While we meet on a virtual platform, we acknowledge the Indigenous Peoples, who traditionally resided on all the lands that we are on today. From coast to coast, to coast, we acknowledge the ancestral territories of all the First Nations, Inuit, and Métis peoples across the country. We do this as a reminder as public servants of our commitments and responsibility in addressing the lasting impacts of colonization in Indigenous communities, especially the public health inequities experienced by Indigenous Populations. I ask that you take a moment to reflect on the traditional territory where you reside.

The Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)

CIPARS Integrated and Key findings

Presented by Dr. Ashley Cormier, PhD

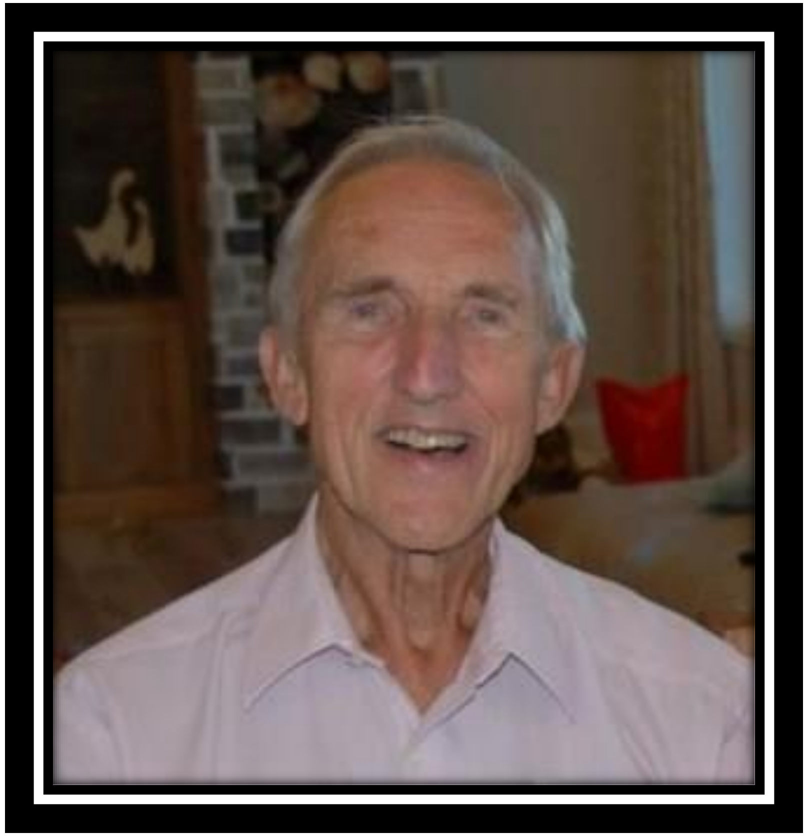
World Antimicrobial Resistance Awareness Week
November 19th, 2024

Canada

In Memoriam

Dr. Lloyd Joseph Weber

May 13, 1944 – July 8, 2024



Dr. Stewart John Ritchie

June 4, 1958 – May 2, 2023

Dr. Weber and Dr. Ritchie contributed their expertise during the development of the farm program (poultry) and advocated to their producers and industry networks the importance of public health, stewardship of AMU and AMR. To this day, their practices continue to support the farm program.

Housekeeping

New Presentation Format!

Integrated and Key Findings presentation: 45 minutes + questions
Component-specific presentations to follow:

Grower-finisher Pigs with Dr. Angie Bosman
Poultry with Dr. Agnes Agunos
Feedlot Cattle with Dr. Sheryl Gow
Dairy Cattle with Dr. Daniella Rizzo
Human *Salmonella/Campylobacter* with Dr. Melissa MacKinnon

Topics may include, but are not limited to:

- Reasons for AMU
- Detailed AMR and AMU data and trends
- Animal health
- *Enterococcus* data
- Molecular findings

Housekeeping

Presentation link

All presentations (FR/EN) can be found at:
https://cahss.ca/cahss-tools/document-library

- The Canadian Animal Health Surveillance System AMU/AMR Network has also developed several guidance documents on antimicrobial use reporting that can be found at https://cahss.ca/cahss-networks/amuamr

Comments and Questions

- Comments/questions (FR/EN) will be taken at the end of the presentation
- Please mute until the question period begins

Survey/Poll

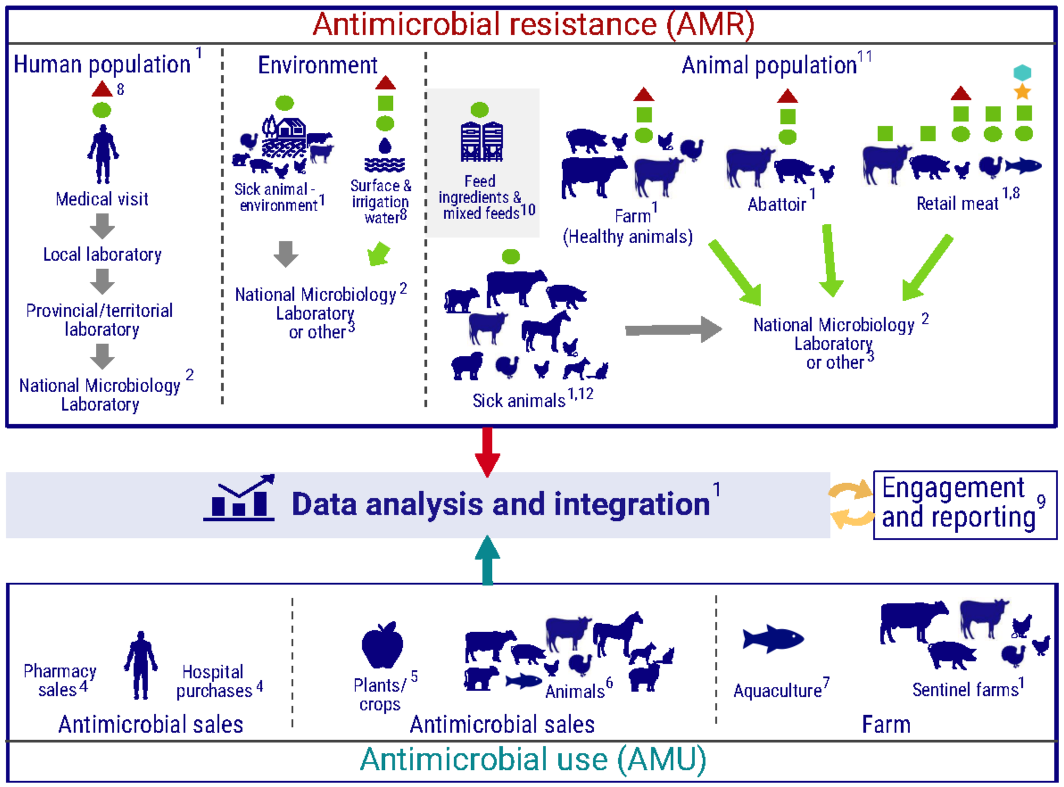
- Please use the link in the chat to access the survey
- All responses are anonymous!

Agenda

- CIPARS Activities
- 2023 Integrated and Key Findings
- Interactive Data
- Summary
- Discussion
- Component-specific Sessions

CIPARS

Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)



1 Centre for Foodborne and Environmental and Zoonotic Infectious Diseases (CFEZID), Infectious Diseases and Vaccination Programs Branch (IDVPB), Public Health Agency of Canada (PHAC)
2 Bacterial Pathogens, AMR and Wastewater Division and Division of Enteric Diseases, National Microbiology Laboratory Branch, PHAC
3 Provincial animal health laboratory, university laboratory or private laboratory
4 Canadian Antimicrobial Resistance Surveillance System (CARSS), PHAC. Data source: IQVIA
5 Pest Management Regulatory Agency, Health Canada
6 Veterinary Antimicrobial Sales Reporting (VASR), Veterinary Drugs Directorate, Health Canada and CFEZID, PHAC
7 Fisheries and Oceans Canada
8 FoodNet Canada, CFEZID, IDVPB, PHAC
9 CIPARS engagement and reporting including: Annual Stakeholder Webinars, Integrated Findings Reports, Data Visualizations, Farm Surveillance Technical Reports (including health and biosecurity data), Fact sheets, Infographics, Journal publications, VASR Highlights Reports, and CARSS Reports
10 Canadian Food Inspection Agency (CFIA)
11 Laboratory analysis reporting of *Clostridium perfrigens*, *Enterococcus* spp., and bovine respiratory pathogens occurs for select years and species
12 AMRNet-Vet shares data for bovine respiratory disease bacterial pathogens

➡ Active surveillance
➡ Passive surveillance
➡ AMR data
➡ AMU data
⇄ Communication
▲ *Campylobacter*
■ *Escherichia coli*
● *Salmonella*
⬢ *Aeromonas*
★ *Vibrio*

CIPARS is led by the Public Health Agency of Canada in conjunction with multiple federal departments and relevant parties.

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

Antimicrobial Categorization*

Antimicrobials are grouped into categories based on their importance to human medicine

Medically important antimicrobials

Category I: Very high importance

Examples: 3rd generation cephalosporins, fluoroquinolones

Category II: High importance

Example: macrolides

Category III: Medium importance

Examples: tetracyclines, sulfonamides

Category IV: Low importance

Example: ionophores

*Categorization system developed by Health Canada’s Veterinary Drugs Directorate

Chemical coccidiostats are considered out of scope of medically important antimicrobials. Uncategorized medically important antimicrobials include pleuromutilins, orthosomycins, coumarins and pseudomonic acids

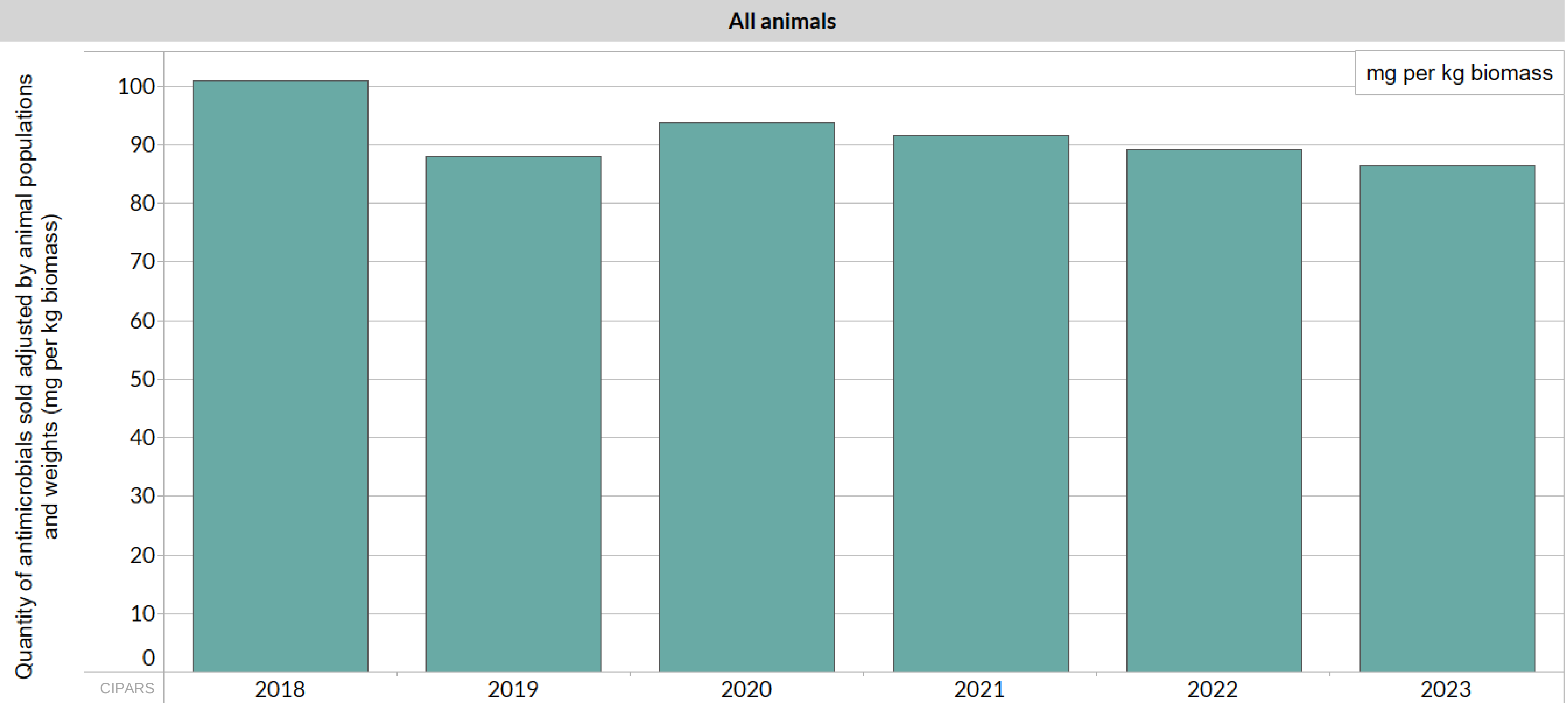
Categorization of antimicrobials: https://www.canada.ca/en/health-canada/services/drugs-health-products/veterinary-drugs/antimicrobial-resistance/categorization-antimicrobial-drugs-based-importance-human-medicine.html
List of certain antimicrobial active pharmaceutical ingredients: https://www.canada.ca/en/public-health/services/antibiotic-antimicrobial-resistance/animals/veterinary-antimicrobial-sales-reporting/list-a.html

Integrated Antimicrobial Sales

Veterinary Antimicrobial Sales Reporting (VASR)

Integrated AMU: Veterinary Antimicrobial Sales Reporting

After accounting for the number of animals and their weights using an average weight at treatment (mg/kg biomass), there was a **14% decrease** in the quantity of medically important antimicrobials sold for use in **all animals since 2018** and a **3% decrease** in the quantity sold **since 2022**.

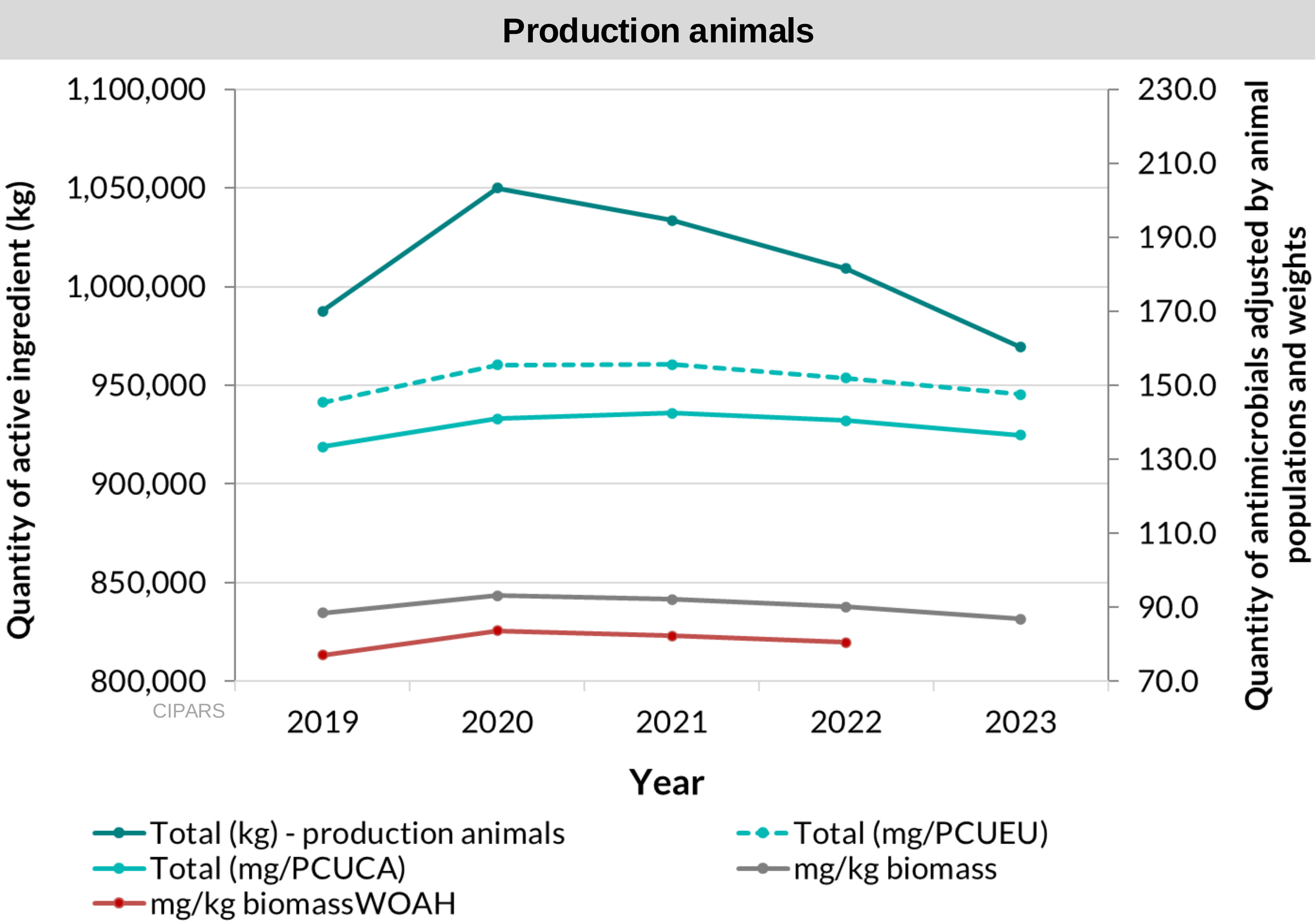


Integrated AMU: Veterinary Antimicrobial Sales Reporting

While the quantity of antimicrobials sold for use in animals has decreased since 2018, sales have plateaued since 2019.

There was only a 2% difference between antimicrobial sales in 2019 and antimicrobial sales in 2023.

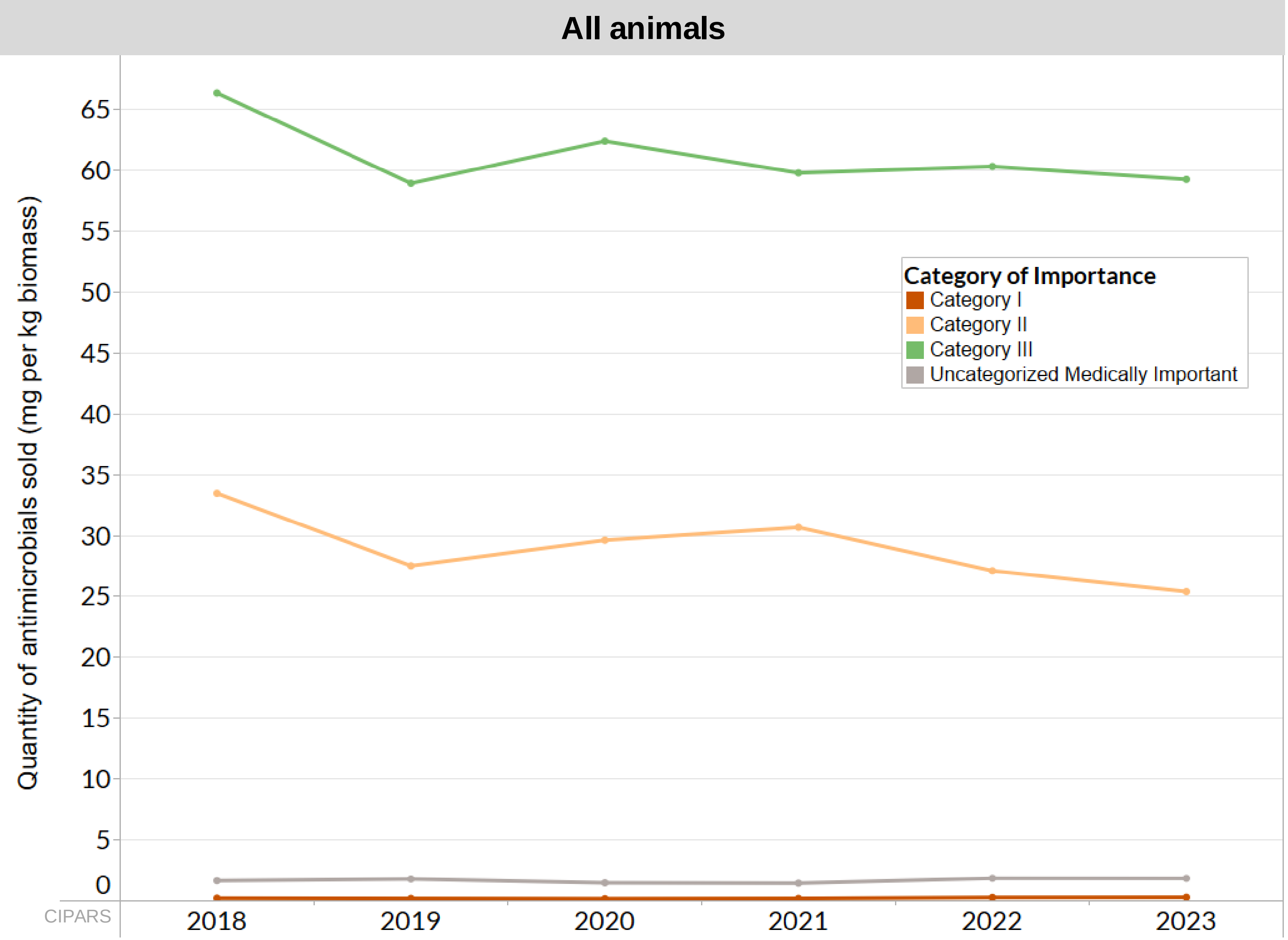
Regardless of the indicator used, the trends in the quantity of antimicrobial sales were similar.



