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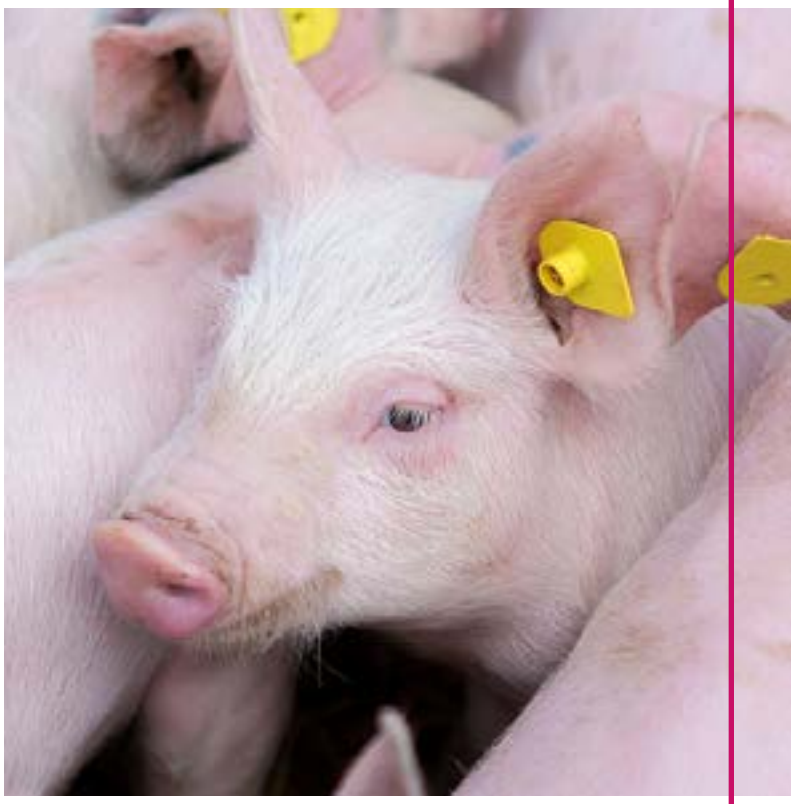
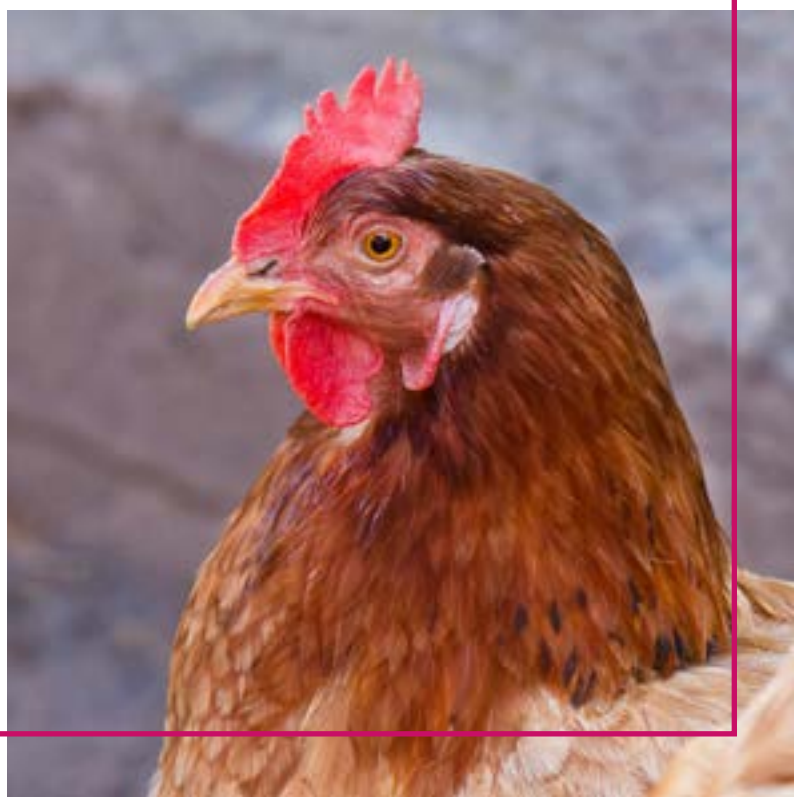
FINRES-Vet 2024

Finnish Veterinary Antimicrobial Resistance Monitoring and Consumption of Antimicrobial Agents



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RUOKAVIRASTO
Livsmedelsverket • Finnish Food Authority

fimea
Lääkealan turvallisuus- ja kehittämiskeskus
Säkerhets- och utvecklingscentret för läkemedelsområdet
Finnish Medicines Agency

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Abstract

Sales of veterinary antibiotics has been monitored in Finland already since 1995, marking 30 years of monitoring. According to the data, antibiotics are used responsibly in Finland for food-producing animals. In 2024, population adjusted sales of veterinary antibiotics was the second lowest since the start of monitoring. The majority, three quarters, of antibiotics sold for production animals were injections or topical preparations for individual animals. The remaining quarter consisted of antibiotics given through feed or drinking water to groups of animals. Injectable penicillin remained the most sold veterinary antibiotic. Sales of critically important antibiotics (HPCIA, WHO) was very low. While sales of antibiotic tablets for companion animals increased slightly in 2024, it has more than halved over the past decade.

There have not been big changes in the antibiotic resistance in bacteria isolated from animals and food, and the resistance situation remained relatively good also in 2024 in Finland. However, in certain bacterial species resistance is detected more often. Resistance was not detected among salmonella from food-producing animals. In Campylobacter isolated from slaughter broilers, antibiotic resistance was more common than earlier in the 2020s, but the proportion of resistant strains was still moderate. The resistance situation among indicator *E. coli* from slaughter broilers has remained good. The prevalence of ESBL/AmpC-producing bacteria was low on non-existent in slaughtered broilers, broiler meat and turkey meat.

The resistance situation among pathogenic bacteria isolated from food-producing animals remained similar to 2023. Resistance was overall low in bovine and porcine respiratory pathogens as well as in pathogens isolated from broilers. Resistance was still detected most in enterotoxigenic *E. coli* from pigs. Among bacteria isolated from companion animals, the changes in resistance levels were mostly small. The possible increasing trend in proportions of non-susceptible isolates detected in 2023 was not showing in 2024. The proportion of MRSA isolates of all *S. aureus* isolates from companion animals was the lowest during the monitoring period (1.7%).

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Tiivistelmä

Eläinten antibioottien myyntiä on Suomessa seurattu jo vuodesta 1995 eli kyseessä on seurannan 30-vuotisjuhlavuosi. Tilastojen perusteella Suomessa käytetään vastuullisesti antibiootteja tuotantoeläimille. Tuotantoeläinten määrään suhteutettu antibioottien myynti vuonna 2024 oli toiseksi matalin seurannan aloittamisen jälkeen. Valtaosa, kolme neljännestä tuotantoeläinten antibioottien myynnistä oli eläinyksilöille injektioina tai paikallisesti annettavia valmisteita. Loppu neljännes oli eläinryhmille rehun tai juomaveden mukana annosteltavia valmisteita. Injektiopenisilliini oli edelleen tuotantoeläimille eniten myyty antibiootti. Ihmisten reserviantibioottien myynti (HPCIA, WHO) oli erittäin vähäistä. Seuraeläinten antibioottitablettien myynti lisääntyi vuonna 2024 hieman, mutta oli puolet vähemmän kuin vuosikymmen aiemmin.

Eläimistä ja elintarvikkeista eristettyjen bakteerien antibioottiresistenssitilanteessa ei ole tapahtunut viime vuosina suuria muutoksia ja tilanne on pysynyt vuonna 2024 suhteellisen hyvänä. Kuitenkin joillain bakteerilajeilla resistenssiä esiintyy yleisemmin. Kotimaisista tuotantoeläimistä eristetyillä salmonelloilla ei todettu resistenssiä vuonna 2024. Teurasbroilereista eristetyillä kampylobakteereilla antibioottiresistenssiä esiintyi enemmän kuin aiemmin 2020-luvulla, mutta resistenttien kantojen osuus oli edelleen maltillinen. Teurasbroilereista eristettyjen *E. coli* -indikaattoribakteerien resistenssitilanne on pysynyt hyvänä. ESBL/AmpC-bakteereita esiintyi suomalaisissa teurasbroilereissa sekä vähittäismyydyssä broilerin- ja kalkkunanlihassa vähän tai ei ollenkaan.

Tuotantoeläinten patogeenien resistenssitilanne pysyi samankaltaisena vuoteen 2023 verrattuna. Resistenssiä todettiin yleisesti ottaen vähän nautojen ja sikojen hengitystietulehduksia aiheuttavissa bakteereissa sekä broilereilta eristetyissä patogeeneissa. Eniten resistenssiä todettiin edelleen sikojen enterotoksisilla *E. coli* -kannoilla. Seura- ja harraste-eläimistä eristettyjen bakteerien resistenssitasojen muutokset olivat pääasiassa pieniä, eikä vuonna 2023 havaittu mahdollinen noususuuntainen trendi herkkyydeltään heikentyneiden kantojen osuuksissa jatkunut samansuuntaisena vuonna 2024. MRSA-kantojen osuus seura- ja harraste-eläimistä eristetyistä *S. aureus* -bakteereista oli seurantajakson alhaisin (1,7 %).

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Försäljningen av antibiotika för djur har följts upp i Finland sedan 1995. Uppföljningen firar med andra ord 30-årsjubileum i år. Enligt statistiken används antibiotika ansvarsfullt för produktionsdjur i Finland. Försäljningen av antibiotika i förhållande till antalet produktionsdjur var år 2024 den näst lägsta sedan uppföljningen inleddes. Största delen, tre fjärdedelar, av försäljningen av antibiotika för produktionsdjur var preparat som ges till enskilda djur som injektioner eller lokalt. Den återstående fjärdedelen var preparat som administrerades åt djurgrupper genom foder eller dricksvatten. Penicillin som ges som injektioner var fortfarande den mest sålda antibiotika för produktionsdjur. Försäljningen av reservantibiotika för människor (HPCIA, WHO) var mycket liten. Försäljningen av antibiotikatabletter för sällskapsdjur ökade något år 2024, men var hälften mindre än årtiondet tidigare.

Under de senaste åren har det inte skett några stora förändringar i antibiotikaresistensen hos bakterier som isolerats från djur och livsmedel, och situationen har förblivit relativt god år 2024. Resistens är dock vanligare hos vissa bakteriearter. Resistens kunde inte påvisats hos salmonellabakterier som isolerats från finska produktionsdjur. Hos campylobacter som isolerats från slaktkycklingar förekom antibiotikaresistens mera än tidigare under 2020-talet, men andelen resistenta stammar var fortfarande måttlig. Resistenssituationen för *E. coli* -indikatorbakterier som isolerats från slaktbroilrar har hållits god. ESBL/AmpC-bakterier förekom i liten mån eller inte alls hos finska slaktbroilrar samt i broilerkött och kalkonkött som såldes i detaljhandeln.

Resistenssituationen för patogener från produktionsdjur förblev liknande jämfört med 2023. I allmänhet var resistensen låg hos bakterier som orsakar luftvägsinfektioner hos nötkreatur och svin, liksom hos patogener som isolerats från slaktkycklingar. Mest resistens hittades fortfarande hos enterotoxiska *E. coli* -stammar från svin. Förändringar i resistenssituationen för patogener som isolerats från sällskaps- och hobbydjur var huvudsakligen små. Den uppåtgående tendensen av isolater med nedsatt känslighet som upptäckts år 2023 sys inte längre i data från 2024. Andelen MRSA-stammar av *S. aureus* -bakterier som isolerats från sällskaps- och hobbydjur var den lägsta som konstaterats under uppföljningsperioden (1,7 %).

Contents

Introduction

FINRES-Vet 2024 reports statistics on sales of veterinary antibiotics and antibiotic resistance in bacteria isolated from animals and food. This report covers the latest results from 2024 but includes data also from previous years to enable a follow-up of trends.

The resistance monitoring in animals in Finland is based on Commission Implementing Decision (EU) 2020/1729, which focuses on zoonotic and indicator bacteria in food-producing animals and meat thereof, but the FINRES-Vet monitoring programme is complemented with other nationally selected monitoring targets such as pathogens from sick animals. In 2024, antibiotic resistance was monitored in zoonotic and indicator bacteria from production animals along with resistance of certain animal pathogens from clinical submissions isolated from production and companion animals.

All use of antibiotics increases the risk of development and spread of resistance and therefore it is important to know how much antibiotics are sold and used in animals. Sales of veterinary antibiotics in Finland have been monitored since 1995 by collecting data from the wholesalers and reporting the sales as weight of active ingredient (in kg) by antimicrobial group and administration route. Data collection was harmonised with the ESVAC protocol in 2010. To enable better assessment of the success of (the national) prudent use guidance the population corrected sales of antibiotics are in this report presented as EU-indicators (in mg/PCU) and the proportion of sales by AMEG category is presented by administration route.

In year 2023 it became obligatory for all the member states to collect data on the use of antibiotics per animal species and categories and report the data to European Medicines Agency. The data collected is harmonised throughout the whole Union and it will be published annually in ESUAvet reports by European Medicines Agency. In this FINRES-Vet report, the data collected by Finnish Food Authority on the use of antibiotics in laying hens, broilers and turkeys are presented the first time.

Monitoring of antimicrobial resistance in bacteria isolated from animals is important as resistant bacteria can transfer between animals and humans as well as via other routes such as food, feed, and the environment. New emerging resistance traits such as carbapenemase-producing bacteria are of great concern as they pose a serious threat to human health. Furthermore, resistance in animal pathogens needs continuous monitoring in order to indicate effectiveness of antibiotic treatments and whether prudent use guidelines to veterinarians are up to date. However, it must be emphasised that when assessing the overall resistance levels of pathogenic bacteria isolated from clinical cases, data may be biased because the isolates are frequently obtained from uncommonly severe or recurrent infections.

The antibiotic resistance of indicator bacteria in a certain animal population reflects the selection pressure caused by antibiotic use and the resistance trends seen in these bacteria are thought to evolve over time depending on the antibiotic use. To assess resistance trends, harmonised EU outcome indicators of antimicrobial resistance are presented.

The FINRES-Vet programme has the following objectives:

- to monitor the consumption of antibiotics used in veterinary medicine,
- to monitor antibiotic resistance in bacteria from major food-producing animals, food, and companion animals,
- to analyse trends in the occurrence of resistant bacteria from animals and food,
- to monitor the emergence of resistant clones and the appearance of new resistance phenotypes in bacteria from the aforementioned sources.

