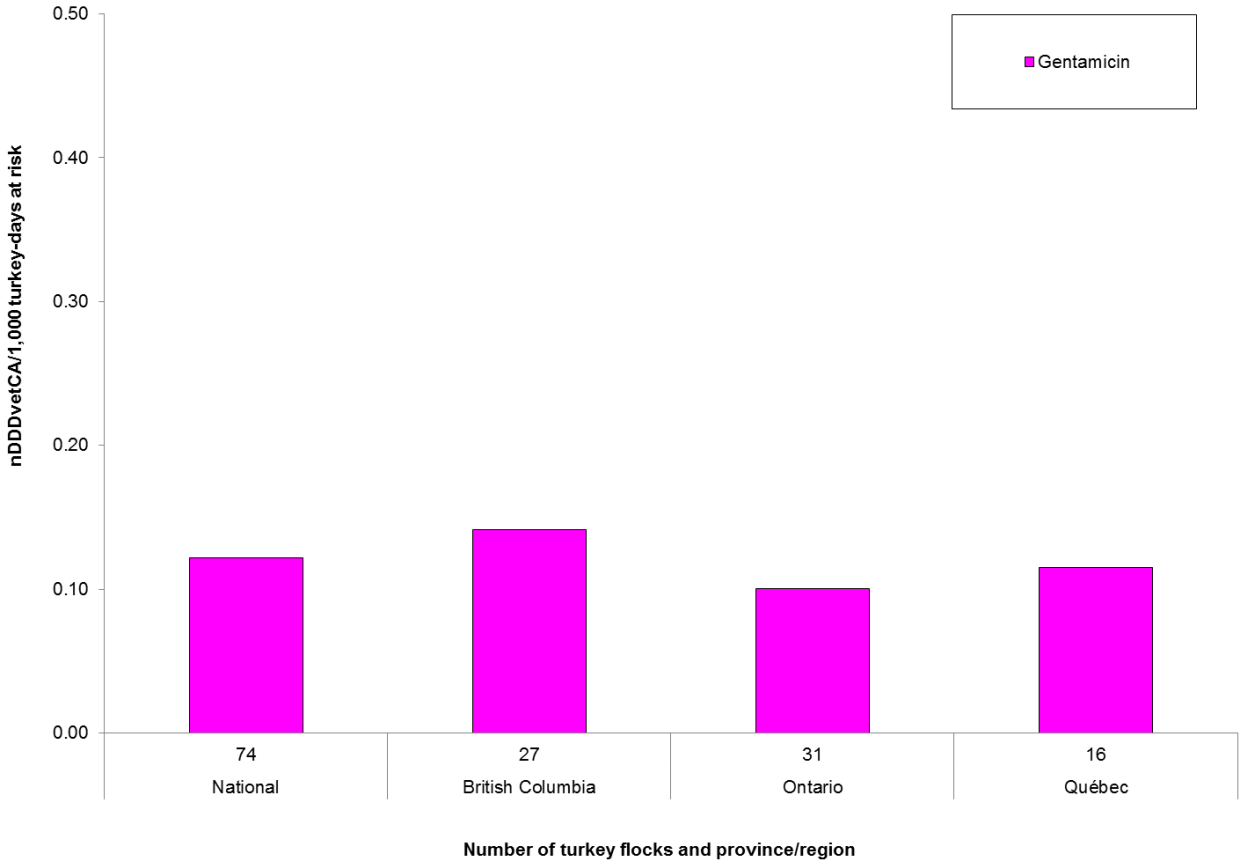
Figure 2. 11 Quantity of antimicrobials used *in ovo* or subcutaneous injections adjusted for population and turkey weight (milligrams/PCU), 2017



Province/region	National		British Columbia		Ontario		Québec	
Year	2016	2017	2016	2017	2016	2017	2016	2017
Number of flocks	72	74	30	27	30	31	12	16
Antimicrobial class								
II Gentamicin	0.13	0.11	0.13	0.14	0.13	0.09	0.11	0.10
Total	0.13	0.11	0.13	0.14	0.13	0.09	0.11	0.10

Roman numeral II indicates category of importance to human medicine as outlined by the Veterinary Drugs Directorate.
Total milligrams active ingredient was calculated using the final dose (in milligrams per hatching egg or poult) suggested by the manufacturer and expert opinion based on milligrams per body weight or residue avoidance information: gentamicin routine dose (1 mg/poult).
mg/PCU = milligrams/population correction unit.
For detailed indicator description, please refer to Table 2. 1.