Integrated AMU: Veterinary Antimicrobial Sales Reporting

The majority of antimicrobials sold since data collection began in VASR in 2018 were Category II and III.

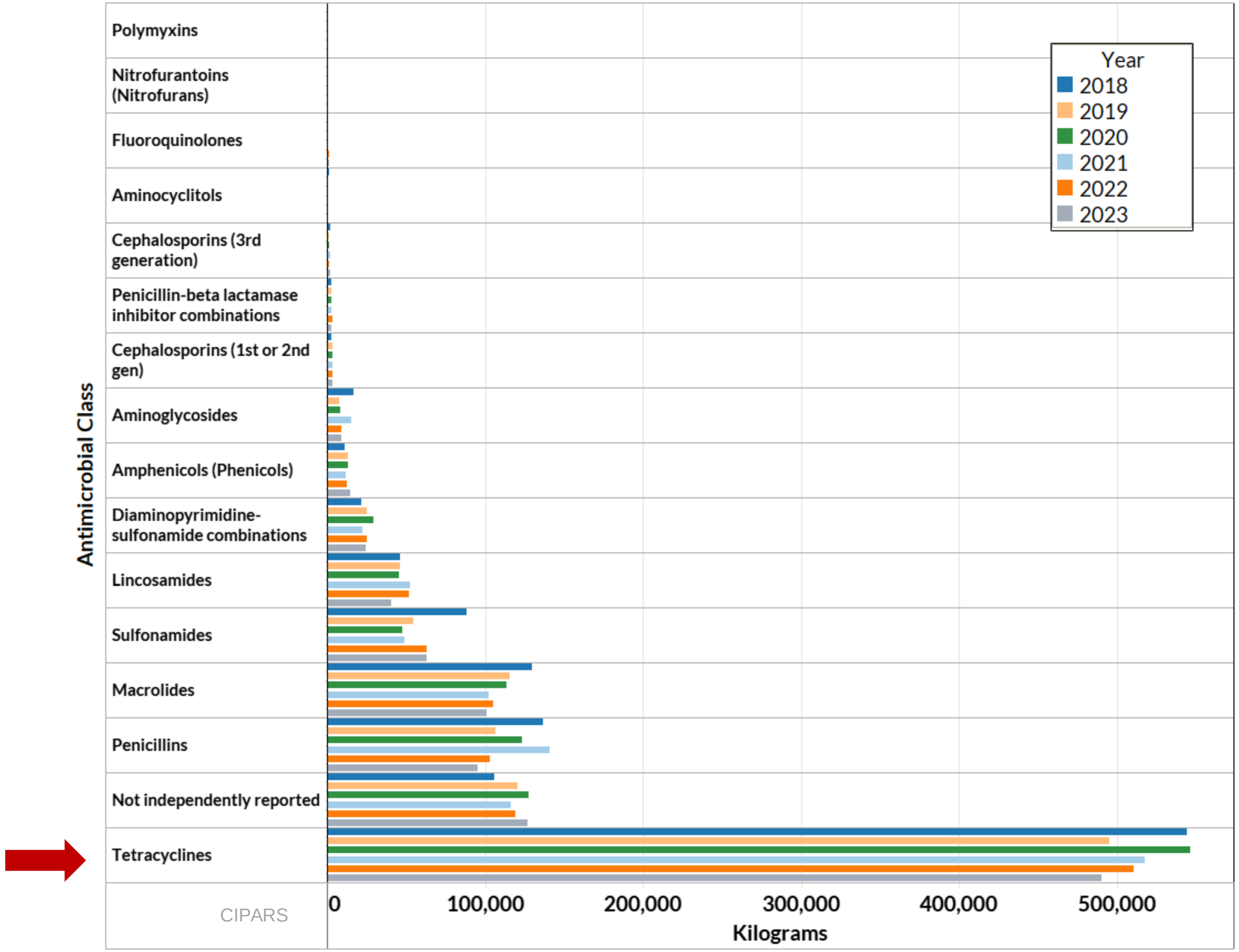
- **Less than 1%** of antimicrobials sold annually were **Category I**
- Between 2022 and 2023, Category I antimicrobial sales for production animals (adjusted by animal biomass) **increased by 5%**
- Category I antimicrobial sales increased since 2020



https://www.canada.ca/en/health-canada/services/drugs-health-products/veterinary-drugs/antimicrobial-resistance/categorization-antimicrobial-drugs-based-importance-human-medicine.html

Integrated AMU: Veterinary Antimicrobial Sales Reporting

Tetracyclines had the highest quantity of antimicrobial sales, followed by macrolides, penicillins, and bacitracins



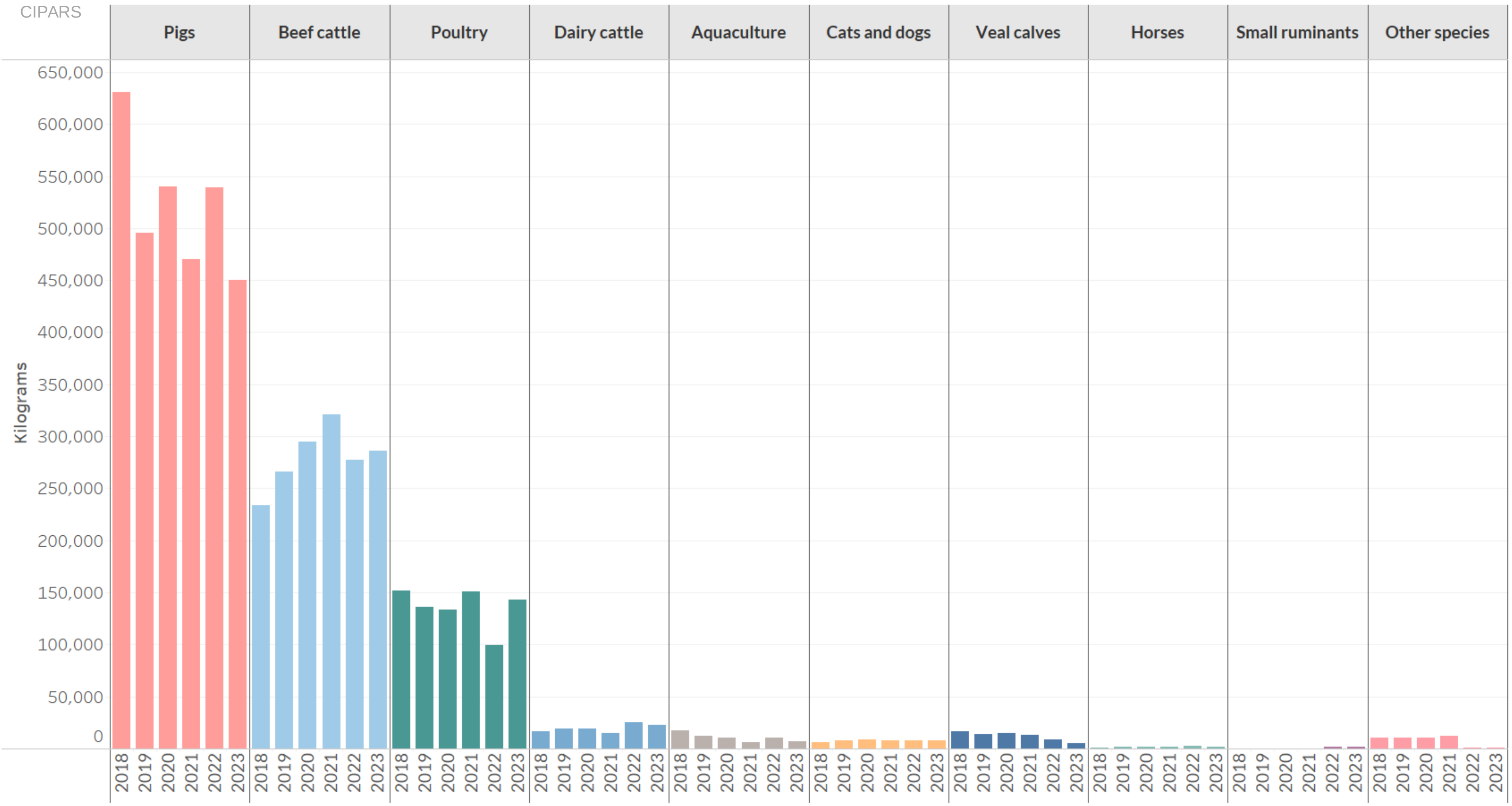
Kilograms of antimicrobials sold for use in all animals (manufacturers and importers) (unadjusted)

- Depending on the year, 40-60% of tetracycline sales were for pigs, and 40-50% were for beef cattle, primarily for use in feed

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

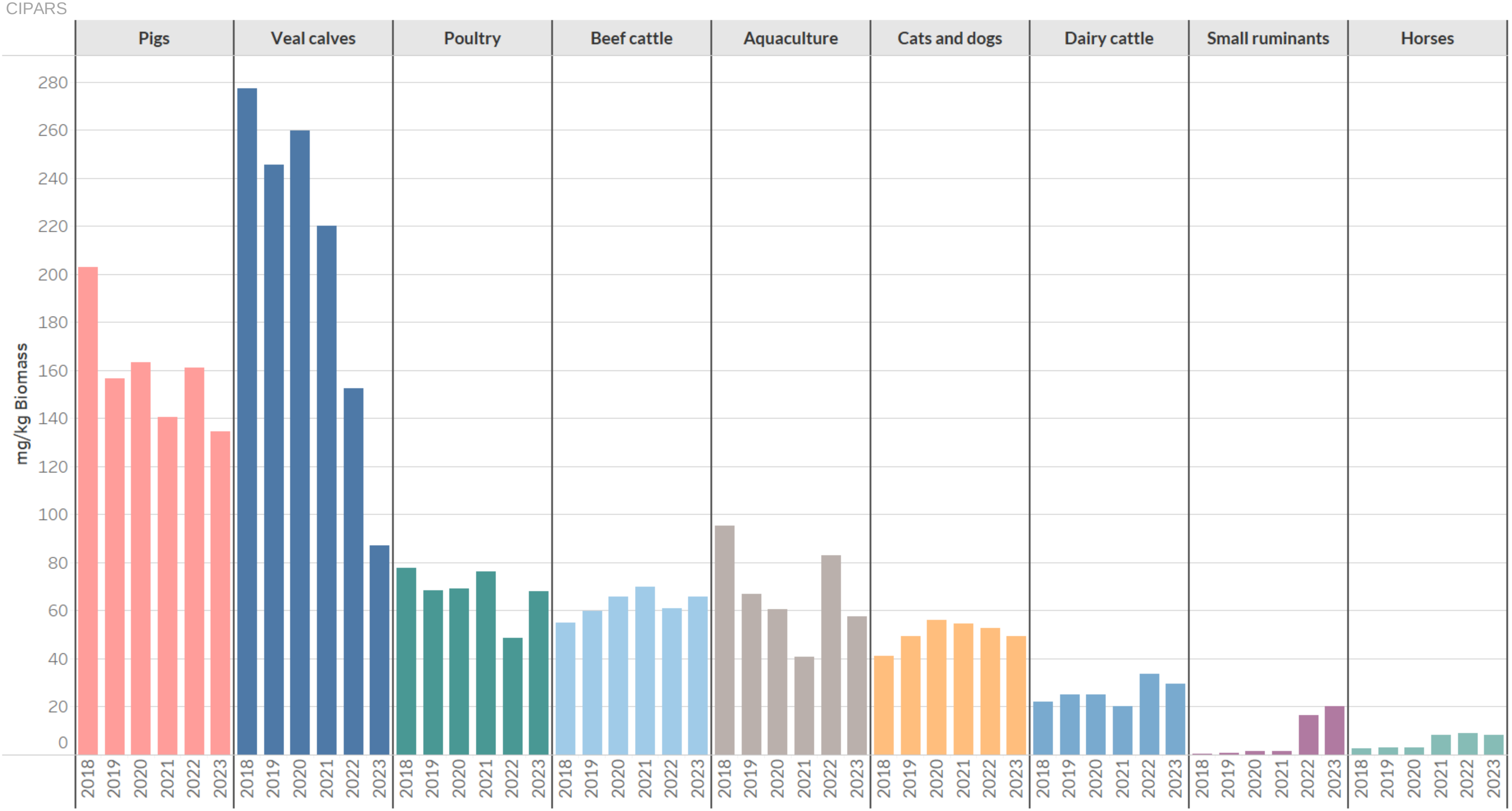
Integrated AMU: Veterinary Antimicrobial Sales Reporting

In kilograms (unadjusted), the majority of antimicrobial sales in 2023 were intended for use in pigs, beef cattle, and poultry



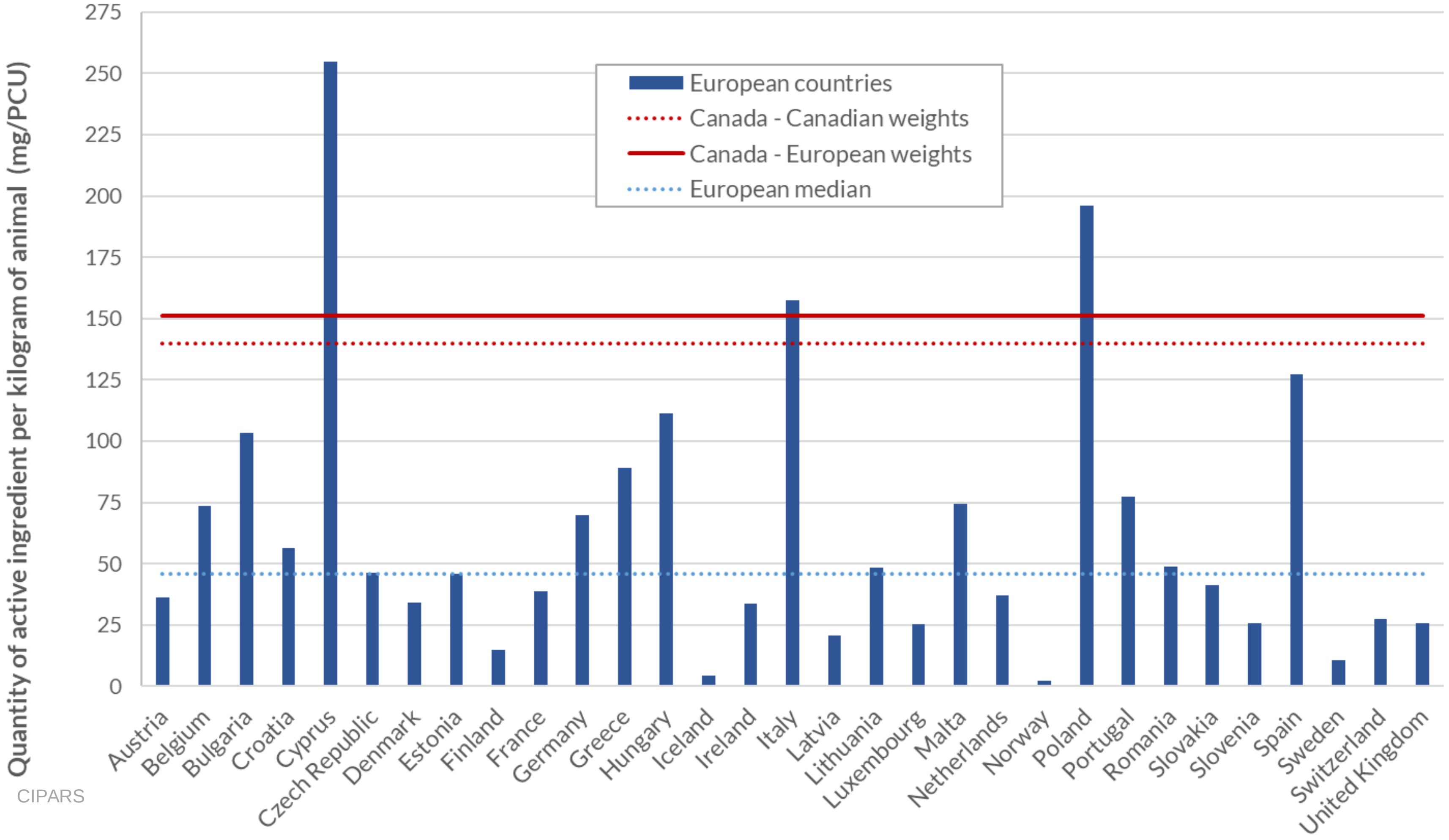
Integrated AMU: Veterinary Antimicrobial Sales Reporting

After adjusting for biomass, the majority of antimicrobial sales in 2023 were intended for use in pigs, veal calves, poultry, beef cattle, aquaculture, and cats and dogs



Integrated AMU: VASR and European Surveillance of Veterinary Antimicrobial Consumption

Antimicrobial sales in Canada plateaued; EU antimicrobial sales decreased overall. Canada's ranking relative to the EU has not improved.



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*US data are not included due to absence of comparable indicator

In 2021, Canada ranked 6th highest.

Canada now ranks <u>**4th**</u> highest in comparison with Europe (2022).

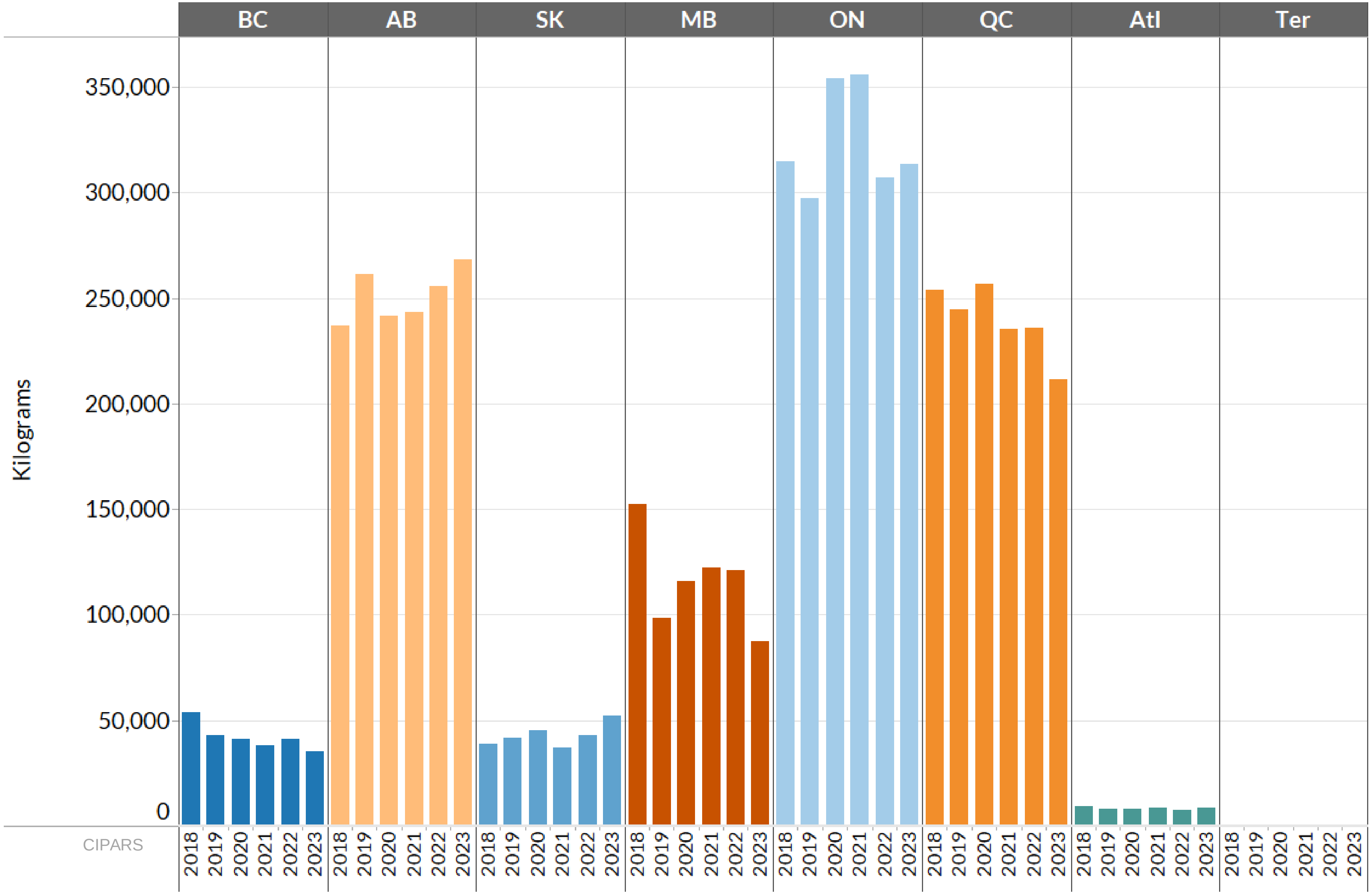
Production animals only

Canada:
mg/PCU$_{CA}$ – 140
mg/PCU$_{EU}$ – 151

European median:
mg/PCU – 45.8

European data sources:
European database of sales of veterinary antimicrobial agents - https://esvacbi.ema.europa.eu/analytics/saw.dll?PortalPages
Thirteenth ESVAC report - https://www.ema.europa.eu/en/documents/report/sales-veterinary-antimicrobial-agents-31-european-countries-2022-trends-2010-2022-thirteenth-esvac-report_en.pdf

