CIPARS AMU and AMR surveillance

Poultry 2023 results

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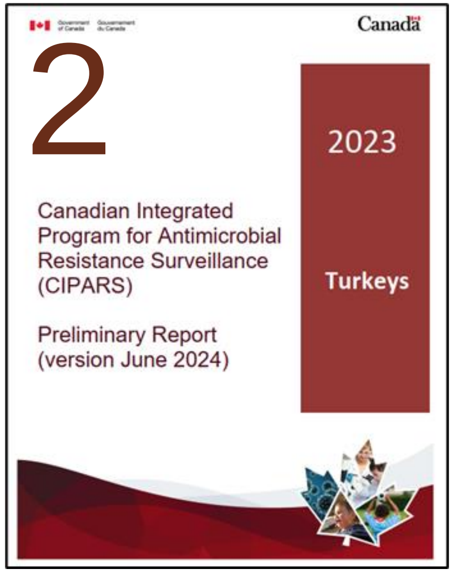
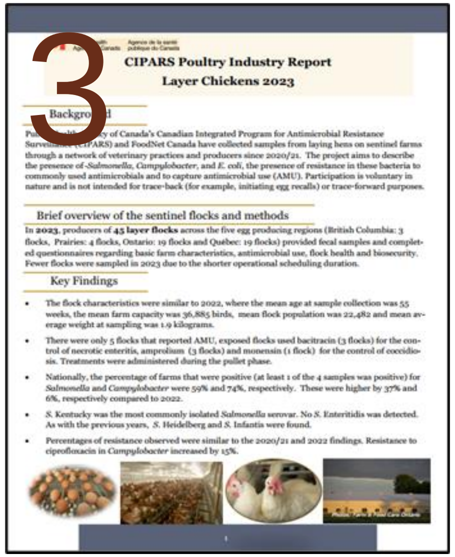
World Antimicrobial Resistance Awareness Week
November 19th, 2024.

About the data presented here

- AMR data from the CIPARS poultry farm components (includes abattoir in chickens).
- Final results from the broiler breeder pilot project are presented.
- **New data**: Gram-positive organisms.
- Select findings will be discussed. Detailed information is provided in the poultry industry reports available in English. Please contact either:
  - Louise (louise.bellai@phac-aspc.gc.ca)
  - Kelly (Kelly.pike@phac-aspc.gc.ca)
- Data up to 2022 are available via our interactive data visualization platform (CIPARS data visualization's webpage).
- If you need to leave early and have questions – please use the chat function.

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CIPARS Poultry Industry Report
Layer Chickens 2023

Backgro[illegible]d

Pu[illegible] of Canada's Canadian Integrated Program for Antimicrobial Resistance Surve[illegible] (CIPARS) and FoodNet Canada have collected samples from laying hens on sentinel farms through a network of veterinary practices and producers since 2020/21. The project aims to describe the presence of *Salmonella*, *Campylobacter*, and *E. coli*, the presence of resistance in these bacteria to commonly used antimicrobials and to capture antimicrobial use (AMU). Participation is voluntary in nature and is not intended for trace-back (for example, initiating egg recalls) or trace-forward purposes.

Brief overview of the sentinel flocks and methods

In **2023**, producers of **45 layer flocks** across the five egg producing regions (British Columbia: 3 flocks, Prairies: 4 flocks, Ontario: 19 flocks and Québec: 19 flocks) provided fecal samples and completed questionnaires regarding basic farm characteristics, antimicrobial use, flock health and biosecurity. Fewer flocks were sampled in 2023 due to the shorter operational scheduling duration.

Key Findings

- The flock characteristics were similar to 2022, where the mean age at sample collection was 55 weeks, the mean farm capacity was 36,885 birds, mean flock population was 22,482 and mean average weight at sampling was 1.9 kilograms.
- There were only 5 flocks that reported AMU, exposed flocks used bacitracin (3 flocks) for the control of necrotic enteritis, amprolium (3 flocks) and monensin (1 flock) for the control of coccidiosis. Treatments were administered during the pullet phase.
- Nationally, the percentage of farms that were positive (at least 1 of the 4 samples was positive) for *Salmonella* and *Campylobacter* were 59% and 74%, respectively. These were higher by 37% and 6%, respectively compared to 2022.
- *S.* Kentucky was the most commonly isolated *Salmonella* serovar. No *S.* Enteritidis was detected. As with the previous years, *S.* Heidelberg and *S.* Infantis were found.
- Percentages of resistance observed were similar to the 2020/21 and 2022 findings. Resistance to ciprofloxacin in *Campylobacter* increased by 15%.

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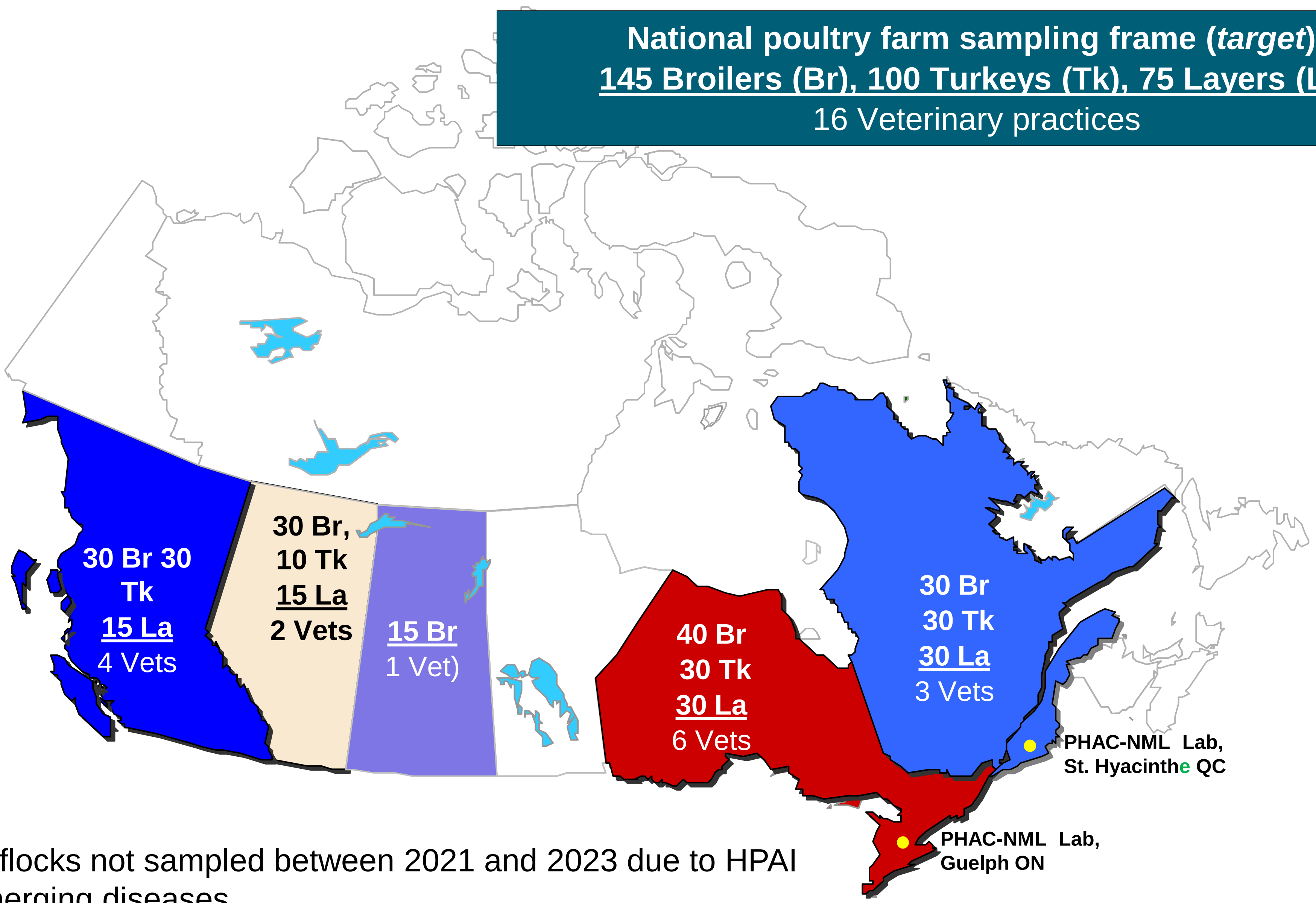
Design and Methods

National poultry farm sampling frame (*target*):
145 Broilers (Br), 100 Turkeys (Tk), 75 Layers (La)
16 Veterinary practices



Target number of flocks not sampled between 2021 and 2023 due to HPAI outbreaks and emerging diseases

WHAT'S NEW!

Bacterial identification and antimicrobial resistance (AMR)

- Updated gentamicin resistance percentages due to changes in the clinical breakpoints.
- Reporting of ciprofloxacin non-susceptible *E. coli* and *Salmonella* – resistance prediction based on the presence of genes using whole genome sequencing*.
- Antimicrobial resistance in *Enterococcus* spp. (US NARMS antimicrobial panel).
- Antimicrobial resistance in *Clostridium perfringens* (7 antimicrobials).

Antimicrobial use (AMU)

- milligrams/kg animal biomass - additional measurement for reporting AMU quantity and trends.

*https://www.canada.ca/en/public-health/services/surveillance/canadian-integrated-program-antimicrobial-resistance-surveillance-cipars/design-methods.html

Review of CIPARS surveillance objectives

Abattoir

- To provide nationally representative, annual antimicrobial resistance data for bacteria isolated from animals entering the food chain.
- To monitor temporal variations in the prevalence of antimicrobial resistance in these bacteria.

Farm

- Primary Objective
  - Provide representative qualitative and quantitative farm data on antimicrobial use and resistance at the national and regional levels.
- Secondary Objective
  - Investigate associated trends in antimicrobial use (AMU) and resistance (AMR) at a national and regional level.
- Long-term objectives
  - Provide sound data for human health risk assessments.
  - Provide data to industry to help support science-based decisions to reduce AMR.

BROILER CHICKENS


Government of Canada Gouvernement du Canada

Canada

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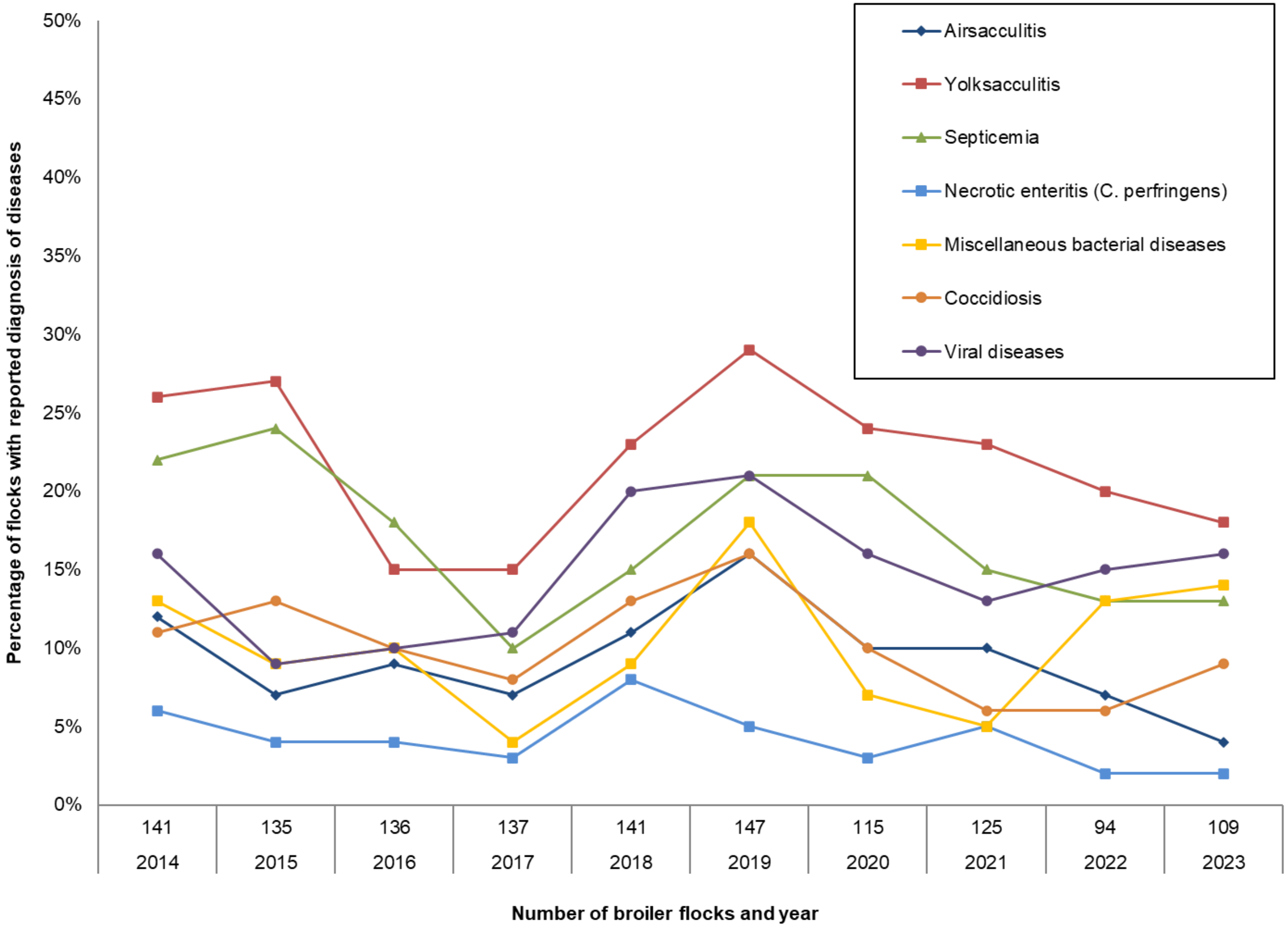
2023

Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)

Preliminary (version June 25, 2024)

Broiler chickens

Broiler health status – diseases* continued to be diagnosed

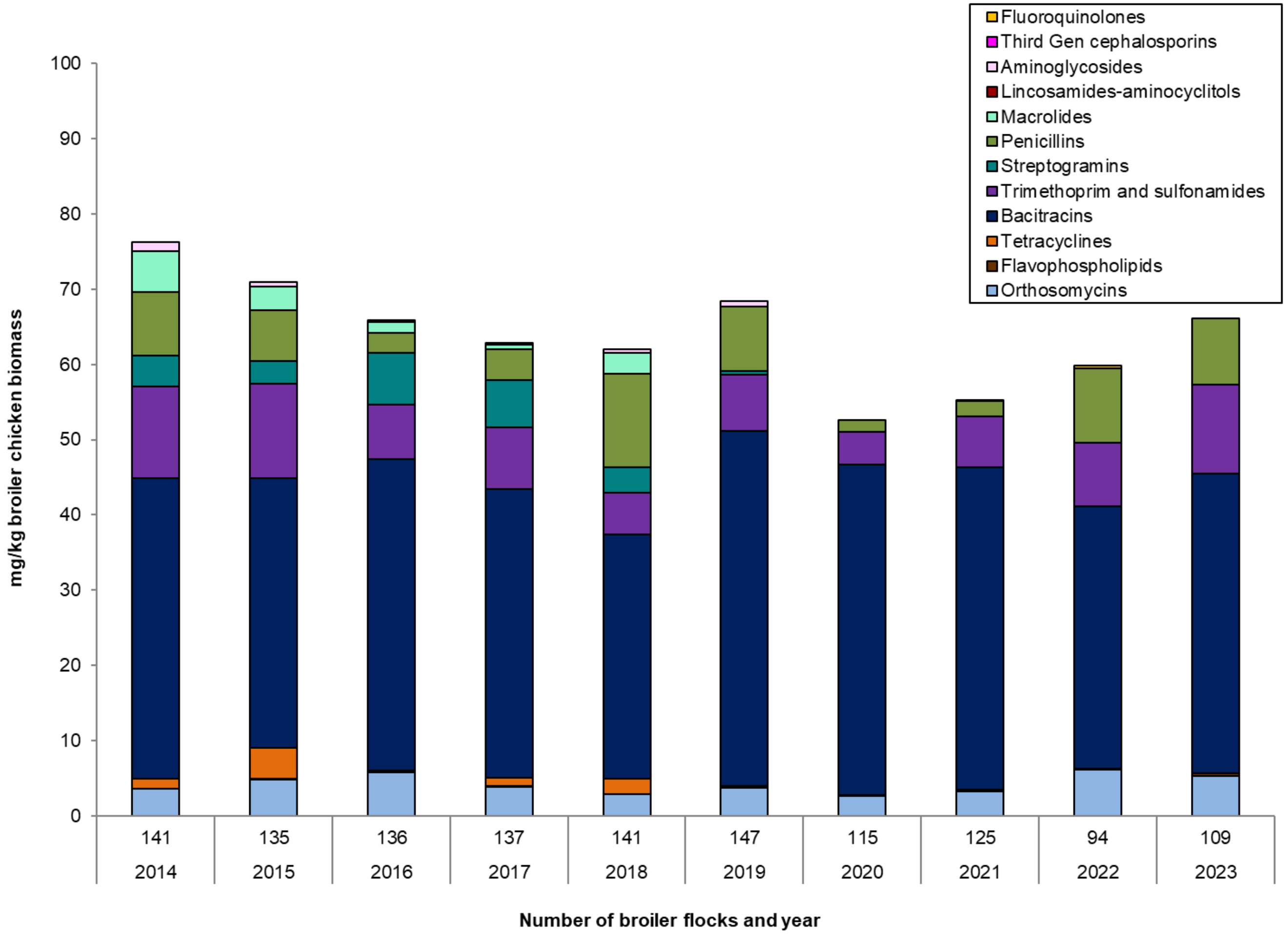


- Slight increase in coccidiosis (↑ 3%), viral diseases (↑ 1%) and miscellaneous bacterial diseases (↑ 1%)
- High mortality in one flock (30%) was due to Infectious Bronchitis Virus outbreak
- Vaccination of common respiratory and immunosuppressive viral diseases is a common practice in broiler production
  - ➢ Limited vaccine options against bacterial diseases (examples: *E. coli* and *C. perfringens*)