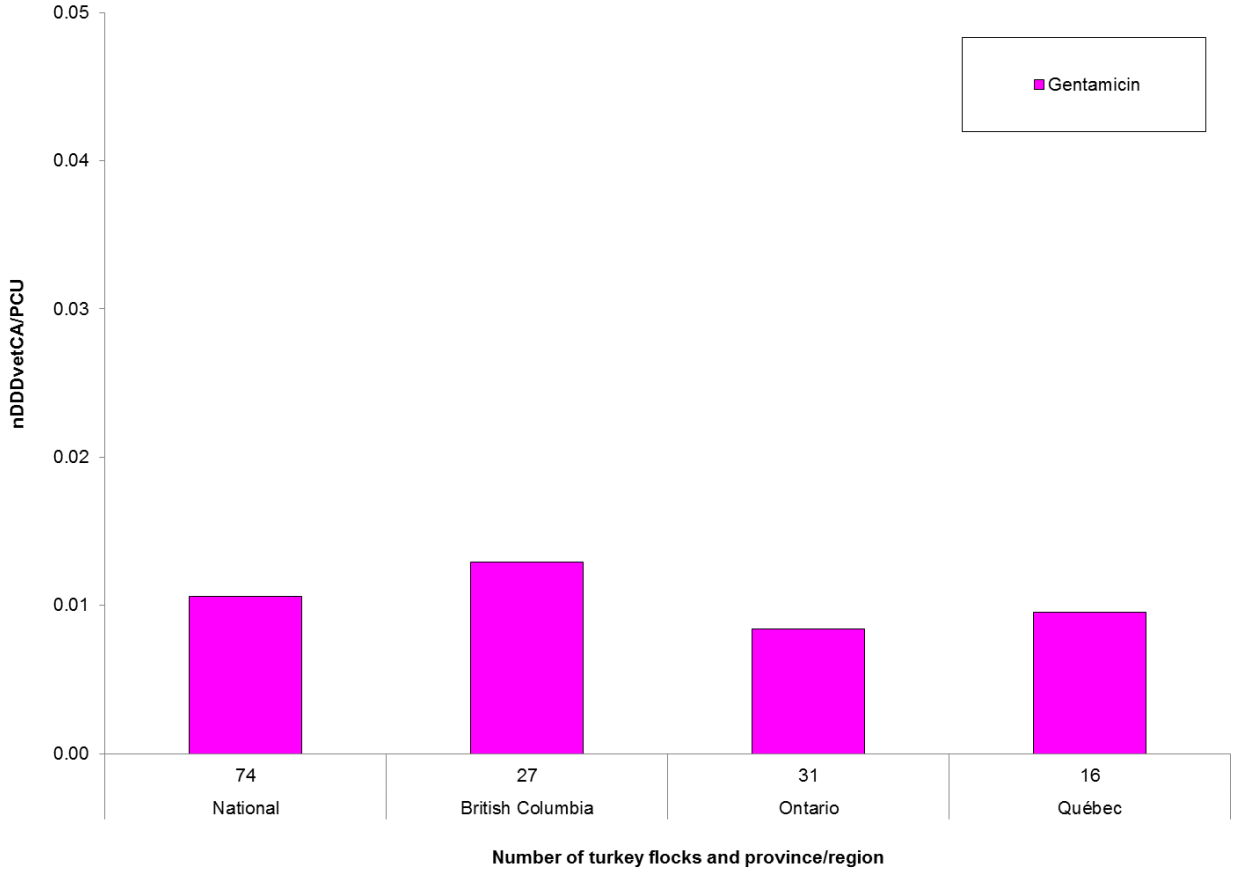
Figure 2. 12 Number of Canadian Defined Daily Doses for animals per 1,000 turkey-days (nDDDvetCA/1,000 turkey-days) for antimicrobials administered *in ovo* or subcutaneous injection, 2017



Province/region	National		British Columbia		Ontario		Québec	
Year	2016	2017	2016	2017	2016	2017	2016	2017
Number of flocks	72	74	30	27	30	31	12	16
Antimicrobial								
II Gentamicin	0.14	0.12	0.14	0.14	0.14	0.10	0.12	0.11
Total	0.14	0.12	0.14	0.14	0.14	0.10	0.12	0.11

Roman numeral II indicates category of importance to human medicine as outlined by the Veterinary Drugs Directorate.
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram turkey weight per day (mg_{drug}/kg_{animal}/day); please refer to Table A. 1 of Chapter 5: Design and methods of the 2016 CIPARS Annual Report for the list of standards.
nDDDvetCA/1,000 turkey-days at risk = number of DDDvetCA/1,000 turkey-days at risk.
For detailed indicator description, please refer to Table 2. 1.