Integrated AMU: Veterinary Antimicrobial Sales Reporting

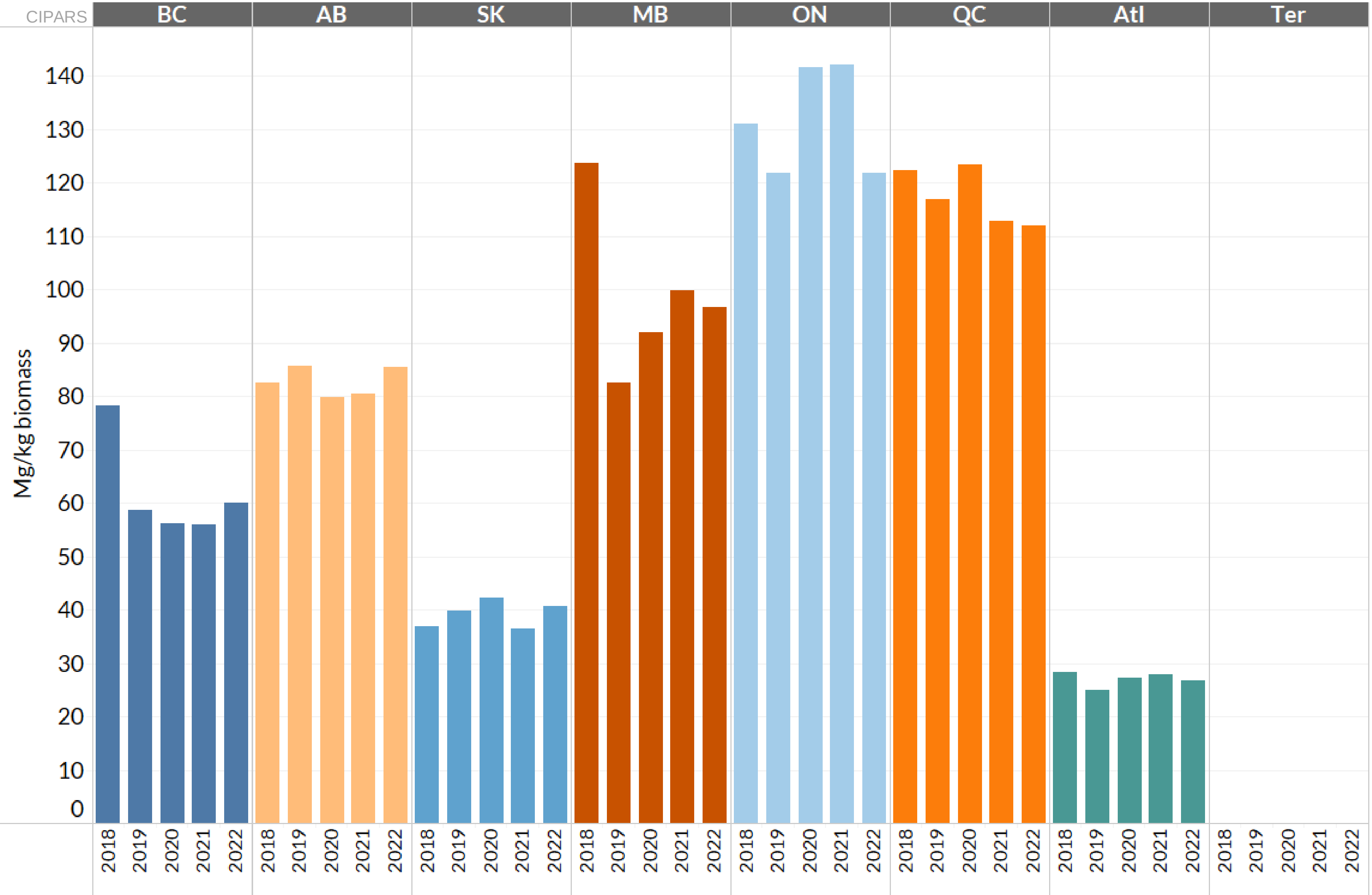


We see the most antimicrobial sales where there are the most animals

In kilograms (unadjusted), antimicrobial sales were primarily in Ontario, Québec, and Alberta.

Integrated AMU: Veterinary Antimicrobial Sales Reporting

NEW!



We see the most antimicrobial sales where there are the most animals

When we adjust for the biomass of animals in each province, sales of antimicrobials in Manitoba and British Columbia become more prominent.

**2023 provincial biomass adjusted sales data are pending*

Integrated AMU: Veterinary Antimicrobial Sales Reporting

In 2023:

CIPARS

Unadjusted (kg only):

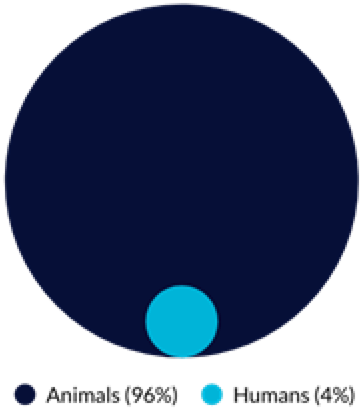
78% Production animals

19% Humans

2% Crops

< 1% Cats and Dogs

~ **22x** **more animals** than people in Canada



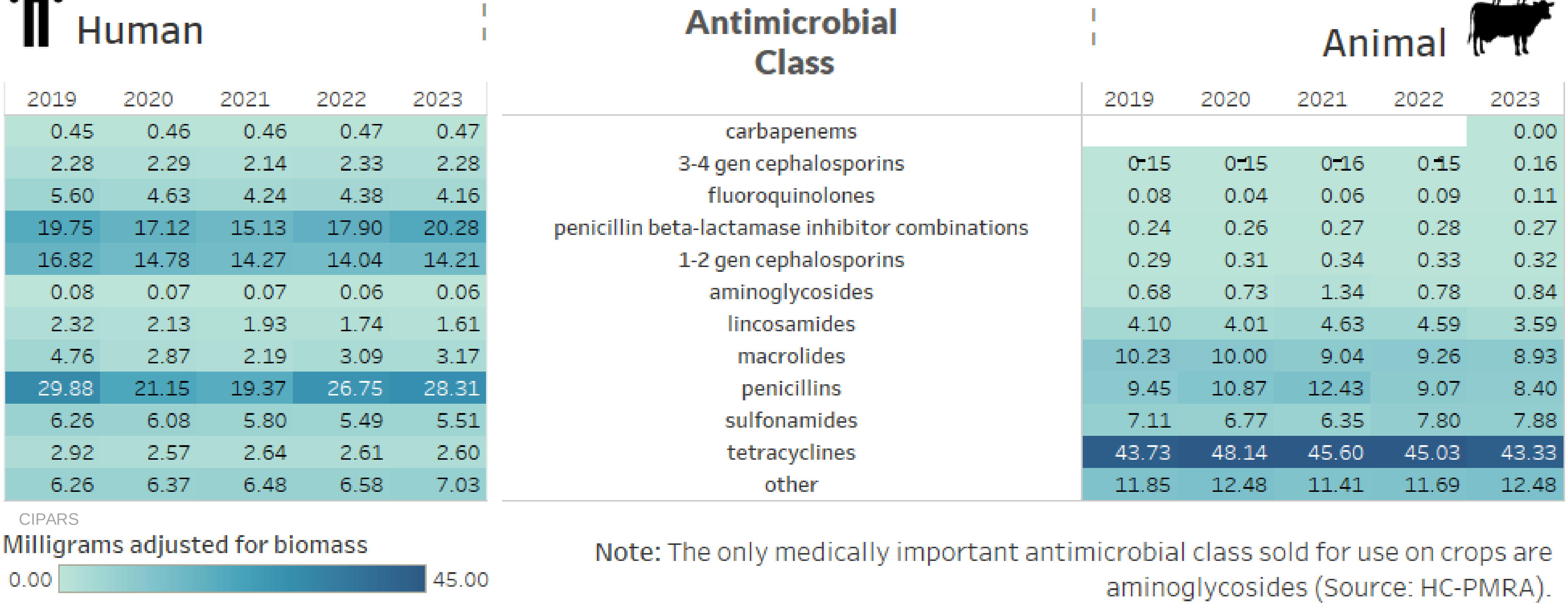
~1.5x

More medically important antimicrobials were sold for use in animals (**all**) than for use in all people **after adjusting for underlying biomass**

Data sources:
Human hospital purchases and community pharmacy dispensations: CARSS (IQVIA); Crops: Health Canada's Pest Management Regulatory Agency (HC-PMRA);
Human population: Statistics Canada

Integrated AMU: Veterinary Antimicrobial Sales Reporting

There was a different spectrum of antimicrobials sold for use in animals compared to people



Human					Antimicrobial Class	Animal				
2019	2020	2021	2022	2023		2019	2020	2021	2022	2023
0.45	0.46	0.46	0.47	0.47	carbapenems					0.00
2.28	2.29	2.14	2.33	2.28	3-4 gen cephalosporins	0.15	0.15	0.16	0.15	0.16
5.60	4.63	4.24	4.38	4.16	fluoroquinolones	0.08	0.04	0.06	0.09	0.11
19.75	17.12	15.13	17.90	20.28	penicillin beta-lactamase inhibitor combinations	0.24	0.26	0.27	0.28	0.27
16.82	14.78	14.27	14.04	14.21	1-2 gen cephalosporins	0.29	0.31	0.34	0.33	0.32
0.08	0.07	0.07	0.06	0.06	aminoglycosides	0.68	0.73	1.34	0.78	0.84
2.32	2.13	1.93	1.74	1.61	lincosamides	4.10	4.01	4.63	4.59	3.59
4.76	2.87	2.19	3.09	3.17	macrolides	10.23	10.00	9.04	9.26	8.93
29.88	21.15	19.37	26.75	28.31	penicillins	9.45	10.87	12.43	9.07	8.40
6.26	6.08	5.80	5.49	5.51	sulfonamides	7.11	6.77	6.35	7.80	7.88
2.92	2.57	2.64	2.61	2.60	tetracyclines	43.73	48.14	45.60	45.03	43.33
6.26	6.37	6.48	6.58	7.03	other	11.85	12.48	11.41	11.69	12.48

CIPARS

Milligrams adjusted for biomass

0.00 – 45.00

Note: The only medically important antimicrobial class sold for use on crops are aminoglycosides (Source: HC-PMRA).

Animal = food animals, horses, and cats and dogs

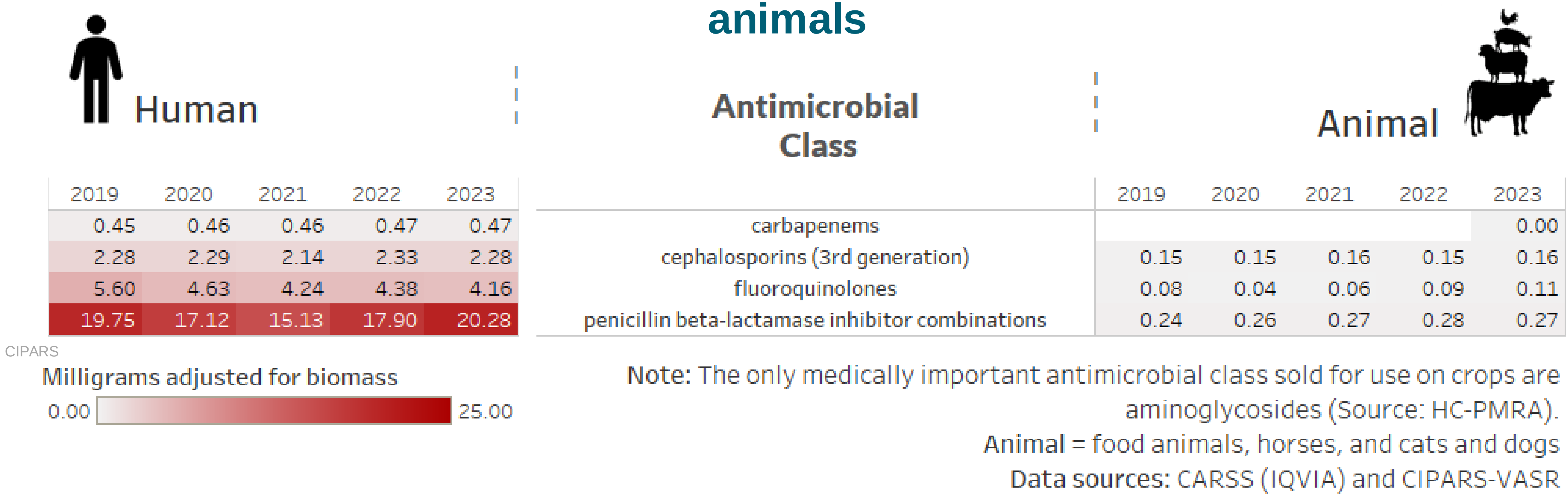
Data sources: CARSS (IQVIA) and CIPARS-VASR

Others for **humans** includes: bacitracins, 5th generation cephalosporins, fosfomycins, fusidic acid, glycopeptides, lipopeptides, monobactams, nitrofurans, nitroimidazoles, oxazolidinones, phenicols, and polymyxins.

Others for **animals** includes: aminocoumarins, aminocyclitols, amphenicols, β-lactamase inhibitors, cyclic polypeptides, fusidic acid, glycopeptides, nitrofurantoins, nitroimidazoles, orthosomycins, phosphonic acid derivatives, pleuromutilins, polymyxins, pseudomonic acids, streptogramins, and therapeutic agents for tuberculosis

Integrated AMU: Veterinary Antimicrobial Sales Reporting

There were more Category I antimicrobials sold for use in humans than in animals



Human 2019	Human 2020	Human 2021	Human 2022	Human 2023	Antimicrobial Class	Animal 2019	Animal 2020	Animal 2021	Animal 2022	Animal 2023
0.45	0.46	0.46	0.47	0.47	carbapenems					0.00
2.28	2.29	2.14	2.33	2.28	cephalosporins (3rd generation)	0.15	0.15	0.16	0.15	0.16
5.60	4.63	4.24	4.38	4.16	fluoroquinolones	0.08	0.04	0.06	0.09	0.11
19.75	17.12	15.13	17.90	20.28	penicillin beta-lactamase inhibitor combinations	0.24	0.26	0.27	0.28	0.27

CIPARS

Milligrams adjusted for biomass

0.00 – 25.00

Note: The only medically important antimicrobial class sold for use on crops are aminoglycosides (Source: HC-PMRA).

Animal = food animals, horses, and cats and dogs

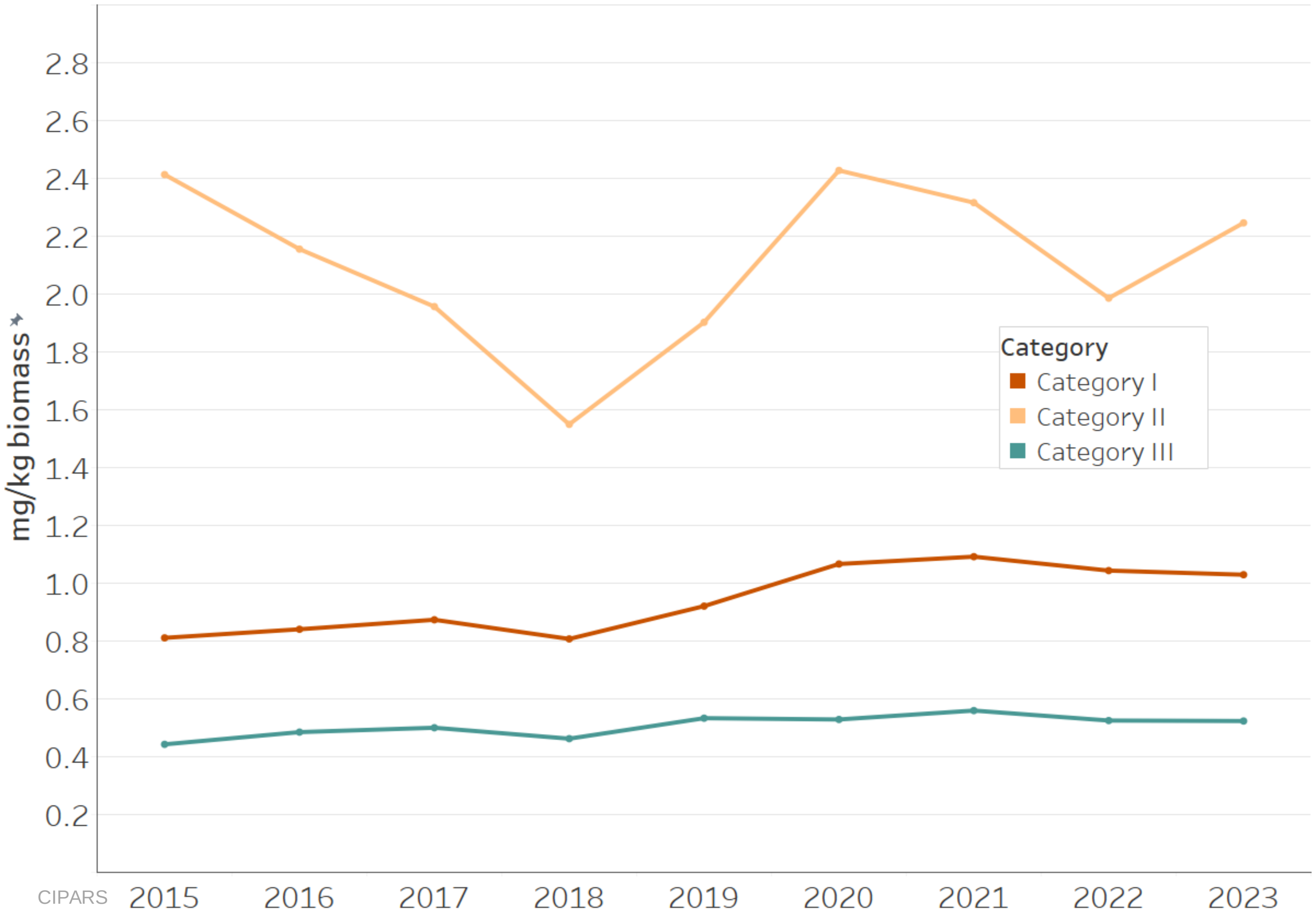
Data sources: CARSS (IQVIA) and CIPARS-VASR

<u>Category I antimicrobials are considered very high importance to human medicine.</u>

*Note the quantity of carbapenems sold for use in animals in 2023 were <0.01 mg/kg biomass. Prior to 2023 there were no reported sales of carbapenems for use in animals.

Integrated AMU: Human Pharmacy Dispensations for Animals

NEW!



The spectrum of antimicrobial classes and routes of administration (largely oral tablets, capsules, or suspensions) suggest that most dispensing for animals at human pharmacies was for cats and dogs.