The overall resistance situation in bacteria isolated from animals and food of animal origin in Finland has generally been favourable. This is most likely due to the long history of strict antibiotic policy, and active promotion of health and welfare of food-producing animals i.e. preventive measures. National prudent use guidelines recommend choosing narrow spectrum antibiotics and individual treatment whenever possible (Evira, 2016). Overall sales of veterinary antibiotics in Finland are low. In 2024, the population corrected sales of antibiotics to food-producing animals decreased by 2% and were the second lowest ever reported. Narrow spectrum penicillin is the most used antibiotic, and the majority of antibiotics are given to individual animals. However, resistance in some zoonotic bacteria and certain animal pathogens has been observed in recent years. This highlights the importance of long-term monitoring of antibiotic resistance also at herd level and indicates the importance of preventive measures and the need to keep the prudent use guidelines updated. The species-specific data on the use of antibiotics will be important as well in the future years when reliable data is available. It is generally acknowledged that when a new data collection system has been initiated it takes at least 3-5 years before a solid baseline is achieved.

The FINRES-Vet programme is coordinated by the Finnish Food Authority. Other collaborators are the Finnish Medicines Agency (Fimea) and the University of Helsinki. The Finnish Food Authority monitors antibiotic resistance in bacteria in food-producing and fur animals as well as in food. The Finnish Medicines Agency monitors sales of veterinary antibiotics, and the Finnish Food Authority the use of feed additives and medicated feeds. The Clinical Microbiology Laboratory of the Veterinary Teaching Hospital (University of Helsinki) provides antibiotic susceptibility data from companion animals and horses.

1 Sales and use of antibiotics for use in animals

1.1 Changes in animal population

The overall number of food-producing animals from 2015 to 2024 continued to show a slight decrease. Figure 1.1). Details on the number of holdings, live animals, and meat and milk production are presented in Appendix 1. The number of livestock and the number of animals slaughtered are used for calculating Population Correction Unit (PCU) which takes into account both the number of animals and their weights. Since 2015, the PCU has decreased by 10% from 520 to 465 (thousand tons).

The PCU unit has been used in ESVAC reporting as a measure of animal biomass since 2009 (EMA, 2011). In 2023, ESVAC reporting was replaced by ESUAvet reporting, and at the same time, the calculation method for animal biomass was changed. This report employs both units of animal biomass, with each unit clearly indicated in the respective sections.

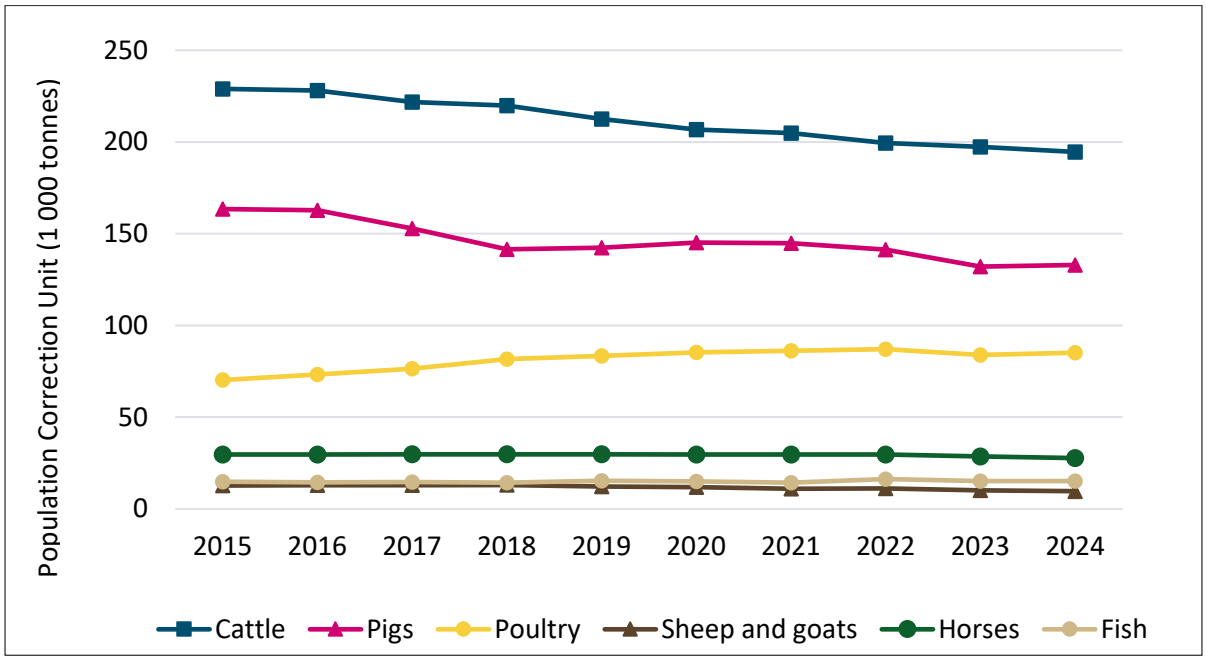

Figure 1.1. *Changes in food-producing animal population in Finland in 2015–2024, PCU (1 000 tonnes). Detailed data on the PCU of food-producing animals in a tabulated form is presented in Appendix 1.*

Regarding the number of companion animals, Statistics Finland estimated that the number of dogs and cats in 2016 was about 700 000 and 600 000, respectively. It has been estimated that the number of companion animals increased during the COVID-19 pandemic. According to a survey commissioned by the Finnish Kennel Club, there were approximately 800 000 dogs in Finland in 2023. The number of fur animals in Finland has fluctuated significantly over the past decade (FIFUR, 2025). In 2015, the number of cubs born peaked at approximately 4.7 million, corresponding to an estimated 30 tonnes of live animals. Since then,

the trend has been steadily declining. By 2024, only 800 000 cubs were born — a drop of more than 30% compared to 2023. This sharp decrease was primarily due to an outbreak of Avian Influenza in Finland, during which hundreds of thousands of animals were culled to prevent the spread of the disease.

1.2 Sales of antibiotics for treatment of animals

1.2.1 Background

Finnish Medicines Agency Fimea monitors the sales of veterinary antibiotics based on statistics obtained from pharmaceutical wholesalers. Sales data are available since 1995. This report includes data for 2015–2024 with a particular focus on 2024. For a review of data for 1995–2014, see the FINRES-Vet reports covering the corresponding years.

Data is collected in accordance with the protocol of the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) project (EMA, 2021). It also covers sales of veterinary antibiotics that are used on a special licence (exemption from a requirement for a marketing authorisation in Finland i.e. veterinary antibiotic products obtained from other Member States and permitted to be released for consumption for use in specified animal species). In 2024, their proportion was approximately 8% of the overall sales.

Sales data are presented as kg active ingredient for overall sales and sales by different pharmaceutical forms (i.e. injectables, antibiotics administered orally, intramammaries and tablets). For intramammaries, sales of tubes per cow is also reported. It should be noted that the dosing of antibiotics varies between and within antibiotic classes, and between animal species treated. In addition, sales expressed as kg active ingredient does not take into account changes in animal populations and therefore it is important to compare trends in sales of antibiotics to the same class over a longer period of time.

To compare changes in annual sales of antibiotics, the data should be in proportion to the population of animals in the given period. In this report, a population correction unit (PCU) is used. One PCU corresponds to approximately one kg and represents an estimate of livestock population and slaughtered animals each year. PCU is strictly a technical unit and covers the population of major food-producing species. PCU was developed within the ESVAC project, and a detailed description is available in ‘Trends in the sales of veterinary antimicrobial agents in nine European countries: Reporting period 2005–2009‘ (EMA, 2011). Population adjusted sales, mg active ingredient per PCU (mg/PCU) are presented in this report only for the EU indicators of veterinary antibiotics applicable in Finland i.e. overall sales, sales of fluoroquinolones and 3rd generation cephalosporins (ECDC, EFSA and EMA, 2017). PCU adjusted data does not include tablets, as they are almost exclusively used in companion animals. Only estimates of the number of dogs and cats in Finland are available, and therefore sales of tablets cannot be adjusted to the population of companion animals, but are presented in a separate figure, as kg active ingredient.

1.2.2 Overall sales (kg active ingredient)

Overall sales of veterinary antibiotics in 2024 was 8 104 kg, which is the second lowest ever reported (Figure 1.2, Table A6. in Appendix 2). From 2023 to 2024, sales decreased by 2%. Biggest decreases were noted in

sales of tetracyclines, sulfonamide-trimethoprim combination and sales of penicillin. For population corrected sales see section 1.2.5. on EU-indicators.

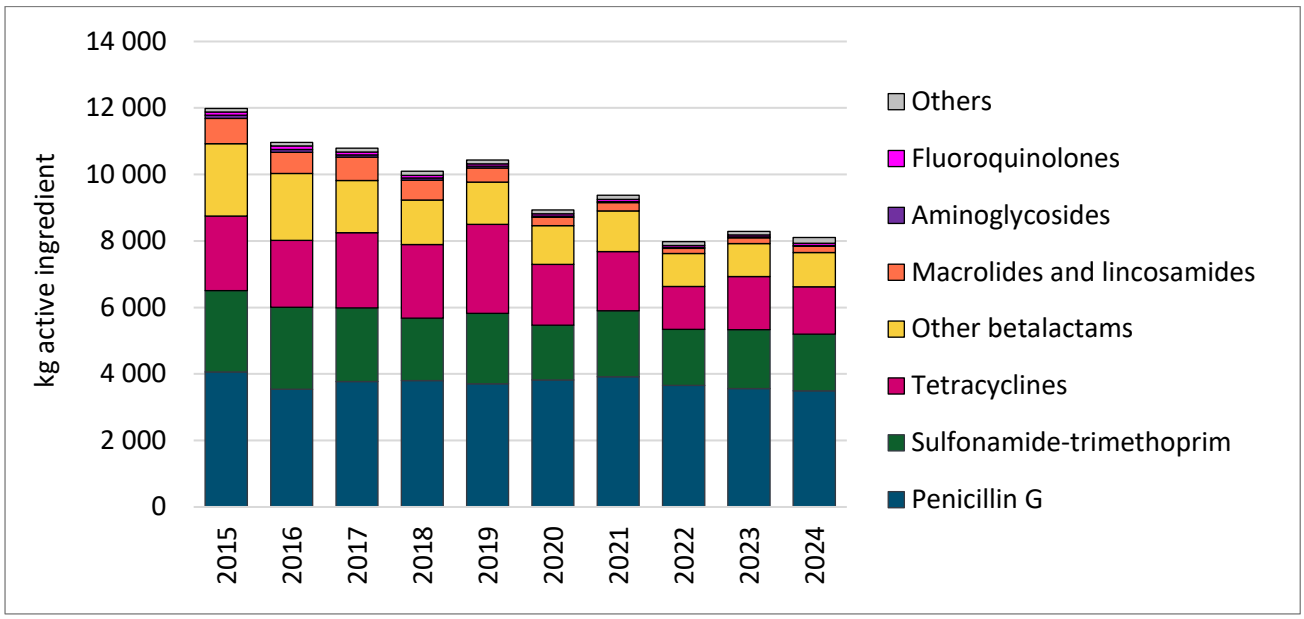

***Figure 1.2**. Overall sales (kg active ingredient) by class in 2015–2024 (tablets included). Other betalactams = aminopenicillins, cephalosporins and cloxacillin. Others = pleuromutilins, amphenicol and imidazole derivatives. For detailed data in tabulated form, see Appendix 2.*

The most-sold antibiotics continued to be penicillin G (43%), sulfonamide-trimethoprim combinations (21%) and tetracyclines (18%) (Figure 1.2). Of the antibiotic classes considered as critically important in human medicine (HPCIA) by both EMA and WHO (EMA, 2019 and WHO, 2019), only two are authorised for use in animals in Finland, namely fluoroquinolones, and 3rd generation cephalosporins. The proportion of sales for these remained low to extremely low (fluoroquinolones 0.7% and 3rd generation cephalosporins 0.001%). WHO also considers macrolides as HPCIA, their sales for use in animals in Finland was also low (1.6% of the overall sales in 2024, Table A6 in Appendix 2).

1.2.3 Proportion of individual treatment vs. group treatment (tablets excluded)

Three quarters (76%) of antibiotics sold for treatment of food-producing and fur animals in 2024 were pharmaceutical forms intended for the treatment of individual animals (injectables, oral pastes, and intramammary products). The remaining quarter was for products applicable for group treatment (premixes, oral powders, and oral solutions) (Figure 1.3).

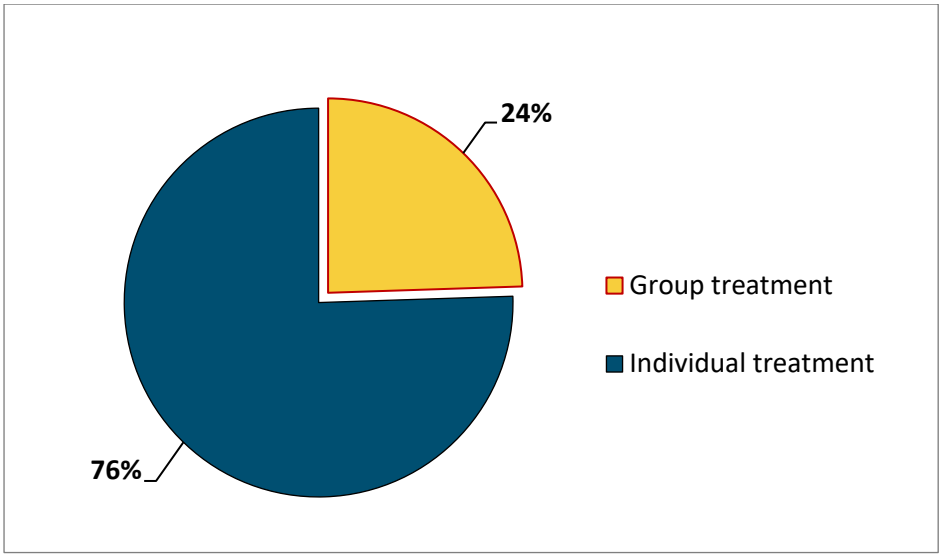

***Figure 1.3**. Sales of veterinary antibiotics for treatment of food-producing animals and fur animals by treatment type (group vs. individual) in 2024 (tablets excluded). Group treatment: premixes, oral solutions, and oral powders. Individual treatment: injectables, intramammaries and oral paste.*

1.2.4 Sales based on route of administration (kg active ingredient)

Injectables

Over half of the antibiotics sold (52%) were products administered as injections to animals (see Appendix 2). The proportion of AMEG D category antimicrobials of the sales of injectables was very high 97% (Fact box 1). Penicillin continues to be the by far most sold injectable (76%), followed by tetracyclines (12%) and aminopenicillins (6%) (Figure 1.4A). Proportion of AMEG B category antimicrobials was only 1.1%, of which 99.8% were fluoroquinolones and the remaining 0.2% 3rd generation cephalosporins.