*Response to the questionnaire: confirmed positive or likely positive for the disease

Antimicrobials are used for the control of bacterial diseases in broiler chickens

mg/kg broiler chicken biomass indicates an increasing trend

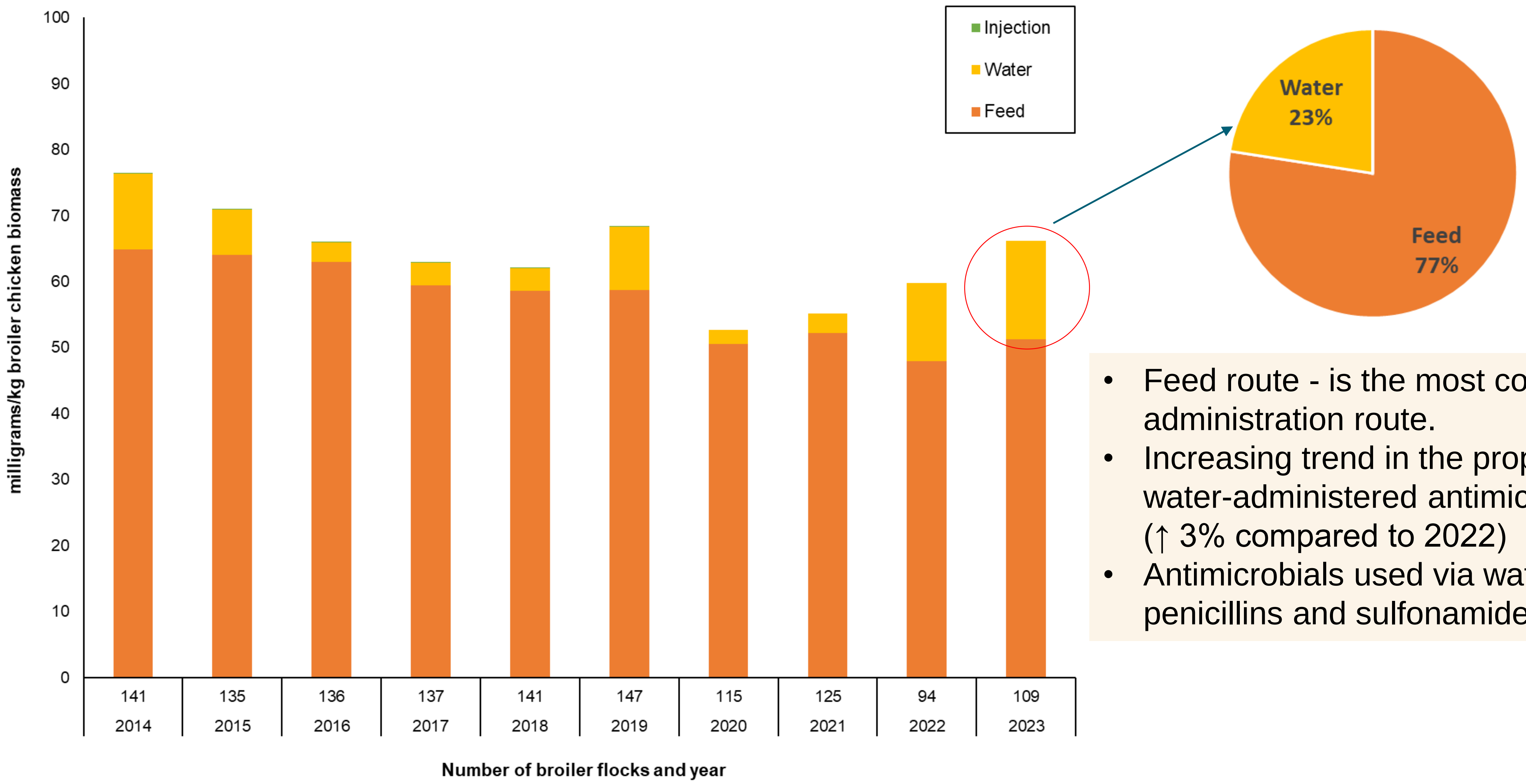


- Increased in AMU quantity but the diversity of antimicrobial classes used was similar to 2022
- Driven by bacitracins, trimethoprim-sulfonamides and penicillins.
- Days of exposure (necrotic enteritis control) compared to 2022
  - Bacitracin: ↓ 4 days
  - Avilamycin: ↓ 2 days
- No fluoroquinolone use in 2023.

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2022 vs. 2023 (% change)
Total	76	71	66	63	62	68	53	55	59	66	↑ 7 mg/kg (11%)

Shift in the route of administration from feed to water

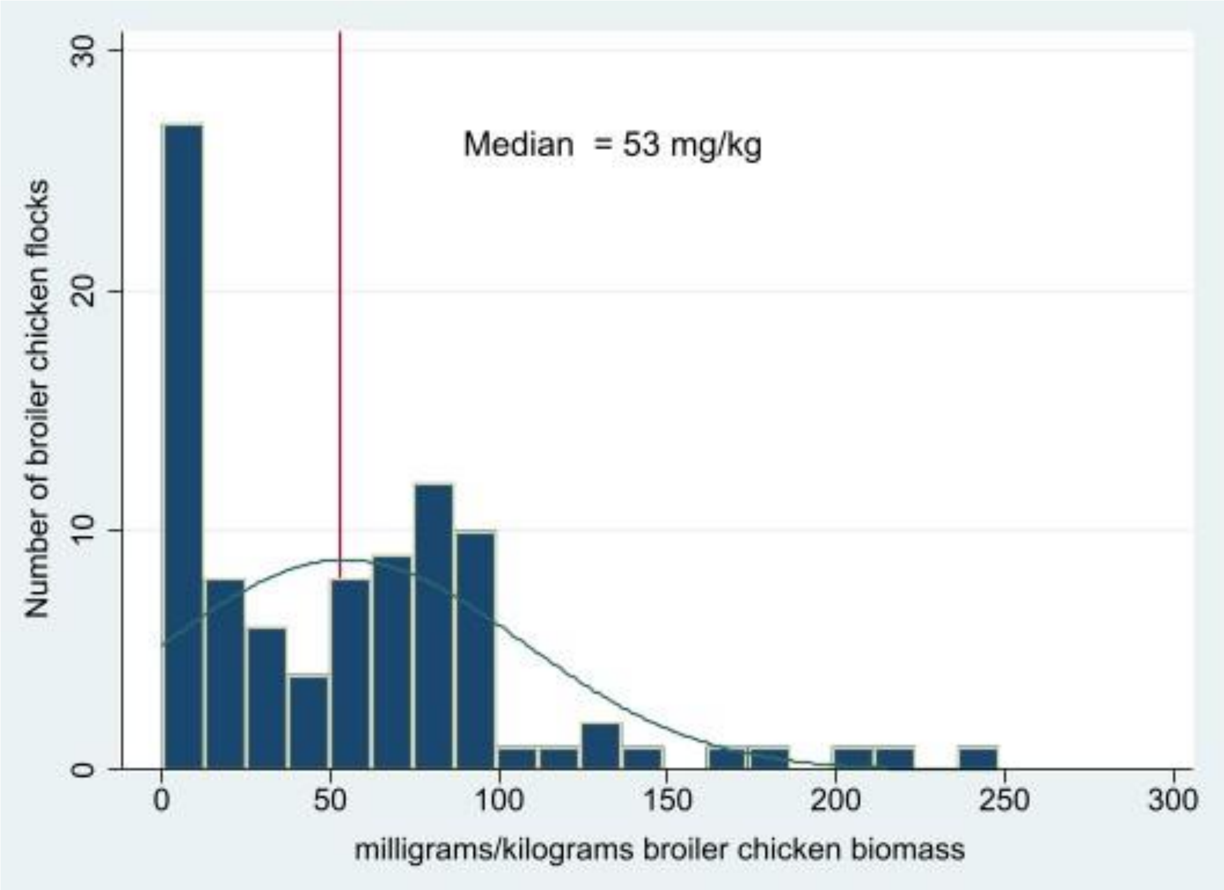
mg/kg broiler chicken biomass – increasing trend in the proportion administered via water



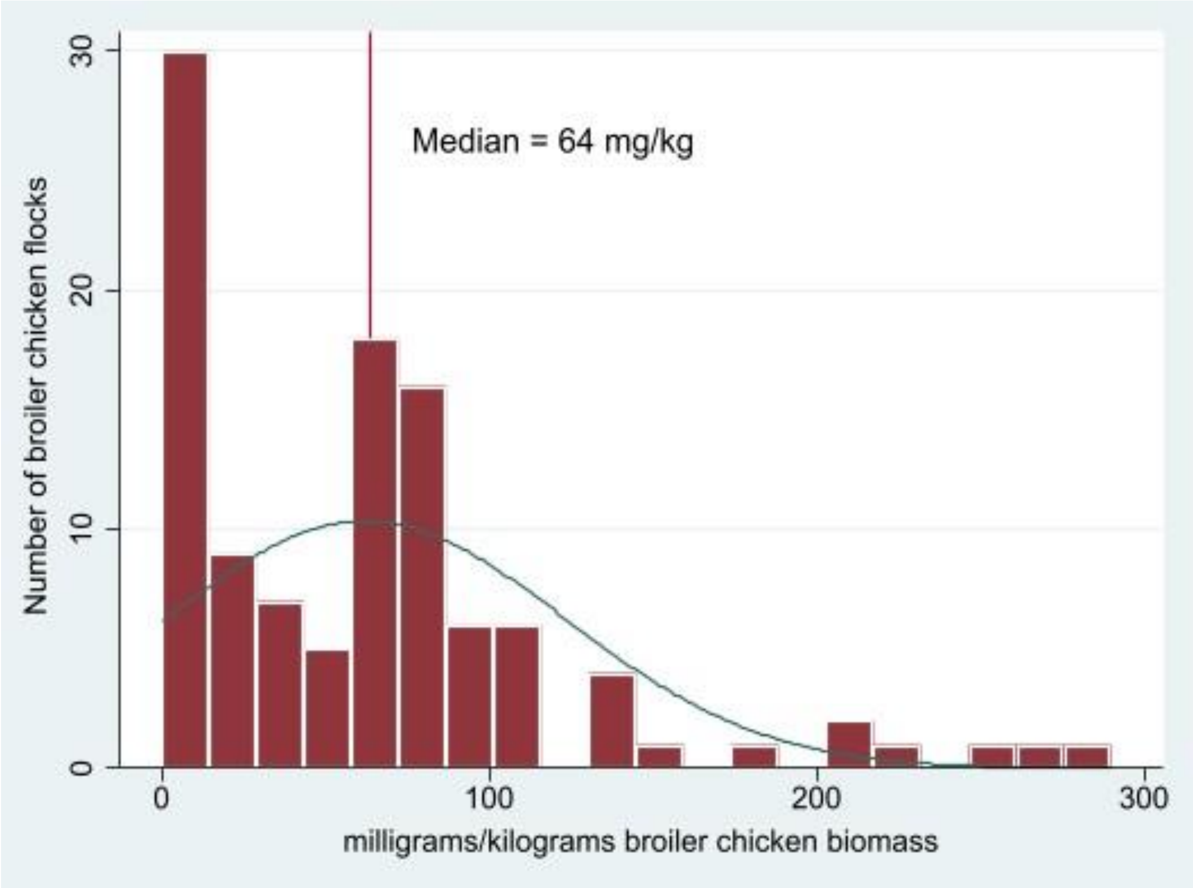
- Feed route - is the most common administration route.
- Increasing trend in the proportion of water-administered antimicrobials (↑ 3% compared to 2022)
- Antimicrobials used via water: penicillins and sulfonamides.

Flock level quantity of use – depends on the flock health situation

2022 (n = 94 flocks)



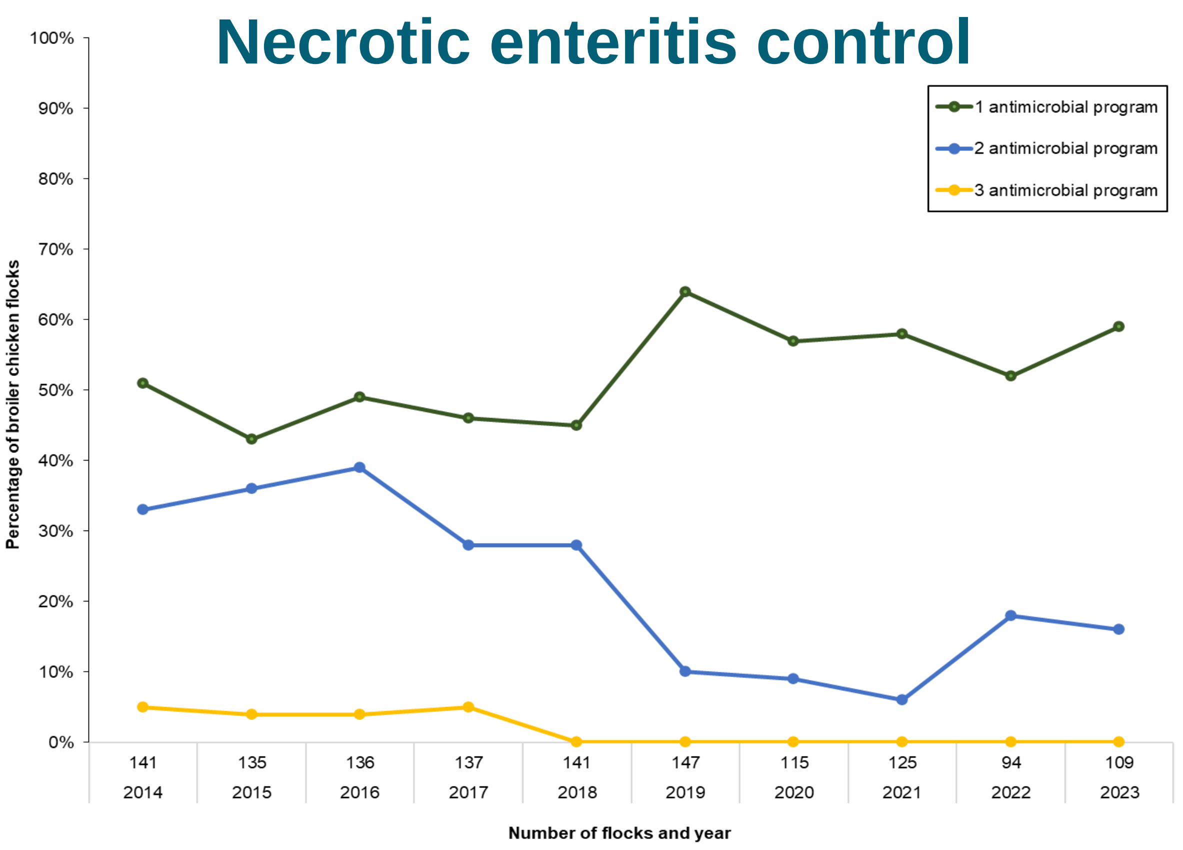
2023 (n = 109 flocks)



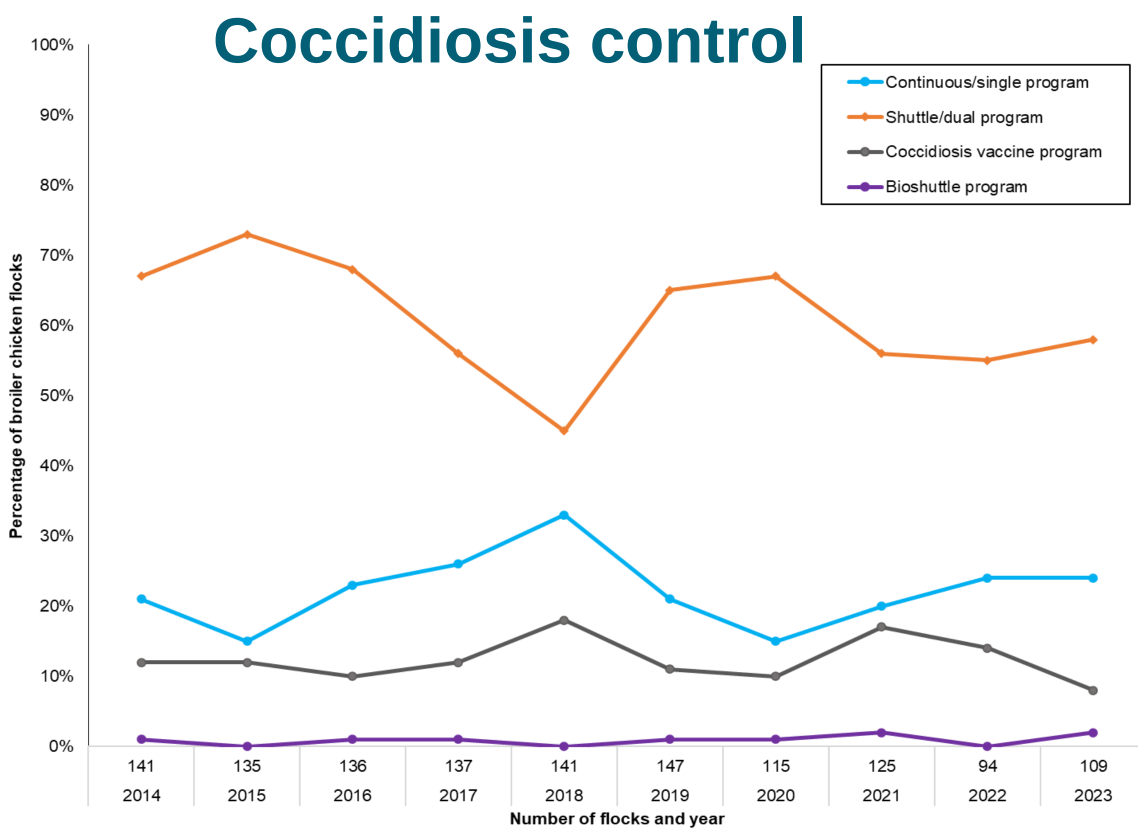
The data shown are flock-level AMU estimates (flock-specific AMU). The distribution of low, medium, and high users did not change significantly between 2022 and 2023.