Between 2015 – 2023:

- Annual dispensing for animals ranged between 440 – 595 kilograms
- Dispensing was proportionally around 7-8% of the total sales for companion animals reported to VASR
- Small quantities of carbapenems were dispensed each year (<0.3 kg annually)
- 27% increase in Category I dispensing since 2015

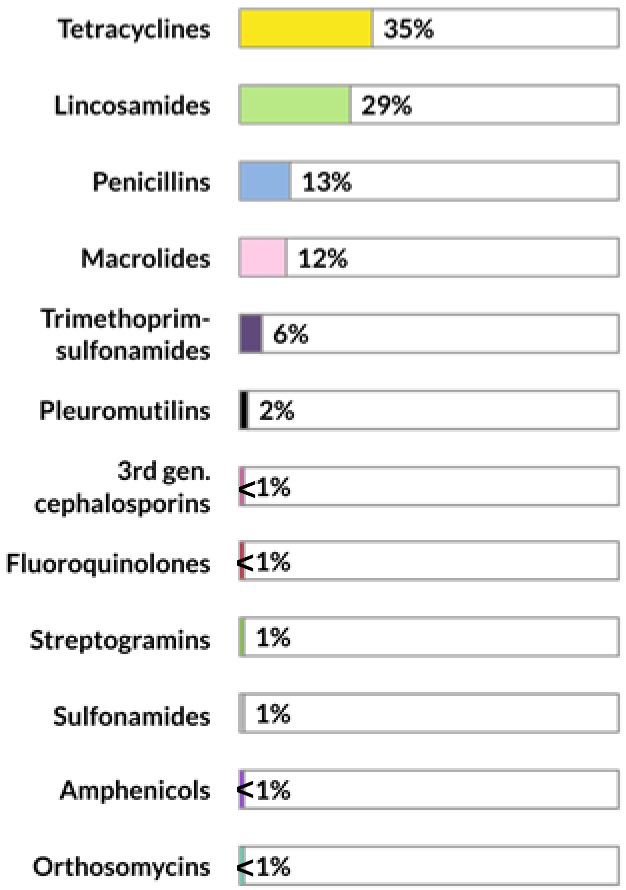
Data sources: CARSS (IQVIA), CAHI (cat and dog population numbers)

Integrated Farm AMU, and AMR at Farm, Abattoir and Retail

Integrated Farm AMU: Top Classes Reported For Use in Animals on Sentinel Farms

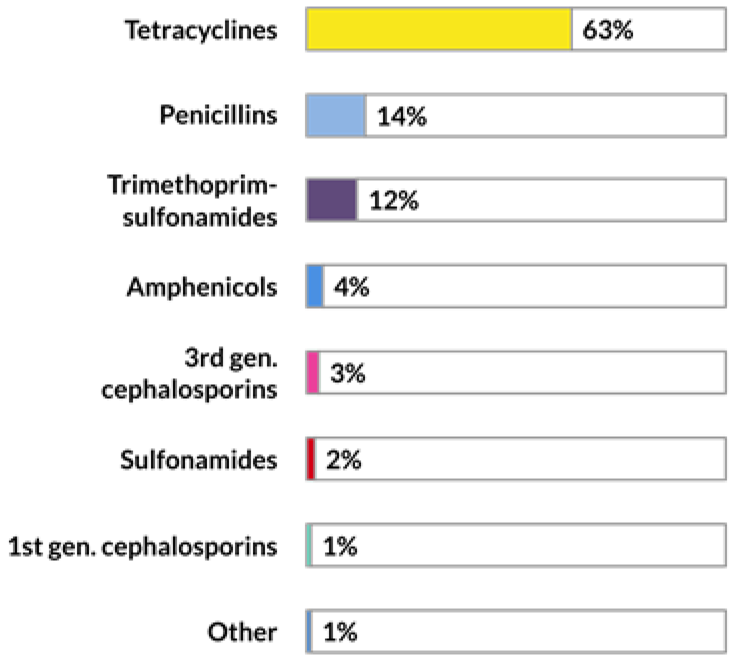
Tetracyclines and penicillins were most consistently seen among the top 3 classes reported for use, across farm components

Grower-finisher Pigs

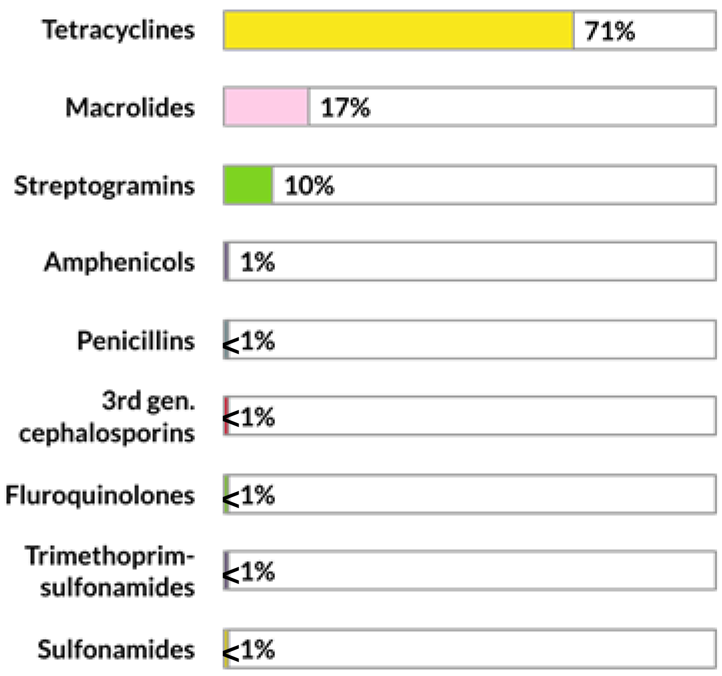


CIPARS

Dairy Cattle

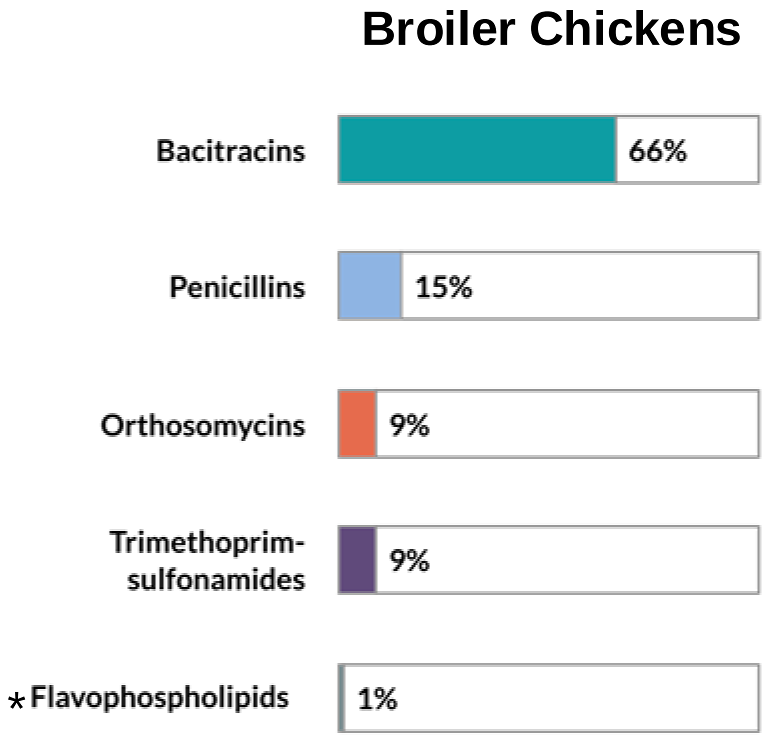


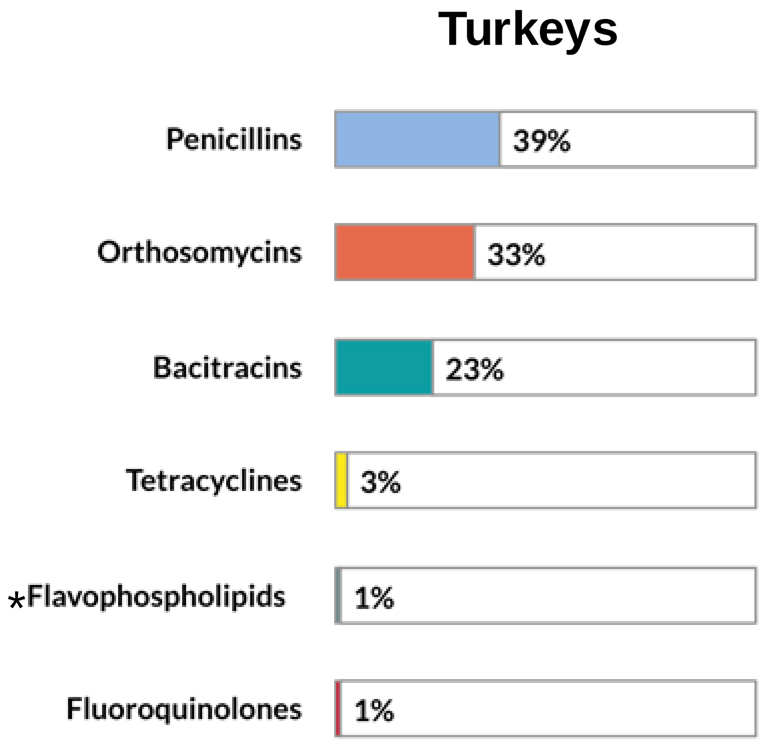
Feedlot Cattle



Integrated Farm AMU: Top Classes Reported For Use in Animals on Sentinel Farms

The top antimicrobial classes reported for use in broiler chickens and turkey were similar, to each other





CIPARS

*Flavophospholipids are reportedly used for the control of enteric diseases in chickens and turkeys.

CIPARS-VASR-DFO: Aquaculture Sales and AMU

The quantity of antimicrobials sold and used nationally in aquaculture in kg and adjusted for population biomass*.

- Sales data (VASR), aquaculture prescription data (DFO), and antimicrobial quantities adjusted for biomass follow similar trends
- A downward trend was noted between 2018 and 2021, followed by a sharp increase in 2022
- Only sales data are currently available for 2023, but seems to resume a downward trend

*Antimicrobial totals do not include anti-parasitic drugs

Broiler Chickens: AMR Surveillance at Farm, Abattoir, and Retail

Bacteria	Indicator	Sampling location	5-year trend	% change since 2019; % in 2023
E. coli	Fully susceptible (%)	Farm	Stable	0%;34%
		Abattoir	Stable	+5%;36%
		Retail	Stable	+3%;41%
	Ciprofloxacin NS (%)	Farm	Stable	0%;9%
		Abattoir	***Increase***	***+9%;15%***
		Retail	Stable	+1%;8%
	Ceftriaxone resistance (%)	Farm	Stable	-3%;4%
		Abattoir	Stable	-1%;2%
		Retail	Stable	-3%;3%
Salmonella	Fully susceptible (%)	Farm	Increase	+20%;56%
		Abattoir	Increase	+11%;46%
		Retail	***Decrease***	***-6%;50%***
	Ciprofloxacin NS (%)	Farm	***Increase***	***+6%;10%***
		Abattoir	***Increase***	***+6%;10%***
		Retail	***Increase***	***+18%;20%***
	Ceftriaxone resistance (%)	Farm	Stable	-1%;7%
		Abattoir	Stable	-4%;4%
		Retail	Stable	<1%;6%
Campylobacter	Fully susceptible (%)	Farm	***Decrease***	***-21%;43%***
		Abattoir	Increase	+12%;55%
		Retail	**Decrease**	**-11%;43%**
	Ciprofloxacin resistance (%)	Farm	***Increase***	***+9%;33%***
		Abattoir	Stable	+5%;30%
		Retail	***Increase***	***+14%;37%***
			% in 2023	**Vancomycin resistance**
Enterococcus	Ciprofloxacin resistance (%)	Farm	1%	VRE not detected
	Avilamycin resistance (%)		5%	
	Erythromycin resistance (%)		37%	
	Tetracycline resistance (%)		54%	
	Quinupristin-dalfopristin resistance (%)		100%	

CIPARS

Fully susceptible

- The proportion of fully susceptible *Campylobacter* **decreased substantially** (-21%) at farm

Ciprofloxacin resistance/non-susceptibility (NS)

- **Moderate increases** among *Salmonella* isolates at farm and retail, *E. coli* and *Salmonella* at abattoir
- Resistant *Campylobacter* was **stable** at abattoir while detection **increased** among farm and retail isolates

Ceftriaxone resistance

- Sustained **low-level resistance**

🔴 ***Unfavourable change > ±5%***

🟡 Change ≤ ±5%

🟢 Favourable change > ±5%

Broiler Chickens: AMU and Resistance to ≥3 Antimicrobial Classes at Farm

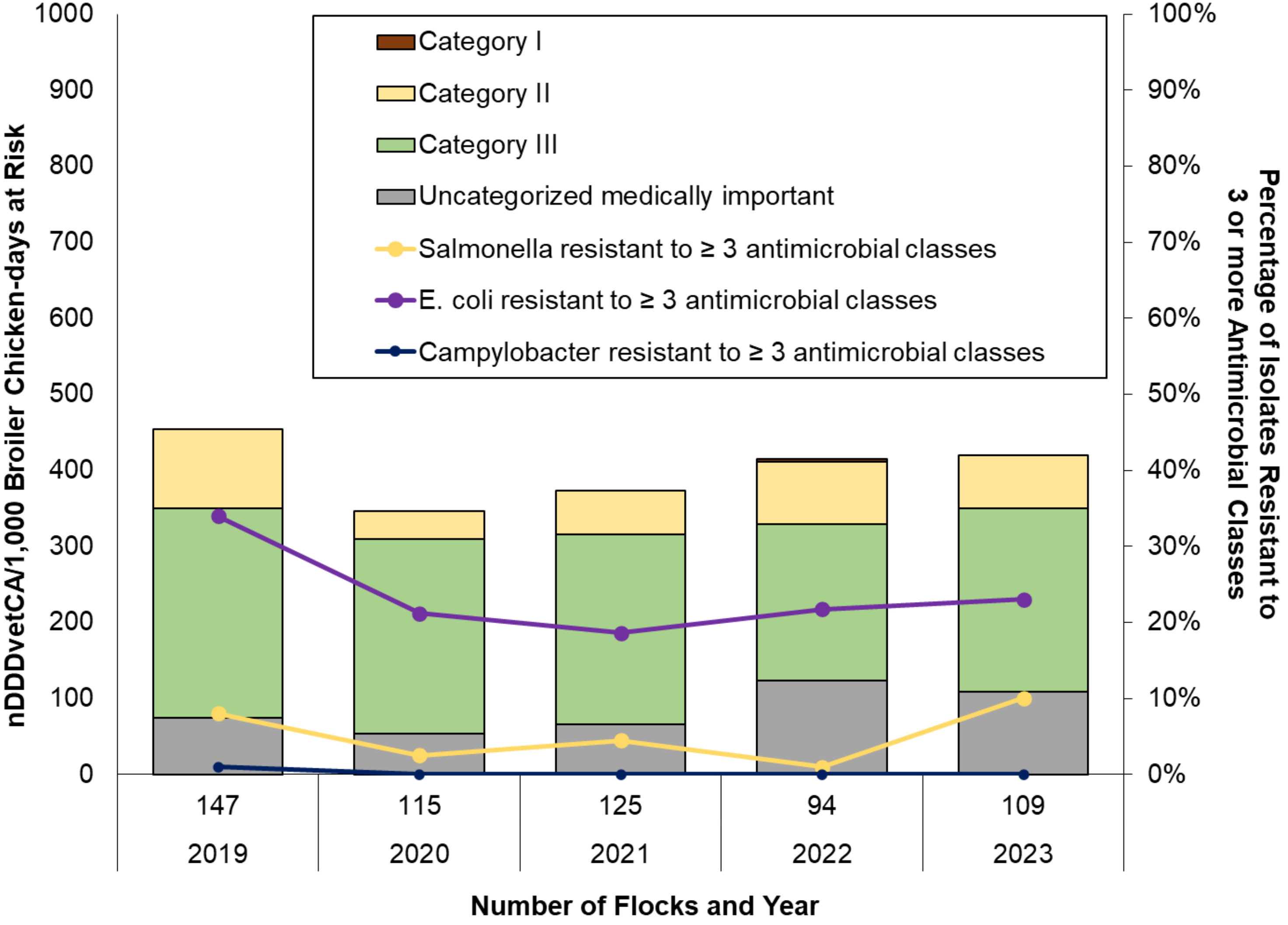
Overall, AMU was stable, and *Salmonella* resistant to ≥3 antimicrobial classes increased

AMU

- Between 2022 and 2023, the total nDDDvetCA/1,000 broiler chicken-days at risk was stable (+1%)
- Category III use **increased** (+17%)
- Category II (-15%) and Uncategorized antimicrobial (-12%) use **decreased**

Resistance to ≥3 classes

- Resistant *Salmonella* **increased** (+9%), while resistance was stable among *E. coli* (+1%) and *Campylobacter* isolates



Retail chicken (FNC/CIPARS): Resistance to ≥3 Antimicrobial Classes

Resistance to ≥3 antimicrobials increased both at farm and at retail, for *Salmonella*

E. coli

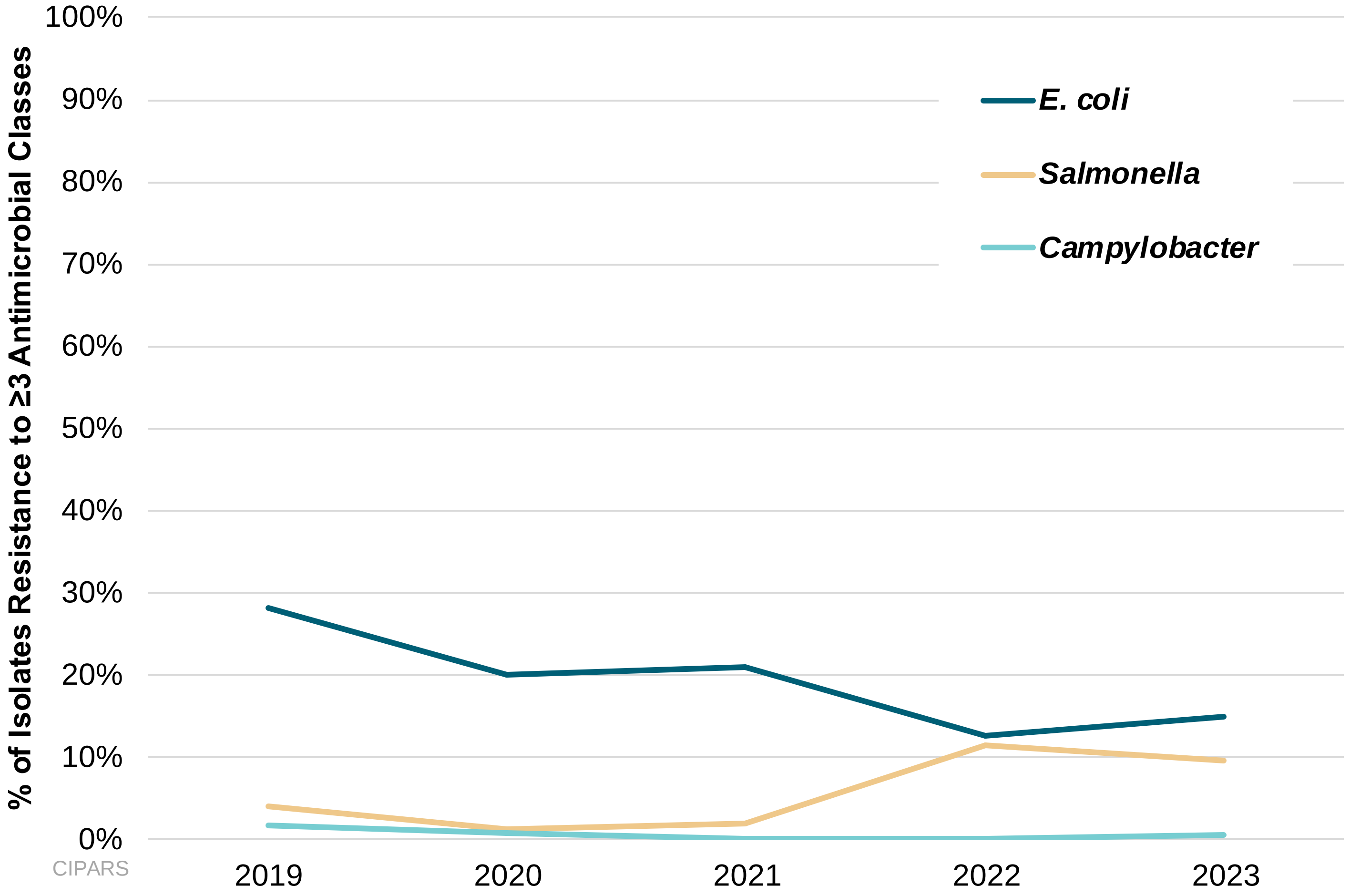
- Since 2019, resistance to ≥3 antimicrobial classes **decreased** steadily by 13%

Salmonella

- Similar to the trend seen at farm, the proportion of isolates resistant to ≥3 antimicrobial classes **increased** (+8%) in recent years

Campylobacter

- The occurrence of multi-class resistance remains **low** and **stable**



		2019	2020	2021	2022	2023
n	***Salmonella***	223	92	104	159	200
	E. coli	526	225	350	442	460
	Campylobacter	299	120	177	199	213

Year, Bacteria and Isolate Number (n)

Turkeys: AMR Surveillance at Farm and Retail

Bacteria	Indicator	Sampling location	5-year trend	% change since 2019; % in 2023
E. coli	Fully susceptible (%)	Farm	Increase	+9%;37%
		Retail	Stable	-<1%; 49%
	Ciprofloxacin NS (%)	Farm	Stable	-1%;3%
		Retail	Stable	2%;5%
	Ceftriaxone resistance (%)	Farm	Stable	-2%;0%
		Retail	Stable	-3%;0%
Salmonella	Fully susceptible (%)	Farm	Increase	+21%;69%
		Retail	Increase	+7%; 67%
	Ciprofloxacin NS (%)	Farm	Stable	-1%;2%
		Retail	Stable	+4%;4%
	Ceftriaxone resistance (%)	Farm	Stable	0%;2%
		Retail	Stable	0%;0%
Campylobacter	Fully susceptible (%)	Farm	Increase	+11%;50%
	Ciprofloxacin resistance (%)		decrease	-11%;26%
			% in 2023	**Vancomycin resistance**
Enterococcus	Ciprofloxacin resistance (%)	Farm	0%	VRE not detected
	Avilamycin resistance (%)		4%	
	Erythromycin resistance (%)		25%	
	Tetracycline resistance (%)		78%	
	Quinupristin-dalfopristin resistance (%)		67%	