A general decreasing trend in the sales of injectable antimicrobials has been observed through the decade and in 2024 sales, 4 242 kg, is the lowest ever recorded. For low selling injectables (less than 30 kg/year) fluctuations in annual sales are common. For details see Table A7. in Appendix 2.

Orally administered products (tablets excluded)

Sales of orally administered veterinary antibiotics, excluding veterinary antibiotic tablets, are presented in Figure 1.4B. Two most sold antibiotic groups for oral administration were sulfonamide-trimethoprim combination (42%) and tetracyclines (25%), contributing to the high proportion of AMEG D category antimicrobials in orally administered products (90%) (Fact box 1).

Sales of orally administered products, in kg active ingredient, has almost halved in ten years (-45%), but annual variation has been significant particularly in recent years (Figure 1.4B and Table A8-A in Appendix 2. Decrease was observed in sales of the two high selling orally administered classes, tetracyclines (-15%) and sulfonamide-trimethoprim combination (-4%). The biggest proportional changes from 2023 to 2024 were increase in sales of amphenicols (+89%) and penicillin V (52%).

To note is that some oral powder and oral solution products including e.g. aminopenicillins, cephalosporins and fluoroquinolones, solely used in companion animals, are still included in the sales of orally administered products, but their proportion is very small; less than 0.5% of orally administered antibiotics in 2015–2024.

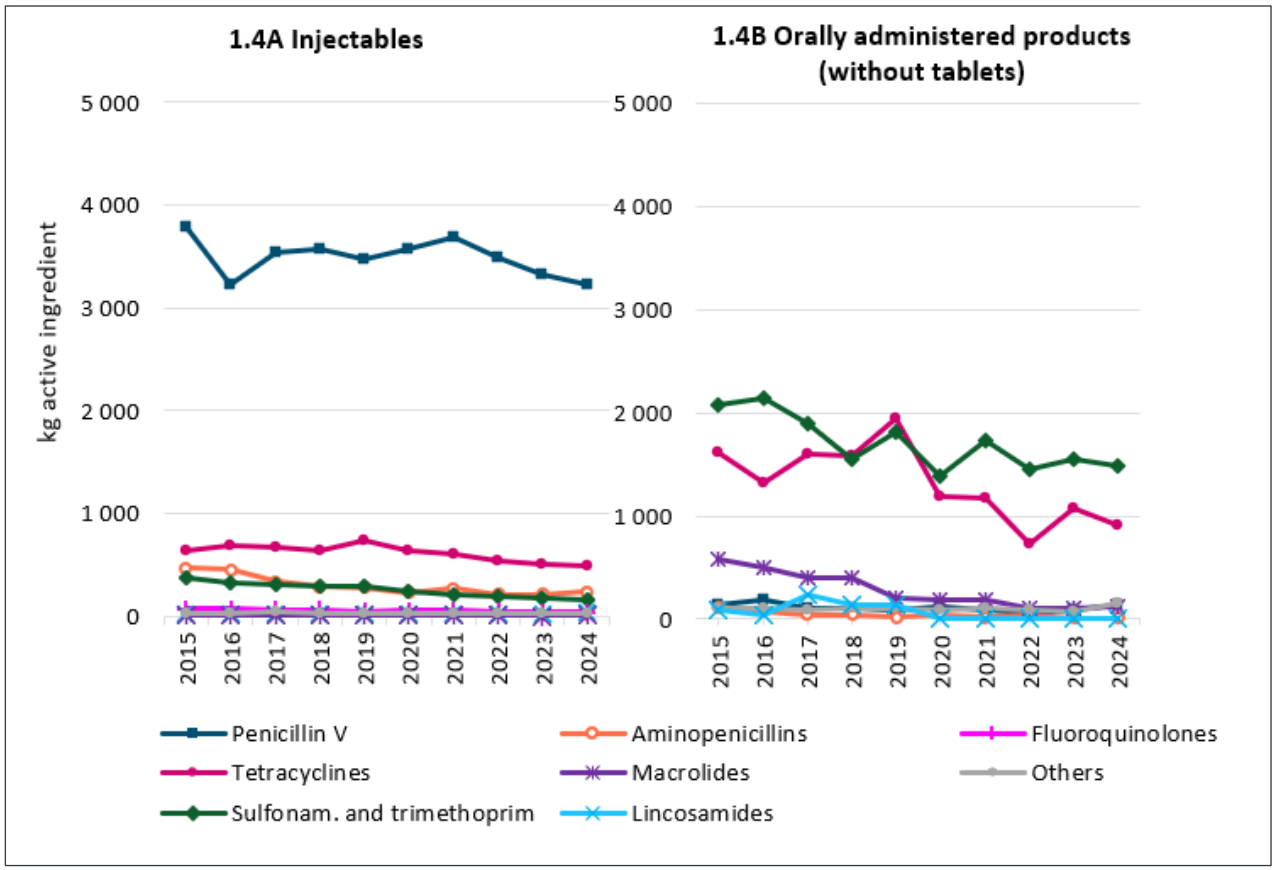

Figure 1.4A and 1.4B. *Trends in sales of injectables (1.4A) and in sales of orally administered veterinary antibiotics (1.4B) in 2015–2024 (tablets excluded). Other injectables = amphenicols, aminoglycosides and cephalosporins. Other oral products = amphenicols, 1st gen. cephalosporins and pleuromutilins. Detailed data in tabulated form in Appendix 2. Table A7 and A8-A.*

Fact box 1. Sales of veterinary antimicrobials by AMEG category in Finland

Antibiotics have been categorised in the EU into four groups based on their potential consequences to public health due to increased antimicrobial resistance when antibiotics are used in animals. This categorisation has been done by the European Medicine Agency and includes antibiotic classes authorised for human and/or veterinary use in the EU. **The AMEG categorisation is intended as a tool for veterinarians to support prudent use and decision-making on which antibiotic to use** (EMA, 2019).

The antibiotics recommended as a first-line treatment of animals belong to AMEG category D and include e.g. penicillin G, tetracyclines and sulfonamide-trimethoprim combination. If there are no clinically efficient alternatives belonging to category D, then AMEG category C antibiotics can be considered (e.g. macrolides, aminoglycosides, 1st generation cephalosporins and aminopenicillins with beta-lactamase inhibitors). If there are no clinically effective antibiotics in categories C or D, only then can category B antibiotics be considered. All category B antibiotics are critically important in human medicine and their use should be restricted to a minimum.

In 2024, the proportion of AMEG D category antimicrobials of the total veterinary antimicrobial sales in Finland was 93%. By administration routes, the highest proportion of AMEG D antibiotics was for intramammaries for lactation period (100%), followed by injectables (97%) and orally administered antibiotics (tablets excluded) (90%). For veterinary antibiotic tablets, the proportion of AMEG D category antibiotics was only 9%.

Table 1.1. *The proportion of antibiotic sales by AMEG category for different administration routes in 2024.*

	Total sales 2024	Injectables	Orally administered (excl. tablets)	Tablets	Intrammmaries for lactation period	Intrammmaries for dry cow treatment
AMEG B	1%	1%	0%	1.5%	0%	0%
AMEG C	6%	2%	10%	90%	0%	22%
AMEG D	93%	97%	90%	8.5%	100%	78%

Tablets

Veterinary antibiotic tablets are almost solely used for the treatment of companion animals. Their sales have more than halved from 2010 to 2022 (Figure 1.5). The sales of veterinary antibiotic tablets increased by 2% from 2023 to 2024. The major changes observed were the increase in sales of amoxicillin (+8%) and the decrease in sales of 1st generation cephalosporins (-30%).

Amoxicillins are the most sold veterinary antibiotic tablets (78%), and their sales consists almost entirely of amoxicillin-clavulanic acid combination (over 99% of amoxicillin sold in veterinary tablets in 2024). The second most sold veterinary antibiotic tablets are 1st generation cephalosporins (9%) followed by sulfonamide-trimethoprim combination (6%) (Table A8-B. in Annex 2). Veterinary antimicrobials used for the treatment of companion animals had in general a broader spectrum than antimicrobials used for the treatment of food-producing animals in Finland. The proportion of AMEG D category antimicrobials in 2024 was 9% for veterinary antimicrobial tablets compared to 93% in the overall sales in 2024 (Fact box 1).

It should be noted that this report contains only sales of veterinary antibiotic products. The amount of human medicinal products prescribed for use in companion animals is not known as their sales are not captured with the current methodology. Such data collection would require an electronic prescribing or other data collection system, which is currently not available for veterinarians in Finland. Legislation, nevertheless, requires veterinarians to choose a veterinary medicinal product if such is available. To which extent this rule is followed, is not known.

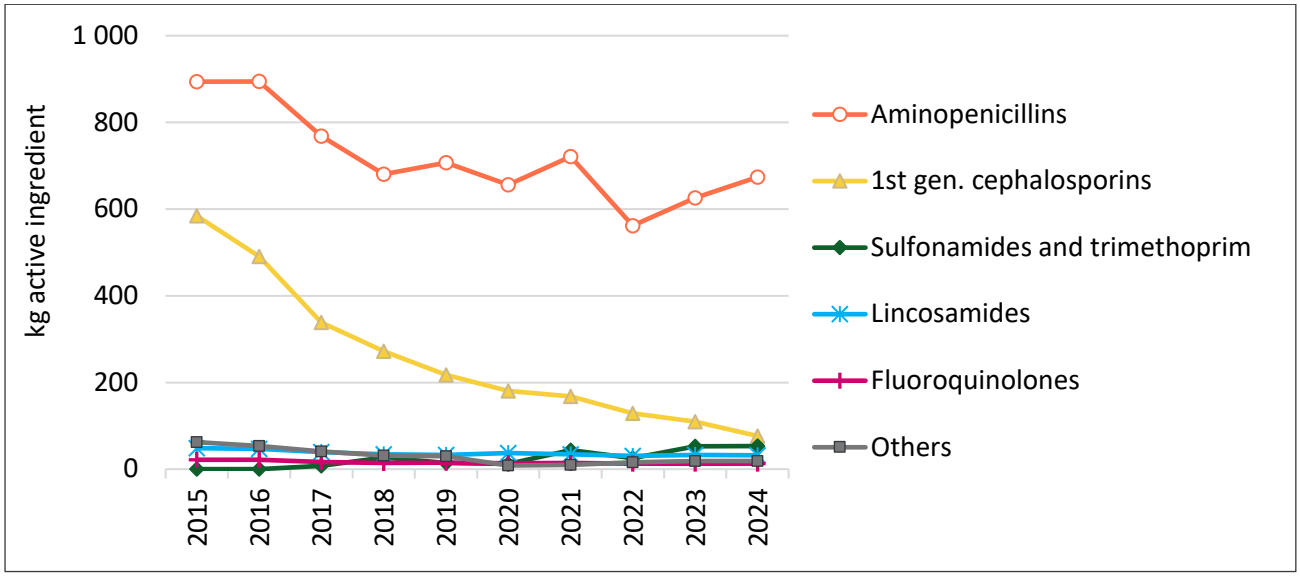

Figure 1.5. *Sales of antibiotic tablets to companion animals (kg active ingredient) by class in Finland in 2015–2024. Others include tetracyclines, imidazole derivatives and aminoglycosides. Sulfonamide-trimethoprim combination is available through special license.*

Intramammaries

Sales of intramammary products for the lactation period per cow have almost halved since 2015 (-45%). In 2015, approximately 1.4 tubes for the lactation period were sold per cow whereas in 2024, the corresponding figure was 0.8 (Figure 1.6). All antimicrobial intramammary products for use during the lactation period in Finland belong to AMEG category D i.e. are of narrow spectrum. Penicillin is by far the most used antimicrobial for the lactation period (87%), followed by cloxacillin (13%) (Table A9-A in Appendix 2).

Sales of dry cow products has remained stable being approximately 0.9 tubes/cows in 2015–2024 (variation 0,74–0.96 tubes/cow) (Figure 1.6). Availability of dry cow intramammary products is constantly affected by shortages in supply chain and also in 2024, special license arrangements were necessary to secure the availability of replacement products. Proportion of AMEG D category antimicrobials of the sales of all dry cow products was 78% in 2024 (penicillin G 54% and cloxacillin 24%). Remaining 22% were AMEG C category aminoglycosides (Tables A9-A and A9-B in Appendix 2).

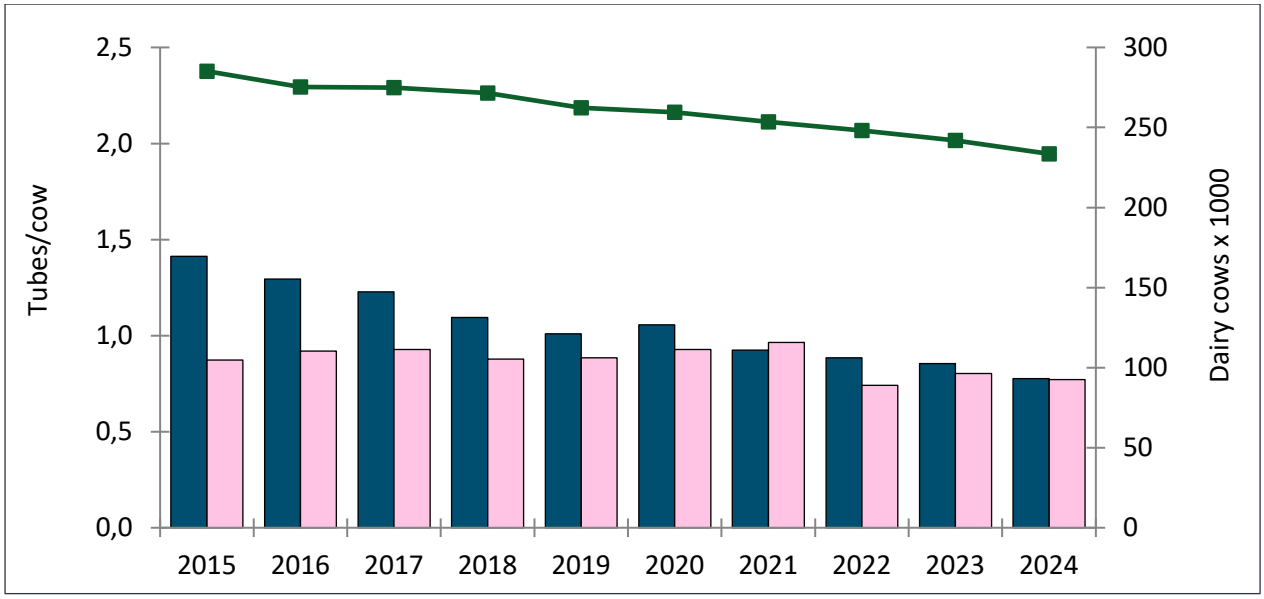

Figure 1.6. *The number of antibiotic intramammary tubes sold per cow during lactation period (blue column) and during dry cow period (pink column) and the number of dairy cows (green curve).*

1.2.5 EU-indicators of antibiotic consumption in food-producing animals (mg/PCU)

ECDC, EFSA and EMA have jointly established a list of indicators to assist EU Member States in assessing their progress in reducing the use of antibiotics and the occurrence of antibiotic resistance in both humans and food-producing animals (ECDC, EFSA and EMA 2017). Of these, overall sales of veterinary antibiotics, sales of 3rd generation cephalosporins and sales of fluoroquinolones measured in mg/PCU are applicable in Finland.