Figure 2. 13 Number of Canadian Defined Daily Doses for animals per population correction unit (nDDDvetCA/PCU) for antimicrobials administered *in ovo* or subcutaneous injection, 2017

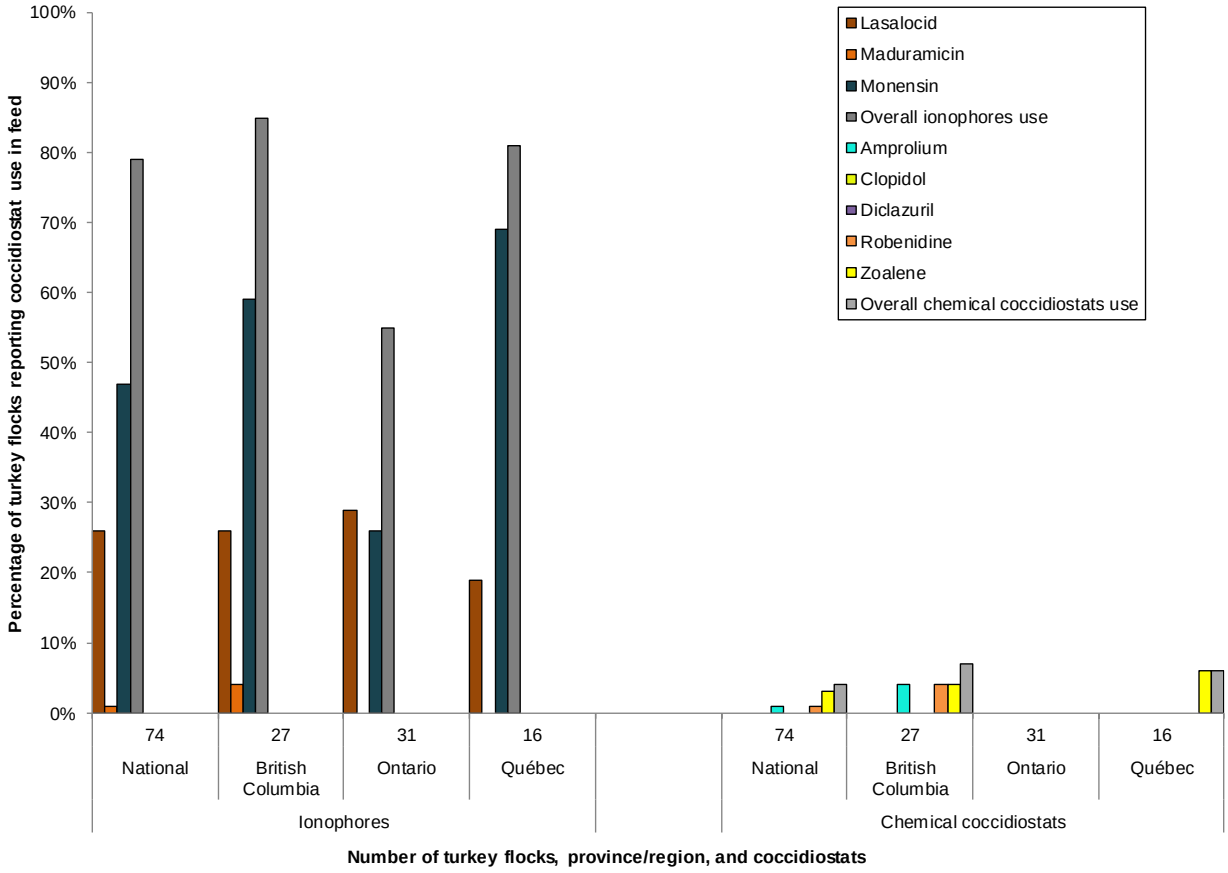


Province/region	National		British Columbia		Ontario		Québec	
Year	2016	2017	2016	2017	2016	2017	2016	2017
Number of flocks	72	74	30	27	30	31	12	16
Antimicrobial								
II Gentamicin	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Roman numeral II indicates category of importance to human medicine as outlined by the Veterinary Drugs Directorate.
DDDvetCA = Canadian Defined Daily Doses for animals (average labelled dose) in milligram per kilogram turkey weight (mg_{drug}/kg_{animal}/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.