CIPARS

Fully susceptible

- Overall, the proportion of fully susceptible isolates **increased**

Ciprofloxacin resistance/NS

- Although resistant *Campylobacter* decreased since 2019 (-11%), a **substantial increase** was reported between 2022 and 2023 (+15%)

Ceftriaxone resistance

- In 2023 ceftriaxone resistance (2%) was only observed in *Salmonella* Indiana at farm

🔴 ***Unfavourable change > ±5%***

🟡 Change ≤ ±5%

🟢 Favourable change > ±5%

Turkeys: AMU and Resistance to ≥3 Antimicrobial Classes at Farm

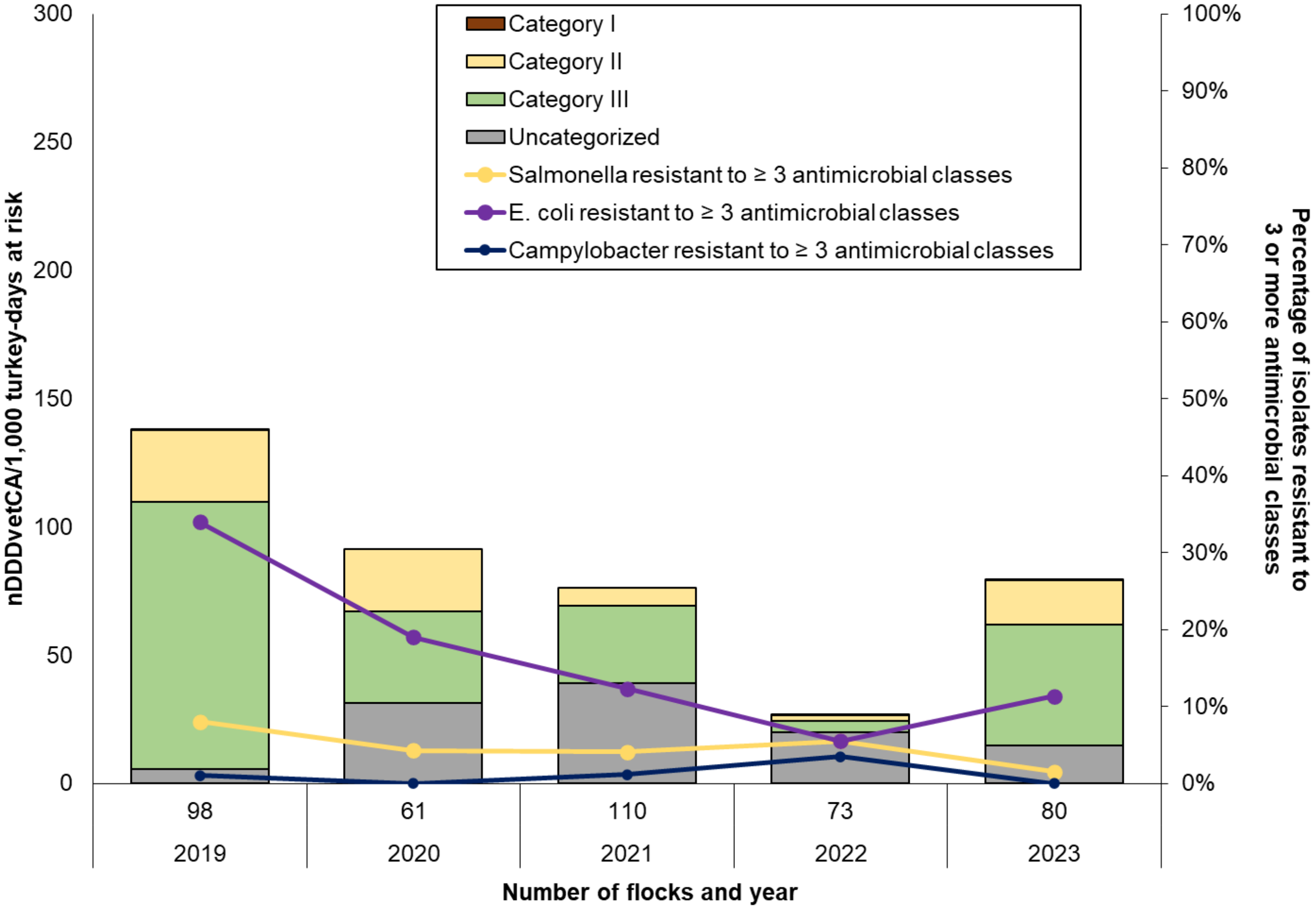
Substantial increases in AMU Category II and III antimicrobials

AMU

- Between 2022 and 2023, the total nDDDvetCA/1,000 turkey-days at risk **increased**
- Uncategorized antimicrobials **decreased**
- Categories II and III markedly **increased**
- Limited quantity of Category I were used (<1% of total use)

Resistance to ≥3 classes

- Resistance among *E. coli* isolates **increased** (+ 5%) while among *Salmonella*, resistance **decreased** (- 5%). Resistance to ≥3 antimicrobial classes was not detected among *Campylobacter* isolates in 2023



CIPARS

Retail Turkey (CIPARS/FNC): Resistance to ≥3 Antimicrobial Classes

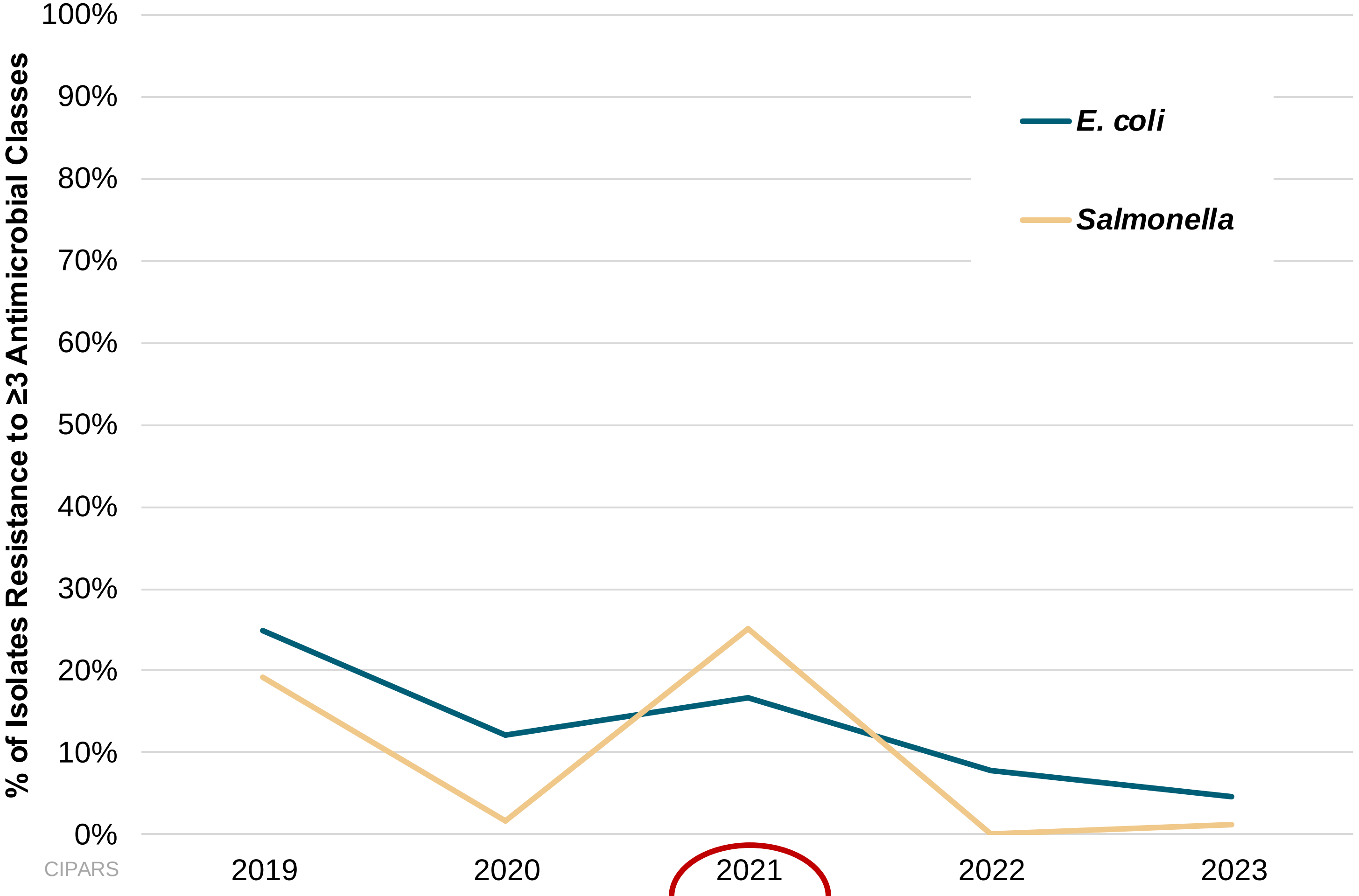
Antimicrobial resistance to ≥3 classes decreased for both *E. coli* and *Salmonella*

E. coli and *Salmonella*

- Since 2019, resistance to ≥3 antimicrobial classes **decreased** substantially in *E. coli* (-20%) and *Salmonella* (-18%). However, noting smaller isolate numbers from 2020-2022

Campylobacter

- Please note that *Campylobacter* testing in turkey was not conducted in 2018-2019 and fewer isolates were recovered (≤10) in 2020-2023 due to lower sample numbers. Therefore, data are not shown



		2019	2020	2021	2022	2023
n	***Salmonella***	**115**	**57**	**12**	**48**	**83**
	E. coli	**181**	**90**	**30**	**78**	**111**

Year, Bacteria and Isolate Number (n)

Layers: AMU and AMR Surveillance at Farm

Bacteria	**Indicator**	**2/3-year trend[a]**	**% change since 2020/21; % in 2023**
E. coli	Fully susceptible (%)	Stable	+4%;76%
	Ciprofloxacin NS (%)	Stable	-1%;1%
	Ceftriaxone resistance (%)	Stable	0%;0%
Salmonella	Fully susceptible (%)	***Decrease***	***-36%;37%***
	Ciprofloxacin NS (%)	Stable	0%;0%
	Ceftriaxone resistance (%)	Stable	0%;0%
Campylobacter	Fully susceptible (%)	***Decrease***	***-18%;47%***
	Ciprofloxacin resistance (%)	***Increase***	***+14%;30%***

		% in 2023	**Vancomycin resistance**
Enterococcus	Ciprofloxacin resistance (%)	0%	VRE not detected
	Avilamycin resistance (%)	0%	
	Erythromycin resistance (%)	9%	
	Tetracycline resistance (%)	59%	
	Quinupristin-dalfopristin resistance (%)	100%	

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[a] Please note that 2020 and 2021 represent pilot years of the layer program and data were aggregated

🔴 ***Unfavourable change > ±5%*** 🟡 Change ≤ ±5% 🟢 Favourable change > ±5%

AMU (45 flocks in 2023)

- Bacitracin use was consistently reported (2020/21-2023). However, the frequency of farms reporting bacitracin use decreased from 13% in 2020/21 to 4% in 2023
- In 2023, amprolium (6% of farms) and monensin (2%) were also reportedly used for the control of coccidiosis

AMR

- The proportion of ciprofloxacin-resistant *Campylobacter* **increased** in 2023 compared to 2020/21 and 2022. The proportion of ciprofloxacin-NS *E. coli* and *Salmonella* remain **low**
- Ceftriaxone-resistant *E. coli* or *Salmonella* were **not** detected

Pigs: AMR Surveillance at Farm, Abattoir, and Retail

Bacteria	Indicator	Sampling location	5-year trend	% change since 2019; % in 2023
E. coli	Fully susceptible (%)	Farm	Increase	+8%;30%
		Abattoir	Increase	+9%;35%
		Retail	***Decrease***	***-22%;48%***
	Ciprofloxacin NS (%)	Farm	Stable	+1%;3%
		Abattoir	Stable	+1%;3%
		Retail	Stable	-1%;2%
	Ceftriaxone resistance (%)	Farm	Stable	0%;2%
		Abattoir	Stable	+1%;3%
		Retail	Stable	-2%;0%
Salmonella	Fully susceptible (%)	Farm	Increase	+9%;37%
		Abattoir	Increase	+7%;53%
		Retail[a]	Increase	+38%;83%[a]
	Ciprofloxacin NS (%)	Farm	Stable	+5%;5%
		Abattoir	Stable	0%;1%
		Retail[a]	Stable	0%;0%[a]
	Ceftriaxone resistance (%)	Farm	Stable	-4%;2%
		Abattoir	Stable	0%;3%
		Retail[a]	Stable	0%;0%[a]
Campylobacter	Fully susceptible (%)	Farm	Stable	-3%;20%
		Abattoir	Stable	-1%;29%
	Ciprofloxacin resistance (%)	Farm	***Increase***	***+8%;20%***
		Abattoir	Stable	+4%;14%

[a] Due to low isolate recovery, *Salmonella* data should be interpreted with caution

CIPARS

Fully susceptible

- The proportion of susceptible isolates either **increased** (*E. coli* and *Salmonella*) or remained **stable** (*Campylobacter*)

Ciprofloxacin resistance/NS

- The proportion of resistant/NS isolates **slowly increased** in all 3 organisms since 2019

Ceftriaxone resistance

- Resistance remained stable and at low proportions

🔴 ***Unfavourable change > ±5%***

🟡 Change ≤ ±5%

🟢 Favourable change > ±5%

Pigs: AMU and Resistance to ≥3 Antimicrobial Classes at Farm

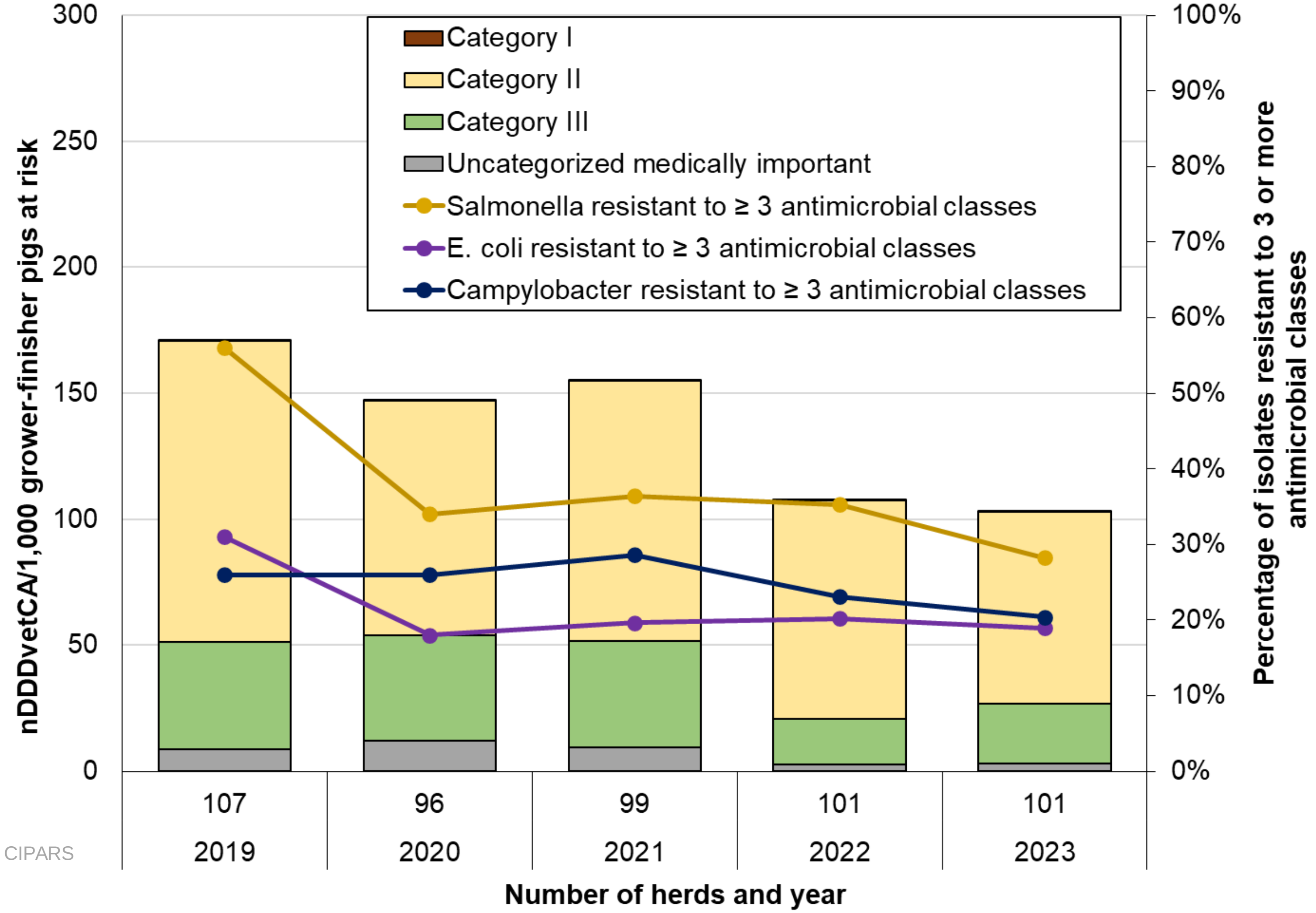
Overall, antimicrobial use decreased, and resistance to ≥3 classes decreased or remained stable

AMU

- The quantity of AMU **decreased:**
  - between 2019 and 2023 (-40%)
  - between 2022 and 2023 (-4%)
- The majority of reported antimicrobial use continued to be Category II antimicrobials
- Small quantities of Category I antimicrobials were used by injection each year

Resistance to ≥3 classes

- In 2023, resistance **decreased** among *Salmonella* and *Campylobacter* isolates and remained **stable** among *E. coli* isolates



Retail Pork (FNC/CIPARS): Resistance to ≥3 Antimicrobial Classes

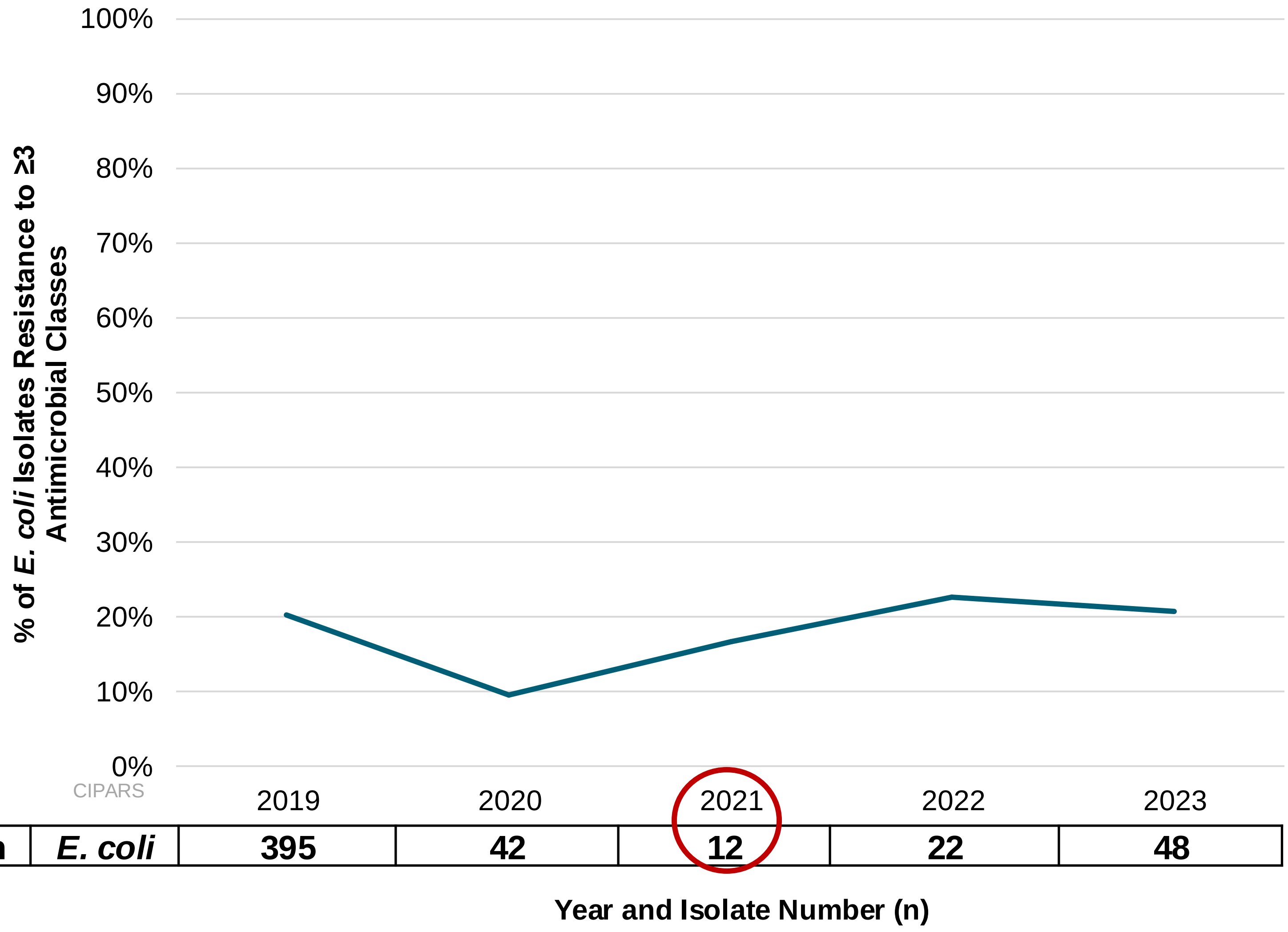
Antimicrobial resistance to ≥3 classes has been stable for *E. coli*

E. coli

- Overall, since 2019, resistant to ≥3 antimicrobial classes was **stable**, apart from 2020. Noting that fewer isolates were recovered in 2020-2023 due to lower sample numbers. Comparisons to pre-2020 data should be interpreted with caution

Salmonella

- Due to small isolate numbers (≤6) since 2020, these data are not shown



n	***E. coli***	**395**	**42**	**12**	**22**	**48**

Year and Isolate Number (n)

Feedlot Cattle: AMR Surveillance at Farm, Abattoir, and Retail

Bacteria	Indicator	Sampling location	5-year trend	% change since 2019; % in 2023
E. coli	Susceptible (%)	Farm	***Decrease***	***-11%;37%***
		Abattoir	***Decrease***	***-15%;41%***
		Retail	Increase	+7%;85%
	Ciprofloxacin NS (%)	Farm	Stable	+3%;3%
		Abattoir	Stable	0%;0%
		Retail	Stable	-1%;1%
	Ceftriaxone resistance (%)	Farm	Stable	<1%;<1%
		Abattoir	Stable	+1%;1%
		Retail	Stable	+1%;1%
Salmonella[a]	Susceptible (%)	Farm	***Decrease***[a]	***-15%;35%***
	Ciprofloxacin NS (%)		***Increase***[a]	***+8%;13%***
	Ceftriaxone resistance (%)		***Increase***[a]	***+20%;38%***
Campylobacter CIPARS	Susceptible (%)	Farm	Stable	-3%;10%
		Abattoir	***Decrease***	***-11%;23%***
	Ciprofloxacin resistance (%)	Farm	***Increase***	***+19%;46%***
		Abattoir	***Increase***	***+19%;39%***

[a] *Salmonella* data should be interpreted with caution due to low isolate recovery. Results were highly impacted by serovar, and clonal spread may be occurring in some cases.