All other pharmaceutical forms except tablets are included in the calculations of population corrected sales in food-producing animals, as veterinary tablets are almost exclusively used for the treatment of companion animals. Injectable antibiotic products are often authorised for both food-producing and companion animals; however, it has been estimated that the volume of the use of injectable antibiotics in companion animals is minor (measured as kg active ingredient) and therefore such sales can be included in the overall sales for food-producing animals (EMA, 2022). For certain injectable antibiotic classes that in Finland are only allowed for use in companion animals and foals, e.g. 3rd generation cephalosporins, their inclusion in population corrected sales results in an overestimation of the use in food-producing animals.

In 2024, population corrected overall sales of veterinary antibiotics for food-producing animals decreased some (-2%; 0.4 mg/PCU) (Table 1.2). Sales of 3rd generation cephalosporins continued to decrease (-17%) and was the lowest ever recorded (0.0002 mg/PCU). Sales of fluoroquinolones was stable at 0.10 mg/PCU (1% increase).

Table 1.2. *EU-indicators of antibiotic consumption in food-producing animals (mg/PCU) in Finland. Note that sales of tablets have been excluded as they are used almost exclusively for companion animals.*

Sales (mg/PCU)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Overall sales	20.0	18.1	18.8	18.1	19.0	16.2	17.1	14.9	15.9	15.5
Fluoroquinolones	0.14	0.15	0.12	0.13	0.10	0.11	0.11	0.10	0.10	0.10
3rd generation cephalosporins[1]	0.014	0.006	0.001	0.001	0.0005	0.0004	0.0004	0.0003	0.0003	0.0002

[1] Since 2017, 3rd generation cephalosporins have been available only for companion animals and individual foals. For details, see the chapters above.

1.3 Use of antibiotics in animals by species

Since 2023, EU Member States have been required to collect species-specific data on the use of antibiotics in animals and report this information to the European Medicines Agency. Finland began collecting such data in spring 2022. According to general estimates, it typically takes at least 3 to 5 years from the initiation of a new data collection method before the data can be considered reliable.

Finland already has reliable data available on antibiotic use in chickens and turkeys. The Figure 1.7 presents the amounts of antibiotics used, adjusted for animal biomass according to the ESUAvet reporting methodology, for production flocks of laying hens, broilers, and turkeys for the years 2023 and 2024. The methodologies of calculation both biomass and amounts of active substances are described in the first ESUAvet report (EMA, 2025). Total animal biomass and the amount of antibiotics used in laying hens, broilers and turkeys are shown in Appendix 2 (Tables A9-A and A9-B).

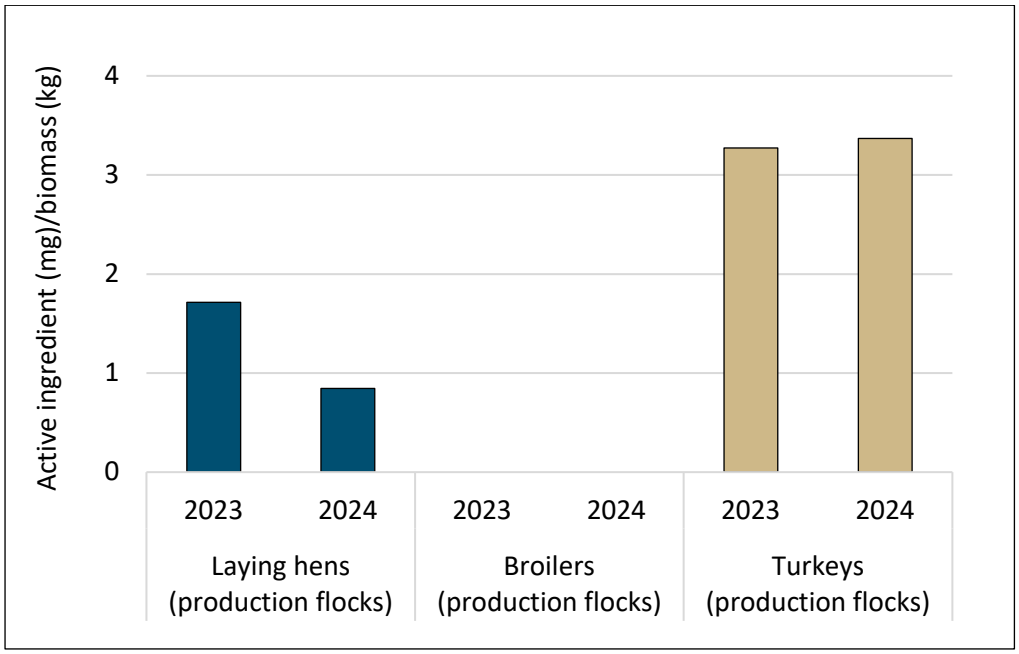

Figure 1.7 *The biomass adjusted use of antibiotics (mg/kg) in production flocks of laying hens, broilers, and turkeys in the years 2023 and 2024.*

As the data collected by the Finnish Food Authority is currently available only from two years it is not yet possible to find any trends. The antibiotics used in laying hens and turkeys belonged to AMEG category D. For turkeys only penicillin was used on both years. For laying hens only penicillin was used in year 2023 whereas in year 2024 both tetracyclines (46%) and penicillin (54%) was used. Annual fluctuations depend not only on the health situation but also on the age and size of the animals while treated with antibiotics. However, according to the data collected by the poultry industry the broiler production flocks has not been treated with antibiotics since 2010.

1.4 Sales of coccidiostats for use in animals

The Finnish Food Authority monitors the annual consumption of feed additives by collecting data from feed manufacturers (Finnish Food Authority, 2025). In 2024, coccidiostats monensin sodium and narasin were used as prophylactic anti-parasitic agents mainly in broiler and turkey production. The use of coccidiostats increased from previous years (Table 1.3). The overall use of coccidiostats has increased by 33% in ten years. During the same time, the production of poultry meat has increased by 27%, and the number of broilers and turkeys by approximately 25%.

Table 1.3. *The use of coccidiostats in feed in Finland in 2015–2024 (kg active substance/year).*

Substance	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Decoquinate	0	0.1	0	0	0	0	0	0	0	0
Diclazuril	0	0	0.8	0.5	0.04	0	0	0.15	0.34	0
Lasalocid sodium	0	0	0	1 336	0	0	0	0	0	0
Madmuramycin ammonium	0	0	0	0	0	0	0	0	0	0
Monensin sodium	12 640	15 373	14 693	5 097	13 979	14 710	14 767	17 410	15 855	18 556[1]
Narasin	5 478	5 026	4 918	13 152	6 535	6 084	6 428	6 191	5 921	5 578
Nicarbazin	0	0	0	0	0	0	117	0	0	0
Salinomycin	0	0	0	0	0	0	0	0	0	0
Robenidine hydrochloride	0	0	0	0	0	0	0	0	0	0
Total	**18 117**	**20 399**	**19 613**	**18 585**	**20 514**	**20 795**	**21 312**	**23 601**	**21 777**	**24 134**

[1] 57 kg used in exported feed mixtures

2 Antibiotic resistance in zoonotic bacteria

The zoonotic bacteria included in the resistance monitoring in Finland include salmonella from food-producing animals and domestic food domestic foods of animal origin, and campylobacter from food-producing and fur animals. The Commission Implementing Decision (EU) 2020/1729 covers *Salmonella* spp. isolates obtained from laying hens, broilers and fattening turkeys taken in the framework of the national control programmes provided for in Article 5 of Regulation (EC) No 2160/2003. In FINRES-Vet, all *Salmonella* spp. isolated within the national salmonella control programme (Ministry of Agriculture and Forestry MAF Decrees 1030/2013; 1037/2013; 134/2012, and the amendment, MAF Decree on zoonoses 316/2021) are included.

The sampling and testing of campylobacter isolated from broilers and pigs is carried out as per requirements laid down in Commission Implementing Decision (EU) 2020/1729. *Campylobacter* spp. isolated from broilers originate from the national campylobacter control programme (MAF Decree on zoonoses 316/2021) and all isolates are tested for resistance annually. In addition, campylobacter from cattle and fur animals are included in the FINRES-Vet on a regular basis.

Details of the susceptibility testing as well as correspondences between the verbal descriptions of the resistance levels and the actual percentage categories are described in Appendix 3.

2.1 *Salmonella* from food-producing animals and domestic food

The prevalence of salmonella in cattle, pigs, and poultry as well as in meat and eggs is monitored yearly through the national salmonella control programme. The objective of the salmonella control programme is to keep the annual incidence of salmonella among food-producing animals at a maximum of 1%, and in meat and eggs at a maximum of 0.5%. Salmonella has been rare in Finnish food-producing animals and domestic foods of animal origin. All *Salmonella* spp. isolates (one serotype per epidemiological unit) from the control programme are tested for susceptibility and included in the resistance monitoring.

In 2024, 41 *Salmonella* spp. isolates from food-producing animals were tested for resistance. Most of the isolates originated from cattle (n=16), followed by broilers (n=11), pigs (n=8), and laying hens (n=6). The most common serotypes were *S*. Typhimurium (n=27) and *S.* Enteritidis (n=5). Other serotypes are shown in Appendix 4.

Resistance in *Salmonella enterica* from food-producing animals was not detected in 2024 (Table 2.1). Salmonella is overall rarely found from Finnish food-producing animals, and the occurrence of multidrug resistance in *Salmonella* spp. has been rare (Figure 2.1).

Table 2.1. *Distribution of MICs for Salmonella enterica from food-producing animals in 2024 (n=41).*

Substance	%R	95% C.I.	Distribution (%) of MICs (mg/L)																
			0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Amikacin[1]	0	0.0–8.6									100								
Ampicillin	0	0.0–8.6							51.2	48.8									
Azithromycin	0	0.0–8.6								2.4	63.4	31.7	2.4						
Cefotaxime[1]	0	0.0–8.6					100												
Ceftazidime	0	0.0–8.6					56.1	43.9											
Chloramphenicol	0	0.0–8.6										97.6	2.4						
Ciprofloxacin	0	0.0–8.6	39.0	61.0															
Colistin[2]									65.9	24.4	9.8								
Gentamicin	0	0.0–8.6						51.2	48.8										
Meropenem[3]	0	0.0–8.6		31.7	68.3														
Nalidixic acid	0	0.0–8.6									97.6	2.4							
Sulfamethoxazole[4]	0	0.0–8.6											4.9	80.5	9.8	4.9			
Tetracycline	0	0.0–8.6								97.6	2.4								
Tigecycline[5]							92.7	7.3											
Trimethoprim[1]	0	0.0–8.6					73.2	24.4	2.4										

Bold vertical lines indicate current (4.6.2025) EUCAST epidemiological cut-off (ECOFF) values for resistance for *Salmonella enterica*. Hatched fields denote range of dilutions tested for each substance. Values above the range denote MIC values greater than the highest concentration in the range. MICs equal to or lower than the lowest concentration tested are given as the lowest concentration. [1]Tentative ECOFF. [2]For colistin, a tentative EUCAST ECOFF is available only for *Salmonella* Dublin (>16 mg/L), and because the natural susceptibility for colistin differs between serovars, no interpretation of resistance is shown. [3]For meropenem, no EUCAST ECOFF is available, therefore, a cut-off value of >0.125 mg/L provided by EFSA (EFSA, 2025) is used (dashed vertical line) for resistance monitoring purposes. [4]For sulfamethoxazole, no EUCAST ECOFF is available, therefore, a cut-off value of >256 mg/L provided by EFSA (EFSA, 2025) is used (dashed vertical line) for resistance monitoring purposes. [5]For tigecycline, no EUCAST ECOFF is available.

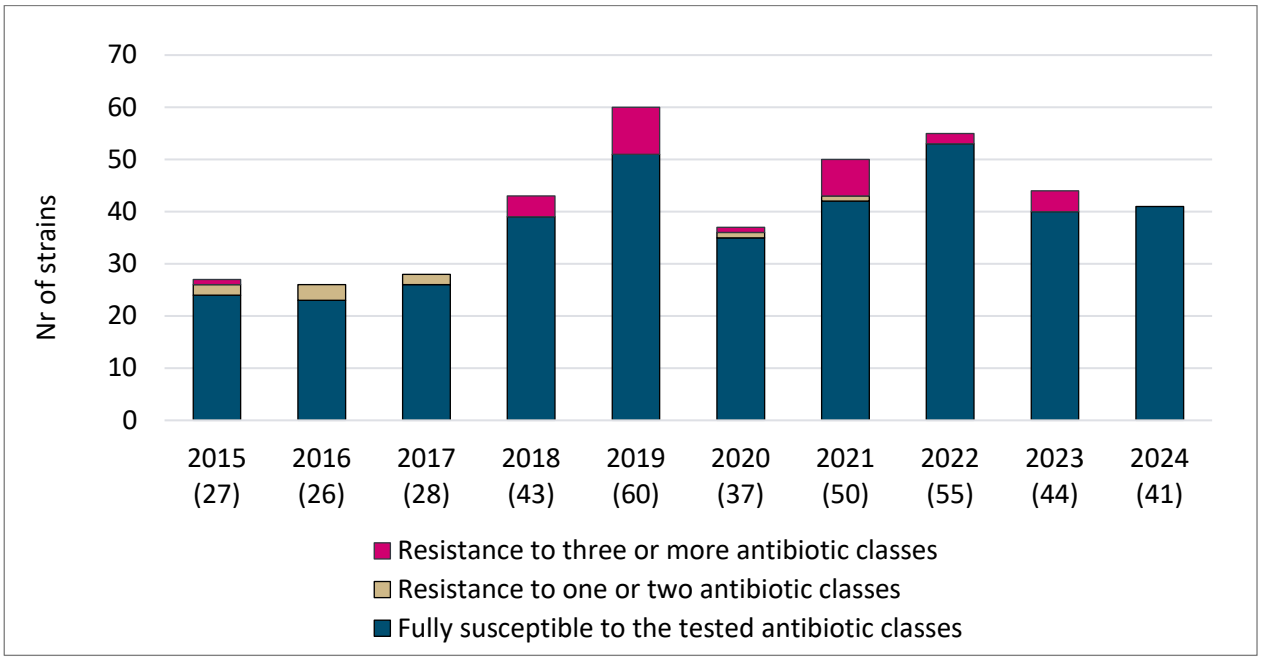

***Figure 2.1**. The number of sensitive and resistant Salmonella isolates from food-producing animals in Finland in 2015–2024. The number of isolates tested each year is in brackets. Antibiotic classes included in the analysis: aminoglycosides, beta-lactams, carbapenems, macrolides, phenicols, quinolones, sulfonamides, tetracyclines and diaminopyrimidines (trimethoprim).*

2.2 *Campylobacter* spp. from production animals

In 2024, *Campylobacter jejuni* and *Campylobacter coli* from broilers were obtained from the national campylobacter control programme. In 2021, chloramphenicol and ertapenem were added to the tested antibiotics and nalidixic acid and streptomycin were removed. To allow comparison over the years, antibiotic susceptibility figures showing complete susceptibility and resistance to one, two or more antibiotic classes were analysed based on the susceptibility results of four antibiotics that remained the same before and after 2021 (ciprofloxacin, erythromycin, tetracycline, and gentamicin).