Coccidiostat and antiprotozoal use in feed by frequency

Figure 2. 14 Percentage of turkey flocks reporting coccidiostats and other antiprotozoals use in feed, 2017



Province/region	National		British Columbia		Ontario		Québec	
Year	2016	2017	2016	2017	2016	2017	2016	2017
Number of flocks	72	74	30	27	30	31	12	16
Coccidiostat								
IV Lasalocid	47%	26%	43%	26%	47%	29%	58%	19%
IV Maduramicin	13%	1%	23%	4%	7%	0%	0%	0%
IV Monensin	28%	47%	37%	59%	17%	26%	33%	69%
Overall ionophores use	83%	72%	93%	85%	70%	55%	92%	81%
N/A Clopidol	3%	0%	7%	0%	0%	0%	0%	0%
N/A Diclazuril	1%	0%	3%	0%	0%	0%	0%	0%
N/A Robenidine	1%	1%	3%	4%	0%	0%	0%	0%
N/A Zoalene	1%	3%	0%	4%	3%	0%	0%	6%
Overall chemical coccidiostats use	6%	4%	10%	7%	3%	0%	0%	6%

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

Chapter 3 Antimicrobial resistance

Turkeys

Key findings

Salmonella (n = 161)

- Overall, the top 3 *Salmonella* serovars were Uganda, Muenchen and Seftenberg (Table 3. 1). Gentamicin resistance decreased by 5% from the previous year (Figure 3. 1). Reistance was higher in British Columbia (35%) compared to Ontario (27%) and Québec (19%). There was only one isolate resistant to 4 to 5 classes of antimicrobials.
- No isolates exhibited resistance to ceftriaxone, nalidixic acid and, meropenem (Table 3. 1).

Escherichia coli (n = 287)

- Two isolates and 6 isolates were resistant to ceftriaxone and nalidixic acid, respectively (Table 3. 2).
- Resistance to gentamicin increased by 4% Figure 3. 2 and the increase was observed in all the provinces sampled.
- Resistance to meropenem was not detected in any of the isolates.

Campylobacter (n = 157)

- Thirty percent (47/157) and 29% (46/157) of the isolates were resistant to nalidixic acid and ciprofloxacin, respectively (Figure 3. 3). The proportion of ciprofloxacin isolates increased from British Columbia (22% to 30%) and Ontario (5% to 11%) between 2016 and 2017.
- Resistance to azithromycin and erythromycin were detected from 23 isolates across all provinces sampled.

Multiclass resistance

Table 3. 1 Number of antimicrobial classes in resistance patterns of *Salmonella* from turkeys, 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	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia																				
Hadar	15 (31.9)		1	14				14	10											14
Senftenberg	8 (17.0)	3	2	3			5	5	3											
Albany	7 (14.9)		5	2			7	2												2
Agona	5 (10.6)			4	1		5	5	1					5						5
Anatum	4 (8.5)	1		3			1	3	2											3
Reading	4 (8.5)	4																		
Montevideo	2 (4.3)		2					2												
Liverpool	1 (2.1)			1				1						1						1
Uganda	1 (2.1)	1																		
Total	**47 (100)**	**9**	**10**	**27**	**1**		**18**	**32**	**16**					**6**						**25**
Ontario																				
Muenchen	27 (35.5)	22	3	2			3	2						2						2
Uganda	26 (31.3)			26				26						26						26
Senftenberg	7 (8.4)	1		6			6	4	6											
Bredeney	5 (6.0)		5				5													
Montevideo	5 (6.0)	4	1				1	1												
Heidelberg	4 (4.8)	3		1			1	1	1											1
Typhimurium	4 (4.8)			4										4						4
Derby	3 (3.6)			3			3	3	3											3
Less common serovars	2 (2.4)		1	1			1	2						1						1
Total	**83 (100)**	**30**	**10**	**43**			**20**	**39**	**10**					**33**						**37**
Quèbec																				
Agona	8 (26.8)	5		3			2	3						2						1
Heidelberg	7 (22.6)	3		4			4	4						4						
Schwarzengrund	7 (22.6)	2		5				5						5						5
Saintpaul	3 (9.7)	3																		
Uganda	3 (9.7)			3				3						3						3
4,12:-:1,2	1 (3.2)	1																		
Senftenberg	1 (3.2)				1			1						1	1		1			1
Worthington	1 (3.2)		1																	1
Total	**31 (100)**	**14**	**1**	**15**	**1**		**6**	**16**						**15**	**1**		**1**			**11**
National																				
Uganda	30 (18.6)	1		29				29						29						29
Muenchen	27 (16.8)	22	3	2			3	2						2						2
Senftenberg	16 (9.9)	4	2	9	1		11	10	9					1	1		1			1
Hadar	15 (9.3)		1	14				14	10											14
Agona	13 (8.1)	5		7	1		7	8	1					7						6
Heidelberg	11 (6.8)	6		5			5	5	1					4						1
Albany	8 (5.0)		6	2			8	3												2
Montevideo	7 (4.4)	4	3				1	3												
Schwarzengrund	7 (4.4)	2		5				5						5						5
Bredeney	5 (3.1)		5				5													
Anatum	4 (2.5)	1		3			1	3	2											3
Reading	4 (2.5)	4																		
Typhimurium	4 (2.5)			4										4						4
Derby	3 (1.9)			3			3	3	3											3
Saintpaul	3 (1.9)	3																		
Less common serovars	4 (2.5)	1	1	2				2						2						3
Total	**161 (100)**	**53**	**21**	**85**	**2**		**44**	**87**	**26**					**54**	**1**		**1**			**73**