Fully susceptible[a]

- Overall, the proportion of susceptible isolates **decreased,** except for *E. coli* recovered at retail

Ciprofloxacin resistance/NS[a]

- The proportions of NS *E. coli* were **stable**
- Notably, the proportions of ciprofloxacin-resistant *Campylobacter* **increased substantially** since 2019

Ceftriaxone resistance[a]

- Resistance among *E. coli* isolated remained stable and at **low proportions**

🔴 ***Unfavourable change > ±5%*** 🟡 Change ≤ ±5% 🟢 Favourable change > ±5%

Feedlot Cattle: AMU and Resistance to ≥3 Antimicrobial Classes at Farm

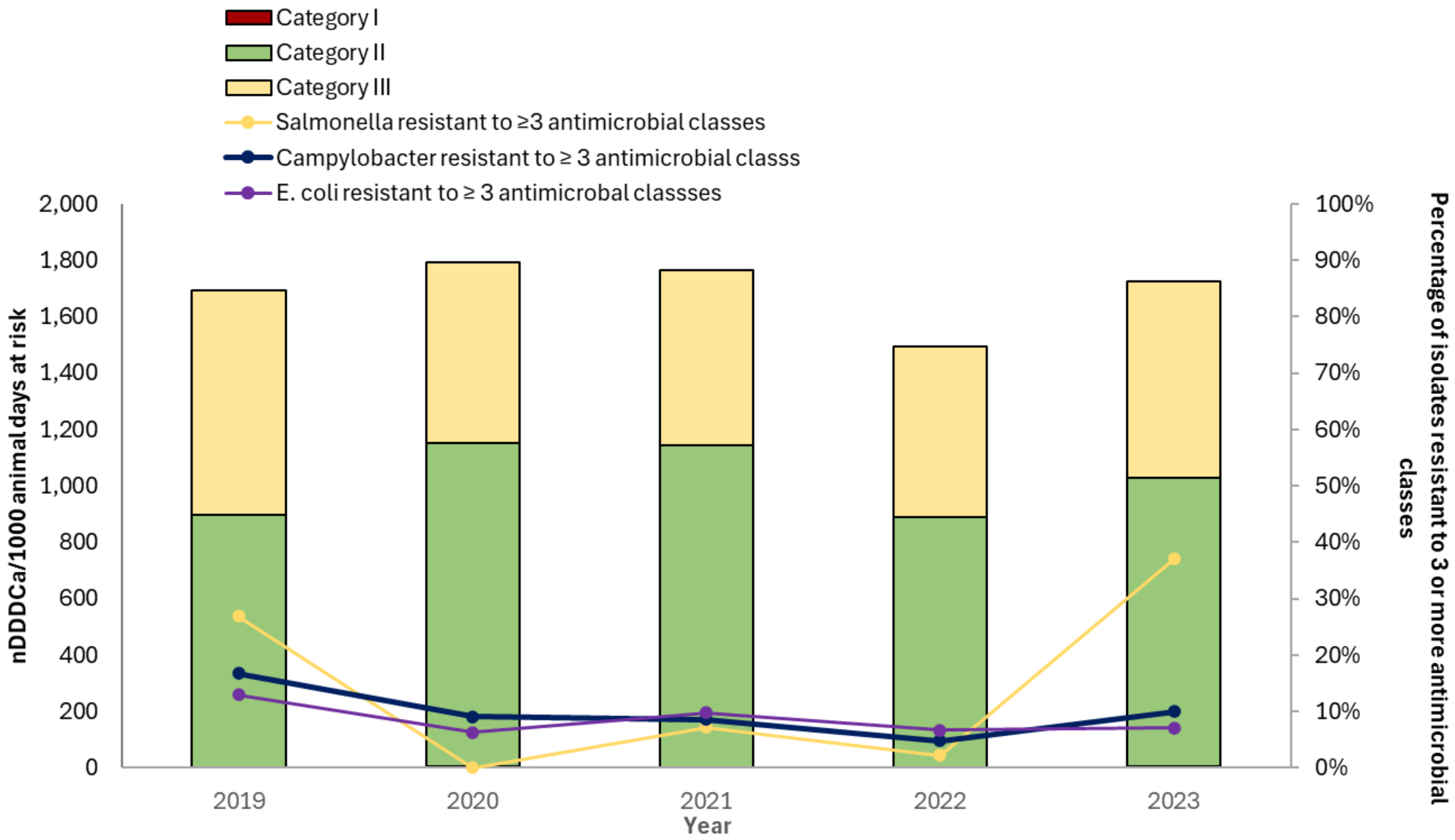
Overall, AMU increased and resistance to ≥3 classes increased or remained stable

AMU

- Between 2022 and 2023, the total nDDDvetCA/1,000 cattle days at risk **increased** (+13%)
- Category III use increased (+ 13%)
- Category II use increased (+13%)
- Category I use increased (+31%)

Resistance to ≥3 classes

- Between 2022 and 2023 the proportion of resistant *E. coli* was **stable**, while resistant *Campylobacter* **increased** (+5%). The proportion of resistant *Salmonella* was unstable due to small number of isolates.



CIPARS

Feedlot Cattle: *Enterococcus* from Feedlot Cattle at Farm

Significant increase in resistance to quinupristin-dalfopristin; no vancomycin-resistant enterococci detected

Quinupristin-dalfopristin (QDA)

QDA is a streptogramin related to virginiamycin, which was increasingly used in cattle feed.

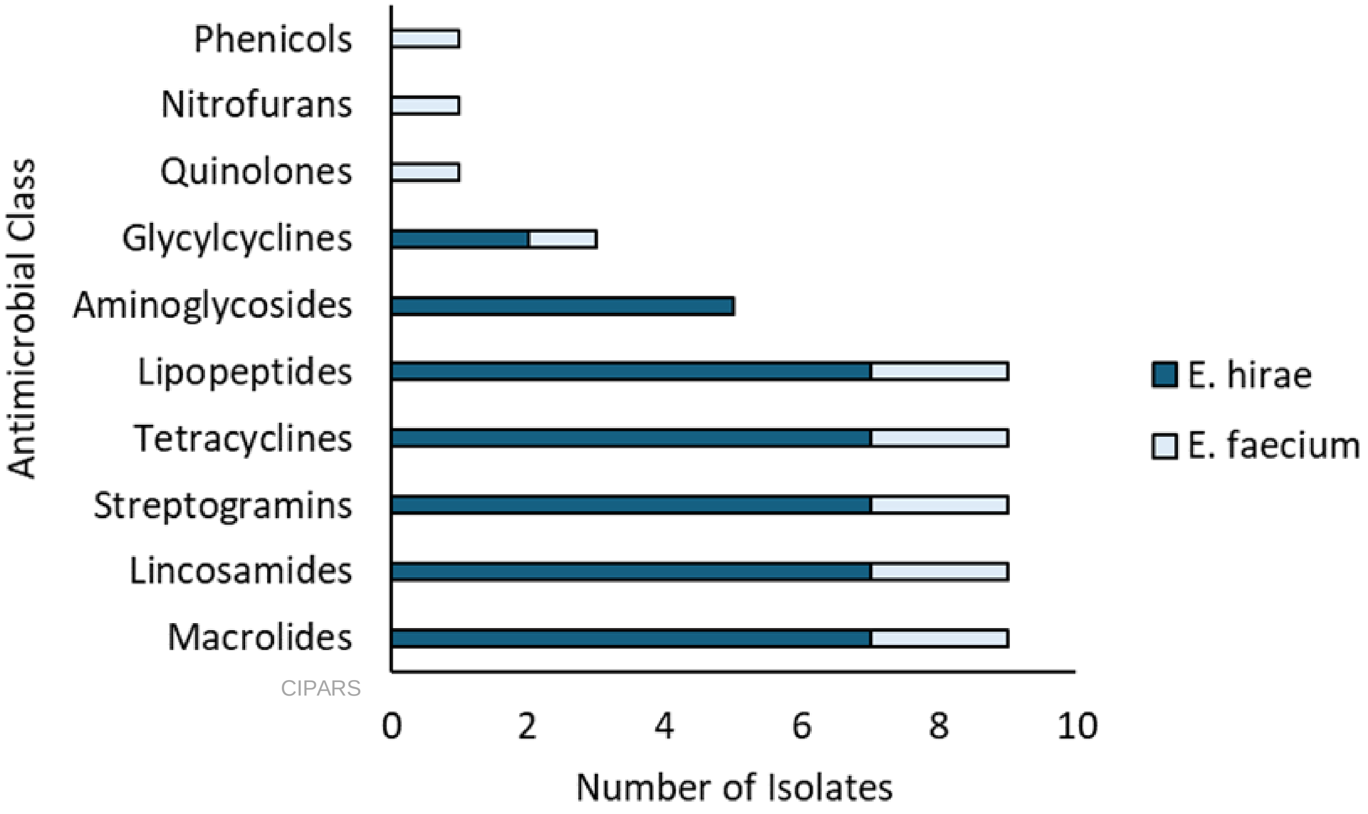
- Resistance rose significantly between 2019 (13%) and 2023 (35%). Between 2022 and 2023 resistance **rose by 14%**

Multiclass resistance

In 2023, **66% of isolates were resistant to ≥3 antimicrobial classes**, 26% to 1 or 2 classes, and 8% were susceptible to the antimicrobial panel.

Most common resistances detected,
- Lincomycin 94%
- Tetracycline 79%
- Tylosin 63%

9 isolates resistant to 6 classes of antimicrobials



CIPARS

Dairy Cattle: AMR Surveillance at Farm

Bacteria	Indicator	5-year trend	% change since 2019; % in 2023
E. coli	Fully susceptible (%)	Increase	+6%;81%
	Ciprofloxacin NS (%)	Stable	+2%;2%
	Ceftriaxone resistance (%)	Stable	-1%;2%
Salmonella[a]	Fully susceptible (%)	***Decrease*[a]**	***-19%;56%***
	Ciprofloxacin NS (%)	***Increase*[a]**	***+19%;19%***
	Ceftriaxone resistance (%)	Stable[a]	0%;0%
Campylobacter	Fully susceptible (%)	Stable	-4%;41%
	Ciprofloxacin resistance (%)	Stable	+4%;25%

CIPARS

[a] *Salmonella* trends should be interpreted with caution due to low isolate recovery (n=28 in 2019; n=16 in 2023)

🔴 ***Unfavourable change > ±5%*** 🟡 Change ≤ ±5% 🟢 Favourable change > ±5%

Fully susceptible

- Overall, susceptibility **increased** or remained **stable**, except for in *Salmonella*. However, caution with interpretation of *Salmonella* trends due to low isolate recovery.

Ceftriaxone and/or ciprofloxacin resistance/NS

- Resistance/NS remained **stable** in *E. coli* and *Campylobacter* (albeit high among *Campylobacter*)

Colistin resistance

- Resistance was detected in 3 *E. coli* isolates from 2023. **Mobile resistance has not yet been confirmed**.

Dairy Cattle: AMU and Resistance to ≥3 Antimicrobial Classes at Farm

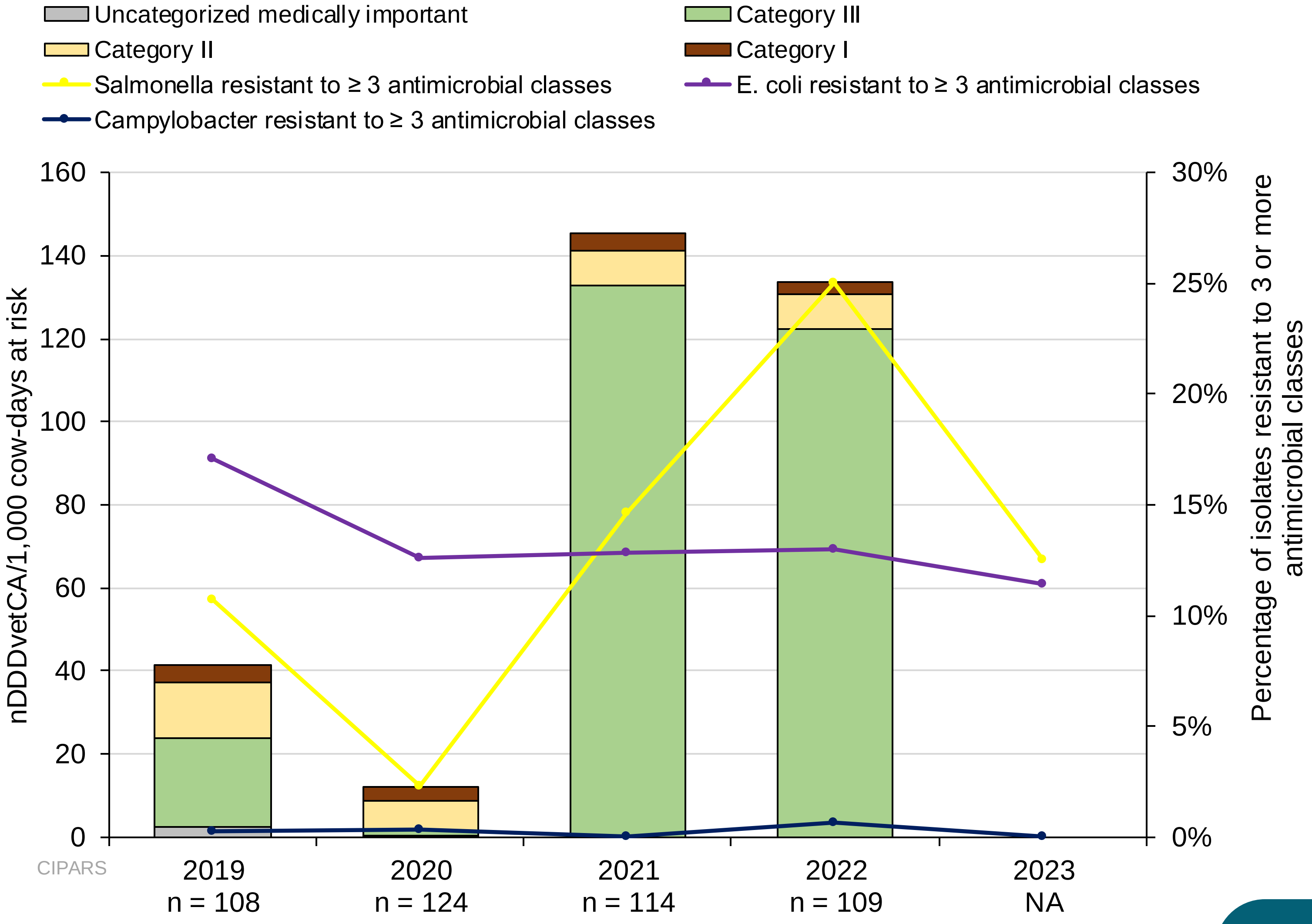
Increase in Category III antimicrobial use was observed in 2021 and 2022 due to an increase in reported use of tetracyclines in both feed and water

<u>AMU</u>

- An increase in Category III antimicrobial use was observed in 2021 and 2022. This was due to an increase in reported use of tetracyclines in both feed and water.

<u>Resistance to ≥3 classes</u>

- The proportion of resistant *E. coli* and *Campylobacter* isolates remains relatively low and stable.
- The proportion of resistant *Salmonella* was unstable due to the small number of isolates recovered.



Retail Ground Beef (FNC/CIPARS): Resistance to ≥3 Antimicrobial Classes

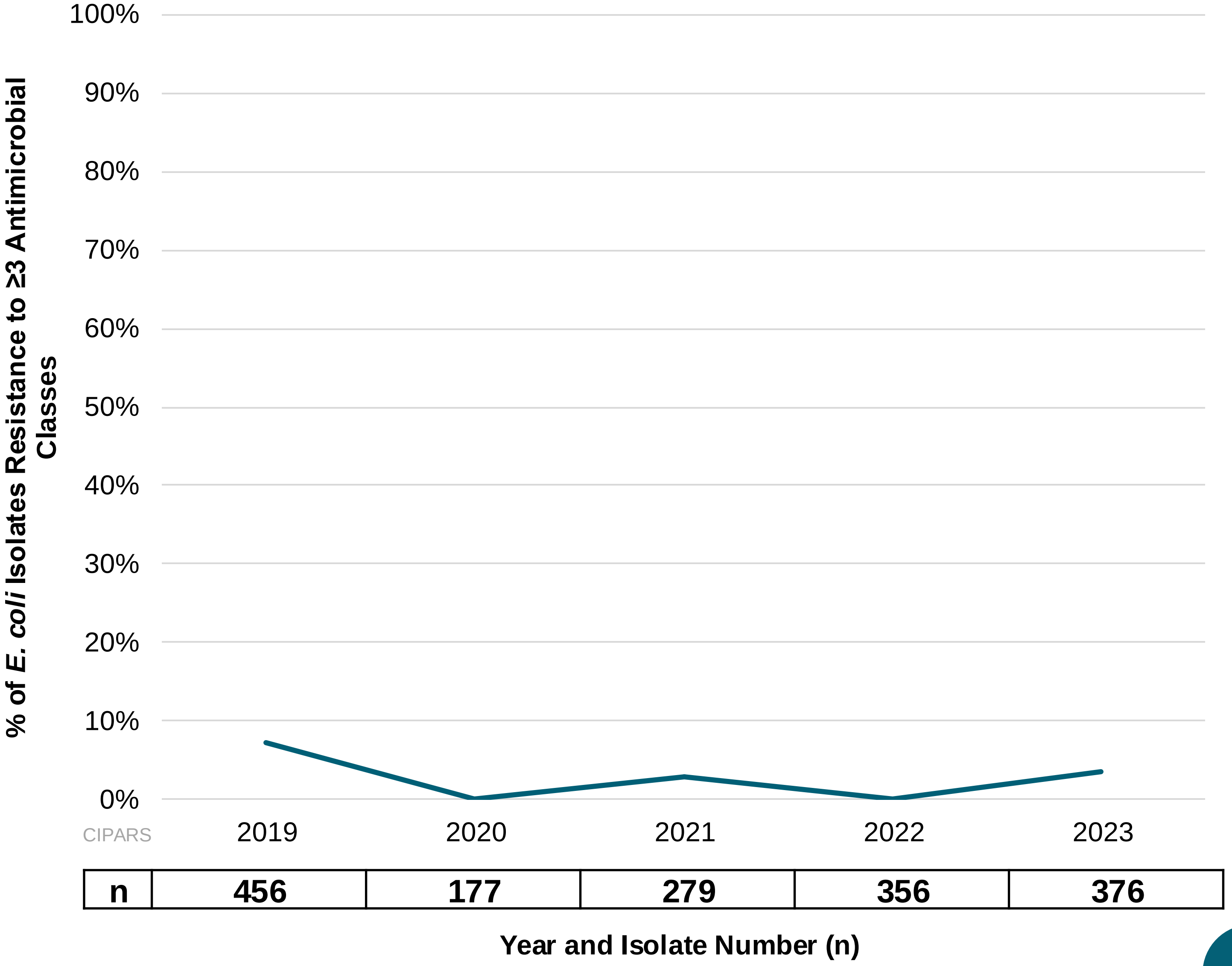
Antimicrobial resistance to ≥3 classes was stable for *E. coli*