2.2.1 *Campylobacter spp.* from broilers

Within the national campylobacter control programme of broilers in 2024, 108 *C. jejuni* and two *C. coli* isolates were tested for susceptibility. Of these, eleven *C. jejuni* isolates (10.2%) were resistant to ciprofloxacin and two (1.9%) to tetracycline. Ertapenem resistance was not detected based on the cut-off value provided by EFSA. However, if a lower EUCAST tentative ECOFF (>0.125 mg/L) is used, 0.9% of *C. jejuni* isolates were resistant (Table 2.2). Resistance against the other studied antibiotics was not detected. No resistance was detected in the studied *C. coli* isolates.

Antibiotic resistance in *C. jejuni* from broilers has been monitored yearly since 2003. The proportions of resistant *C. jejuni* isolates were quite stable until the year 2013 and the occurrence of resistant isolates remained at a low level. However, the occurrence of quinolone resistance in *C. jejuni* has been more common (>5%) in 2014 (25.3%), 2016 (8.4%), 2018 (25.5%) and 2019 (14.6%), and again in 2023 (5.5%) and 2024 (10.2%) (Figure 2.2). In 2014, 2016 and 2023, quinolone resistance was accompanied with tetracycline resistance whereas in 2018, 2019 and 2024 tetracycline resistance was rare.

The proportions of resistant isolates to erythromycin and gentamicin have remained low or non-existent throughout the monitoring period. The proportion of isolates susceptible to all the studied antibiotic classes has varied between 75% and 100%, with the lowest percentages in 2014 and 2018 paralleling the highest occurrences of quinolone resistance (Figure 2.3). Multidrug resistance has not been detected.

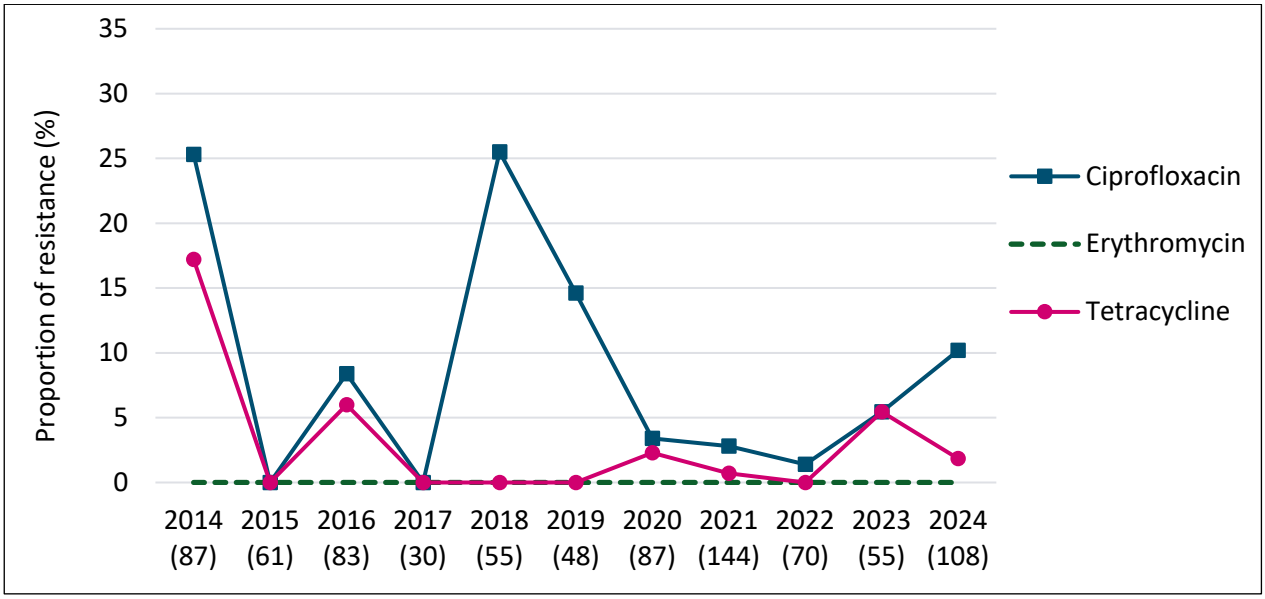

Figure 2.2. *The proportions of resistant Campylobacter jejuni isolates against selected antibiotics from broilers at slaughter in Finland between the years 2014 and 2024. The number of isolates tested each year is in brackets.*

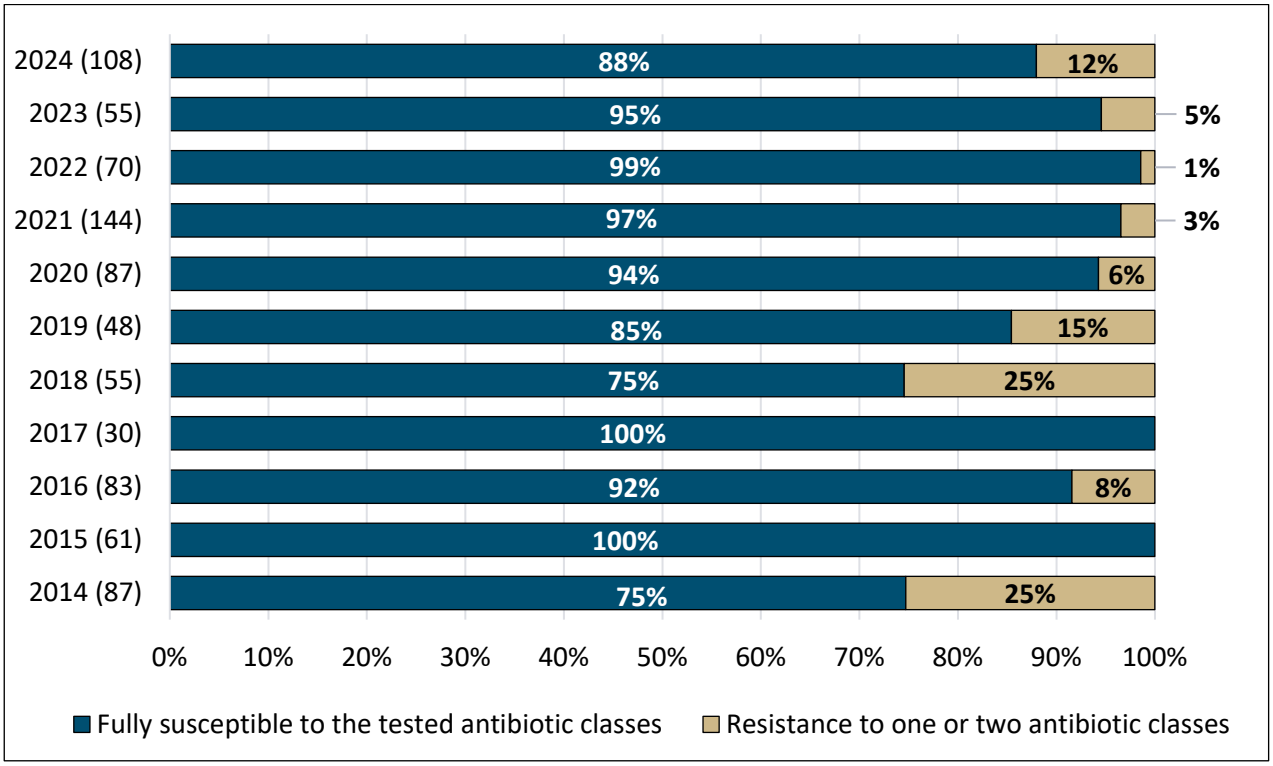

Figure 2.3. *Antibiotic susceptibility of Campylobacter jejuni isolated from broilers at slaughter in Finland between the years 2014 and 2024. The number of isolates tested each year is in brackets. Antibiotic classes included in the analysis: aminoglycosides (gentamicin), fluoroquinolones (ciprofloxacin), macrolides (erythromycin), and tetracyclines.*

Table 2.2. *Distribution of MICs for Campylobacter jejuni from broilers in 2024 (n=108).*

Substance	%R	95% C.I.	Distribution (%) of MICs (mg/L)													
			0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Chloramphenicol	0	0.0–3.4					92.6	7.4								
Ciprofloxacin	10.2	5.8–17.3	65.7	17.6	6.5				6.5	3.7						
Ertapenem[1]	0	0.0–3.4	99.1		0.9											
Erythromycin	0	0.0–3.4				99.1	0.9									
Gentamicin	0	0.0–3.4		6.5	72.2	21.3										
Tetracycline	1.9	0.5–6.5			97.2	0.9			1.9							

Bold vertical lines indicate current (27.5.2025) EUCAST epidemiological cut-off (ECOFF) values for resistance. [1]For ertapenem, a cut-off value >0,5 mg/L provided by EFSA is used (dashed vertical line) (EFSA, 2025). Hatched fields denote range of dilutions tested for each substance. Values above the range denote MIC values greater than the highest concentration in the range. MICs equal to or lower than the lowest concentration tested are given as the lowest concentration.

Table 2.3. *Distribution of MICs for Campylobacter jejuni from fur animals in 2022–2024 (n=28).*

Substance	%R	95% C.I.	Distribution (%) of MICs (mg/L)													
			0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Chloramphenicol	0	0.0–12.1					100									
Ciprofloxacin	57.1	39.1-73.5	35.7	7.1					50.0	7.1						
Ertapenem[1]	0	0.0–12.1	53.6	3.6	42.9											
Erythromycin	0	0.0–12.1				100										
Gentamicin	0	0.0–12.1		17.9	78.6	3.6										
Tetracycline	46.4	29.5-64.2			53.6								46.4			

Bold vertical lines indicate current (27.5.2025) EUCAST epidemiological cut-off (ECOFF) values for resistance. [1]For ertapenem, a cut-off value >0,5 mg/L provided by EFSA is used (dashed vertical line) (EFSA, 2025). Hatched fields denote range of dilutions tested for each substance. Values above the range denote MIC values greater than the highest concentration in the range. MICs equal to or lower than the lowest concentration tested are given as the lowest concentration.

2.2.2 Campylobacter jejuni from fur animals

Campylobacter spp. are isolated from fur animals as part of diarrhoea examination, mostly from farmed foxes and farmed minks. Sick fur animals infected with *Campylobacter jejuni* are treated with antibiotics and these bacteria also pose a risk to the farmers.

Data from years 2020–2021 and 2022–2024 were combined as the number of tested isolates was low in each of the years. In 2021, the susceptibility panel of the tested antibiotics changed: chloramphenicol and ertapenem were added, and nalidixic acid and streptomycin were removed. Figure 2.4 includes antibiotics that remained the same before and after 2021 (ciprofloxacin, erythromycin, tetracycline, and gentamicin).

Highest proportions of resistant isolates were detected against tetracycline and ciprofloxacin (Table 2.3). The proportion of resistant isolates against tetracycline varied from 30 to 40% in 2016 and 2017 and started to increase again in 2020–2021 reaching 46% in the last study period. The proportions of resistant isolates against ciprofloxacin remained between 10 and 20% over the monitoring period until an increase close to 60% in 2022–2024. However, the number of tested isolates remains low despite combining the years and, the sampling covers only diseased animals which needs to be taken into account in trend analysis. To get a better understanding of the resistance situation in fur animals, more isolates would need to be tested in the future and testing should include also healthy animals.

Ertapenem resistance was not detected based on the cut-off value provided by EFSA. However, if a lower EUCAST tentative ECOFF (>0.125 mg/L) is used, 46.4% of *C. jejuni* isolates would be categorized as resistant (Table 2.3).