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

Table 3. 2 Number of antimicrobial classes in resistance patterns of *Escherichia coli* from turkeys, 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	Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	STR	AMP	AMC	CRO	FOX	MEM	SSS	SXT	AZM	CHL	CIP	NAL	TET
British Columbia	106	22	11	46	27		29	69	45	2	1	2		44	5	1	6		4	66
Ontario	120	34	17	49	20		29	56	41	1		1		32	6		5		2	79
Québec	61	17	11	27	6		10	22	21	1	1	1		27	15		1			35
National	**287**	**73**	**39**	**122**	**53**		**68**	**147**	**107**	**4**	**2**	**4**		**103**	**26**	**1**	**12**		**6**	**180**

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

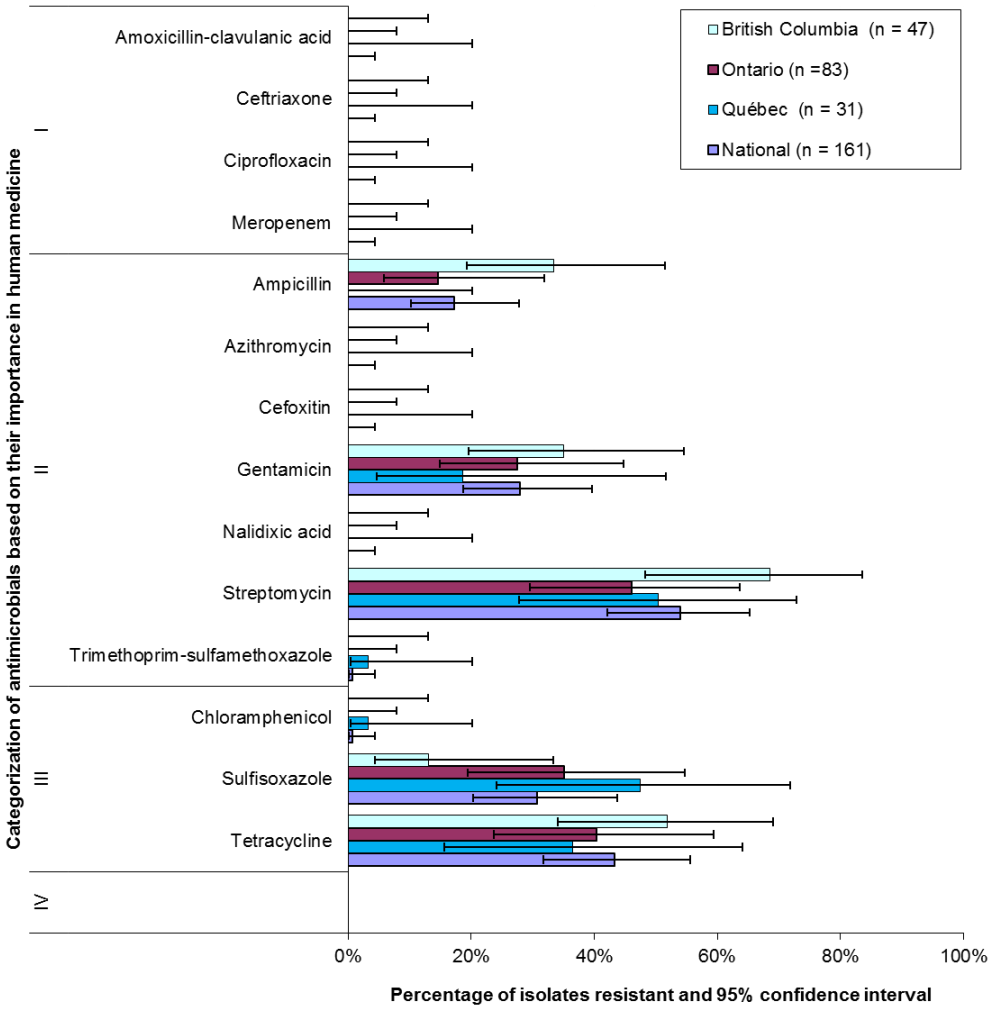
Table 3. 3 Number of antimicrobial classes in resistance patterns of *Campylobacter* from turkeys, 2017