<u>*E. coli*</u>

- Similar to what was reported at farm (feedlot cattle and dairy cows), resistance to ≥3 antimicrobial classes remains relatively **low** and **stable**

<u>*Salmonella*</u>

- For the years presented, there was no *Salmonella* testing in ground beef



Human *Salmonella* and *Campylobacter* Antimicrobial Resistance

Santé Canada Health Canada

Canada

Human: Non-typhoidal and Typhoidal *Salmonella* AMR[a]

Bacteria	Indicator	5-year trend	% change since 2019; % in 2023
All non-typhoidal	Fully susceptible (%)	***Decrease***	***-9%;52%***
	Ciprofloxacin NS (%)	Stable	+5%;31%
	Ceftriaxone resistance (%)	Stable	0%;3%
All typhoidal	Fully susceptible (%)	Stable	+1%;7%
	Ciprofloxacin NS (%)	Stable	-2%;92%
CIPARS	Ceftriaxone resistance (%)	Stable	-2%;5%

🔴 ***Unfavourable change > ±5%*** 🟡 Change ≤ ±5% 🟢 Favourable change > ±5%

All non-typhoidal serovars

- The proportion of fully susceptible isolates was variable since 2019, and **decreased** in 2023
- Ciprofloxacin NS was high and moderately increased in 2023 compared to 2019
  - Despite relative stability, resistance increased by 15% since 2021

All typhoidal serovars

- The proportion of fully susceptible isolates remains **low and stable**
- Ciprofloxacin NS was **extremely high and stable**

---

[a] *Salmonella* data were collected using genomic methodology and therefore AMRs are reported as predicted phenotypes

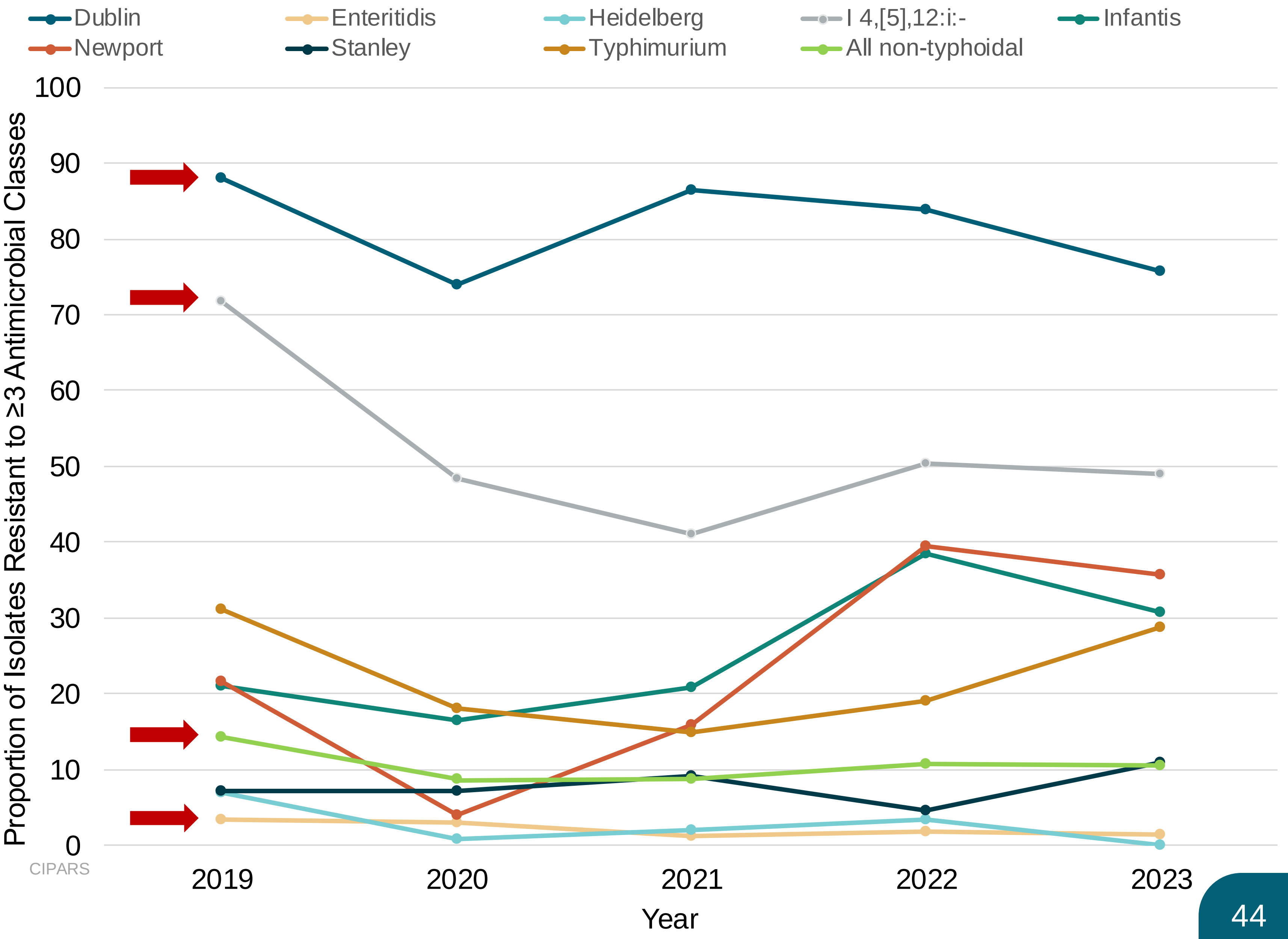
Human: Non-typhoidal *Salmonella* Resistant to ≥3 Antimicrobial Classes

Resistance to ≥3 antimicrobial classes varies with serovar

In all **non-typhoidal serovars**, resistance to ≥3 classes was **stable** around 10%

Among the serovars of interest:

- Resistance to ≥3 classes was consistently **high in *S.* Dublin and *S.* I 4,[5],12:i:-**
- Consistently **low in *S.* Enteritidis and *S.* Heidelberg**



CIPARS

Human (FNC): *Campylobacter* AMR (2018-2022)

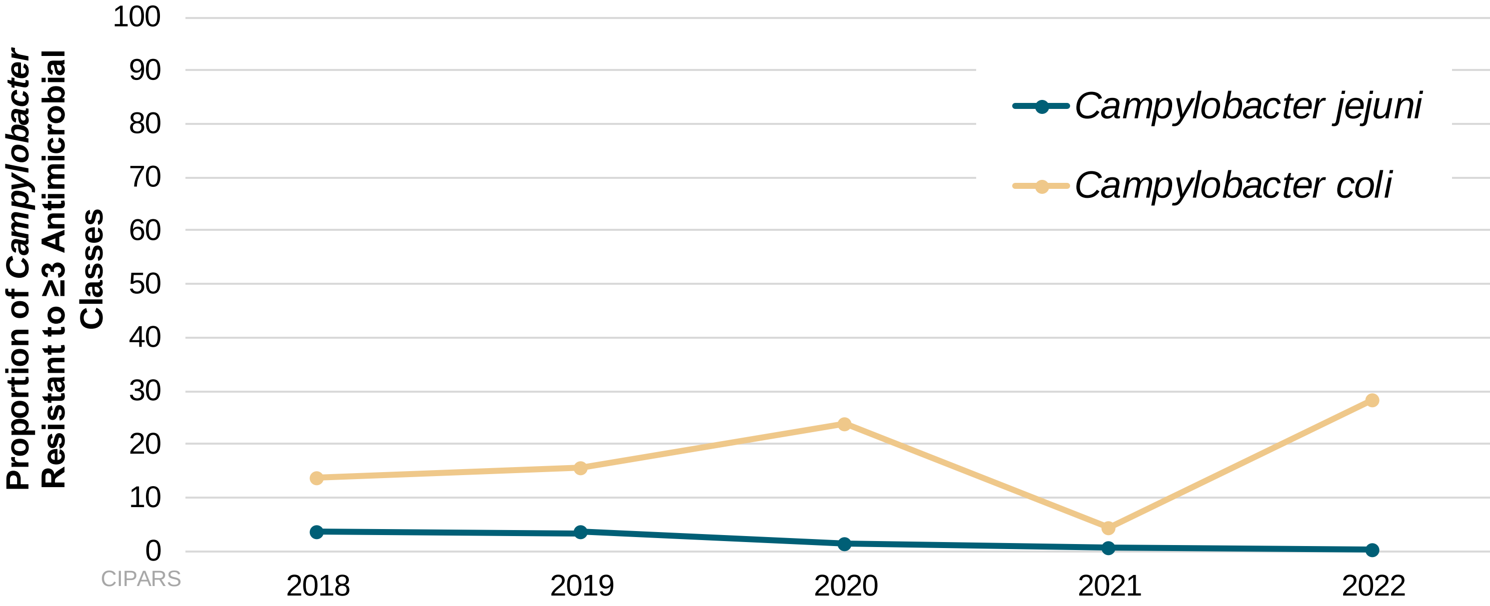
High frequency of ciprofloxacin resistance in *C. jejuni* and *C. coli*

Campylobacter jeuni

- Predominant *Campylobacter* species recovered from humans
- Resistance to ≥3 classes was very low and decreased in 2022
- Ciprofloxacin resistance remains **stable but high**

Campylobacter coli

- In general, a small numbers of isolates with less than 20 isolates in some years (n=10 in 2018, and n=25 in 2022)
- Resistance to ≥3 classes variable over 5-year period, and high and increased in 2022
- Despite an overall decrease since 2018, **ciprofloxacin resistance increased by 24%** compared to 2021



n	*C . coli*	10	33	18	28	25
	C. jejuni	364	431	337	383	279

Year and n-value

Bacteria	Indicator	5-year trend	% change since 2018; % in 2022
C. jejuni	Fully susceptible (%)	Stable	-2%;43%
	Ciprofloxacin resistance (%)	Stable	-1%;31%
C. coli	Fully susceptible (%)	Stable	-2%;28%
	Ciprofloxacin resistance (%)	Decreasing	-10%;60%

🔴 ***Unfavourable change > ±5%*** 🟡 Change ≤ ±5% 🟢 Favourable change > ±5%

New and Resumed Components

Antimicrobial-resistant isolates were infrequent, yet detected in *Salmonella* isolated from feed ingredients and mixed feeds

- Between 2018 and 2023, a small number of *Salmonella* isolates found in the CFIA's sampling programs were resistant to at least one antimicrobial
  - All the resistant isolates from mixed feeds were in feed intended for chickens

Year	Province	Serovar	Feed or Feed Ingredient Type	Antimicrobial Classes in Resistance Pattern
2019	Ontario	*S.* Livingstone	Poultry complete feed – layers	Tetracyclines
2019	British Columbia	*S.* Schwarzengrund	Poultry complete feed - broiler chickens	Tetracyclines
2019	British Columbia	S. Kentucky	Feed ingredient - protein source (poultry rendered product)	Aminoglycosides and Tetracyclines
2019	Québec	*S.* Typhimurium	Feed ingredient -protein source (rendered product - blood meal)	Aminoglycosides, Beta-lactams, Phenicols and Tetracyclines
2023	Manitoba	*S.* Johannesburg	Poultry complete feed – layers	Folate pathway inhibitors and Tetracyclines
2023	Québec	*S.* Worthington	Poultry complete feed - layers	Tetracyclines

*Line listings with completely duplicated data were removed

Diagnostic Animal Data: Non-typhoidal *Salmonella* AMR Surveillance

Host Species	Indicator	5-year trend	% change since 2019; % in 2023
Chickens	Fully susceptible (%)	***Decrease***	***-21%;59%***
	Ciprofloxacin NS (%)	***Increase***	***+20%;25%***
	Ceftriaxone resistance (%)	Stable	-3%;2%
	Resistance to ≥3 classes (%)	Decrease	-6%;2%
Turkeys	Fully susceptible (%)	Increase	+13%;61%
	Ciprofloxacin NS (%)	Stable	+4%;18%
	Ceftriaxone resistance (%)	Stable	-4%;0%
	Resistance to ≥3 classes (%)	Decrease	-27%;11%
Pigs	Fully susceptible (%)	Stable	+1%;23%
	Ciprofloxacin NS (%)	Stable	+3%;4%
	Ceftriaxone resistance (%)	Stable	+1%;12%
	Resistance to ≥3 classes (%)	Stable	-4%;55%
Cattle	Fully susceptible (%)	Increase	+9%;34%
	Ciprofloxacin NS (%)	Stable	+5%;42%
	Ceftriaxone resistance (%)	Stable	-4%;48%
CIPARS	Resistance to ≥3 classes (%)	Decrease	-6%;65%

🔴 ***Unfavourable change > ±5%*** 🟡 Change ≤ ±5% 🟢 Favourable change > ±5%

Fully susceptible

- Overall, the proportion of susceptible isolates **increased** or remained **stable**, with the exception of those from chickens

Ciprofloxacin NS

- Similar to what was observed among at farm, abattoir and retail, the proportion of ciprofloxacin-NS *Salmonella* **increased** among diagnostic samples in chicken

Ceftriaxone resistance

- Resistance remains **stable**, albeit in some cases high (i.e., cattle)

Resistance to ≥3 classes

- Resistance decreased or remained stable, albeit in some cases at high percentages (i.e., pigs and cattle)

Food production environment – *Salmonella* (diagnostic samples)

Resistance to Category I antimicrobials and resistance to 5 or more classes was infrequent yet present in *Salmonella* isolated from the food animal environment

- For the first time, CIPARS is reporting information from the environment of sick animals – these are from samples submitted for diagnostic purposes in which *Salmonella* was isolated
- No meropenem or colistin resistance was found

2019-2023	Chicken Farm Environment	Pig Farm Environment	Turkey Farm Environment
Number of isolates (n)	65	**15**	39
Top 2 Serovars	*S.* Infantis & *S.* Montevideo	*S.* I 4,[5],12:i:- & *S.* Typhimurium	*S.* Uganda & *S.* Mbandaka
% of isolates fully susceptible	82%	27%	36%
% of isolates resistant to ceftriaxone	2% (n = 1; *S.* Montevideo)	13% (n = 2; *S.* Infantis & *S.* Typhimurium)	3% (n = 1; *S.* Infantis)
% isolates non-susceptible to ciprofloxacin	0	0	8% (n = 3; *S.* Infantis, *S.* Senftenberg, & *S.* Ouakam)
Multiclass resistance (resistance to ≥ 3 classes)	0	≥ 3 classes: 40% (n= 6; mostly *S.* Typhimurium) 5 classes: 20% (n= 3; all *S.* Typhimurium)	≥ 3 classes: 15% (n = 6; *S.* Mbandaka (n = 2)) 6 classes: 3% (n= 1; *S.* Infantis)

*only one isolate from a cattle environment was recovered during this time frame

Raw Water (FNC & CIPARS): Surface Water and Irrigation Water (2022-2023)

First reporting of antimicrobial resistance from raw water. Resistance was not detected in irrigation water in 2022-2023

Sampling

- Irrigation water samples were collected in Alberta. Surface water samples were collected in Québec (2022 and 2023) and Ontario (2023 only).
- AMR testing of *E. coli* isolates from surface water began in 2023

Raw water isolates resistant to at ≥1 antimicrobial class

	2022	2023
Salmonella	0% (n=46)	2.6% (n=38)
Campylobacter	21% (n=19)	0% (n=25)
E. coli	-	26% (n=61)

CIPARS

AMR

- Resistance to ≥3 antimicrobial classes was detected in 3% of *E. coli* isolates, and not among *Salmonella* or *Campylobacter;* colistin or ceftriaxone resistance was not detected
- AMR was detected in 1 *Salmonella* isolate (towards tetracycline), in 2023
- In 2022, 4 *Campylobacter* isolates were resistant to 1 antimicrobial class each (Tetracycline [n=1], nalidixic acid [n=1], or ciprofloxacin/nalidixic acid [n=2])
- 26% (16/61) of *E. coli* isolates in 2023 were resistant to ≥1 antimicrobial class; 3% of isolates were ciprofloxacin-resistant

Retail (FNC/CIPARS): Seafood

E. coli

- Isolates from shrimp and salmon were fully susceptible to the panel
- A single isolate from scallops was non-susceptible to ciprofloxacin

Aeromonas

- Colistin resistance (*mcr-3.3)* was detected from a single shrimp isolate (from Vietnam)
- 88% of isolates were fully susceptible, with the only other reported resistance to tetracycline

Vibrio

- 4 ciprofloxacin non-susceptible isolates detected; 2 each from salmon and shrimp (different samples)
- 16% of isolates were fully susceptible; other reported resistances to tetracycline, ampicillin, and trimethoprim-sulfamethoxazole

Sample type	Sample size	Countries of origin	*E. coli*	*Aeromonas*	*Vibrio*
Shrimp	71	Canada, US, Argentina, Chile, China, Ecuador, India, Indonesia, Norway, Vietnam	1	9	48*
Salmon	72		1	32*	3
Scallop	14	China and Japan	1	0	1

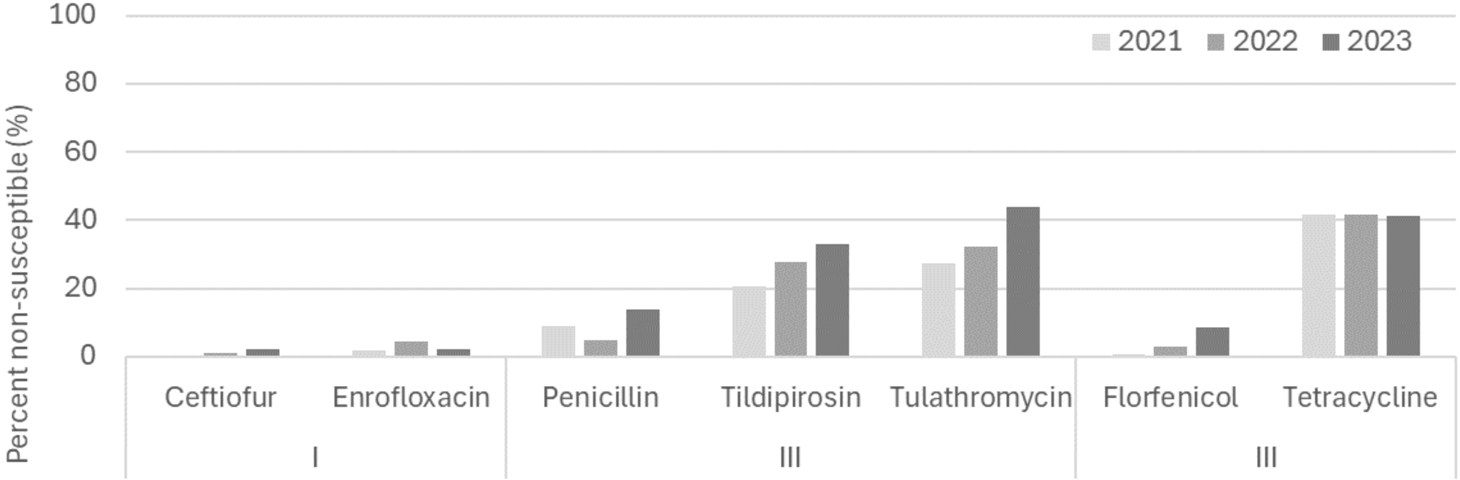
CIPARS

*48 *Vibrio* isolates were recovered from 31 shrimp samples, and 32 *Aeromonas* isolates were recovered from 30 salmon samples. The remaining isolates were recovered at a rate of 1 isolate per positive sample.