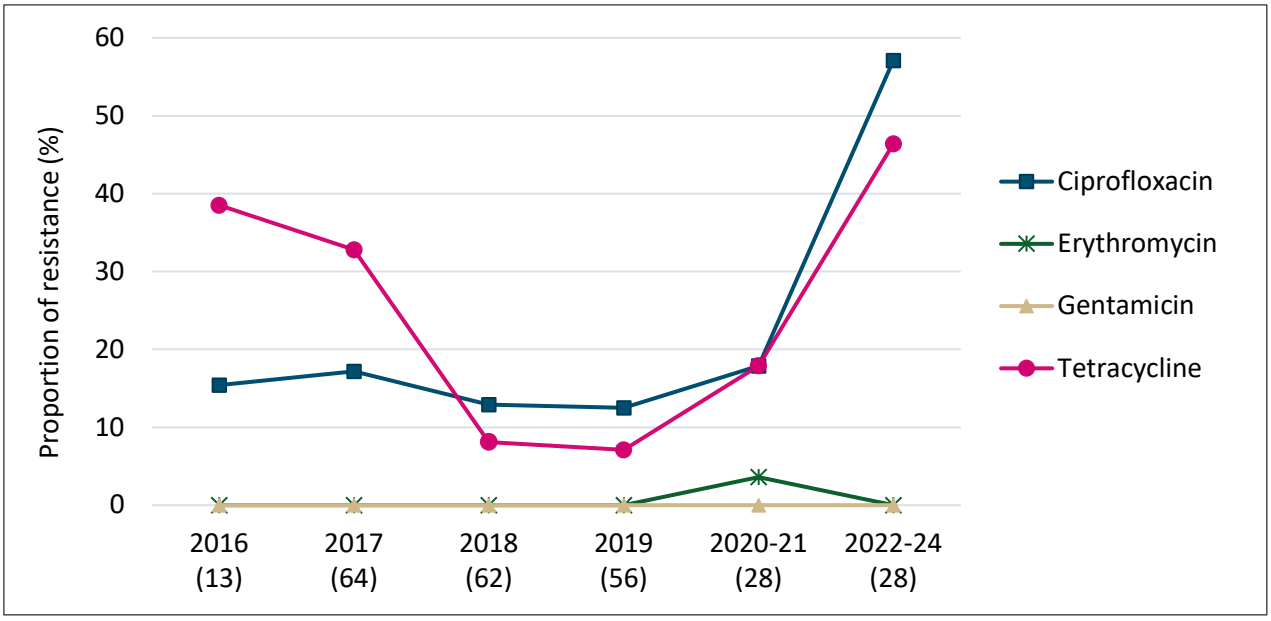

Figure 2.4. *The proportions of resistant Campylobacter jejuni isolates against selected antibiotics from diseased fur animals in Finland between the years 2016 and 2024. Years 2020–2021 and 2022–2024 have been combined in order to increase the number of isolates (which are shown in brackets).*

3 Screening for ESBL-, AmpC- and carbapenemase-producing *Escherichia coli* from food-producing animals and meat

Screening of extended-spectrum beta-lactamase producing *Escherichia coli* from food-producing animals and meat thereof is part of the harmonised monitoring in all EU member states (from 2021, (EU) 2020/1729). In Finland, these bacteria are screened from broilers, cattle, and pigs, as well as meat thereof, targeting broilers and meat from broilers and turkeys in 2024.

In 2021, it became mandatory in the EU to monitor also fresh meat originating from third countries according to (EU) 2020/1729. However, because fresh meat is rarely imported directly from third countries to Finland, the number of samples tested is very small or non-existent. No consignments of meat from broilers or turkeys were imported to Finland in 2024.

Additionally, liners from the transport boxes of imported broiler flocks and eggs, and turkey parental flocks for meat production as well as of imported chicken parental flocks for egg production are screened annually. The details of the methodology are described in Appendix 3.

3.1 ESBL/AmpC- and carbapenemase-producing *Escherichia coli* in broilers and meat from broilers and turkeys

In 2024, extended-spectrum beta-lactamase (including AmpC beta-lactamase) producing *E. coli* were screened with selective isolation method from broiler caecal samples (n=305) collected at slaughterhouses as well as from fresh broiler meat (n=290) and turkey meat (n=130) samples collected at retail. All broiler and turkey meat samples were of domestic origin.

The prevalence of ESBL-producing *E. coli* in broilers was 1.0% (Table 3.1). Neither AmpC- nor carbapenemase-producing *E. coli* were detected. Compared to the previous monitoring year 2022, the prevalence of ESBL/AmpC-producing *E. coli* in broilers stayed approximately on the same level (Table 3.1, Figure 3.1). Molecular analysis of the isolates (n=3) revealed beta-lactamase gene $bla_{\text{CTX-M-1}}$ in all three isolates. No additional resistance determinants were detected.

In 2024, no ESBL-, AmpC- or carbapenemase-producing *E. coli* were isolated from turkey meat. One *E. coli* isolate was detected in broiler meat resulting in a prevalence of 0.3%. According to molecular analysis, the isolate harboured beta-lactamase gene $bla_{\text{CTX-M-1}}$ corresponding to the ESBL phenotype of the isolate. The molecular analysis of the isolate revealed no additional resistance determinants. No AmpC- or carbapenemase-producing *E. coli* were isolated from broiler meat. The proportion of ESBL/AmpC-producing *E. coli* (Table 3.1, Figure 3.1) in broiler meat reduced from 2022.

Table 3.1. *Results of the specific screening of ESBL-, AmpC- and carbapenemase-producing E. coli in broilers, broiler meat and turkey meat in 2016, 2018, 2020, 2022 and 2024.*

Year	Sampling stage	Nr of samples	Nr (%) of ESBL[1]	Nr (%) of AmpC[1]	Nr of CP-EC[2]	% ESBL/AmpC
Broilers						
2024	at slaughter	305[3]	3 (1.0)	0 (0)	0	1.0
2022	at slaughter	301[3]	4 (1.3)	0 (0)	0	1.3
2020	at slaughter	309[4]	1 (0.3)	0 (0)	0	0.3
2018	at slaughter	289[4]	5 (1.7)	33 (11.4)	0	13.1
2016	at slaughter	306[4]	11 (3.6)[5]	33 (11.1)	0	14.4
Broiler meat						
2024	at retail	290	1 (0.3)	0 (0)	0	0.3
2022	at retail	300	5 (1.7)	0 (0)	0	1.7
2020	at retail	296	1 (0.3)	0 (0)	0	0.3
2018	at retail	300	9 (3.0)	37 (12.3)	0	15.3
2016	at retail	309	15 (4.9)	53 (17.1)	0	22.0
Turkey meat						
2024	at retail	130	0 (0)	0 (0)	0	0
2022	at retail	151	0 (0)	0 (0)	0	0

[1] based on phenotypic characterization, see appendix 3, [2] CP-EC, carbapenemase-producing *Escherichia coli,* [3] each sample a pooled sample of caecal content from ten birds, [4] each sample from caecal content of one bird, [5] one isolate had also cefoxitin MIC of 16 i.e. presumptive ESBL+AmpC phenotype

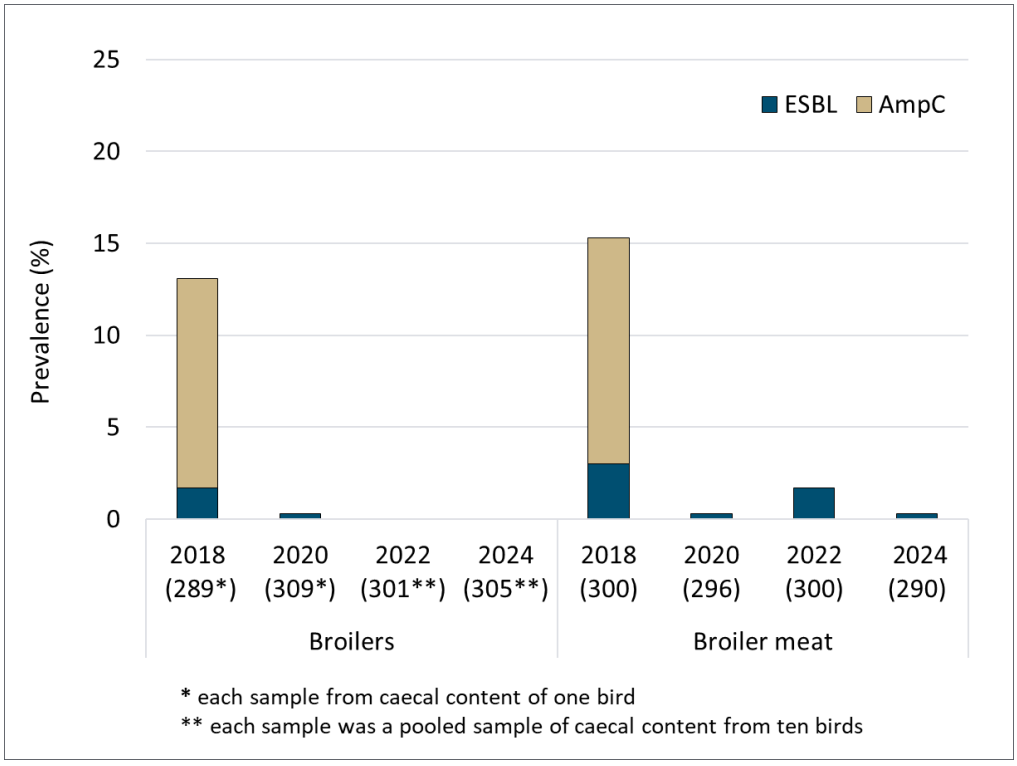

Figure 3.1*. Prevalence (%) of ESBL- and AmpC-producing E. coli in broilers and broiler meat in 2018, 2020, 2022 and 2024. The number of samples tested each year is in brackets.*

3.2 ESBL/AmpC- and carbapenemase-producing *Escherichia coli* in imported poultry flocks

In 2024, liners of transport boxes of imported poultry flocks intended for broiler meat, turkey meat and chicken egg production chains were screened for ESBL/AmpC- and carbapenemase-producing *E. coli* (Table 3.2). This represents the majority of poultry flocks imported to Finland (see details in Appendix 3).

No ESBL/AmpC-producing *E. coli* were found in the imported poultry flocks in 2024. Imported poultry flocks have been part of the resistance monitoring since 2015. The majority of ESBL/AmpC *E. coli* positive flocks were detected between 2015 and 2017. Thereafter, positive findings have been rare. Carbapenemase-producing *E. coli* have not been detected at all.

Table 3.2. *Results of the specific screening of ESBL- and AmpC-producing E. coli in liners from the transport boxes of imported poultry flocks and eggs in 2015–2024.*

Imported poultry flocks	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
For broiler meat production										
Nr of sampled flocks	54	62	37	42	38	34	35	29	28	35
Nr of ESBL positive flocks	**1**	0	0	0	0	0	0	0	0	0
Nr of AmpC positive flocks	**9**	**24**	**8**	0	0	0	0	0	0	0
Nr (%) of ESBL/AmpC positive flocks	10 (19)	24 (39)	8 (22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
For turkey meat production										
Nr of sampled flocks	6	5	4	5	5	4	6	4	5	4
Nr of ESBL positive flocks	0	0	0	0	0	0	0	0	0	0
Nr of AmpC positive flocks	0	0	0	0	0	0	0	0	0	0
Nr (%) of ESBL/AmpC positive flocks	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
For egg production										
Nr of sampled flocks	4	3	4	5	3	5	3	4	1	5
Nr of ESBL positive flocks	**1**	0	0	0	0	0	0	0	0	0
Nr of AmpC positive flocks	**2**	0	**3**	0	0	**1**	0	0	0	0
Nr (%) of ESBL/AmpC positive flocks	**3 (75)**	0 (0)	**3 (75)**	0 (0)	0 (0)	1 **(20)**	0 (0)	0 (0)	0 (0)	0 (0)

4 Antibiotic resistance in animal pathogens from food-producing animals

Animal pathogens isolated from food-producing animals included in this report are from swine, bovine, and broiler clinical cases. In 2024, the reported pathogens from pigs are *E. coli* and *Brachyspira pilosicoli* from porcine enteritis, and *Actinobacillus pleuropneumoniae* from respiratory and joint diseases. From bovines, the respiratory pathogens *Pasteurella multocida, Mannheimia haemolytica* and *Histophilus somni* are reported. From broilers, *E. coli* from colibacillosis, and *Staphylococcus aureus* from arthritis and tenosynovitis are reported. Details of sampling, isolation procedures and susceptibility testing are described in Appendix 3.

4.1 *Escherichia coli* from pig enteritis

E. coli isolates from pig enteritis cases were obtained from fecal or post-mortem samples submitted to the Finnish Food Authority. All isolates were confirmed by PCR to be enterotoxigenic. Altogether, 38 *E. coli* isolates from 15 different farms were included. The number of isolates and farms sending samples in 2024 was on average level compared to previous years. Only a small number of farms send samples each year. Therefore, chance likely has an impact on the results. Furthermore, at least some of these isolates are likely to originate from farms with diarrhoeal problems and higher than average antibiotic usage. The MIC distributions and the resistance percentages using epidemiological cut-off values are given in Table 4.1. As before, resistance was commonly detected against ampicillin, tetracycline, streptomycin, as well as sulfamethoxazole, trimethoprim, and their combination (Figure 4.1). The resistance situation on pig enteritis *E. coli* remains worrying.

In 2024, no resistance to chloramphenicol and florfenicol was detected. Also, no resistance against gentamicin has been detected between 2016 and 2024. Resistance against 3rd generation cephalosporins (according to the epidemiological cut-off values) was detected in four isolates from two farms, from which all were phenotypically AmpC. No ESBL-producers were found. There seems to be a descending trend in resistance against fluoroquinolones, but it remains to be seen whether this is a continuing trend in the coming years. The proportion of multidrug resistance varies annually (Figure 4.2) and in 2024, 29% of the isolates were resistant to three or more antibiotic classes. This was the smallest percentage in several years, but it is still rather high.

In summary, resistance was commonly detected against all antibiotic classes that can be used to treat *E. coli* infections in pigs (sulfonamide-trimethoprim, tetracycline and aminopenicillins). Attention should be paid to the fact that enteritis in pigs can be caused by multidrug-resistant *E. coli*. Thus, taking diagnostic samples to determine the farm-specific resistance profiles of enterotoxigenic *E. coli* is very important. To avoid further selection of antibiotic resistance, the aim should be to minimize the need for antibiotic treatments, and only efficient drugs should be used in the treatment of *E. coli* diarrhoea in pigs.