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		Phenicols	Quinolones		Tetracyclines
		0	1	2–3	4–5	6–7	GEN	TEL	CLI	AZM	ERY	FLR	CIP	NAL	TET
British Columbia															
Campylobacter jejuni	56 (70.0)	23	16	17									20	20	30
Campylobacter coli	23 (28.8)		10	13						1	1		20	20	15
Campylobacter spp.	1 (1.3)		1										1	1	
Total	**80 (100)**	**23**	**27**	**30**						**1**	**1**		**41**	**41**	**45**
Ontario															
Campylobacter jejuni	25 (50.0)	5	20												20
Campylobacter coli	25 (50.0)	15	2	6	2			2	4	8	8		6	5	8
Campylobacter spp.	0 (0)														
Total	**50 (100)**	**20**	**22**	**6**	**2**			**2**	**4**	**8**	**8**		**6**	**5**	**28**
Québec															
Campylobacter jejuni	17 (63.0)	10	3	4					4	4	4				6
Campylobacter coli	10 (37.0)			10					10	10	10				
Campylobacter spp.	0 (0)														
Total	**27 (100)**	**10**	**3**	**14**					**14**	**14**	**14**				**6**
National															
Campylobacter jejuni	98 (62.4)	38	39	21					4	4	4		20	20	56
Campylobacter coli	58 (36.9)	15	12	29	2			2	14	19	19		26	25	23
Campylobacter spp.	1 (0.6)		1										1	1	
Total	**157 (100)**	**53**	**52**	**50**	**2**			**2**	**18**	**23**	**23**		**47**	**46**	**79**

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

Temporal antimicrobial resistance summary

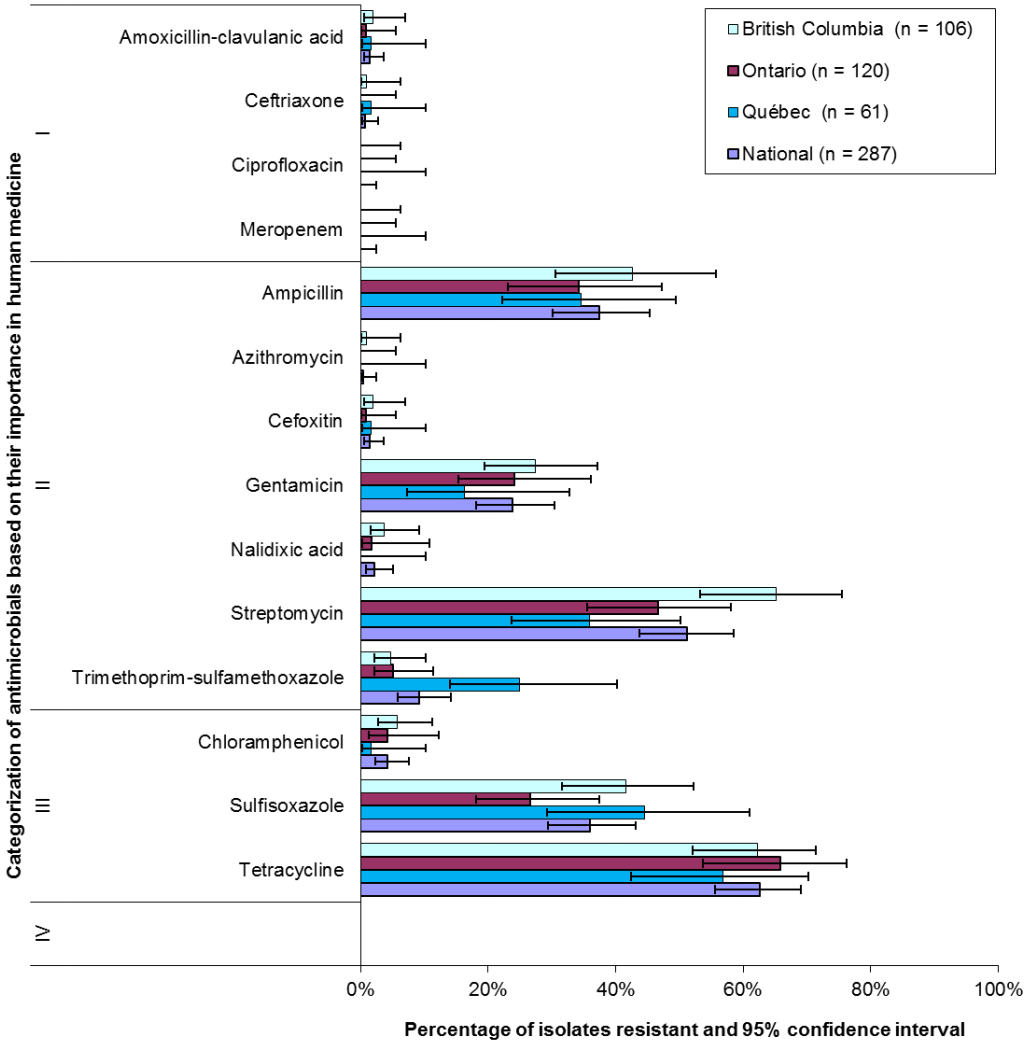
Figure 3. 1 Resistance of *Salmonella* isolates from turkeys, 2017