Enteric disease control – contributes to total AMU

Necrotic enteritis control



Coccidiosis control



- Use of one antimicrobial remained the most common program for necrotic enteritis control.
- ***Clostridium perfringens* Type A vaccination** is an emerging tool for necrotic enteritis control.
  - 2 flocks in 2022, 5 flocks in 2023

- Shuttle/dual program (2 or more coccidiostats) remained the most common program for coccidiosis control.
- **Coccidiosis vaccination** fluctuated over time but has not replaced the use of coccidiostats

Bacterial recovery and the most common *Salmonella* serovars

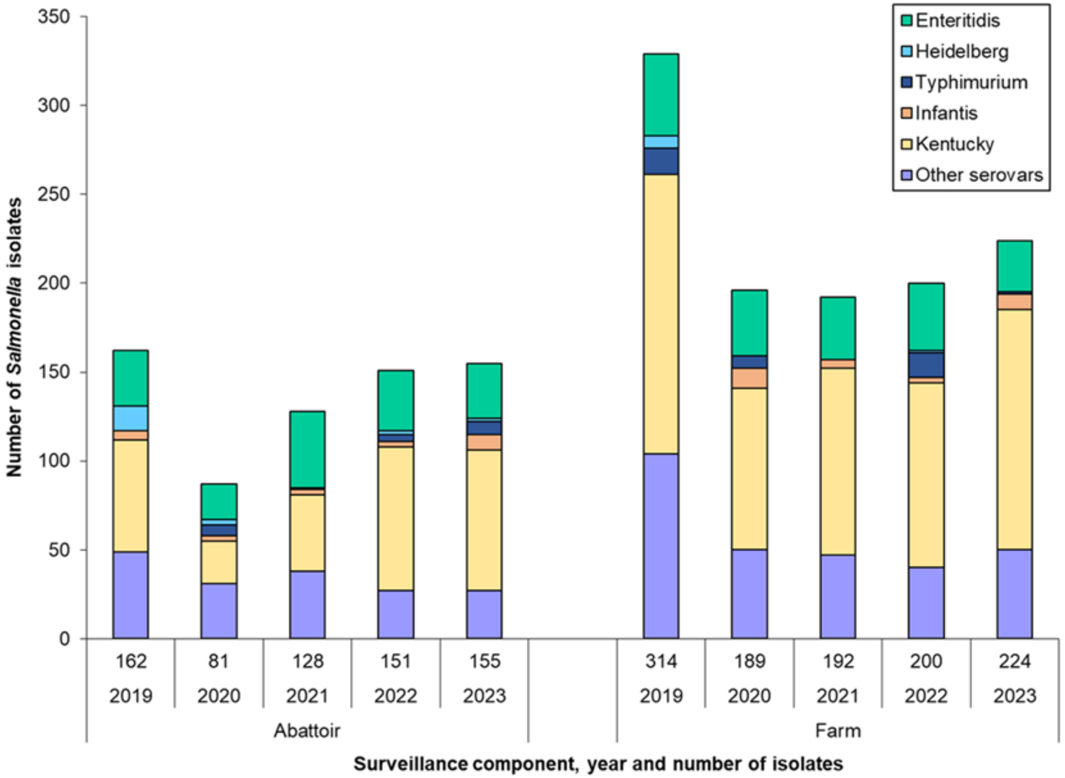
Stable percentage of bacterial recovery in farm and slaughtered broiler chickens

	2019	2020	2021	2022	2023	Trends[1]	2022 vs. 2023 (% change)
Abattoir							
Salmonella	18%	27%	15%	20%	22%		**2%**
Campylobacter	23%	34%	20%	21%	22%		**1%**
Farm							
Salmonella	53%	41%	38%	53%	51%		**-2%**
Campylobacter	24%	19%	25%	33%	32%		**-1%**

[1] 5-year Sparklines; highpoints are in red

Stable percentage of *Salmonella* and *Campylobacter* recovered from farm and slaughtered broiler chicken samples

Salmonella serovars



S. Kentucky and *S.* Enteritidis – most frequently isolated serovars from abattoir and farm. Notable resistance findings:

- ***S.* Kentucky** – non-susceptible ciprofloxacin in 12% of the isolates.
- ***S.* Enteritidis** – non-susceptible ciprofloxacin and resistant nalidixic-acid in 34% of isolates.

AMR status of farm and slaughtered broiler chickens

Salmonella, E. coli and *Campylobacter*

Bacteria / Number of isolates	Abattoir					Farm				
Year	2019	2020	2021	2022	2023	2019	2020	2021	2022	2023
Salmonella, number of isolates	**162**	**81**	**128**	**151**	**155**	**282**	**314**	**189**	**200**	**224**
Ampicillin	11%	4%	5%	6%	4%	9%	7%	9%	5%	10%
Ceftriaxone	8%	4%	2%	5%	4%	8%	4%	9%	5%	7%
Ciprofloxacin, non susceptible	4%	5%	2%	9%	10%	4%	4%	5%	10%	10%
Gentamicin	0%	2%	0%	1%	5%	1%	0%	4%	0%	3%
Nalidixic acid	2%	4%	2%	6%	9%	1%	3%	4%	8%	4%
Tetracycline	56%	52%	51%	56%	47%	54%	54%	58%	54%	36%
Trimethoprim-sulfamethoxazole	2%	1%	0%	2%	4%	1%	1%	2%	2%	3%
E. coli, number of isolates	**216**	**397**	**338**	**179**	**170**	**571**	**422**	**485**	**368**	**428**
Ampicillin	28%	27%	28%	25%	23%	32%	31%	33%	36%	35%
Ceftriaxone	3%	3%	2%	2%	2%	7%	4%	4%	2%	4%
Ciprofloxacin, non susceptible	6%	10%	12%	11%	15%	9%	9%	6%	7%	9%
Gentamicin	16%	11%	16%	18%	18%	19%	20%	22%	23%	24%
Nalidixic acid	5%	9%	10%	9%	15%	8%	8%	5%	5%	7%
Tetracycline	43%	35%	35%	36%	34%	39%	35%	33%	37%	37%
Trimethoprim-sulfamethoxazole	19%	16%	21%	18%	15%	15%	11%	15%	18%	24%
Campylobacter, number of isolates	**206**	**90**	**168**	**158**	**159**	**142**	**78**	**123**	**123**	**140**
Azithromycin	8%	1%	1%	1%	0%	1%	8%	2%	2%	0%
Ciprofloxacin	25%	21%	20%	25%	30%	24%	30%	22%	34%	33%
Gentamicin	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Tetracycline	42%	53%	51%	44%	39%	27%	41%	35%	43%	38%

Reference:

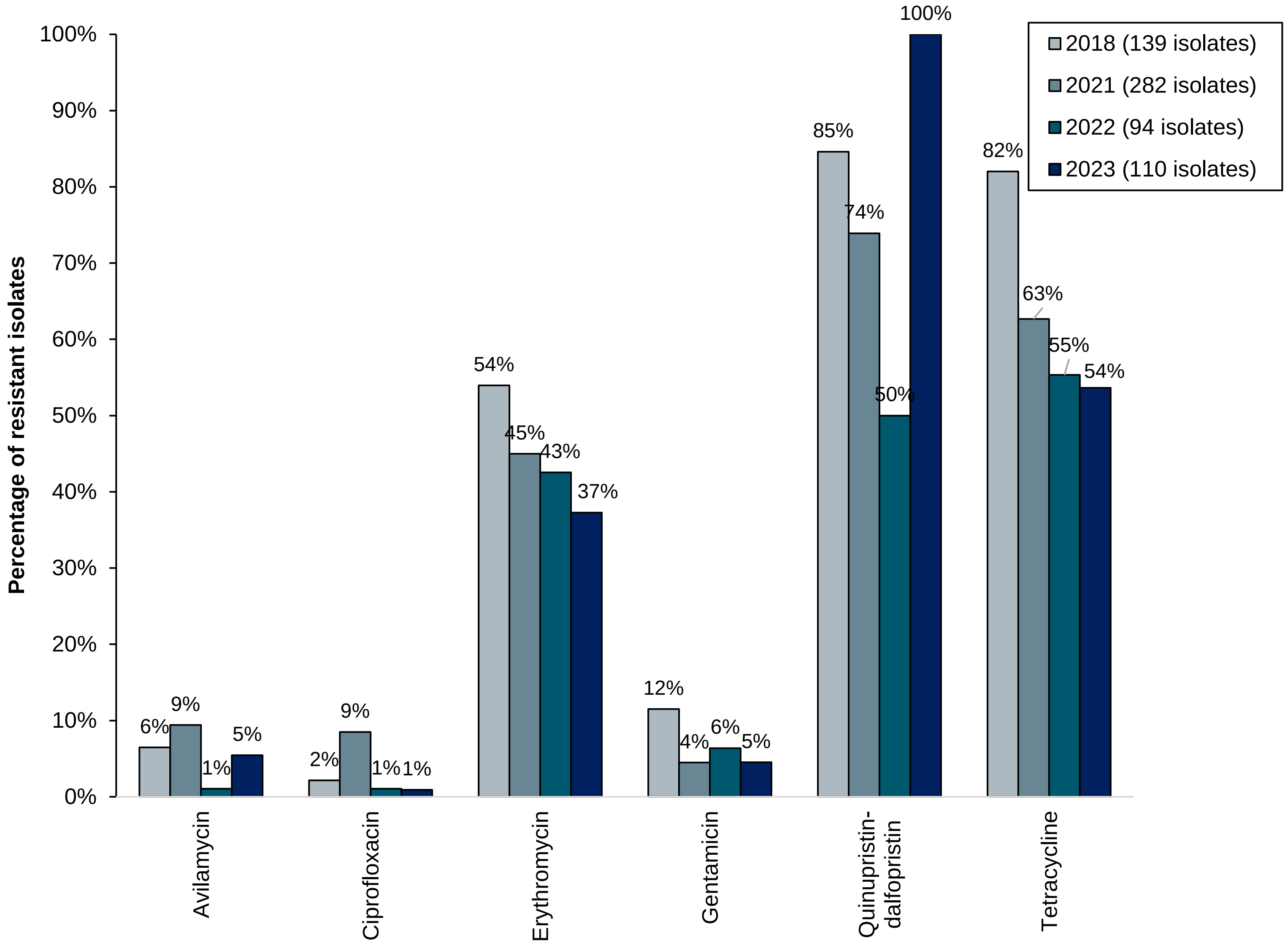
Not detected	0
Rare	< 0.1%
Very low	0.1-1%
Low	>1 - 10%
Moderate	>10-20%
High	>20-50%
Very high	>50-70%
Extremely high	>70

Estimates were adjusted for clustering at the flock level

- A stable level of resistance in **most** antimicrobials across bacterial organisms was observed except in the increase in ciprofloxacin non susceptible abattoir *E. coli*, and gentamicin resistant farm *E. coli* isolates.
- ***Campylobacter spp.***: ciprofloxacin resistance remained high in farm (33%) and slaughtered broiler chicken isolates (30%).

AMR status of farm broiler chickens – *Enterococcus* spp.

- 2018 - the year prior to the implementation of AMU reduction (Category II antimicrobials).
- No resistance was observed in 4 of the 12 antimicrobials evaluated across all years, including vancomycin.
- Very low to low-level resistance to avilamycin.
- Ciprofloxacin resistance decreased from low (9%, 2021) to very low level (1%, 2022 and 2023).



Quinupristin-dalfopristin excludes *E. faecalis*

AMR status of farm broiler chickens: *Clostridium perfringens* minimal change in susceptibility to antimicrobials in 2023 compared to 2017/18

Antimicrobial	Year	Number of isolates	Percentiles MIC_{50}	MIC_{90}	Distribution (%) of MICs (µg/mL) ≤ 0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256	Decreased susceptibility
Bacitracin	2017/18	165	256	> 256							33.9	2.4			2.4	24.8	36.4	**64 %**
	2021	93	128	> 256							36.6	11.8			2.2	21.5	28.0	**52 %** **↓12 % vs. 2017/18**
	2023	100	128	> 256							36.0	8.0			1.0	20.0	35.0	**56 %** **↓8 % vs. 2017/18**
Erythromycin	2017/18	165	2	8				9.7	71.5	8.5	10.3							
	2021	93	2	2				7.5	84.9	5.4	2.2							
	2023	100	2	4				10.0	54.0	29.0	7.0							
Narasin	2017/18	165	0.5	0.5			13.9	86.1										
	2021	93	1	1			2.2	97.8										
	2023	100	1	1			1.0	99.0										
Penicillin	2017/18	165	0.125	0.125	98.2	0.6	0.6	0.6										
	2021	93	0.125	0.125	98.9	1.1												
	2023	100	0.125	0.125	95.0	5.0												
Tetracycline	2017/18	165	8	16					21.8	20.6	21.2	28.5	7.9					**36 %**
	2021	93	8	16					14.0	4.3	33.3	39.8	7.5	1.1				**48 %** **↑12 % vs. 2017/18**
	2023	100	2	8					26.0	8.0	31.0	24.0	10.0					**34 %** **↓2 % vs. 2017/18**
Tylosin	2017/18	165	1	4			11.5	77.6	0.6	1.2	0.6	8.5						
	2021	93	1	1			9.7	88.2				2.2						
	2023	100	1	1			10.0	80.0	4.0	1.0	5.0							
Virginiamycin	2017/18	165	0.25	2	45.5	25.5	1.2	9.1	16.4	2.4								
	2021	93	0.125	2	84.9	1.1	6.5	7.5										
	2023	100	0.25	0.25	44.0	50.0	1.0	2.0	3.0									

MIC_{50} – antimicrobial concentration where at least 50% of the isolates were inhibited
MIC_{90} – antimicrobial concentration where at least 90% of the isolates were inhibited
Vertical lines – breakpoints based on published studies[a] (bacitracin) or the CLSI M100 (penicillin, tetracycline)

Manuscript in preparation

[a] Manson et al., 2004, Antimicrob Agents Chemother 48: 3743–3748)(Chalmers et al., 2008, J Clin Microbiol 46: 3957–3964)

TURKEYS


FarmPhotos.ca


Canada
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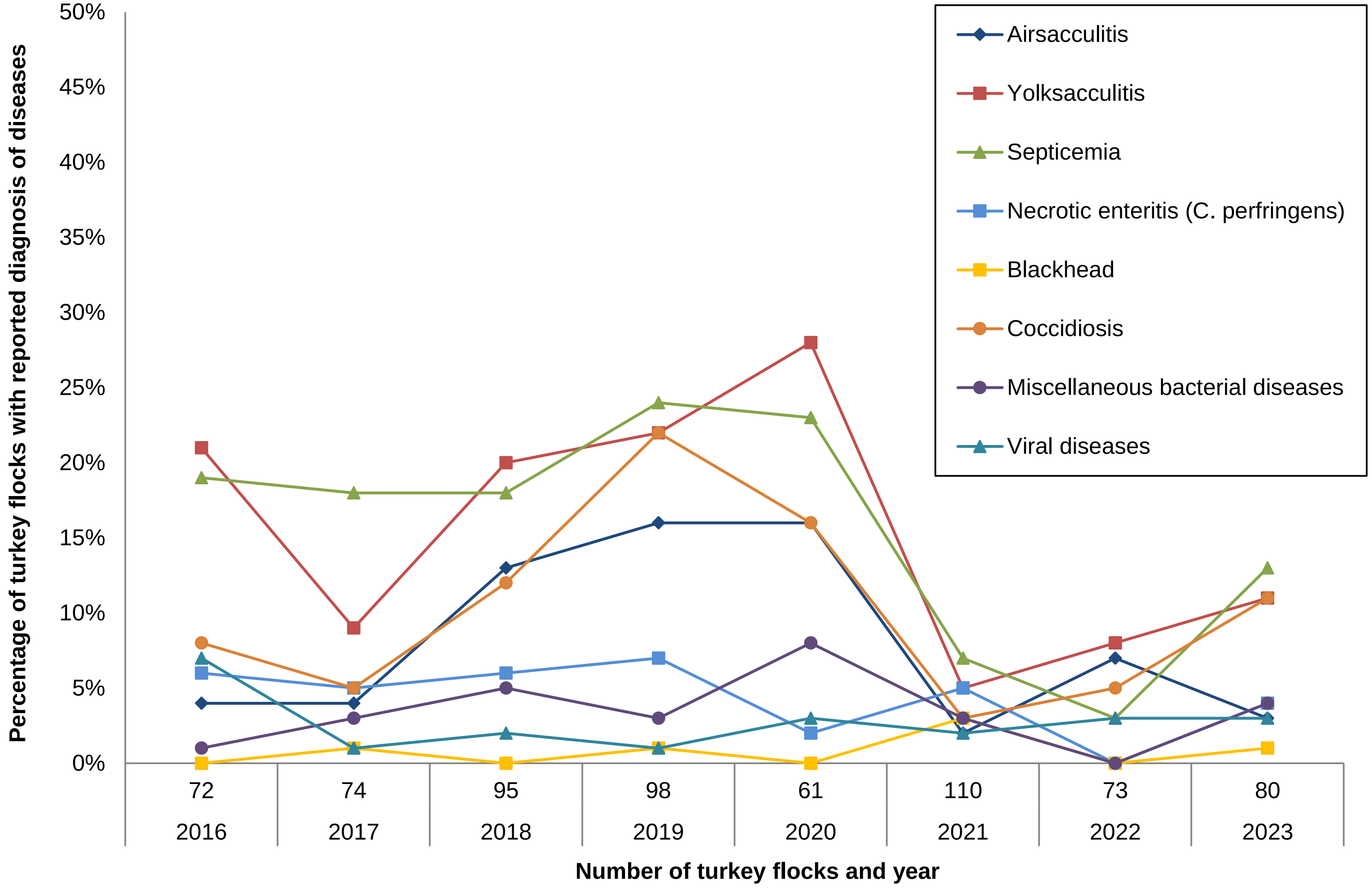
2023
Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)
Preliminary Report (version June 2024)
Turkeys