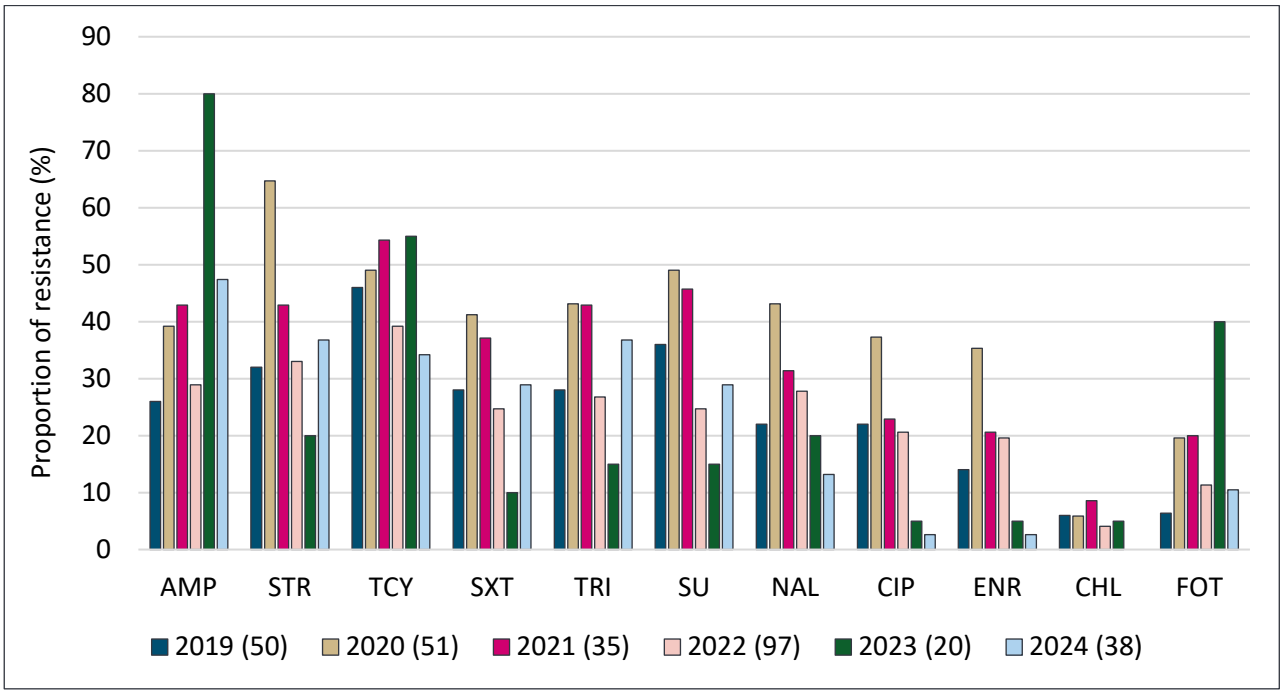

***Figure 4.1**. Resistance to tested antibiotics in 2019–2024, epidemiological cut-off values. The number of isolates tested each year is in brackets.*

AMP, ampicillin; STR, streptomycin, TCY, tetracycline; SXT, trimethoprim-sulfamethoxazole; TRI, trimethoprim, SU, sulfamethoxazole; NAL, nalidixic acid; CIP, ciprofloxacin; ENR; enrofloxacin; CHL, chloramphenicol; FOT, cefotaxime

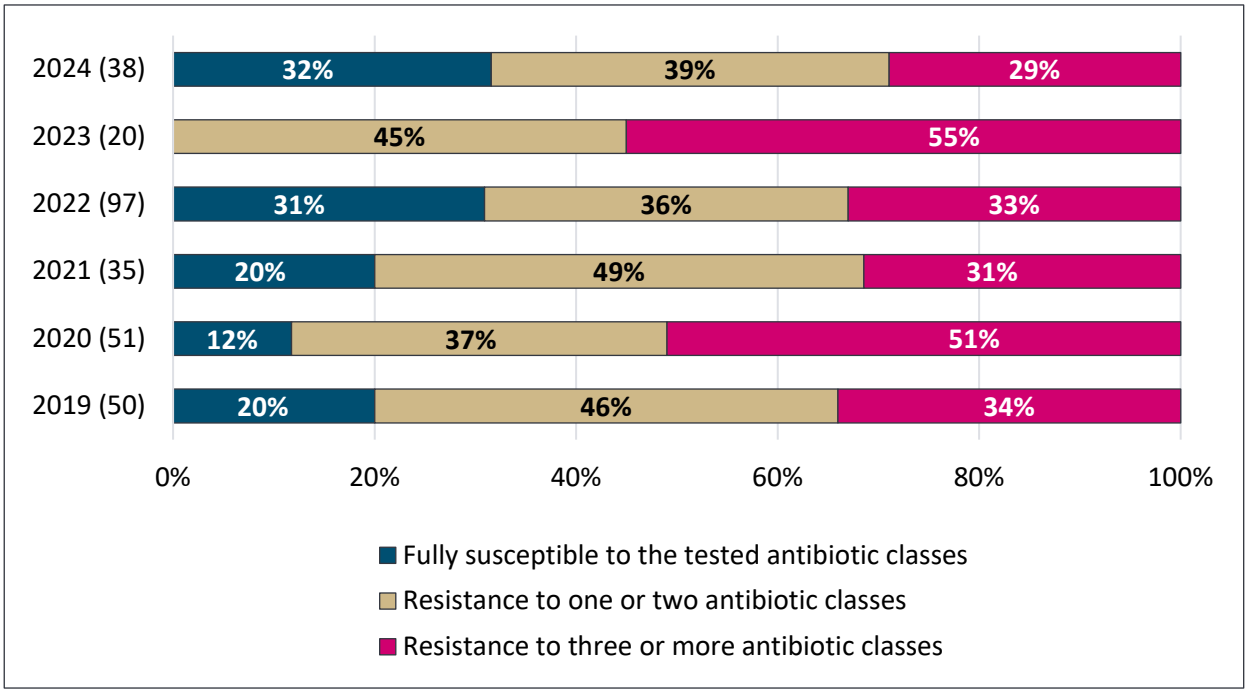

***Figure 4.2**. The proportions of multidrug-resistant E. coli isolates from porcine enteritis in 2019–2024, epidemiological cut-off values used. The number of isolates tested each year is in brackets. Antibiotic classes included in the analysis: aminoglycosides, aminopenicillins, amphenicols, fluoroquinolones, 3rd generation cephalosporins, polymyxins, sulfonamides, tetracyclines and diaminopyrimidines (trimethoprim).*

Table 4.1. *Distribution of MICs for Escherichia coli from porcine enteritis in 2024 (n=38). Resistance percentage is the proportion of resistance calculated with epidemiological cut-off values.*

Substance	%R	95% C.I.	Distribution (%) of MICs (mg/L)																
			0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	512	1024	>1024
Ampicillin	47.4	62.7–32.5							5.3	21.1	18.4	7.9		5.3	42.1					
Cefotaxime	10.5	4.2–24.1			44.7	34.2	10.5	10.5												
Ceftazidime	0	0.0–9.2					86.8	10.5	2.6											
Chloramphenicol	0	0.0–9.2									57.9	39.5	2.6							
Ciprofloxacin	2.6	0.5–13.5	71.1	15.8	10.5		2.6													
Colistin	0	0.0–9.2							100											
Enrofloxacin	2.6	0.5–13.5			86.8	10.5	2.6													
Florfenicol	0	0.0–9.2									60.5	36.8	2.6							
Gentamicin	0	0.0–9.2						89.5	10.5											
Nalidixic acid	13.2	5.8–27.3									84.2	2.6	2.6	7.9		2.6				
Streptomycin	36.8	23.4–52.7									31.6	28.9	2.6	7.9	28.9					
Sulfamethoxazole[1]	28.9	17.0–44.8										55.3	15.8							28.9
Tetracycline	34.2	21.2–50.1							13.2	50.0		2.6				31.6	2.6			
Trimethoprim	36.8	23.4–52.7					44.7	10.5	2.6	5.3	2.6			34.2						
Trim/sulfa[2]	28.9	17.0–44.8						71.1				28.9								

Bold vertical lines indicate current (4.6.2025) EUCAST epidemiological cut-off (ECOFF) values for resistance. Hatched fields denote range of dilutions tested for each substance. Values above the range denote MIC values greater than the highest concentration in the range. MICs equal to or lower than the lowest concentration tested are given as the lowest concentration. [1] No EUCAST ECOFF is available, therefore, a cut-off value of >64 µg/mL provided by EFSA (EFSA, 2025) is used (dashed vertical line) for resistance monitoring purposes. [2] Differs from EUCAST ECOFF (double vertical line), concentration of trimethoprim given, tested with sulfamethoxazole in concentration ratio of 1:20.

4.2 *Actinobacillus pleuropneumoniae* from respiratory and joint diseases of pigs

A. pleuropneumoniae is the most important respiratory pathogen in growing pigs in Finland. Sometimes it causes also joint infections. In 2024, 32 isolates from 24 farms were tested for antibiotic susceptibility. All obtained isolates were included, and they were all from lung infections in 2024. Clinical breakpoints (CLSI, 2024) were used to evaluate decreased susceptibility (Table 4.2). In 2024, decreased susceptibility against oxytetracycline was common as it has also been in previous years. One isolate was resistant against penicillin and one against tiamulin. In summary, no significant changes in the MICs for the tested substances can be seen between 2016 and 2024. Each year the number of tested isolates has been rather small.

Table 4.2. *Distribution of MICs for Actinobacillus pleuropneumoniae from pigs in 2024 (n=32).*

Substance	%R	95% C.I.	Distribution (%) of MICs (mg/l)										
			0.12	0.25	0.5	1	2	4	8	16	32	64	>64
Florfenicol	0	0.0–10.7		46.9	50.0		3.1						
Ceftiofur	0	0.0–10.7		100									
Penicillin[1]	3.1	0.6–15.7	12.5	28.1	50.0	6.3				3.1			
Oxytetracycline	0	0.7–10.7			31.3	68.8							
Tiamulin	3.1	0.6–15.7							9.4	87.5	3.1		
Tulathromycin	0	0.0–10.7								21.9	71.9	6.3	

Bold vertical lines indicate clinical breakpoints for susceptibility (left vertical line) and resistance (right vertical line). Hatched fields denote range of dilutions tested for each substance. Values above the range denote MIC values greater than the highest concentration in the range. MICs equal to or lower than the lowest concentration tested are given as the lowest concentration.
[1] clinical breakpoints not available, breakpoints for ampicillin used instead

4.3 *Brachyspira pilosicoli* from pigs

There are no standardised breakpoints established for *Brachyspira pilosicoli* from pigs. As a guide for the choice of antibiotic for treatment of spirochaetal diarrhoea, clinical resistance breakpoints of >0.5 mg/l for tiamulin, >32 mg/l for tylosin, >4 mg/l for tylvalosin and >2 mg/l for lincomycin were used in Finland in 2024. With these breakpoints, 25% (20% in 2023) of the isolates were resistant against lincomycin, 17% (13% in 2023) against tylosin, and 17% (13% in 2023) against tylvalosin (Table 4.3). Resistance to tiamulin was not detected. Resistance in *B. pilosicoli* has mostly been at moderate level from 2015 to 2024 but the number of isolates tested each year has been small. In 2024, only 12 isolates were tested.

Table 4.3. *Distribution of MICs for Brachyspira pilosicoli from pigs in 2024 (n=12).*

Substance	Distribution (%) of MICs (mg/L)													
	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	>128
Doxycycline			75.0	8.3		8.3	8.3							
Lincomycin					75.0			8.3		16.7				
Tiamulin		75.0	25.0											
Tylosin							41.7	16.7	16.7	8.3				16.7
Tylvalosin					25.0	33.3	25.0					16.7		
Valnemulin	91.7	8.3												

No clinical breakpoints available. Hatched fields denote range of dilutions tested for each substance. Values above the range denote MIC values greater than the highest concentration in the range. MICs equal to or lower than the lowest concentration tested are given as the lowest concentration.

4.4 *Histophilus somni*, *Pasteurella multocida* and *Mannheimia haemolytica* from bovine respiratory disease

A total of 222 *H. somni*, *P. multocida* and *M. haemolytica* isolates from 126 farms were included. Most of the isolates originated from meat productions farms (95 farms), while a smaller number came from dairy herds (28 farms) and suckling beef herds (3 farms). One isolate per submission (and from each compartment if more than one was sampled) and per bacterial species was selected for susceptibility testing. Clinical breakpoints (CLSI, 2024) were used to evaluate decreased susceptibility. All tested isolates were susceptible to ceftiofur and enrofloxacin.

H. somni isolates (n=19) obtained from 16 farms were fully susceptible in 2024. Between 2016 and 2020, decreased susceptibility was detected against oxytetracycline in one calf-rearing farm.

In 2024, the majority (87%) of *P. multocida* isolates (n=163) were fully susceptible. The isolates were obtained from 118 farms and on 88% of these farms all *P. multocida* isolates were fully susceptible. In 13 farms, resistant isolates (n=21) were detected. Florfenicol resistant isolates, now found in two farms, has been the last time reported in 2020. The most commonly, resistance to one antibiotic compound was seen: resistance to oxytetracycline (7 farms) being the most common, but also florfenicol and penicillin resistance was detected. Isolates resistant to both oxytetracycline and tulathromycin were detected in three farms (one dairy farm and two meat production farms) and one of these farms had isolates resistant to three antibiotics (oxytetracycline, tulathromycin and florfenicol).

Since 2018, resistance has overall been low among *P. multocida* from bovine respiratory diseases (Figure 4.3). Resistance has most commonly been detected against oxytetracycline with a proportion between one and eight percent. The MIC distributions of different antibiotics for *P. multocida* isolated in 2024 are shown in Table 4.4.

Table 4.4. *Distribution of MICs for Pasteurella multocida from bovine respiratory disease in 2024 (n=163).*

Substance	%R	95% C.I.	Distribution (%) of MICs (mg/L)										
			0.12	0.25	0.5	1	2	4	8	16	32	64	>64
Ceftiofur	0	0.0–2.3		98.8	1.2								
Enrofloxacin	0	0.0–2.3	98.2	1.8									
Florfenicol	3.7	1.7–7.8		40.5	53.4	2.5			2.5	1.2			
Oxytetracycline	8.0	4.7–13.2			67.5	6.1	17.8	0.6		8.0			
Penicillin	2.5	1.0–6.1	92.0	4.9	0.6					2.5			
Tulathromycin	3.1	1.3–7.0				54.6	40.5	1.8				1.2	1.8

Bold vertical lines indicate clinical breakpoints for susceptibility (left vertical line) and resistance (right vertical line). Hatched fields denote range of dilutions tested for each substance. Values above the range denote MIC values greater than the highest concentration in the range. MICs equal to or lower than the lowest concentration tested are given as the lowest concentration.