Province/region	British Columbia		Ontario		Québec		National	
Year	2016	2017	2016	2017	2016	2017	2016	2017
Number of isolates	50	47	70	83	26	31	146	161
Antimicrobial								
Ampicillin	33%	33%	15%	15%	23%	0%	23%	17%
Ceftriaxone	0%	0%	7%	0%	0%	0%	3%	0%
Gentamicin	22%	35%	45%	27%	14%	19%	33%	28%
Nalidixic acid	0%	0%	0%	0%	0%	0%	0%	0%
Streptomycin	86%	69%	41%	46%	37%	50%	54%	54%
Tetracycline	83%	52%	24%	40%	22%	36%	42%	43%
Trimethoprim-sulfamethoxazole	0%	0%	1%	0%	4%	3%	1%	1%

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per flock. The figure above represents 2017 results and the table shows 2016 and 2017 results.

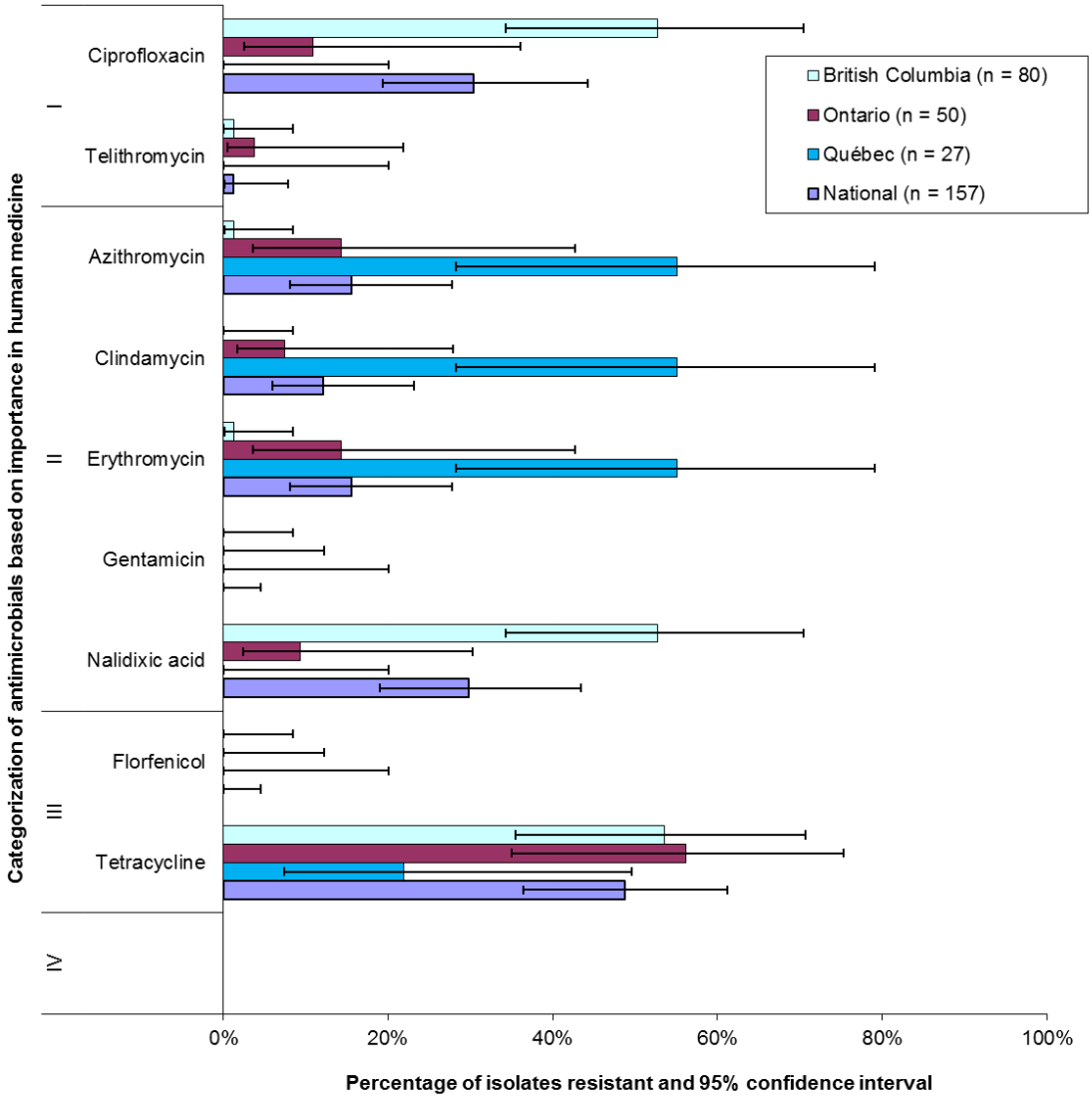
Figure 3. 2 Resistance of *Escherichia coli* isolates from turkeys, 2017