Turkey health status – diseases* continued to be diagnosed



- Diagnosis of most diseases increased in 2023 compared to 2022:
  - ➢ Septicemia ↑ 10%
  - ➢ Coccidiosis ↑ 6%
  - ➢ Necrotic enteritis ↑ 4%
- Vaccination against viral diseases such as haemorrhagic enteritis was a common practice.
- Limited vaccines against bacterial diseases.
  - *E. coli* vaccine

*Response to the questionnaire: confirmed positive or likely positive for the disease

Antimicrobials are used to control bacterial diseases

More diverse antimicrobial active ingredients reported in 2023 compared to 2021 and 2022

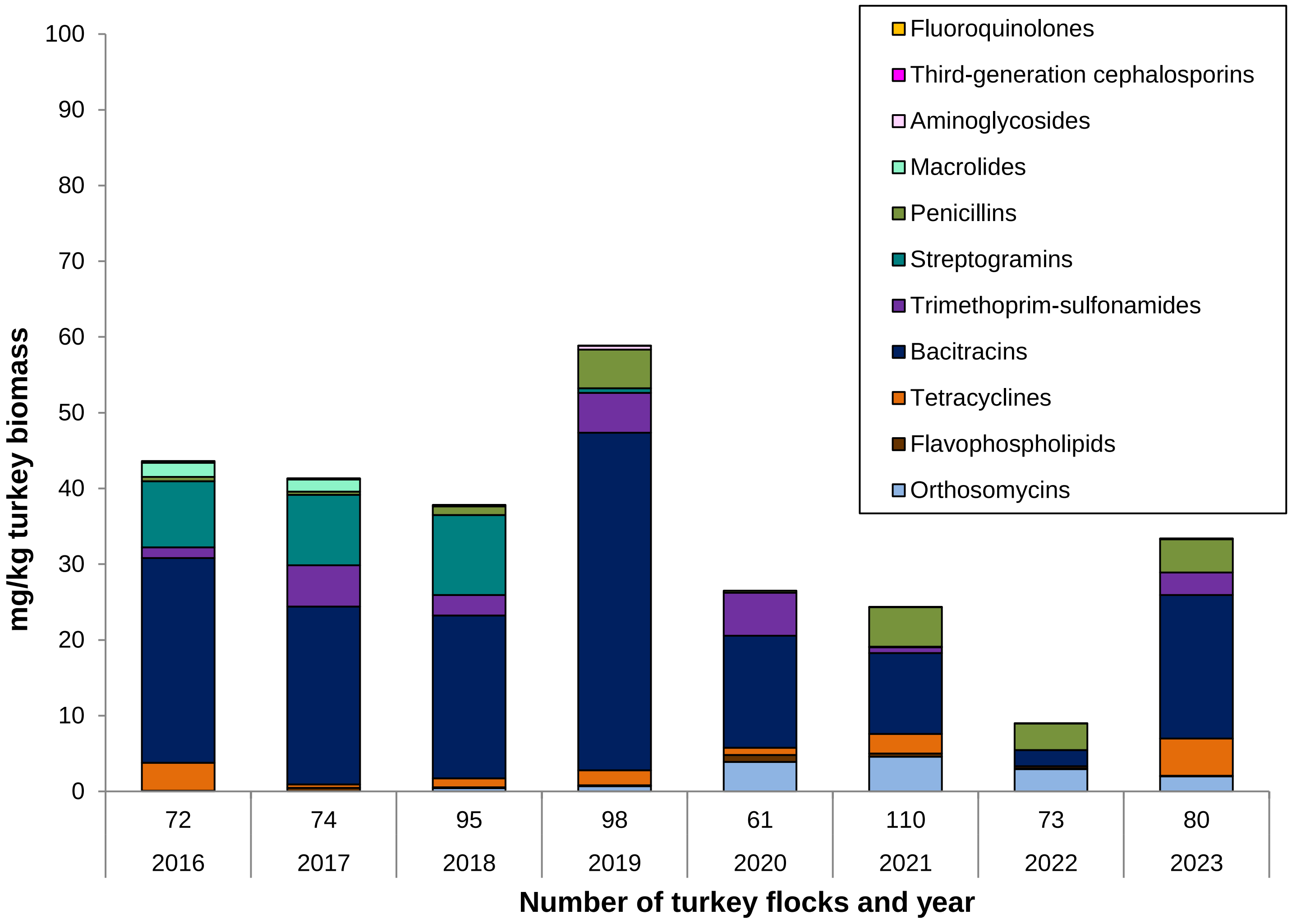
Route of administration	Year Number of flocks	2016 72	2017 74	2018 95	2019 98	2020 61	2021 110	2022 73	2023 80
Feed									
II	Tylosin	7%	5%	0%	0%	0%	0%	0%	0%
II	Penicillin G potassium	0%	0%	0%	0%	0%	0%	0%	0%
II	Penicillin G procaine	7%	1%	3%	0%	0%	0%	0%	3%
II	Virginiamycin	38%	36%	37%	5%	0%	1%	0%	0%
II	Trimethoprim-sulfadiazine	6%	9%	4%	6%	10%	1%	0%	1%
III	Bacitracin	36%	38%	27%	59%	28%	11%	4%	21%
III	Chlortetracycline	3%	3%	2%	2%	3%	2%	0%	3%
III	Oxytetracycline	3%	0%	0%	0%	0%	0%	0%	0%
IV	Bambermycin	4%	16%	4%	5%	21%	18%	5%	3%
Uncategorized	Avilamycin	0%	0%	3%	7%	21%	18%	10%	13%
	No antimicrobials used in feed	**17%**	**27%**	**37%**	**36%**	**52%**	**72%**	**86%**	**65%**
Water									
I	Enrofloxacin	0%	1%	1%	2%	0%	1%	1%	3%
II	Amoxicillin	1%	1%	1%	2%	2%	3%	3%	3%
II	Penicillin G potassium	7%	7%	11%	6%	10%	6%	3%	3%
II	Penicillin-streptomycin	4%	1%	2%	0%	0%	0%	0%	0%
II	Neomycin	4%	1%	1%	1%	0%	0%	0%	0%
III	Sulfaquinoxaline	0%	3%	0%	0%	0%	0%	0%	0%
III	Sulfaquinoxaline-pyrimethamine	0%	1%	0%	0%	0%	0%	0%	0%
III	Oxytetracycline-neomycin	1%	0%	0%	0%	0%	0%	0%	0%
III	Tetracycline	1%	0%	5%	3%	2%	2%	3%	5%
III	Tetracycline-neomycin	1%	0%	1%	0%	0%	0%	0%	1%
	No antimicrobials used in water	**89%**	**86%**	**87%**	**88%**	**87%**	**90%**	**95%**	**90%**
Injection									
II	Gentamicin	81%	72%	8%	1%	0%	1%	0%	0%
	No antimicrobials used at the hatchery	**19%**	**28%**	**92%**	**99%**	**100%**	**99%**	**100%**	**100%**
Overall									
	No antimicrobials used (any route of administration)	**17%**	**27%**	**35%**	**35%**	**49%**	**65%**	**82%**	**64%**

Reference:

Rare	< 0.1%
Very low	0.1-1%
Low	>1 - 10%
Moderate	>10-20%
High	>20-50%
Very high	>50-70%
Extremely high	>70

Antimicrobials are used for the control of bacterial diseases in turkeys

mg/kg turkey biomass increased between 2022 and 2023

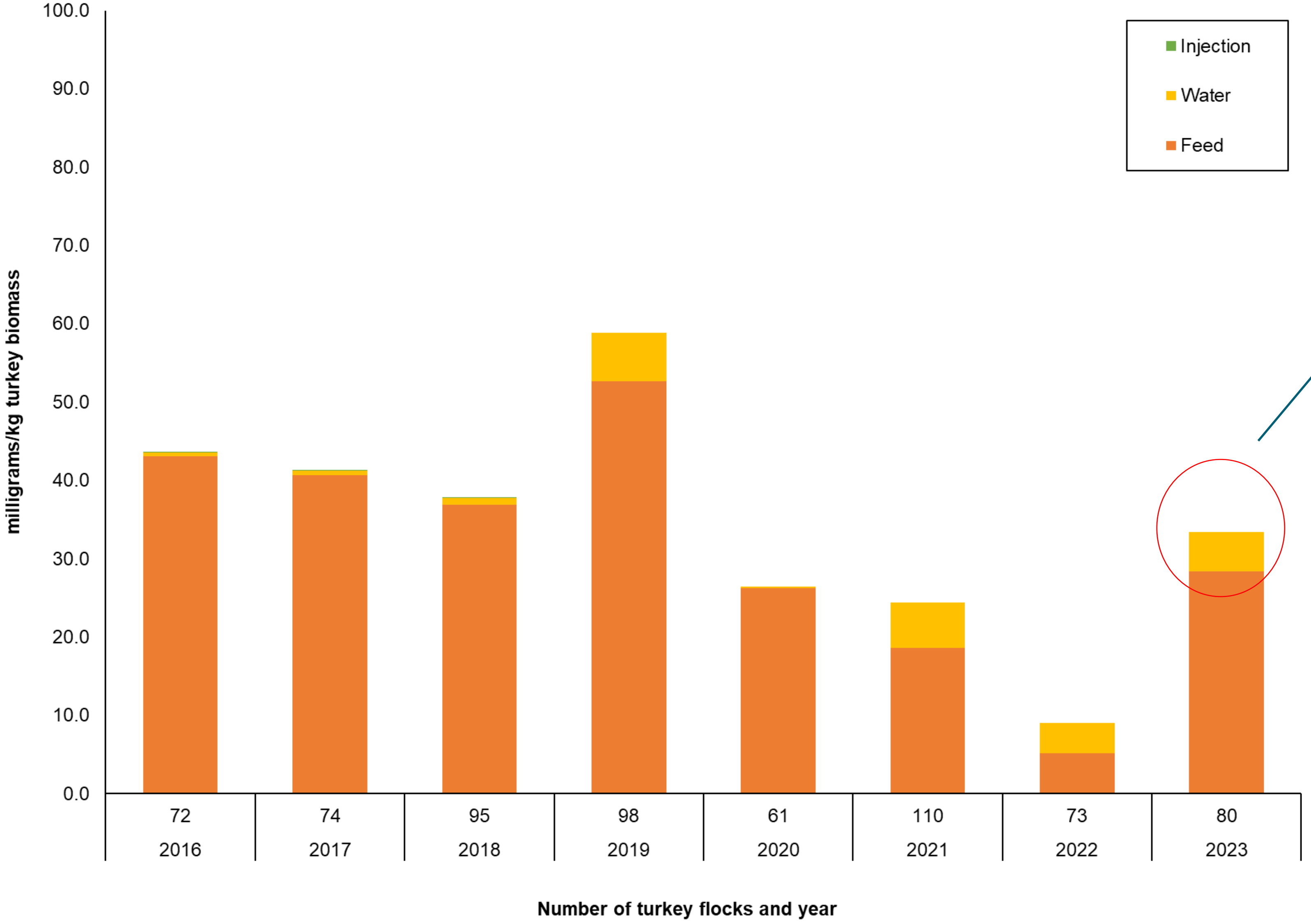


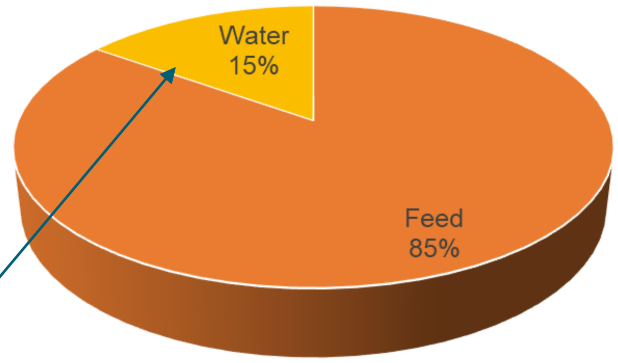
- AMU quantity and patterns of use in 2023 changed vs. 2022
  - ➢ Tetracyclines and trimethoprim-sulfadiazine (not reported in 2022)
  - ➢ Bacitracins – increased mg/kg animal biomass
- Days of exposure (necrotic enteritis control) compared to 2022
  - ➢ Bacitracin: ↑ 5 days
  - ➢ Avilamycin: ↓ 2 days
- Category I use
  - ➢ Fluoroquinolone – used in 2 flocks for treating yolk sac infection and salmonellosis

	2016	2017	2018	2019	2020	2021	2022	2023	2022 vs. 2023
Total	44	41	38	59	26	24	9	33	↑ 24 mg/kg

Shift in the route of administration from feed to water

mg/kg turkey biomass – proportion administered via water increased

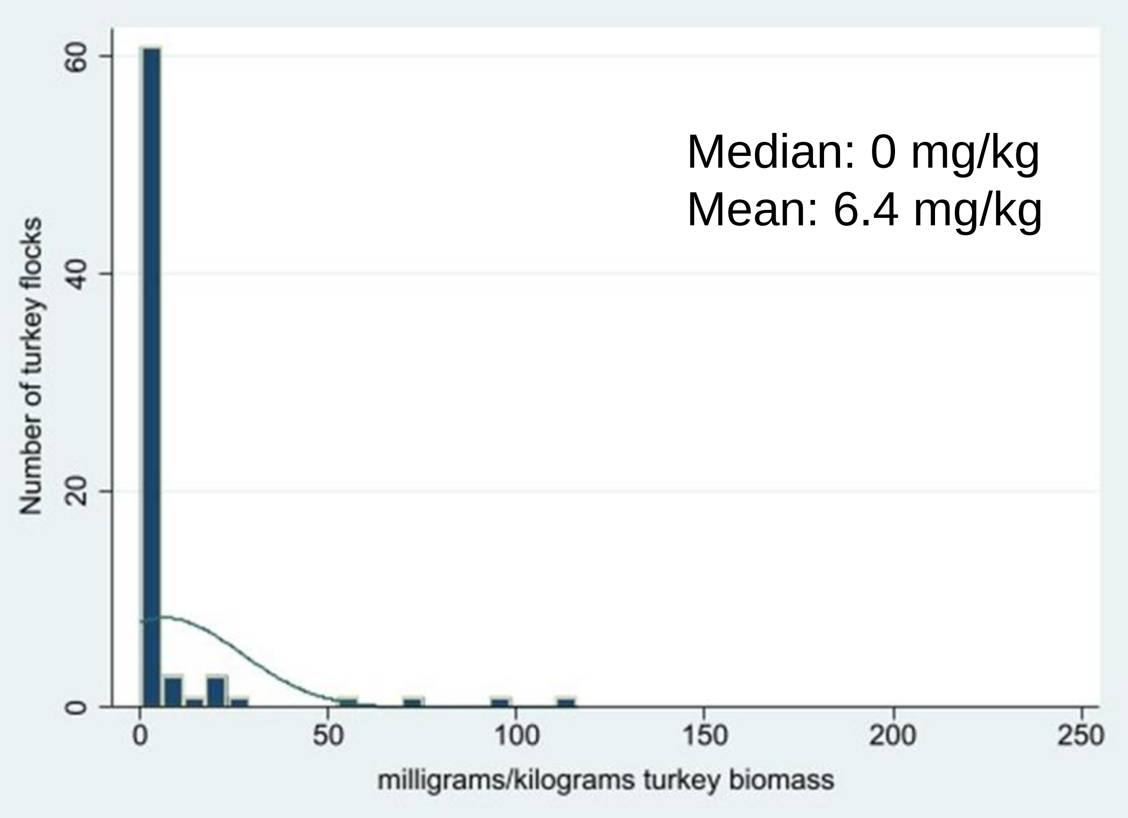




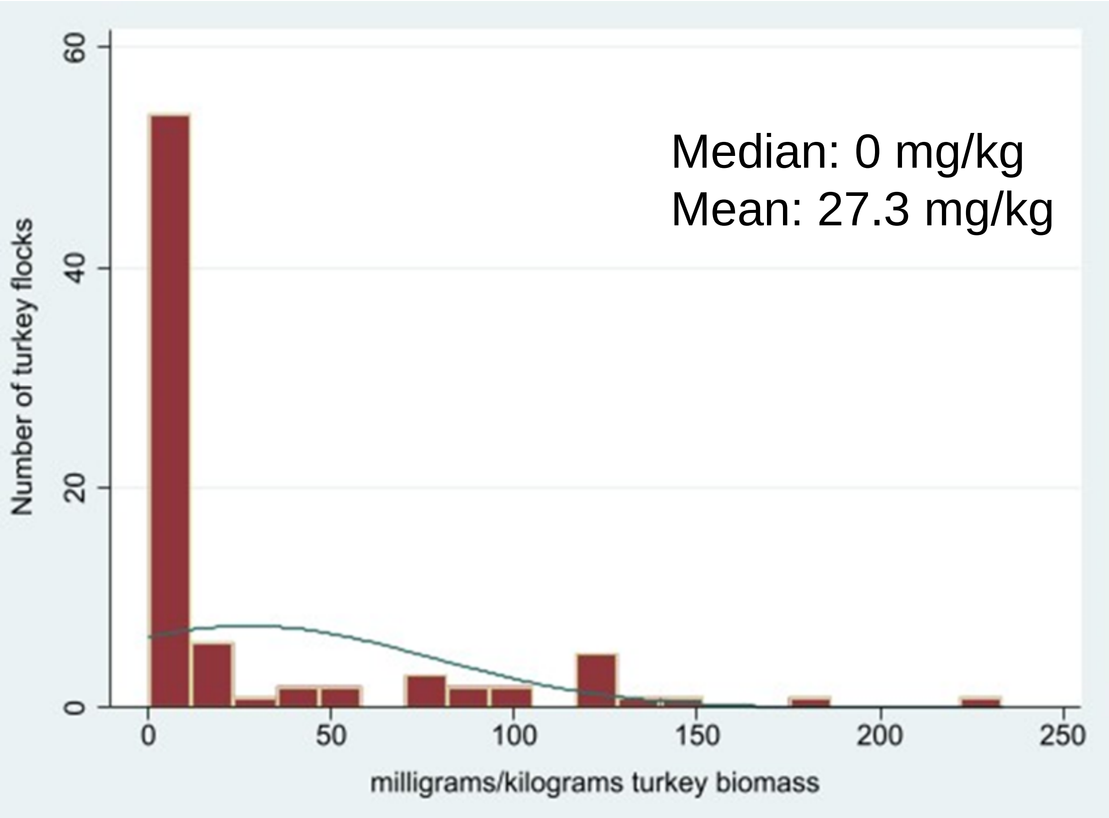
- The proportion of water-administered antimicrobials between 2021 and 2023 has increased (15%-23%) compared to 2020 (1%).
- Water-administered antimicrobials in 2023: penicillins, tetracyclines-aminoglycosides and fluoroquinolones