Bovine/Cattle (clinical isolates) – *Preliminary Results*

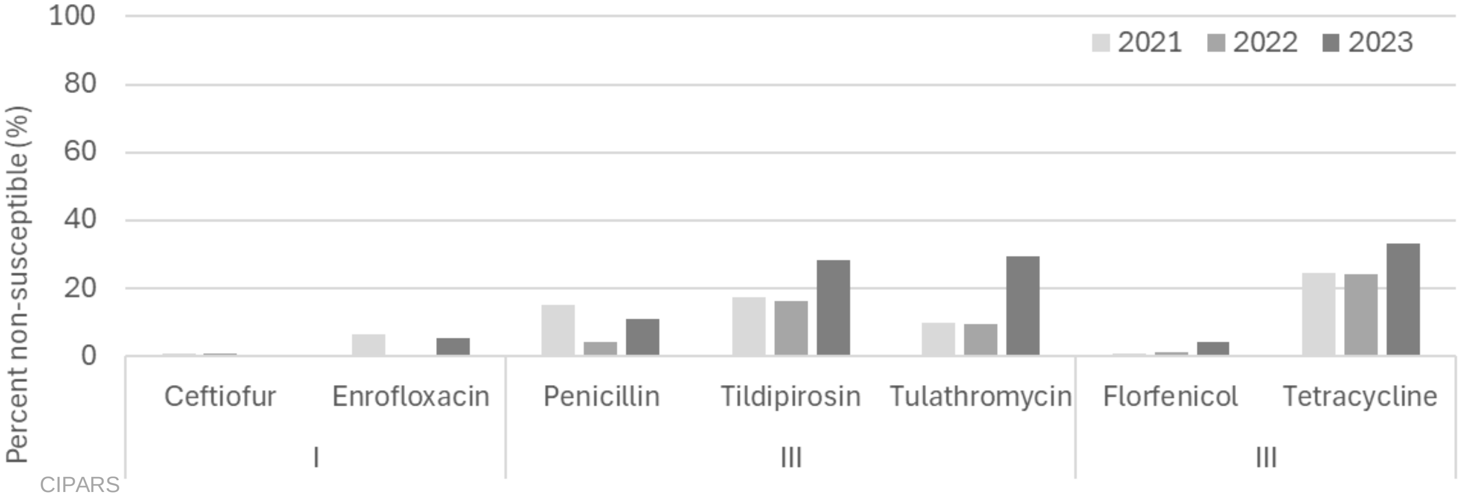
Mannheimia haemolytica

n=634



Pasteurella multocida

n=342



Includes data from labs in ON, NB, PE and SK; not all labs submitted data in all years. Breakpoint interpretations provided by labs or results interpreted as per CLSI VET01S. Data may include duplicate submissions from the same animal/herd; categorization of antimicrobials (I, II, III) based on importance to human health.

Interactive Data Displays

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

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

Sales: https://health-infobase.canada.ca/carss/amu/results.html?ind=05

Integrated AMU: https://health-infobase.canada.ca/carss/amu/

Human *Salmonella*: https://health-infobase.canada.ca/carss/amr/results.html?ind=13

CIPARS website

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

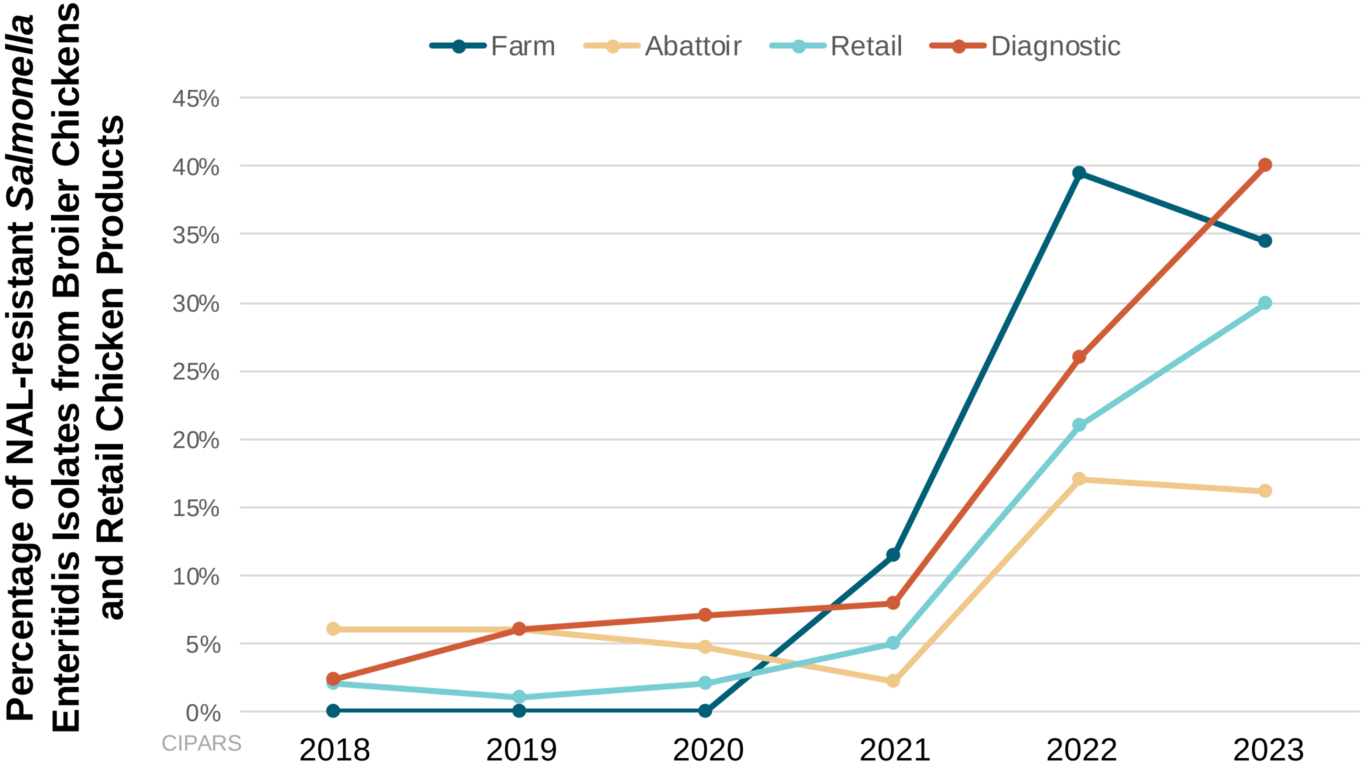
Emerging Stories and Follow-ups

Emerging Stories: Nalidixic acid-resistant *Salmonella* Enteritidis

Rapid emergence of a mutation in *gyrA* (D87Y) in *Salmonella* Enteritidis (SE) from chickens and chicken retail products

CIPARS has been watching the emergence and subsequent increases in nalidixic acid-resistant SE from chickens and chicken meat since 2018.

- All nalidixic acid-resistant SE isolates from farm (broiler), abattoir and retail, since 2018 were sequence type 11 and exhibited a mutation in *gyrA* (D87Y).



n	Farm	70	46	37	35	38	29
	Abattoir	33	33	21	44	41	37
	Retail	64	74	51	55	57	70
	Diagnostic	111	133	92	87	43	78

Year, Sampling Site, and Isolate Number (n)

Follow-up to Emerging Stories: Rise in ESBL-producing *Salmonella*

The detection of ESBL-carrying non-typhoidal *Salmonella* isolates recovered from humans, animals and food continued to steadily increase

Human

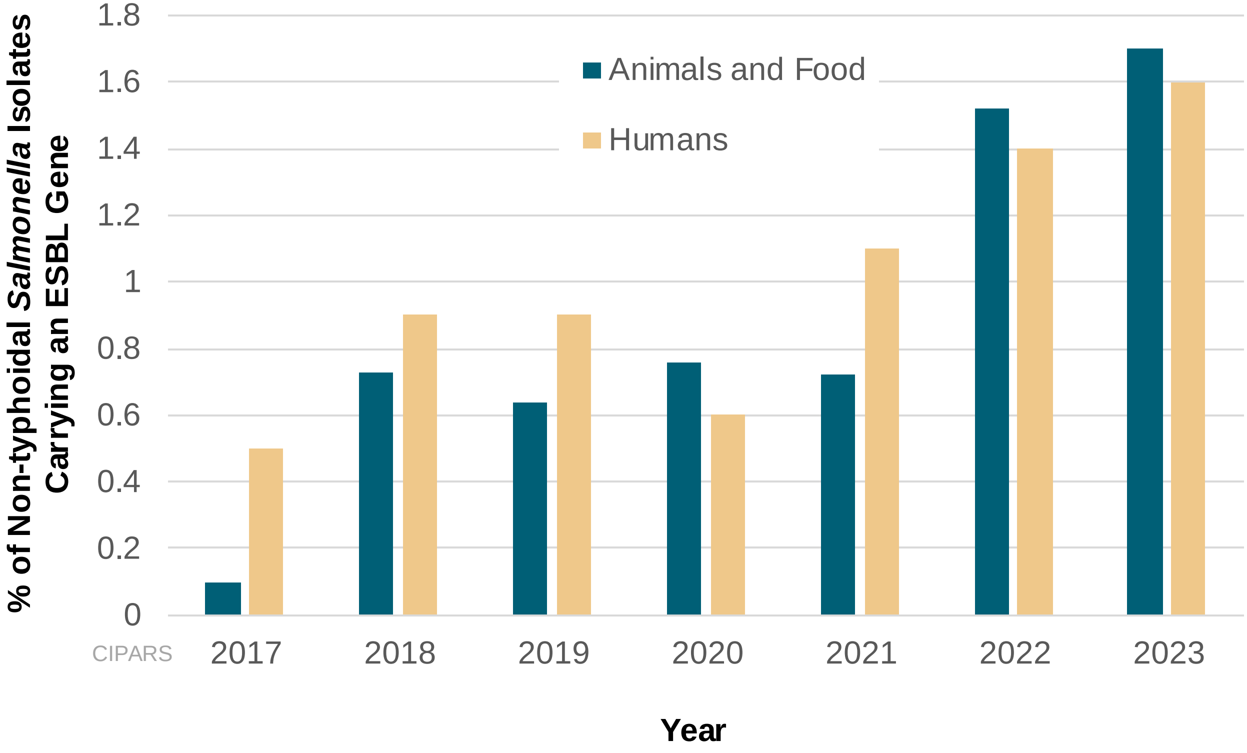
Since 2017,

- The proportion of *bla*$_{\text{CTX-M-65}}$ (among ESBL-positive isolates) steadily decreased (63% → 41.8%; majority *S*. Infantis)
- The proportion of *bla*$_{\text{CTX-M-55}}$ increased (14.8% → 37.4%; majority *Salmonella* I, 4 [5], 12:i:-)

- The proportion of *bla*$_{\text{CTX-M-15}}$ isolates (among ESBL-positive isolates) remained variable between 3-10% for all years

Animal and Food Sources

- *bla*$_{\text{CTX-M-65}}$ substantially increased since 2021 among ESBL-positive isolates (37% → 81%; majority *S*. Infantis), and *bla*$_{\text{CTX-M-55}}$ remained stable



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Follow-up to Emerging Stories: Colistin and Carbapenem Resistance

Mobile colistin resistance continued to be rarely detected among human samples and not from animal or food samples.

- In 2020, **THREE** *Salmonella* isolates from humans
  - Serovars I: 4,5,12:i:- (n=1), and Cerro (n=2) were multiclass resistant and carried a ***mcr* gene**

- Human: mobile colistin resistance (*mcr* 1.1) was detected in one *Salmonella* isolate in **2023**. No mobile colistin resistance was found in *Salmonella* in 2021 and 2022. There were 17 isolates with mobile colistin resistance detected between 2017 and 2020

- Animals and food: *mcr3.3* was detected in a single *Aeromonas* isolate from retail shrimp, from Vietnam. Mobile colistin resistance has not been detected in submitted isolates of *Salmonella* and *E. coli.* Colistin resistance was detected in 3 *E. coli* isolates from dairy cattle; **mobile resistance has not yet been confirmed.**

Carbapenem resistance

- *Salmonella*: isolates from a sick pig (2017) and one human sample (2018)

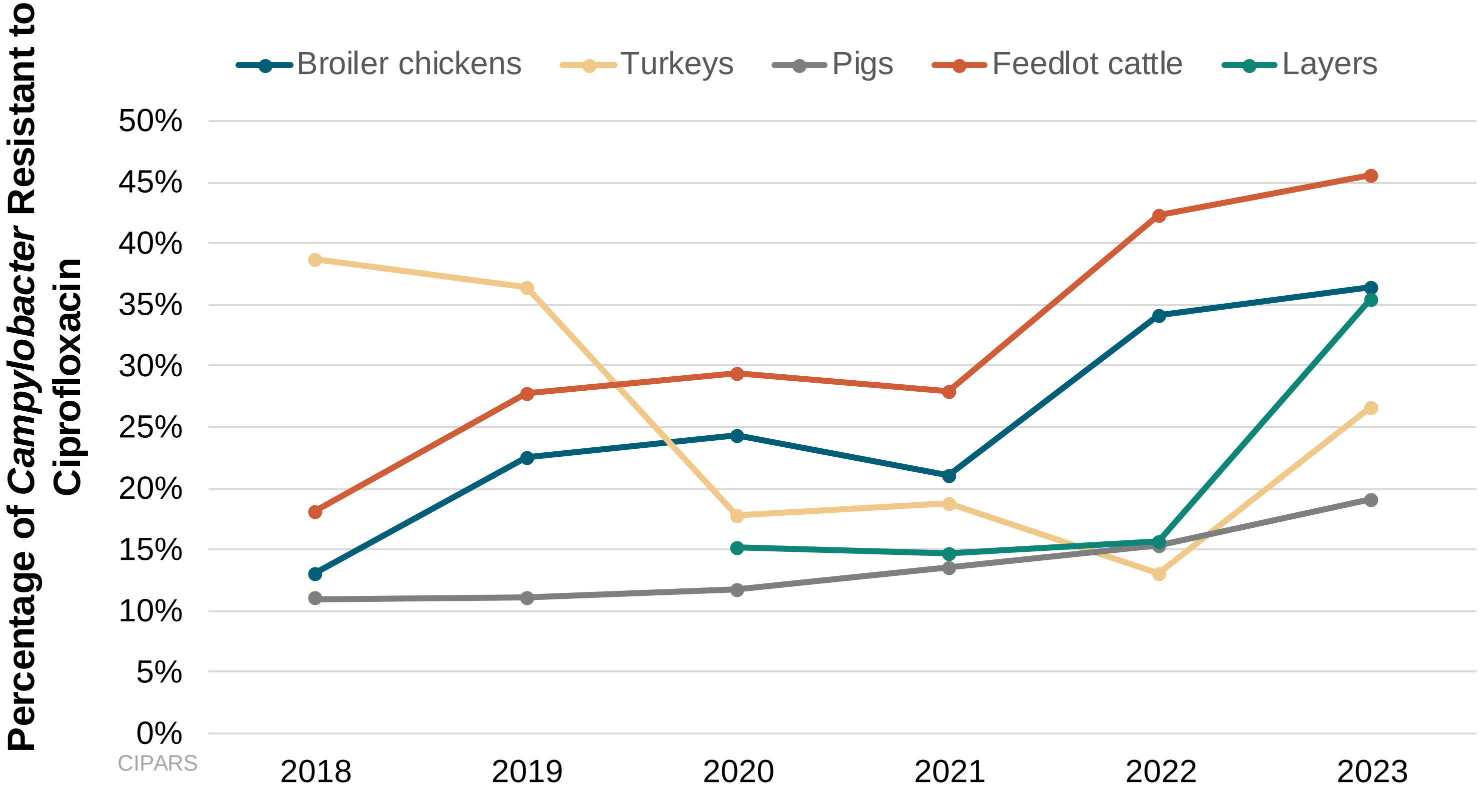
- Carbapenem resistance has not been detected in isolates of human or animal origin since 2018

Follow-up to Emerging Stories: Ciprofloxacin-resistant *Campylobacter*

The recovery of ciprofloxacin-resistant *Campylobacter* continued to increase from all animal commodities

Ciprofloxacin-resistant *Campylobacter* isolates recovered from feedlot cattle, broiler chickens, and pigs continued to increase.

A substantial increase in resistance was also observed among isolates recovered from **turkeys** and **laying hens.**



n	Broiler chickens	122	142	78	123	123	140
	Turkeys	191	214	90	240	115	109
	Pigs	483	447	349	367	365	425
	Feedlot cattle	94	162	92	247	184	149
	Layers	-	-	33	150	115	107

Year, Component, and n-value

Follow-up to Emerging Stories: Gentamicin Resistance

Recovery of gentamicin-resistant *Campylobacter* from healthy cattle is increasing

Historically, gentamicin resistance was not reported in *Campylobacter* isolates at the farm or abattoir level.

However,

- In 2019, 1 *Campylobacter* isolate from healthy feedlot cattle
- In 2022, 2 *Campylobacter* isolates from healthy cattle at slaughter

In 2023,

- There were seven isolates from **feedlot cattle (n=4)** and cattle at **abattoirs (n=3)**. These isolates were also resistant to nalidixic-acid, ciprofloxacin and tetracycline.

NOTE:

In our 2022 reporting, we noted gentamicin-resistant *Campylobacter* from other CIPARS components (chickens (n=1) and pigs (n=3) at abattoir). Upon further exploration of the data, the chicken and pig data were misclassified; therefore, the only CIPARS components with gentamicin-resistant *Campylobacter* were cattle sources.

Summary: Antimicrobial Sales and AMU (5 yr trend)

	Antimicrobial Sales (mg/kg biomass) (2019-2023)	AMU (2019-2023)
Pigs	↓	Grower-finisher pigs: ↓
Cattle	Dairy cattle: ↑ Beef cattle: ↑ Veal calves: ↓	Dairy cattle (2019-2022): ↑ Feedlot cattle: ↑
Poultry	→	Broilers: ↓ Turkey: ↓
Cats and Dogs	→	NA
Horses	↑	NA
Small Ruminants	↑ *due to improvements in reporting	NA
Aquaculture	↓	2018-2022 ↓

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NA – not applicable

↑ - Increasing

↓ - Decreasing

→ - Stable

Summary: Antimicrobial Resistance to ≥ 3 Antimicrobial Classes[a] (5 yr trend)

	AMR (farm)	**AMR (abattoir)**	**AMR (retail meat)**	**Diagnostic (*Salmonella*)**
Pigs/Pork	*E. coli/Salmonella/Campylobacter:* ↓	*E. coli/Salmonella/ Campylobacter:* ↓	*E. coli*: →	→
Cattle/Beef	Dairy cattle – *E. coli*: ↓ Dairy cattle – *Campylobacter*: → Feedlot – *E. coli*: → Feedlot – *Campylobacter*: →	*E. coli/Campylobacter*: →	*E. coli*: →	↓
Chickens/ Chicken	*E. coli*: ↓ *Salmonella:* ↑ *Campylobacter:* →	*E. coli:* ↓ *Salmonella:* ↑ *Campylobacter*: →	*E. coli*: ↓ *Salmonella*: ↑	↓
Turkeys/ Turkey	*E. coli/Salmonella*: ↓ *Campylobacter*: →	NA	*E. coli/Salmonella*: ↓	↓

NA – not applicable

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[a] AMR for this table is reflected primarily by the indicator "resistant to ≥ 3 antimicrobial classes". Noting that there are fluctuations in resistance to individual antimicrobials within bacterial species.

[b] A 5yr trend may not be presented for Salmonella and/or Campylobacter in every component due to low sample sizes and/or low isolate recovery.

Take-away Messages

- The quantity of antimicrobials sold for use in animals (adjusted for animal biomass) remained relatively stable since 2019. While sales in Canada plateaued, sales in the European Union decreased, **Canada now ranks 4th highest in comparison to countries in the European Union** (in comparison to 6th in 2021).

- **Colistin and carbapenem resistance were rarely detected**. Mobile colistin resistance was detected in one human *Salmonella* isolate in **2023.** Transmissible colistin resistance was not detected in any animal or food isolates of Canadian-origin, and carbapenem resistance was not detected from either human or animal sources since 2018.

- In 2023, we reported a **notable increase in ciprofloxacin resistance** among *Campylobacter* recovered from chickens, feedlot cattle, and grower-finisher pigs. **This trend now includes turkey and layer flocks.** Overall, ciprofloxacin resistance in *Campylobacter* from humans remains high (32%, 2022) and stable.

Take-away Messages

- ESBL-carrying non-typhoidal *Salmonella* from humans, animals, and food continued to increase. The frequency of ESBL-producing *Salmonella* prior to 2017 was less than 0.5% for each of humans and animals, in 2023 this stands at 1.6% and 1.7%, respectively.

- In 2023, **CIPARS continued to detect increasing proportions of nalidixic acid-resistant *S.* Enteritidis** from poultry and poultry products. This increase appeared to be attributed to the emergence of a mutation in *gyrA* (D87Y). Genomic analyses is currently on-going.

Acknowledgements

Human (AMR)

- NML Division of Enteric Diseases and PulseNet Canada
- Provincial Public Health Laboratories
- FoodNet Canada (*Campylobacter*)
- National Enteric Surveillance Program (NESP)

Farm (AMR and AMU):

- Veterinarians, producers and component groups who participate in the farm program, Saskatchewan Agriculture
- Feedlot Cattle Surveillance Funding: Canadian Agricultural Partnership in Alberta and Ontario, Alberta Cattle Feeders Association, Bayer Animal Health, Beef Farmers of Ontario, Beef Cattle Research Council, Alberta Beef Producers, McDonald's, Saskatchewan Cattle Feeders and Vetoquinol
- Dairy Cattle Surveillance: Funding provided by Dairy Farmers of Canada Dairy Research Cluster as part of the Canadian Agricultural Partnership
- Fisheries and Oceans Canada (DFO)

Abattoir:

- Canadian Food Inspection Agency, abattoir operators, samplers and personnel

Retail:

- Participating health units and institutions
- FoodNet Canada

Clinical Animal Isolates:

- Provincial Animal Health Laboratories

Antimicrobial sales for animals:

- VASR: Health Canada's Veterinary Drugs Directorate, PHAC

Antimicrobial Use - humans:

- AMR Task Force and IQVIA

Antimicrobials Sold as Pesticides for use in Crops:

- Health Canada's Pest Management Regulatory Agency