Province/region	British Columbia		Ontario		Québec		National	
Year	2016	2017	2016	2017	2016	2017	2016	2017
Number of isolates	116	106	113	120	31	48	277	287
Antimicrobial								
Ampicillin	31%	43%	24%	34%	42%	35%	30%	37%
Ceftriaxone	2%	1%	0%	0%	0%	2%	1%	1%
Gentamicin	25%	27%	19%	24%	12%	16%	20%	24%
Nalidixic acid	2%	4%	1%	2%	0%	0%	1%	2%
Streptomycin	58%	65%	40%	47%	44%	36%	48%	51%
Tetracycline	64%	62%	73%	66%	69%	57%	69%	63%
Trimethoprim-sulfamethoxazole	7%	5%	4%	5%	25%	25%	9%	9%

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per flock. The figure above represents 2017 results and the table shows the 2016 and 2017 results.

Figure 3. 3 Resistance of *Campylobacter* isolates from turkeys, 2017



Province/region	British Columbia		Ontario		Québec		National	
Year	2016	2017	2016	2017	2016	2017	2016	2017
Number of isolates	79	80	65	50	27	27	171	157
Antimicrobial								
Azithromycin	0%	1%	3%	14%	0%	55%	1%	16%
Ciprofloxacin	44%	53%	5%	11%	0%	0%	22%	30%
Gentamicin	0%	0%	0%	0%	0%	0%	0%	0%
Telithromycin	0%	1%	3%	4%	0%	0%	1%	1%
Tetracycline	19%	54%	71%	56%	45%	22%	43%	49%

The proportion of resistant isolates for all antimicrobials was adjusted to account for multiple samples per flock. The figure above represents 2017 results and the table shows 2016 and 2017 results.

Recovery results

Table 3. 4 Farm Surveillance recovery rates in turkeys, 2016 to 2017

Animal species	Province/region	Year	Percentage (%) of isolates recovered and number of isolates recovered / number of samples submitted						
			Escherichia coli		*Salmonella*		*Campylobacter*		*Enterococcus*
Turkeys	British Columbia	2016	**100%**	116/116	**43%**	50/116	**68%**	79/116	
		2017	**98%**	106/108	**44%**	47/108	**75%**	80/108	
	Ontario	2016	**97%**	113/116	**60%**	70/116	**56%**	65/116	
		2017	**100%**	120/120	**69%**	83/120	**42%**	50/120	
	Québec	2016	**100%**	48/48	**54%**	26/48	**56%**	27/48	
		2017	**95%**	61/64	**48%**	31/64	**42%**	27/64	
	National	2016	**99%**	277/280	**52%**	146/280	**61%**	171/280	
		2017	**98%**	287/292	**55%**	161/292	**54%**	157/292	

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).

Appendix

Abbreviations

Canadian provinces, territories, and regions

Provinces

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

Territories

YT Yukon
NT Northwest Territories
NU Nunavut

Regions

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

Antimicrobials

AMC Amoxicillin-clavulanic acid
AMP Ampicillin
AZM Azithromycin
CHL Chloramphenicol
CIP Ciprofloxacin
CLI Clindamycin
CRO Ceftriaxone
ERY Erythromycin
FLR Florfenicol
FOX Cefoxitin
GEN Gentamicin
MEM Meropenem
NAL Nalidixic acid
SSS Sulfisoxazole
STR Streptomycin
SXT Trimethoprim-sulfamethoxazole
TEL Telithromycin
TET Tetracycline
TIO Ceftiofur