Flock level quantity of use – depends on the flock health situation

2022 (n = 73 flocks)



2023 (n = 81 flocks)

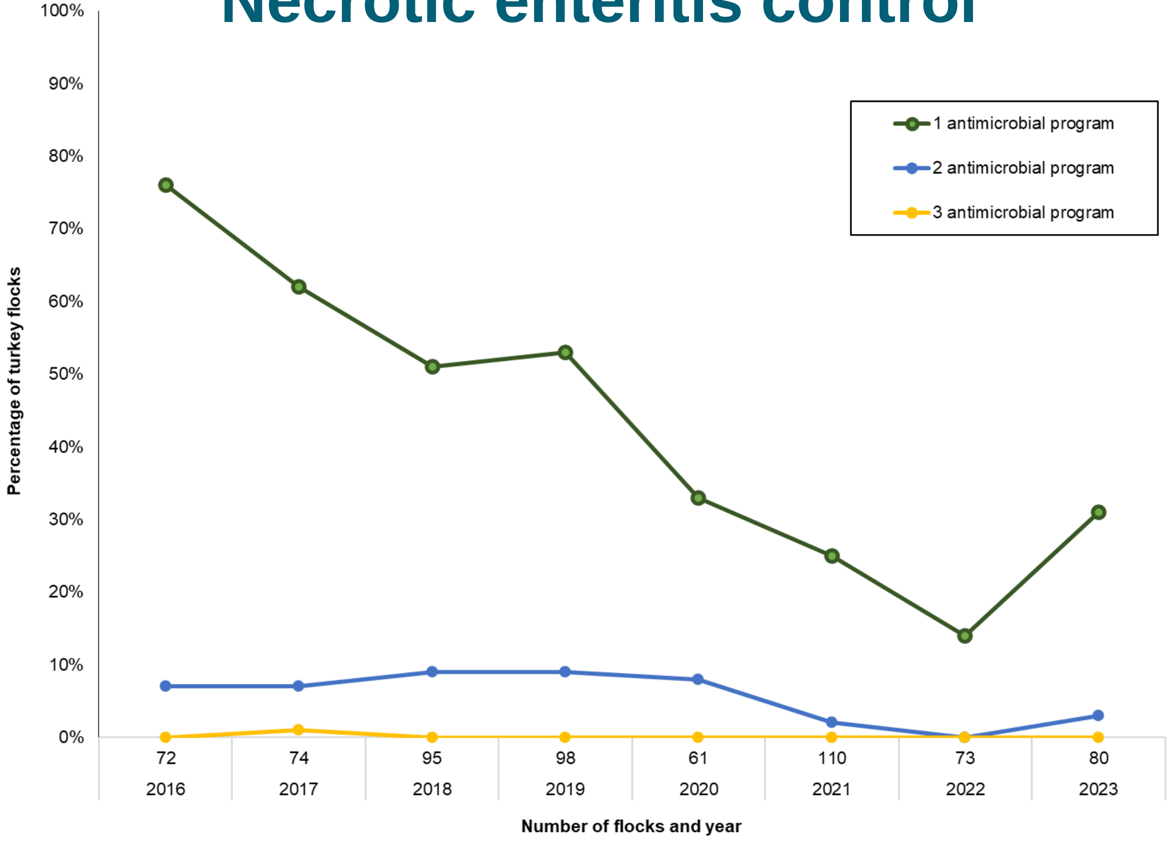


Data shown are flock-level estimates (flock-specific AMU parameters). The distribution of low, medium and high users significantly changed* between 2022 and 2023 (medium to high users detected in 2023).

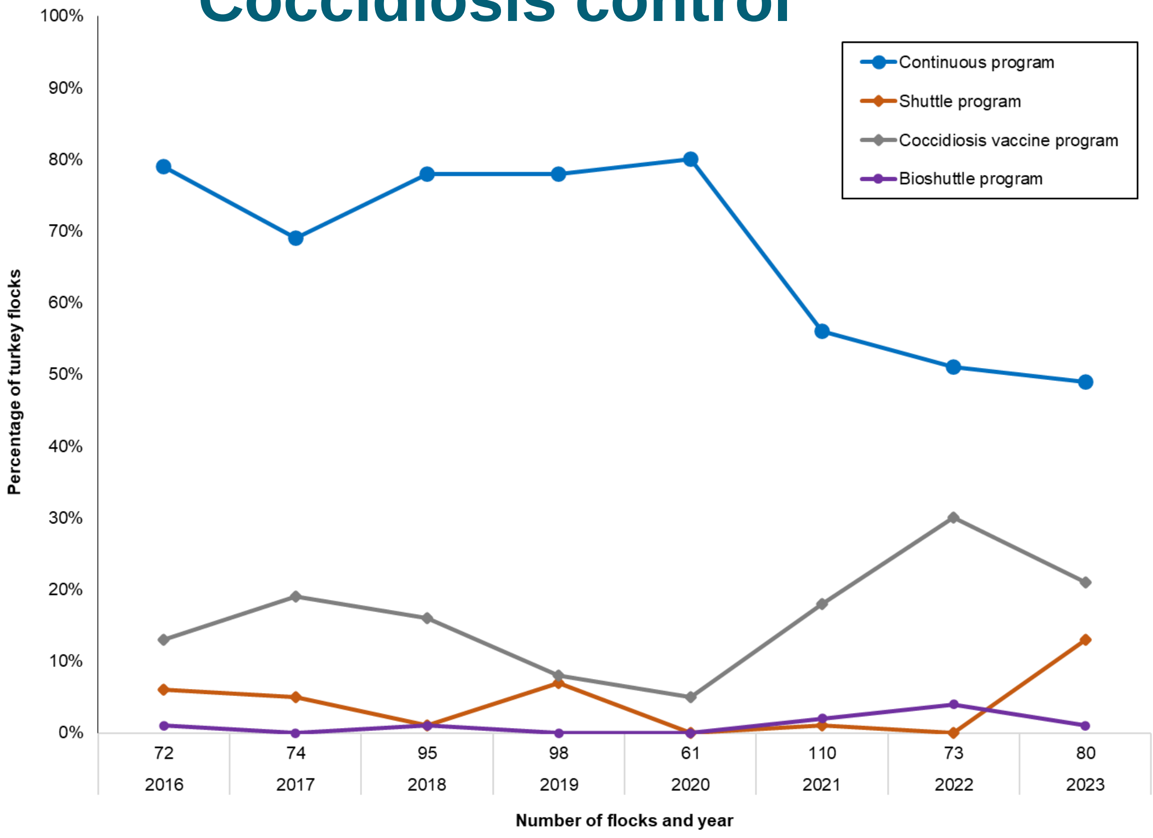
*Two-sample Wilcoxon rank-sum (Mann–Whitney) test

Enteric disease control – contributes to total AMU

Necrotic enteritis control



Coccidiosis control



- Use of one antimicrobial programme remained the most common program for necrotic enteritis control.

- Continuous/straight (1 coccidiostat) remained the most common program for coccidiosis control
- **Coccidiosis vaccination** fluctuated over time but has not replaced the use of coccidiostats.

Bacterial recovery and the most common *Salmonella* serovars

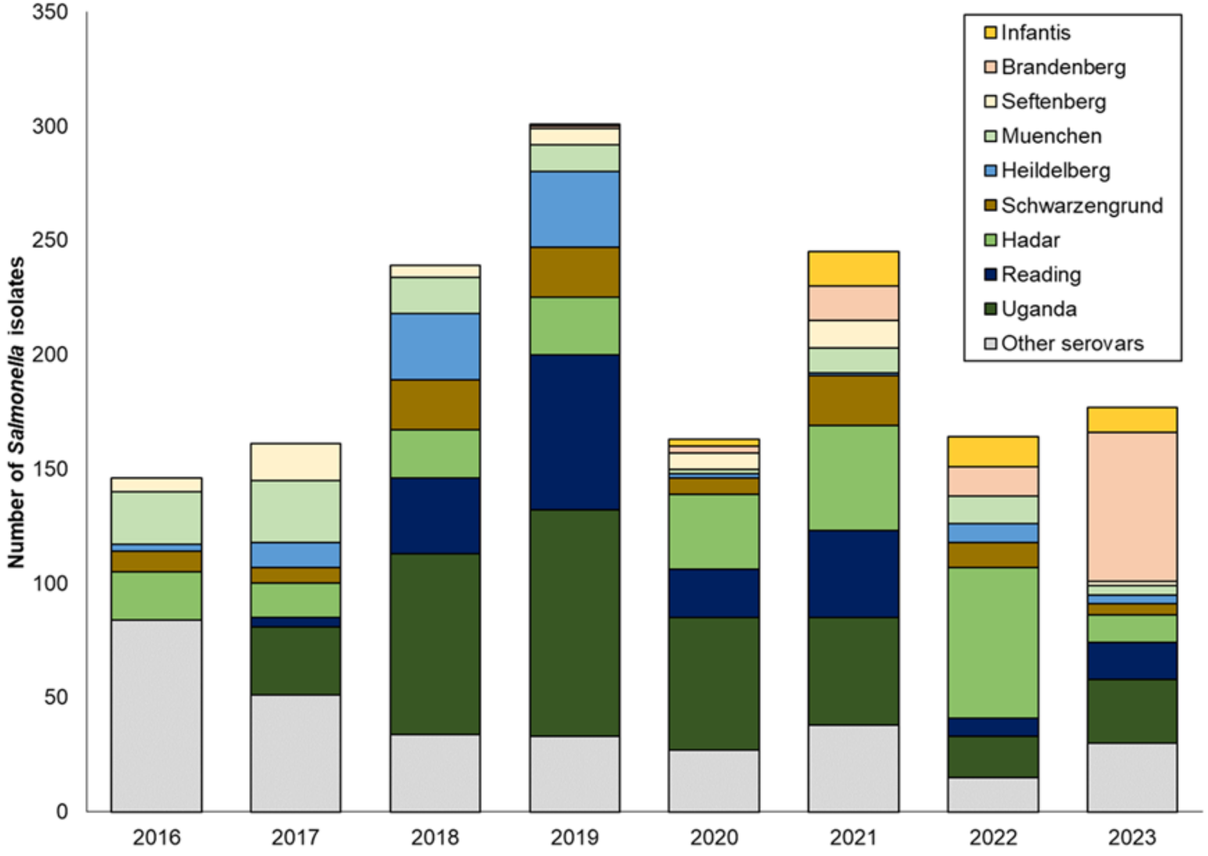
Percentage of bacterial recovery in farm turkeys decreased

	2019	2020	2021	2022	2023	Trends	2022 vs. 2023 (% change)
Salmonella	75%	69%	57%	56%	55%		-1%
Campylobacter	54%	43%	56%	39%	34%		-5%

[1] 5-year Sparklines; highpoints are in red

Decreased percentage of *Salmonella* and *Campylobacter* recovered from farm samples.

Salmonella serovars



- The diversity and proportion of serovars varied each year. More diverse serovars have been observed since 2020.
- The most common serovars in 2023 were Brandenberg, Uganda and Reading.
- *S*. Enteritidis was rarely isolated from turkey samples. In 2023, the *S*. Enteritidis isolate was ciprofloxacin non-susceptible and nalidixic acid resistant.
  - ➢ The flock was treated with a fluoroquinolone via water.

AMR status of farm turkeys

Salmonella, E. coli and *Campylobacter*

Year	2019	2020	2021	2022	2023
***Salmonella*, number of isolates**	**301**	**163**	**245**	**164**	**177**
Ampicillin	14%	9%	6%	3%	6%
Ceftriaxone	2%	0%	2%	3%	2%
Ciprofloxacin, non-susceptible	3%	2%	2%	3%	1%
Gentamicin	1%	2%	2%	4%	3%
Nalidixic acid	3%	0%	2%	3%	1%
Tetracycline	40%	50%	37%	58%	24%
Trimethoprim-sulfamethoxazole	0%	1%	1%	1%	1%
***E. coli*, number of isolates**	**393**	**223**	**429**	**289**	**318**
Ampicillin	29%	36%	26%	24%	28%
Ceftriaxone	2%	0.4%	1%	0%	0%
Ciprofloxacin, non-susceptible	4%	5%	2%	2%	3%
Gentamicin	11%	8%	8%	5%	13%
Nalidixic acid	2%	2%	1%	2%	2%
Tetracycline	61%	54%	49%	48%	49%
Trimethoprim-sulfamethoxazole	10%	14%	9%	5%	6%
***Campylobacter*, number of isolates**	**214**	**90**	**240**	**115**	**109**
Azithromycin	5%	12%	11%	3%	11%
Ciprofloxacin	37%	18%	19%	11%	26%
Gentamicin	0%	0%	0%	0%	0%
Tetracycline	43%	48%	39%	44%	21%

Reference:

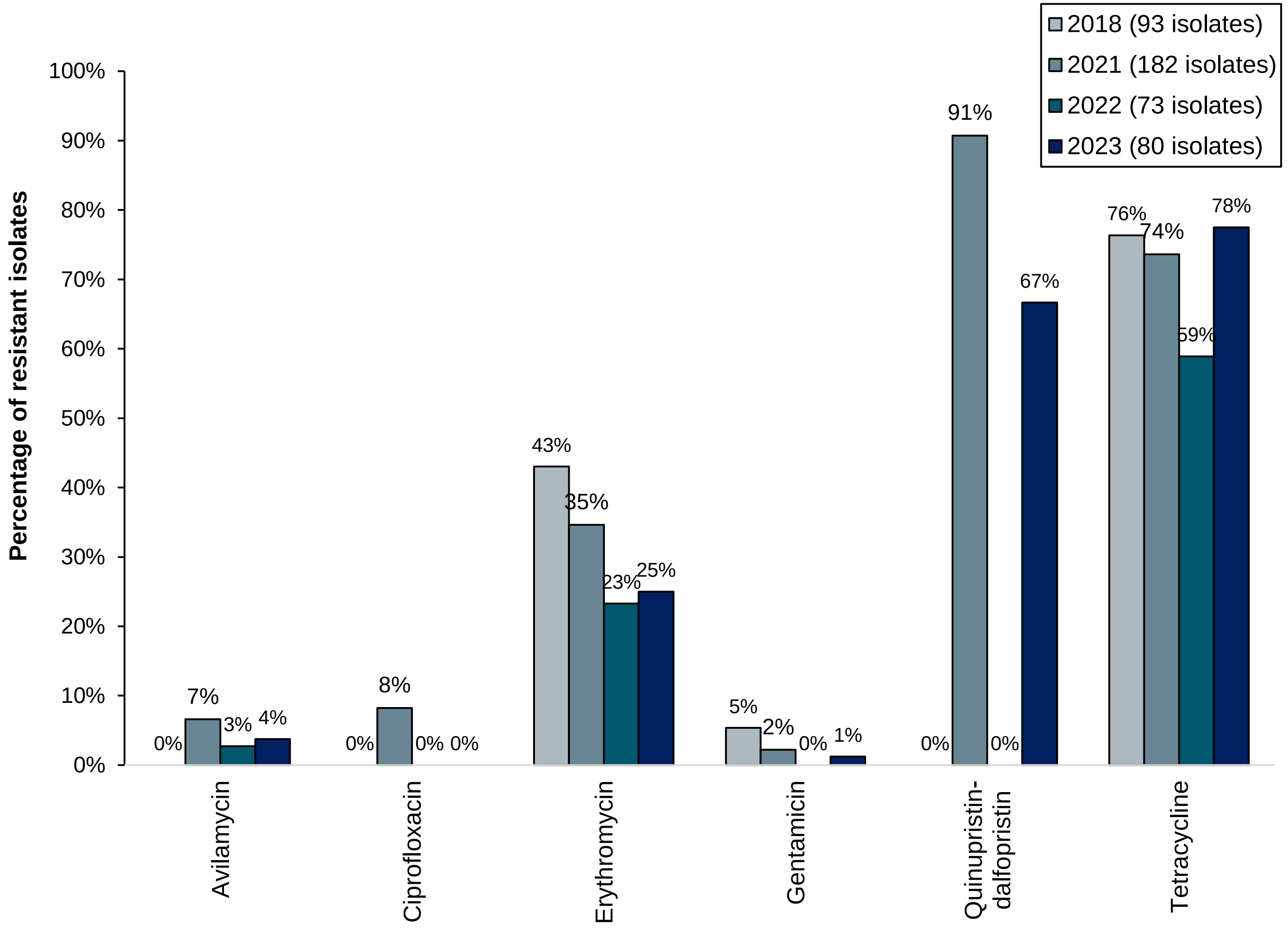
Not detected	0
Rare	< 0.1%
Very low	0.1-1%
Low	>1 - 10%
Moderate	>10-20%
High	>20-50%
Very high	>50-70%
Extremely high	>70

*Estimates were adjusted for clustering at the flock level

- Stable or decreased resistance in most antimicrobials in *E. coli* and *Salmonella*.
- ***Campylobacter spp.:*** increased resistance to ciprofloxacin (15%) and azithromycin (8%) were observed.

AMR status of farm turkeys – *Enterococcus* spp.

- 2018 - the year prior to the implementation of AMU reduction (Category II).
- No resistance was observed in 4 of the 12 antimicrobials evaluated across all years including vancomycin.
- Low-level resistance to avilamycin was observed.
- Ciprofloxacin resistance was observed only in 2021 (8%).
- Decreasing erythromycin resistance trend observed.
- Tetracycline resistance increased in 2023 (tetracycline was reportedly used in 2023).



Quinupristin-dalfopristin excludes *E. faecalis*

AMR status of farm turkeys: *Clostridium perfringens*

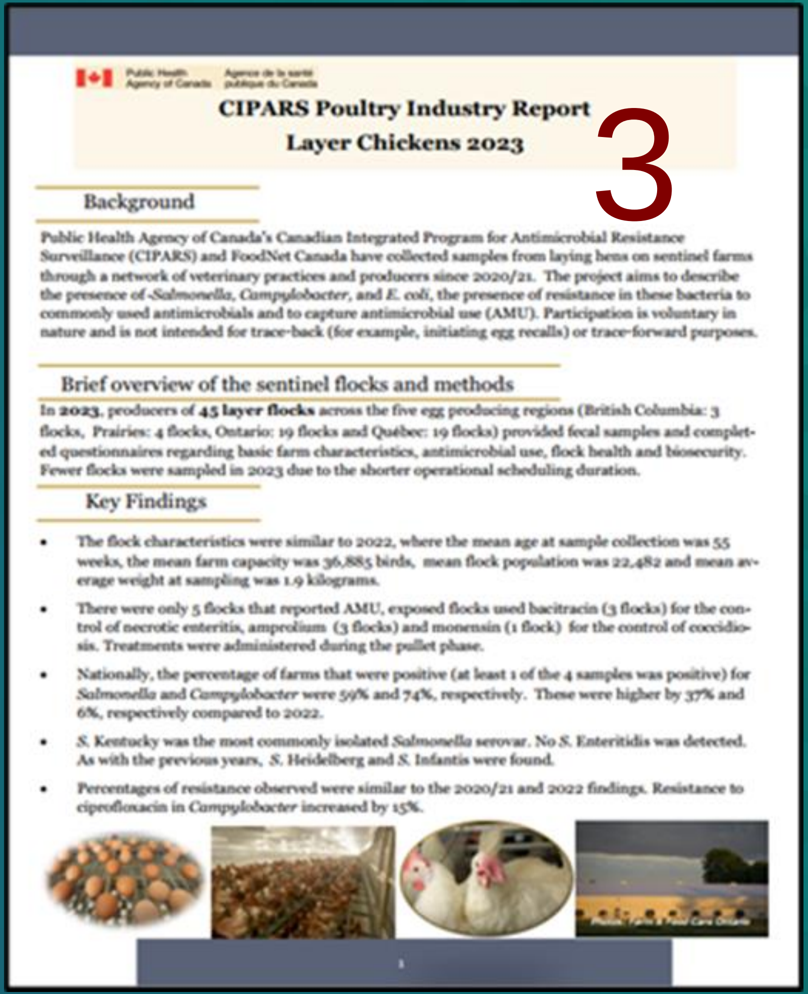
Antimicrobial	Year	Number of isolates	Percentiles MIC_{50}	Percentiles MIC_{90}	Distribution (%) of MICs (ug/mL) 0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	512	Decreased Susceptibility
Bacitracin	2021	83	8	256							63.9	10.8			7.2	12.0	6.0	25 %
	2023	87	8	> 256							65.5					20.7	13.8	34 % ↑9 % vs. 2021
Erythromycin	2021	83	2	2				13.3	79.5	4.8	2.4							
	2023	87	4	4				19.5	28.7	49.4	2.3							
Narasin	2021	83	1	1			18.1	81.9										
	2023	87	1	1	1.1		16.1	82.8										
Penicillin	2021	83	0.125	0.125	97.6	2.4												
	2023	87	0.125	0.125	90.8	9.2												
Tetracycline	2021	83	16	32					13.3	3.6	24.1	48.2	9.6	1.2				59 %
	2023	87	16	16					10.3	5.7	27.6	48.3	8.0					56 % ↓3 % vs. 2021
Tylosin	2021	83	1	1			41.0	56.6			2.4							
	2023	87	1	1			5.7	92.0			2.3							
Virginiamycin	2021	83	0.125	2	81.9	3.6	1.2	13.3										
	2023	87	0.25	0.25	29.9	67.8	2.3											

MIC_{50} – antimicrobial concentration where at least 50% of the isolates were inhibited
MIC_{90} – antimicrobial concentration where at least 90% of the isolates were inhibited
Vertical lines – breakpoints based on published studies[a] (bacitracin) or the CLSI M100 (penicillin, tetracycline)

Manuscript in preparation

[a] Manson et al., 2004, Antimicrob Agents Chemother 48: 3743–3748)(Chalmers et al., 2008, J Clin Microbiol 46: 3957–3964)

LAYERS



CIPARS Poultry Industry Report
Layer Chickens 2023

3

Background

Public Health Agency of Canada's Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) and FoodNet Canada have collected samples from laying hens on sentinel farms through a network of veterinary practices and producers since 2020/21. The project aims to describe the presence of *Salmonella*, *Campylobacter*, and *E. coli*, the presence of resistance in these bacteria to commonly used antimicrobials and to capture antimicrobial use (AMU). Participation is voluntary in nature and is not intended for trace-back (for example, initiating egg recalls) or trace-forward purposes.

Brief overview of the sentinel flocks and methods

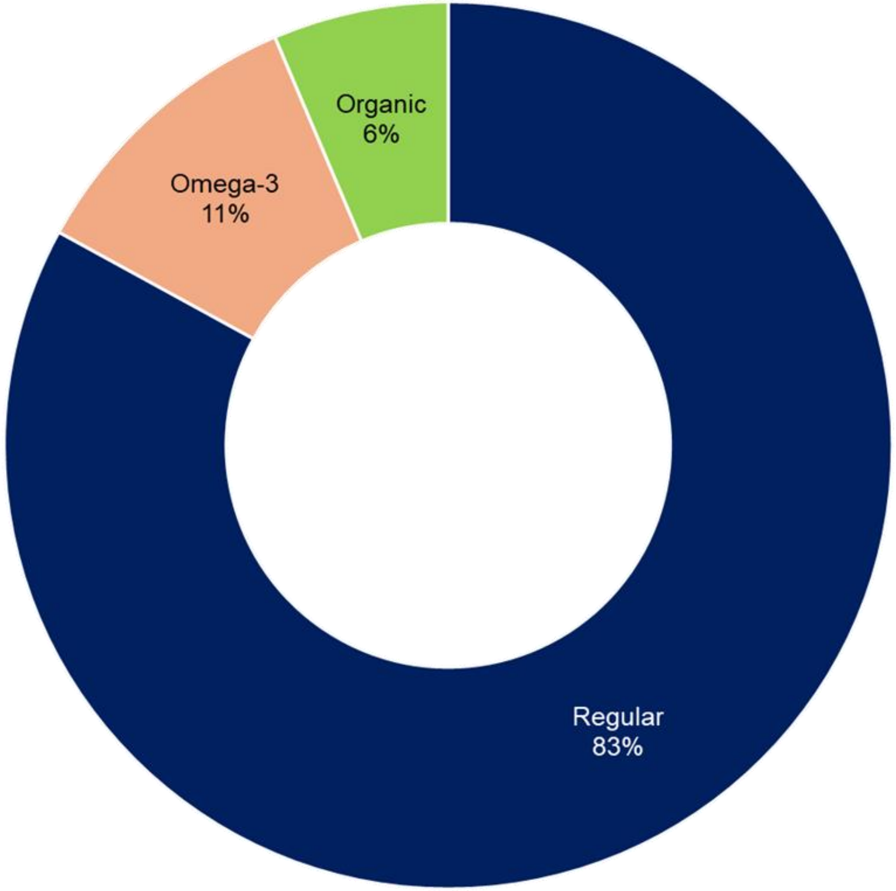
In **2023**, producers of **45 layer flocks** across the five egg producing regions (British Columbia: 3 flocks, Prairies: 4 flocks, Ontario: 19 flocks and Québec: 19 flocks) provided fecal samples and completed questionnaires regarding basic farm characteristics, antimicrobial use, flock health and biosecurity. Fewer flocks were sampled in 2023 due to the shorter operational scheduling duration.

Key Findings

- The flock characteristics were similar to 2022, where the mean age at sample collection was 55 weeks, the mean farm capacity was 36,885 birds, mean flock population was 22,482 and mean average weight at sampling was 1.9 kilograms.
- There were only 5 flocks that reported AMU, exposed flocks used bacitracin (3 flocks) for the control of necrotic enteritis, amprolium (3 flocks) and monensin (1 flock) for the control of coccidiosis. Treatments were administered during the pullet phase.
- Nationally, the percentage of farms that were positive (at least 1 of the 4 samples was positive) for *Salmonella* and *Campylobacter* were 59% and 74%, respectively. These were higher by 37% and 6%, respectively compared to 2022.
- *S.* Kentucky was the most commonly isolated *Salmonella* serovar. No *S.* Enteritidis was detected. As with the previous years, *S.* Heidelberg and *S.* Infantis were found.
- Percentages of resistance observed were similar to the 2020/21 and 2022 findings. Resistance to ciprofloxacin in *Campylobacter* increased by 15%.

Layer flock characteristics and disease status in 2023 (n = 50 flocks)

Eggs marketed as:



Barn set up

- 50% of the sampled flocks were housed in conventional housing system, 37% were in enriched colony system and the remaining flocks were in free-run/free range system.

Farm building structure

- 56% of the flocks originated from farms with single-barn and the remaining flocks were from farms with complex and multi-barn structures.

Egg color

- 89% were producing white egg producers and the remaining 11% were brown egg producers

Diagnosis of disease

- Occasional necrotic enteritis and coccidiosis symptoms during the pullet stage.

Vaccination

- Comprehensive and covered most diseases affecting layer flocks in Canada.

Limited layer flocks reportedly using antimicrobials

Year Number of flocks	2020/2021 70	2022 50	2023 47	Reasons for use
Medically important				
Bacitracin	13%	20%	4%	Necrotic enteritis
Oxytetracycline	1%	0%	0%	Respiratory diseases
Nonmedically important (coccidiostats)				
Amprolium	3%	2%	6%	Coccidiosis
Monensin	7%	0%	2%	Coccidiosis

- Bacitracin was consistently reported for the control of necrotic enteritis.
- Oxytetracycline was reported once in 2020/21
- Amprolium and monensin were reportedly used for the control of coccidiosis.
- Layer flocks appear to be susceptible to enteric diseases.

Bacterial recovery and common *Salmonella* serovars

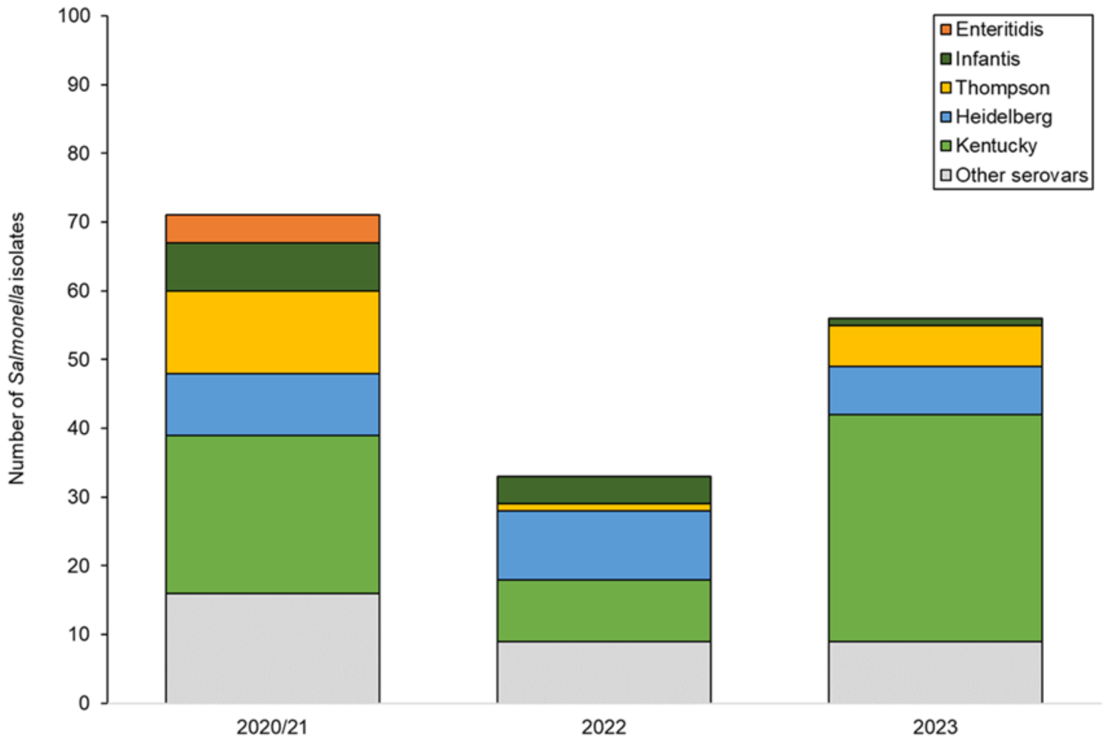
Percentage of bacterial recovery (flock-level) increased

	2020/21	2022	2023	Trends	2022 vs. 2023 (% difference)
	72	50	46		
Salmonella	42%	22%	59%		37%
Campylobacter	74%	68%	74%		6%

[1] 5-year Sparklines; highpoints are in red

Increased percentage of farms positive to *Salmonella* and *Campylobacter* (at least 1 of the 4 fecal samples collected from one farm tested positive).

Salmonella serovars



Salmonella Kentucky was the most frequently isolated serovar in 2020/21 and 2023.

All of the *S.* Kentucky isolates in 2023 were resistant to tetracycline.

S. Heidelberg and Infantis were consistently found.

No *S*. Enteritidis was found in 2022 and 2023.

AMR status of layers

Salmonella, E. coli and *Campylobacter*

Year	2020/21	2022	2023
Salmonella, number of isolates	**71**	**33**	**56**
Ampicillin	0%	0%	0%
Ceftriaxone	0%	0%	0%
Ciprofloxacin, non-susceptible	0%	0%	0%
Gentamicin	0%	0%	0%
Nalidixic acid	0%	0%	0%
Tetracycline	37%	27%	67%
Trimethoprim-sulfamethoxazole	3%	0%	0%
E. coli, number of isolates	**280**	**198**	**177**
Ampicillin	7%	8%	4%
Ceftriaxone	0%	0%	0%
Ciprofloxacin, non-susceptible	2%	1%	1%
Gentamicin	2%	0%	1%
Nalidixic acid	1%	1%	1%
Tetracycline	24%	23%	19%
Trimethoprim-sulfamethoxazole	2%	3%	2%
Campylobacter, number of isolates	**183**	**115**	**107**
Azithromycin	0%	8%	0%
Ciprofloxacin	16%	15%	30%
Gentamicin	0%	0%	0%
Tetracycline	29%	28%	40%

Reference:

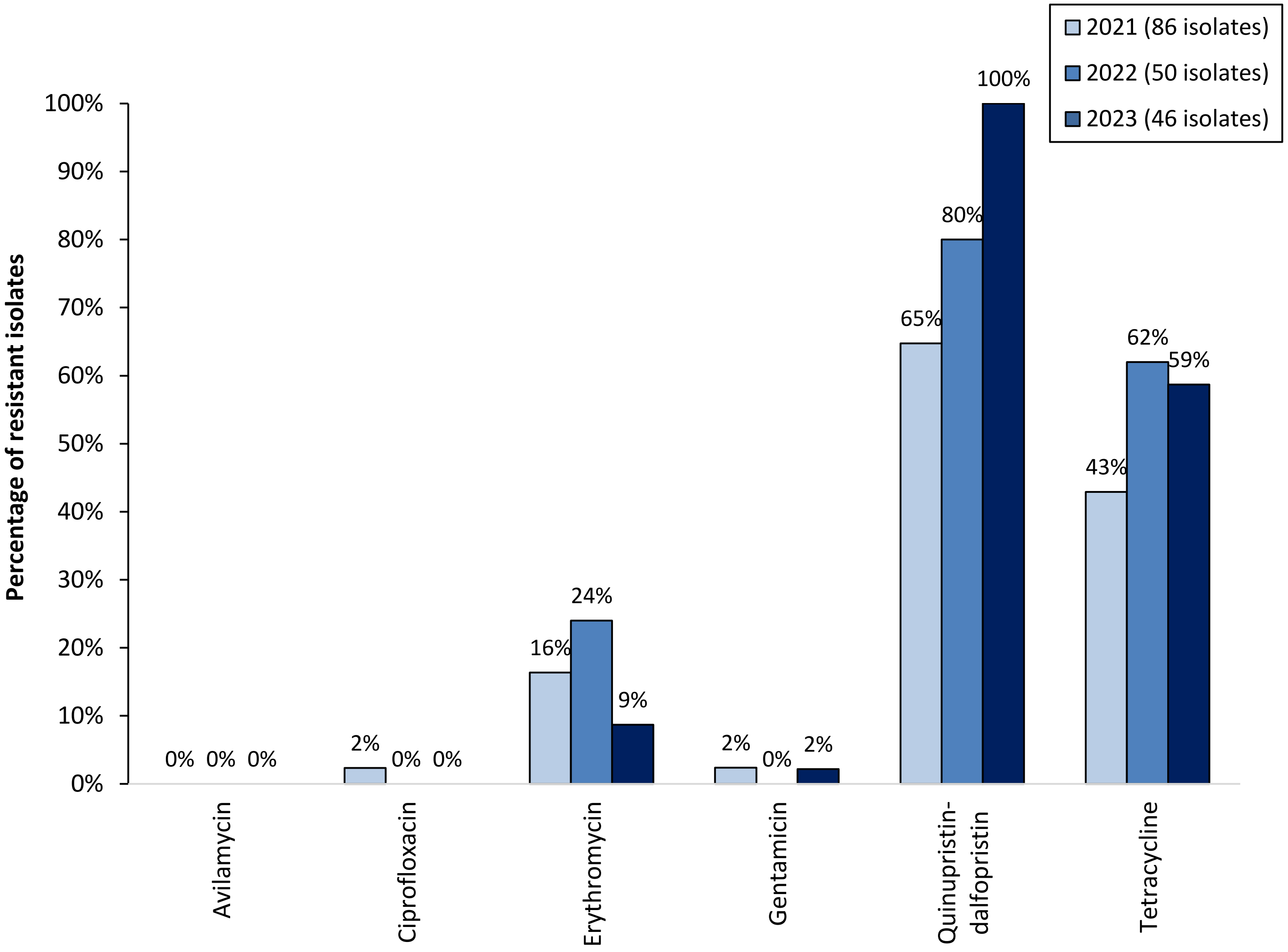
Not detected	0
Rare	< 0.1%
Very low	0.1-1%
Low	>1 - 10%
Moderate	>10-20%
High	>20-50%
Very high	>50-70%
Extremely high	>70

*Estimates were adjusted for clustering at the flock level

Increased resistance to tetracycline in *Salmonella* (30% increase, driven by *S.* Kentucky).
Campylobacter spp.: increased resistance to ciprofloxacin (15%) and tetracycline (12%).

AMR status of layers – *Enterococcus* spp.

- No resistance observed for 6 of the 12 antimicrobials examined (including vancomycin and avilamycin) across all years.
- Ciprofloxacin resistance was observed only in 2021 (2%)
- Quinupristin-dalfopristin and tetracycline resistance increased in 2023 compared to 2020/21.



Quinupristin-dalfopristin excludes *E. faecalis*

AMR status of layers: *Clostridium perfringens*

Antimicrobial	Year	Number of isolates	Percentiles MIC_{50}	MIC_{90}	Distribution (%) of minimum inhibitory concentrations (µg/mL) ≤ 0.125	0.25	0.5	1	2	4	8	16	32	64	128	256	> 256	Decreased susceptibility
Bacitracin	2021	54	8	256							75.9	9.3			1.9	5.6	7.4	**15 %**
	2023	63	8	256							57.1	28.6			1.6	6.3	6.3	**14 %**
Erythromycin	2021	54	2	4			1.9	33.3	53.7	5.6	5.6							
	2023	63	2	2				20.6	73.0	6.3								
Narasin	2021	54	0.5	0.5			98.1	1.9										
	2023	63	1	1			22.2	77.8										
Penicillin	2021	54	0.125	0.125	100.0													
	2023	63	0.125	0.125	100.0													
Tetracycline	2021	54	8	32					20.4	22.2	25.9	14.8	14.8	1.9				**31 %**
	2023	63	4	32					36.5	25.4	14.3	12.7	9.5	1.6				**24 %** **↓7 % vs. 2021**
Tylosin	2021	54	0.5	1		5.6	53.7	35.2	1.9			3.7						
	2023	63	1	1			20.6	73.0										
Virginiamycin	2021	54	0.125	0.125	100.0													
	2023	63	0.125	0.25	87.3	12.7												

MIC_{50} – antimicrobial concentration where at least 50% of the isolates were inhibited
MIC_{90} – antimicrobial concentration where at least 90% of the isolates were inhibited
Vertical lines – breakpoints based on published studies[a] (bacitracin) or the CLSI M100 (penicillin, tetracycline)

Manuscript in preparation

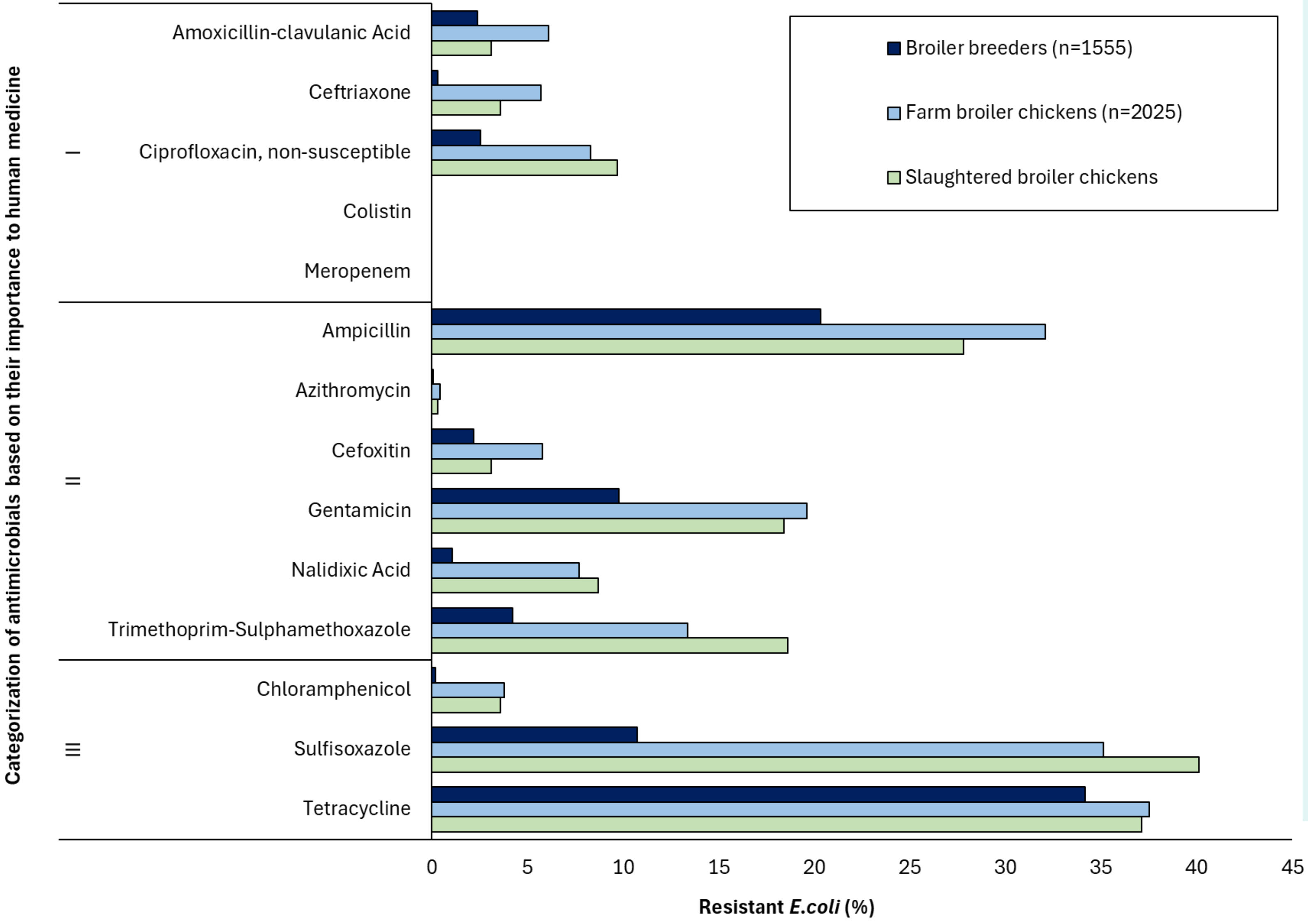
[a] Manson et al., 2004, Antimicrob Agents Chemother 48: 3743–3748)(Chalmers et al., 2008, J Clin Microbiol 46: 3957–3964)

BROILER BREEDERS

Research study final results (*manuscript in preparation*)

AMR in *E. coli* from slaughtered broiler breeders

Results were compared with farm and slaughtered broiler chickens during the surveillance timeframe

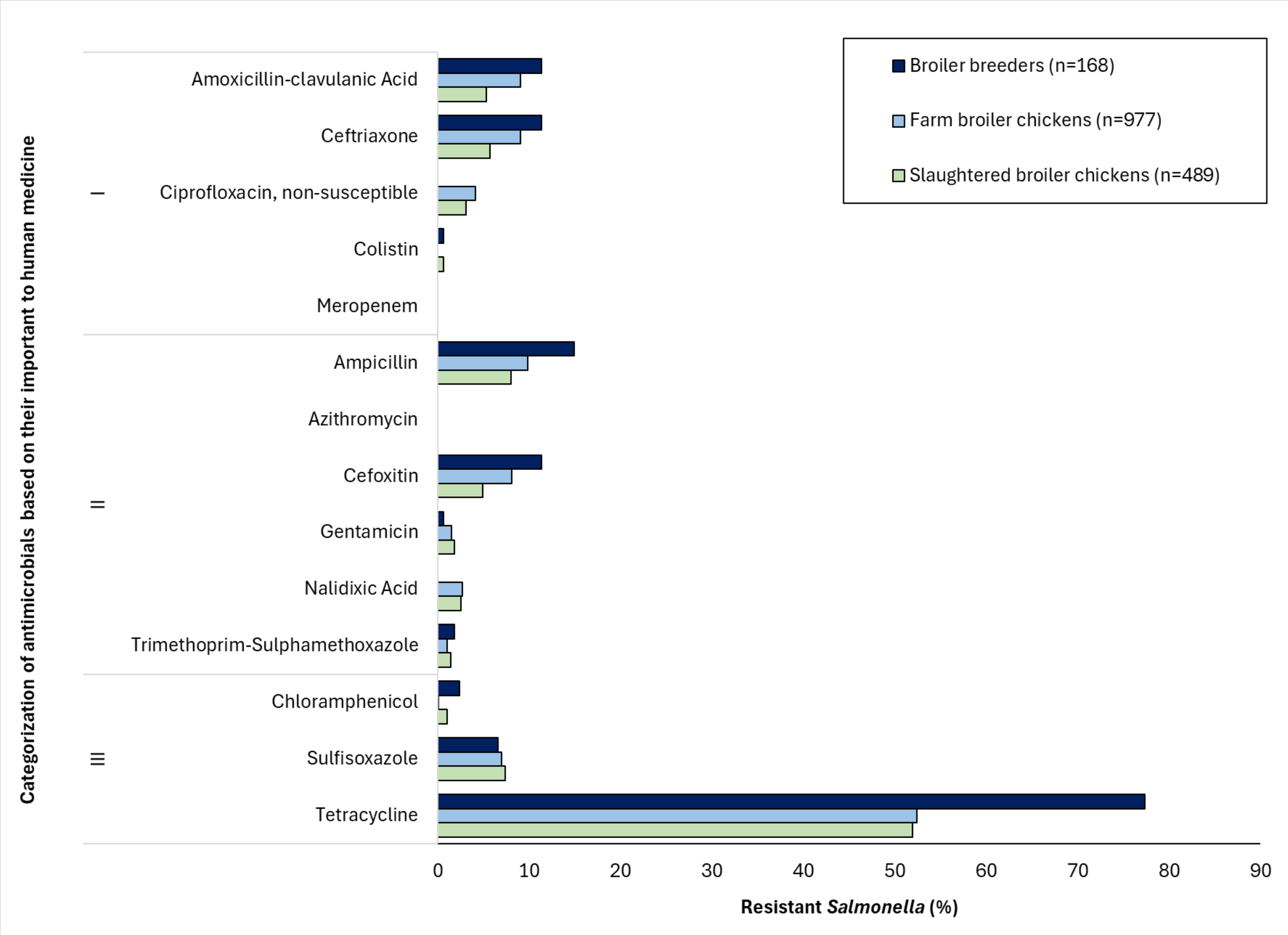


- AMR across the food production continuum was assessed for similarities.
- Resistance to most antimicrobials was significantly higher in farm and slaughtered broiler chickens* compared to broiler breeders.
- Tetracycline resistance – comparable across the 3 production stages.

**Ceftriaxone, ciprofloxacin, ampicillin, cefoxitin, gentamicin, nalidixic acid, and sulfisoxazole*

AMR in *Salmonella* from slaughtered broiler breeders

Results were compared with farm and slaughtered broiler chickens during the surveillance timeframe

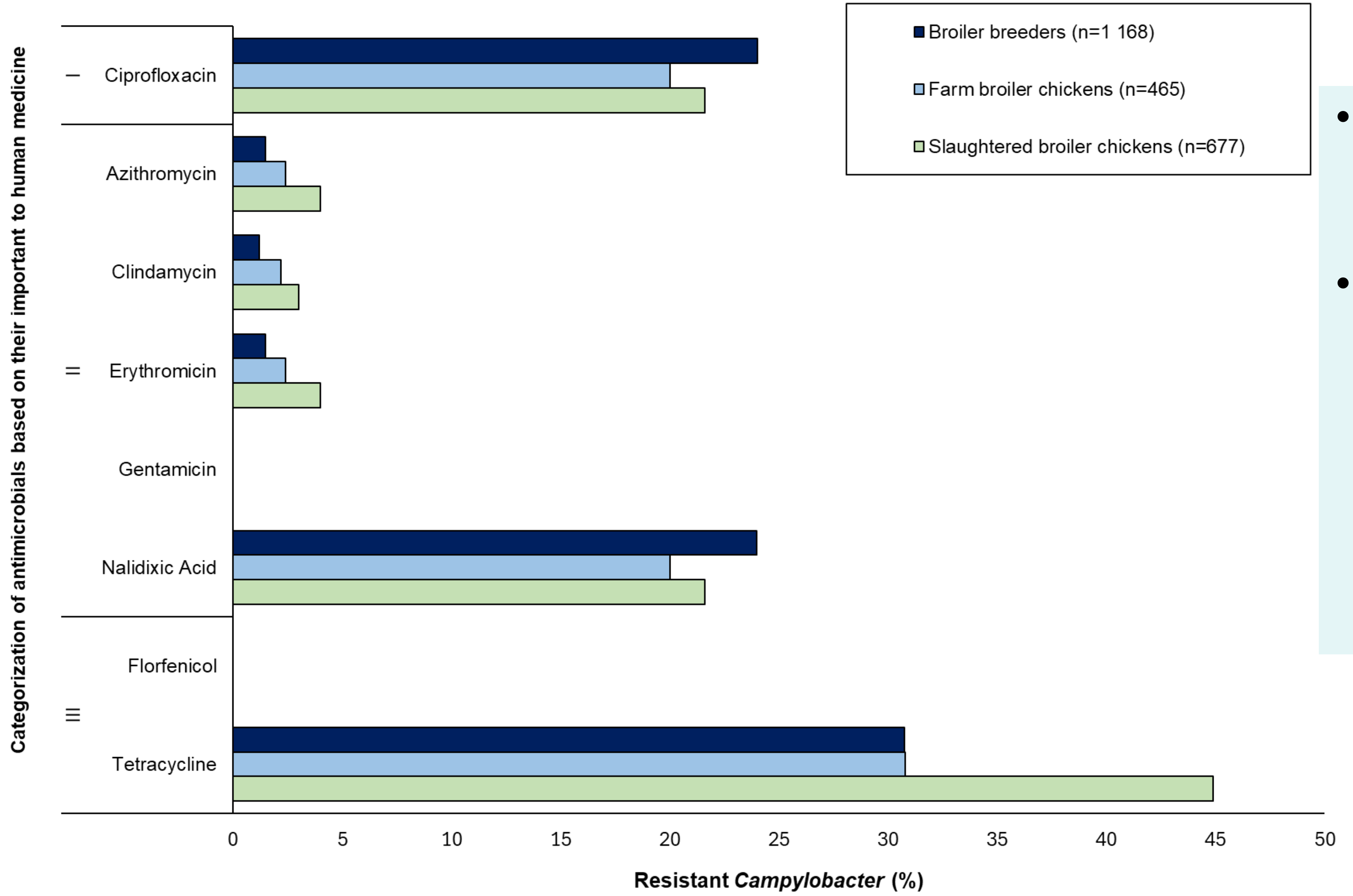


- Resistance to most antimicrobials was significantly lower in farm and slaughtered broiler chickens* compared to breeders.
- S. Kentucky was the most frequently isolated serovar across the 3 production stages.
- Regional variations were noted in the clusters of AMR phenotypes in S. Kentucky. Within each region, the AMR phenotypes were similar across the food production continuum.

** amoxicillin-clavulanic acid*

AMR in *Campylobacter* from slaughtered broiler breeders

Results were compared with farm and slaughtered broiler chickens during the surveillance timeframe



- Resistance to ciprofloxacin was observed across all production stages.
- Resistance to azithromycin, erythromycin and tetracycline was significantly higher in slaughtered broiler chickens compared to breeders and farm broiler chickens.

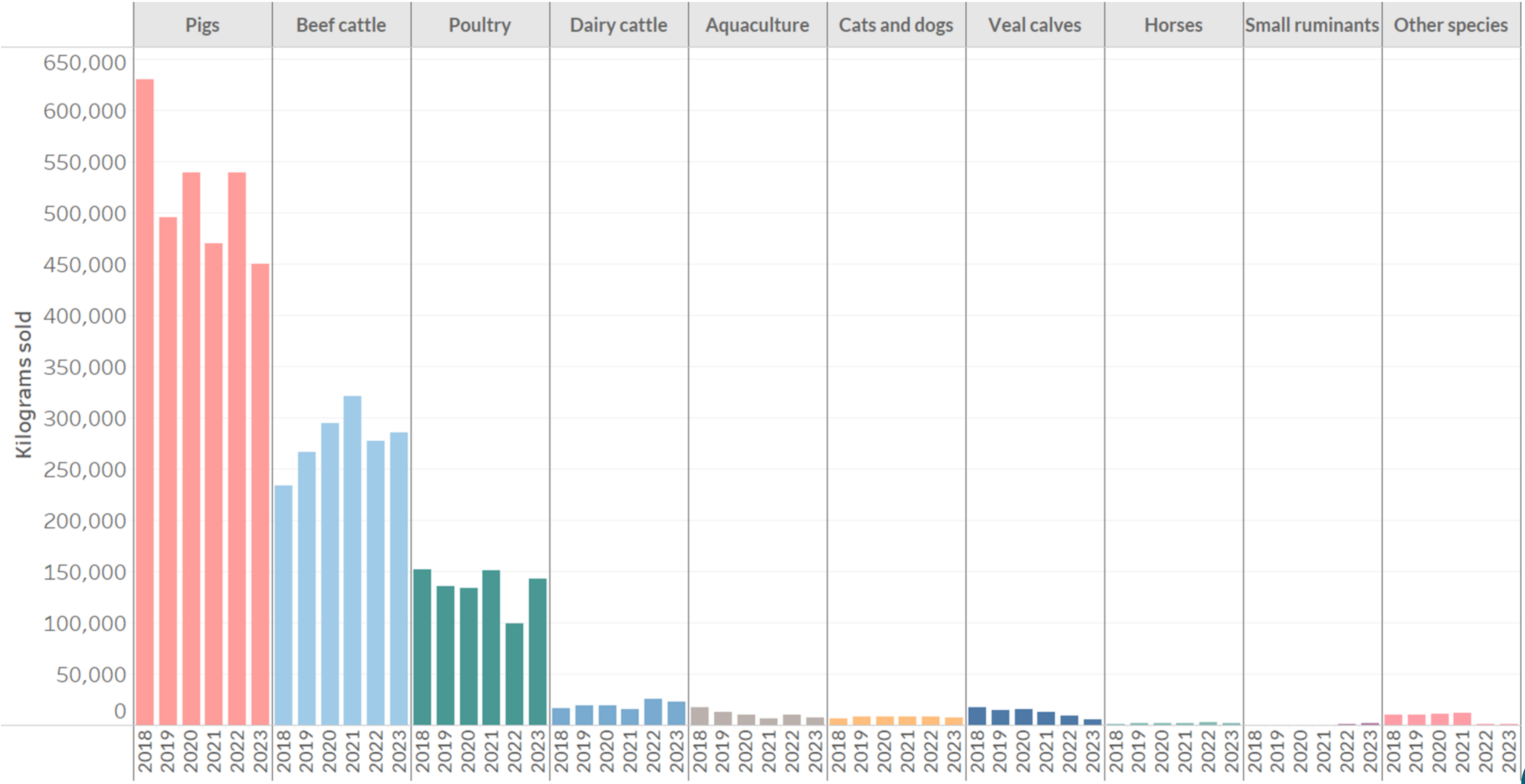
VETERINARY ANTIMICROBIAL SALES REPORTING SYSTEM (VASR)

Poultry

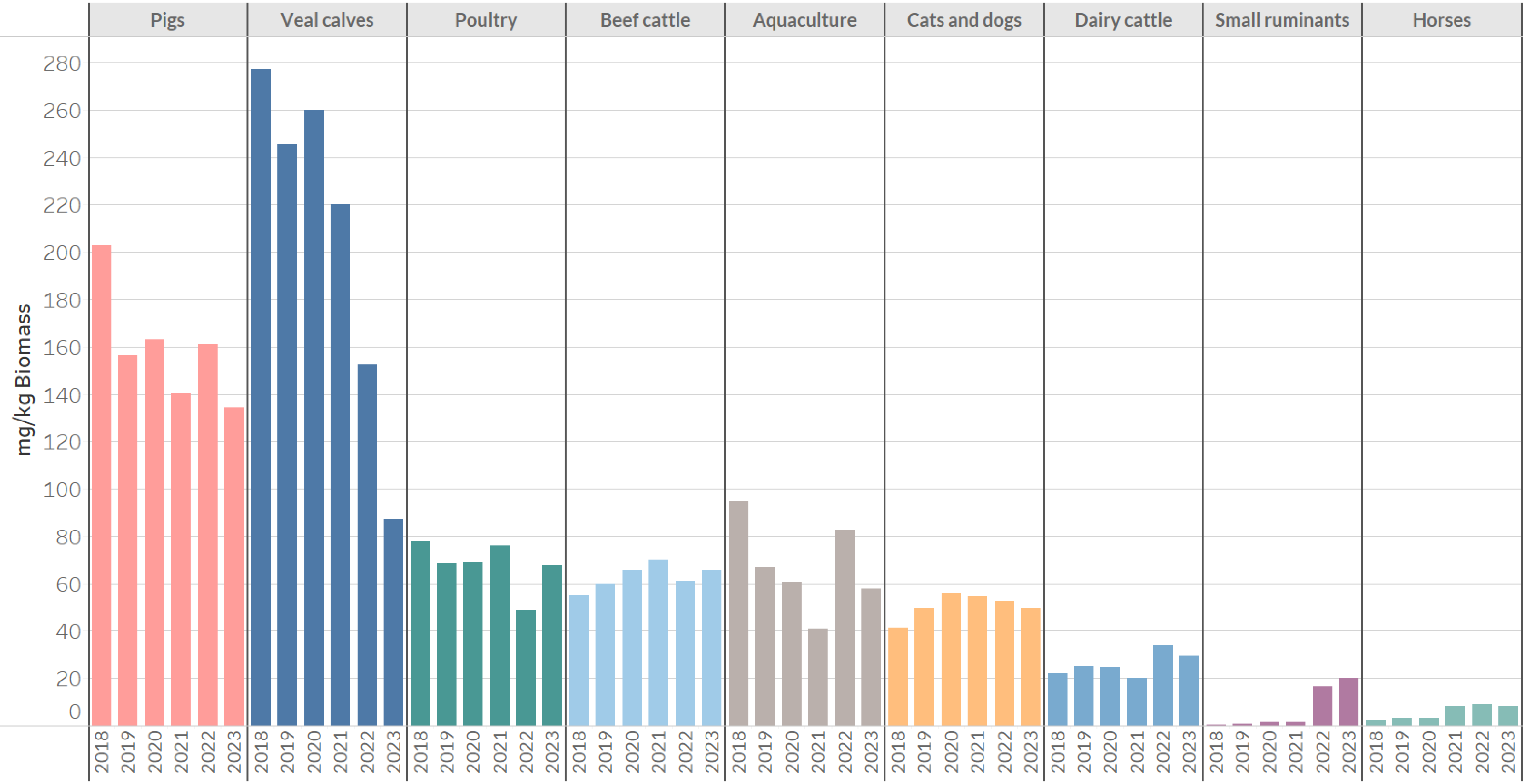
Public Health Agency of Canada
Agence de la santé publique du Canada

Canada

In kg, reported sales are primarily for pigs, beef cattle, and poultry



After adjusting for biomass, sales (in 2023) were primarily for pigs, veal calves, poultry, beef cattle, and aquaculture



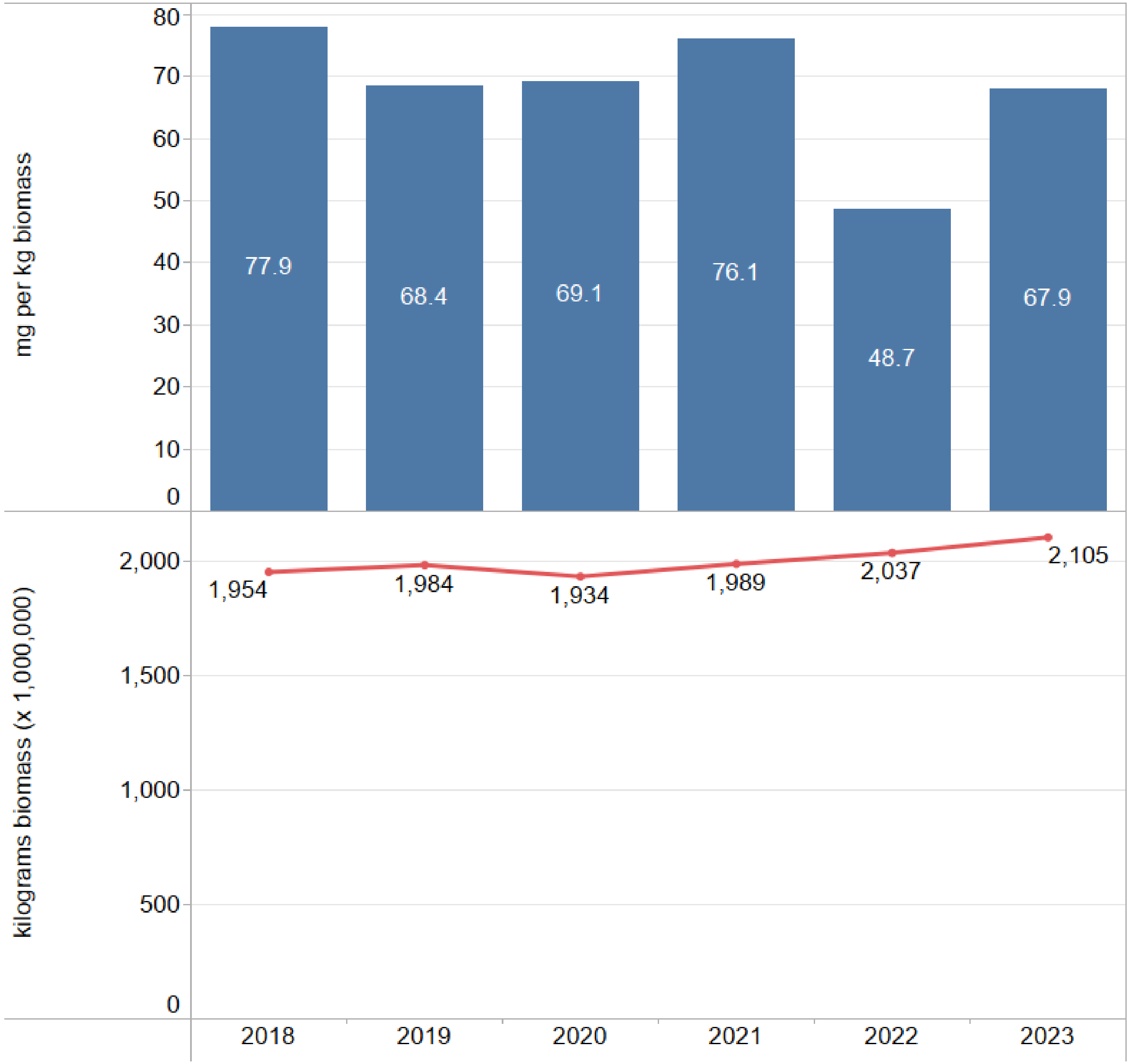
Poultry

While sales have fluctuated (especially in 2022), the overall trend has been stable since 2019 (less than 1% decrease).

There has been a slight increase in the biomass of poultry produced since 2018.

There are small quantities of antimicrobials compounded for use in poultry each year, including Category I antimicrobials.

- In 2023, there was a considerable increase in the quantity of trimethoprim-sulfas compounded for use in water.



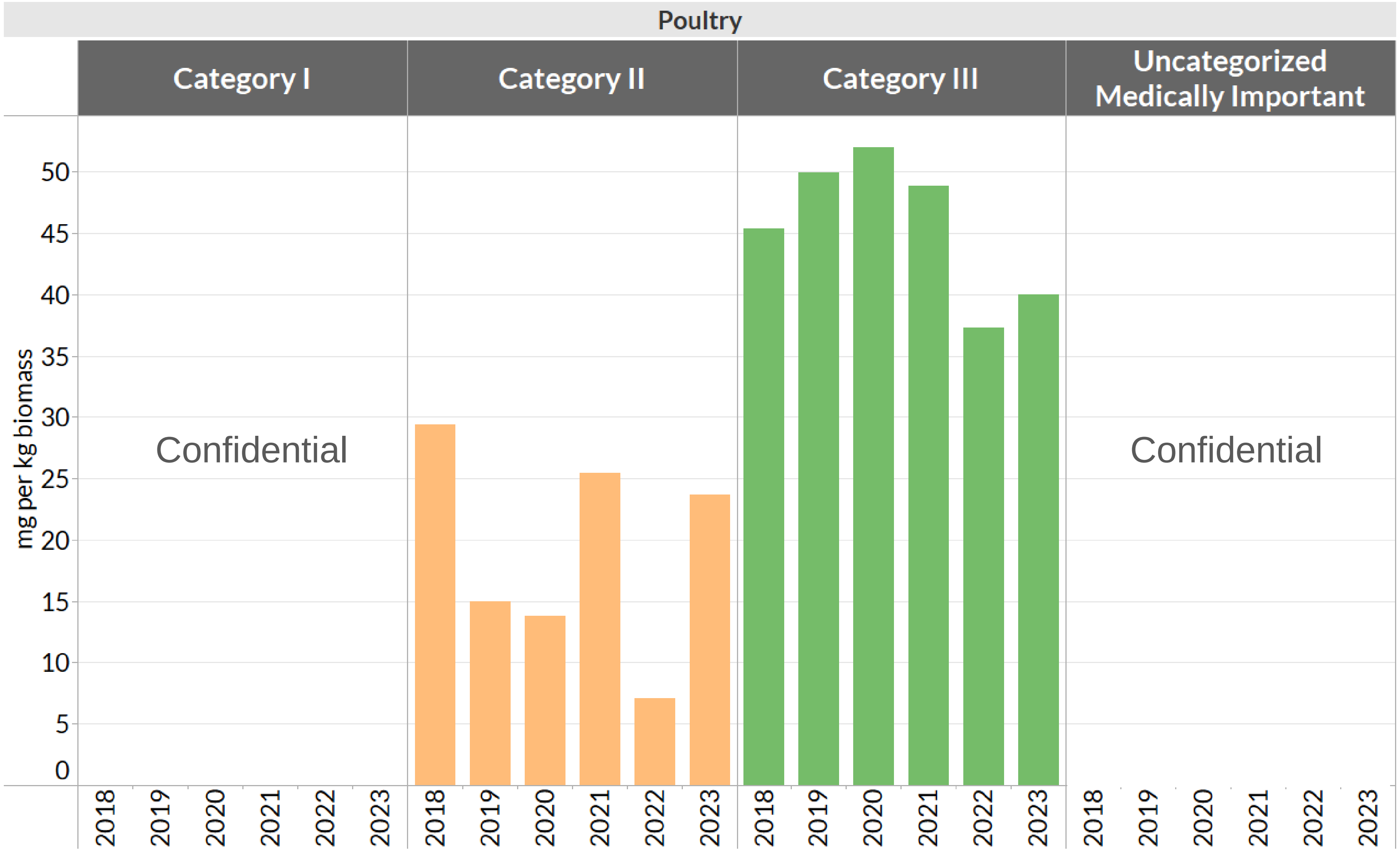
Poultry

Sales for poultry are primarily Category II and III antimicrobials.

- The top class sold is bacitracins.
- In 2023 the next highest classes included macrolides, penicillins, orthosomycins and TMS

There have been no Category I antimicrobial sales by manufacturers and importers since 2018.

Sales are primarily for use in feed, followed by water.



*Uncategorized medically important antimicrobial sales not shown due to confidentiality

Take away messages

- **AMR in Gram-negative organisms:**
  - Resistance to Category I antimicrobials in *E. coli* and *Salmonella* across poultry species persisted; increased ciprofloxacin non susceptible *Salmonella* in chicken abattoir isolates.
  - High-level ciprofloxacin resistance in *Campylobacter* across poultry commodities; increased in turkeys and layers between 2022 and 2023.
- **AMR in Gram-positive organisms in relation to antimicrobials intended for necrotic enteritis:**
  - Low-level resistance to avilamycin found in *Enterococcus* from broilers and turkeys but not in layers; avilamycin was not reportedly used in layers.
  - Proportion of *Clostridium perfringens* with decreased susceptibility to bacitracin was very high in broiler chickens and found at moderate to high levels in turkey and layer isolates, respectively. All poultry species reportedly used bacitracin. Further analysis is ongoing.
- **Antimicrobial sales (VASR):** poultry sales increased between 2022 and 2023, corresponding with the same trend observed at the farm level (broiler chickens and turkeys).
- **Broiler breeders:** Has potential role in the ecology of AMR in poultry (contamination along the food production continuum). Whole genome sequencing is underway.

Acknowledgement

- Producers and veterinarians, participating abattoirs
- CIPARS and FoodNet Canada Farm Working Group
- Provincial and national poultry marketing boards
- Saskatchewan Agriculture
- Research collaborators and funding sources
  - Canadian Poultry Research Council, Canadian Hatching Egg Producers, and University of Montréal/Dr. Martine Boulianne (Broiler breeder project).
  - Chicken Farmers of Canada, Animal Health Laboratory - University of Guelph, Elanco/Thermo-Fisher
- Health Canada
- Canadian Food Inspection Agency
- Other partners and collaborators providing support to CIPARS

Where can I find more information

- CIPARS Interactive data visualizations

https://www.canada.ca/en/public-health/services/surveillance/canadian-integrated-program-antimicrobial-resistance-surveillance-cipars/interactive-data.html

- CARSS Interactive data visualizations

https://health-infobase.canada.ca/carss/amu/results.html?ind=06

- CIPARS publication's webpage

https://www.canada.ca/en/public-health/services/surveillance/canadian-integrated-program-antimicrobial-resistance-surveillance-cipars/publications.html

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