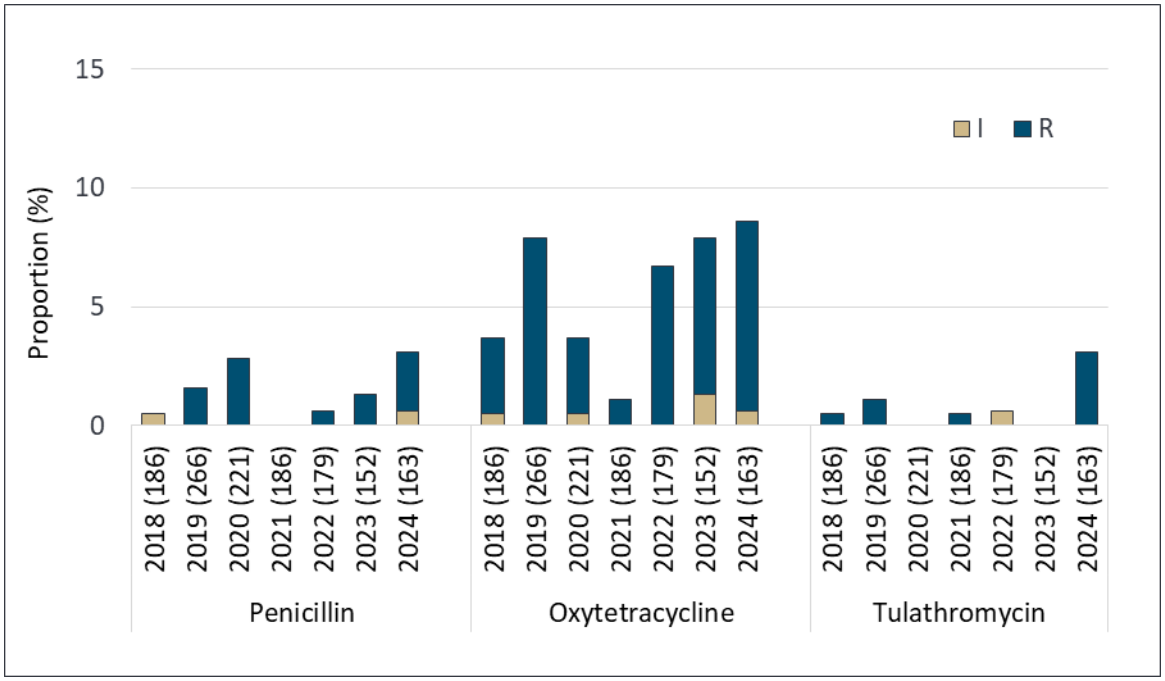

Figure 4.3. *Proportion (%) of Pasteurella multocida from bovine respiratory disease not susceptible to penicillin. oxytetracycline and tulathromycin in 2018–2024. The number of isolates tested each year is in brackets.*

In 2024, a total of 40 *M. haemolytica* isolates were obtained from 40 farms and the isolates were fully susceptible on 68% of these farms. Two isolates, from different farms, were resistant to two antibiotics (florfenicol and penicillin; oxytetracycline and penicillin). Florfenicol resistance has been last time detected in 2020. Altogether, isolates from 11 farms had intermediate susceptibility to penicillin, while no isolates had intermediate susceptibility to oxytetracycline. It seems that the proportion of isolates with intermediate susceptibility to penicillin has increased since 2019 (Figure 4.4). The MIC distributions of different antibiotics for *M. haemolytica* isolated in 2024 are shown in Table 4.5.

Table 4.5. *Distribution of MICs for Mannheimia haemolytica from bovine respiratory disease in 2024 (n=40).*

Substance	%R	95% C.I.	Distribution (%) of MICs (mg/L)										
			0.12	0.25	0.5	1	2	4	8	16	32	64	>64
Ceftiofur	0	0.0–8.8		100									
Enrofloxacin	0	0.0–8.8	100										
Florfenicol	2.5	0.4–12.9			22.5	75.0				2.5			
Oxytetracycline	2.5	0.4–12.9			55.0	42.5				2.5			
Penicillin	5.0	1.4–16.5	42.5	25.0	27.5					5.0			
Tulathromycin	0	0.0–8.8				2.5	80.0	17.5					

Bold vertical lines indicate clinical breakpoints for susceptibility (left vertical line) and resistance (right vertical line). Hatched fields denote range of dilutions tested for each substance. Values above the range denote MIC values greater than the highest concentration in the range. MICs equal to or lower than the lowest concentration tested are given as the lowest concentration.

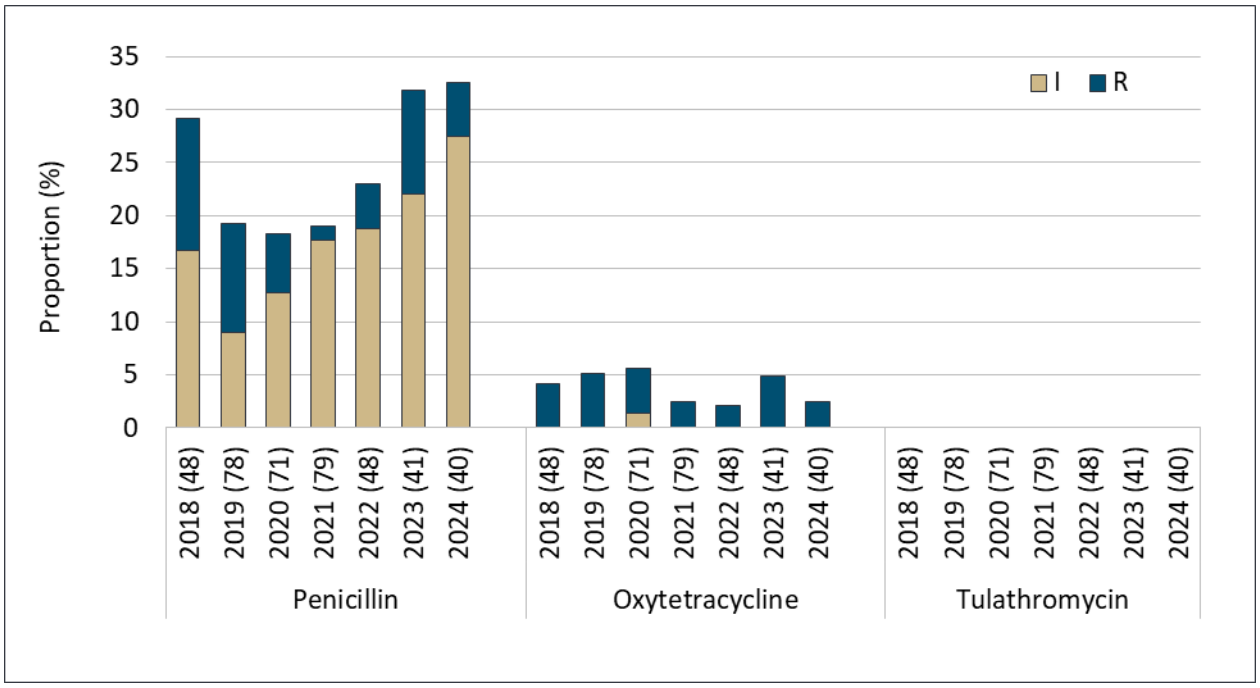

Figure 4.4. *Proportion (%) of Mannheimia haemolytica from bovine respiratory disease not susceptible to penicillin. oxytetracycline and tulathromycin in 2018–2024. The number of isolates tested each year is in brackets.*

4.5 *Escherichia coli* from colibacillosis in broilers

Colibacillosis infections in broilers and broiler parents are not treated with antibiotics in Finland. In 2024, altogether 131 *E. coli* isolates from colibacillosis cases representing 92 different farms and 114 different sample submission. No specific colibacillosis outbreaks were noted in 2024, but problems with colibacillosis alone or related to other health issues were frequent, and farmers comprehensively sent clinical samples to the laboratory. Therefore, it can be assumed that the reported resistance rates represent the real situation in *E. coli* isolates causing colibacillosis.

Based on epidemiological cut-off values, resistance against sulfamethoxazole, fluoroquinolones, and tetracycline remained low (Figure 4.5, Table 4.6). In 2024, no resistance against trimethoprim was seen. As in previous years (2019–2023), no resistance against 3rd generation cephalosporins was recorded. Long-term variation in antibiotic susceptibility is difficult to assess due to the very low number of isolates prior to 2021.

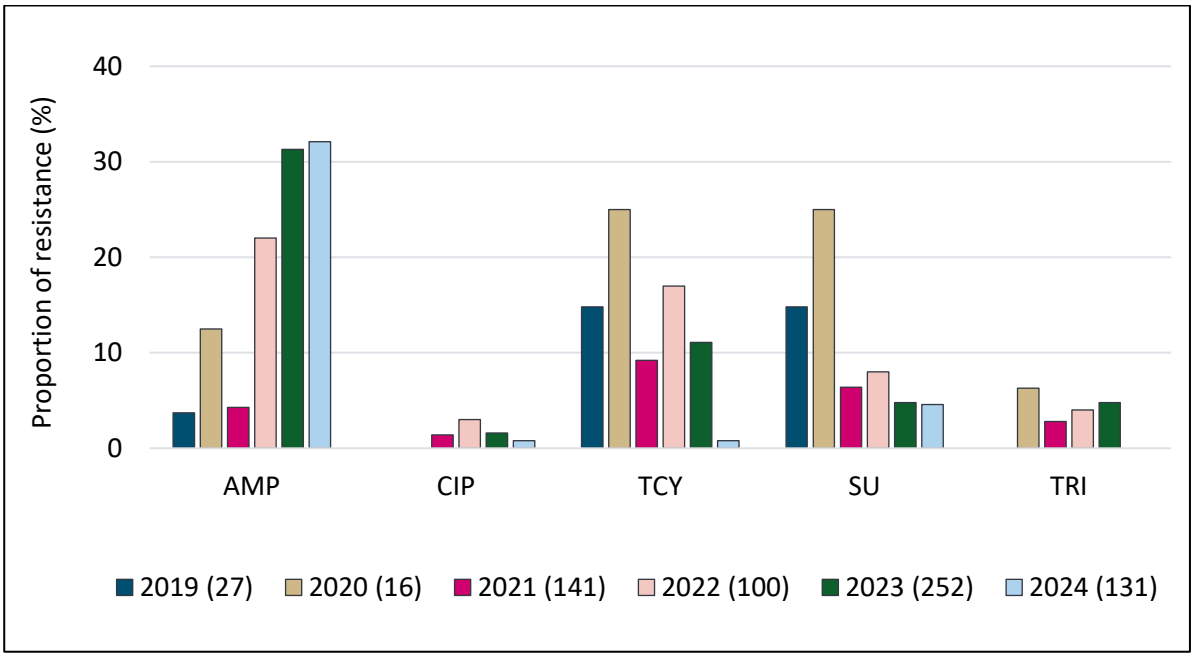

***Figure 4.5**. Antibiotic resistance (%) in E. coli from colibacillosis in the years 2019–2024, epidemiological cut-off values. The number of isolates tested each year is in brackets.*
AMP, ampicillin; CIP, ciprofloxacin; TCY, tetracycline; SU, sulfamethoxazole; TRI, trimethoprim

4.6 *Staphylococcus aureus* from tenosynovitis in broilers

Staphylococcus aureus from broiler tenosynovitis cases were isolated from post-mortem samples submitted to the Finnish Food Authority. All obtained *S. aureus* isolates were tested for antibiotic susceptibility. Only four isolates from two broiler flocks and one parent flock were obtained in 2024. They were fully susceptible to the investigated antibiotics. Tenosynovitis is occasionally treated with antibiotics in broiler parent flocks. Production flocks have not been treated with antibiotics since 2010 (Animal Health ETT, 2023).

Table 4.6. *Distribution of MICs for Escherichia coli from colibacillosis in 2024 (n=131).*

Substance	%R	95% C.I.	Distribution (%) of MICs (mg/L)																
			0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	512	1024	>1024
Ampicillin	32.1	24.7–40.5								22.9	44.3	0.8		0.8	31.3					
Cefotaxime	0	0.0–2.8			44.3	48.9	6.9													
Ciprofloxacin	0.8	0.1–4.2	66.4	29.0	3.8		0.8													
Colistin	0	0.0–2.8							100											
Sulfamethoxazole[1]	4.6	2.1–9.6										60.3	26.7	7.6	0.8				0.8	3.8
Tetracycline	0.8	0.1–4.2							16.0	52.7	28.2	2.3				0.8				
Trimethoprim	0	0.0–2.8					64.1	26.7	7.6	1.5										

Bold vertical lines indicate current (4.6.2025) EUCAST epidemiological cut-off (ECOFF) values for resistance. Hatched fields denote range of dilutions tested for each substance. Values above the range denote MIC values greater than the highest concentration in the range. MICs equal to or lower than the lowest concentration tested are given as the lowest concentration. [1]No EUCAST ECOFF is available, therefore, a cut-off value of >64 µg/mL provided by EFSA (EFSA, 2025) is used (dashed vertical line) for resistance monitoring purposes.

5 Antibiotic resistance in animal pathogens from companion animals and horses

Antibiotic resistance figures from companion animal (dogs and cats) and horse pathogens were collected from the Clinical Microbiology Laboratory (YESLAB) of the Veterinary Teaching Hospital (VTH), University of Helsinki. Antibiotic non-susceptibility was reported separately for intermediate and resistant isolates. Statistics for 2019–2022 were re-evaluated from original data according to updated breakpoints in 2023; data inclusion criteria may thus have small differences compared to previous reports, which may cause some variations to proportions of non-susceptible isolates compared to previously reported results. The reporting period covers January 2019 – December 2024 and includes solely bacterial isolates derived from clinical infections. Screening specimens for multidrug-resistant bacteria (MRSA, MRSP, ESBL) were omitted from the analysis. Approximately 42% of specimens analysed at YESLAB in 2024 were from the VTH, and 58% from private clinics. From April to July 2024, YESLAB received specimens from the VTH as usual, but accepted only urinary specimens and screening specimens from private clinics, which had some influence on the total number of isolates reported. If the number of tested bacterial isolates for the bacterial species in question was large enough for confident analysis, data are presented separately for dogs, cats, and horses. Otherwise, collated data are presented. Details of the susceptibility testing method are described in Appendix 3.

5.1 *Staphylococcus aureus* from companion animals and horses

Antibiotic resistance level in *S. aureus* of dogs, cats and horses was low (Figure 5.1), except for penicillin (not shown in figure). In 2024, beta-lactamase results were available for 59 isolates, of which 51% produced penicillinase. In 2024 and 2023, the proportion of beta-lactamase producing isolates has been lower than before (43% in 2023); the corresponding proportion varied between 60% and 69% in 2019–2022.

Non-susceptibility to clindamycin has remained at a slightly higher level since 2022, being 8.5% in 2024. In 2024, non-susceptibility to erythromycin also increased to 8.5%. Following the increase in non-susceptible isolates to trimethoprim-sulfamethoxazole in 2023, no non-susceptible isolates were detected among *S. aureus* isolates in 2024. Proportion of non-susceptible isolates to tetracycline also decreased markedly compared to 2023.

In 2023, oxacillin resistance indicating the presence of MRSA among *S. aureus* isolates was at the highest during the monitoring period (8.8%), while in 2024 it was at the lowest, being 1.7%. In 2024, MRSA was isolated only once from an infection site specimen, a deep surgical site wound from a dog. This isolate was of *spa* type t1255, which belongs to the CC398 complex.

5.1.1 Significance of resistance in *S. aureus*

S. aureus is a part of the normal microbiome of the skin and mucous membranes of cats and horses, as well as humans. As an opportunistic pathogen, it usually causes skin or wound infections in animals.

Occasionally, there can be infections caused by *S. aureus* also in dogs. MRSA is considered to have zoonotic potential and may thus have an impact on public health.

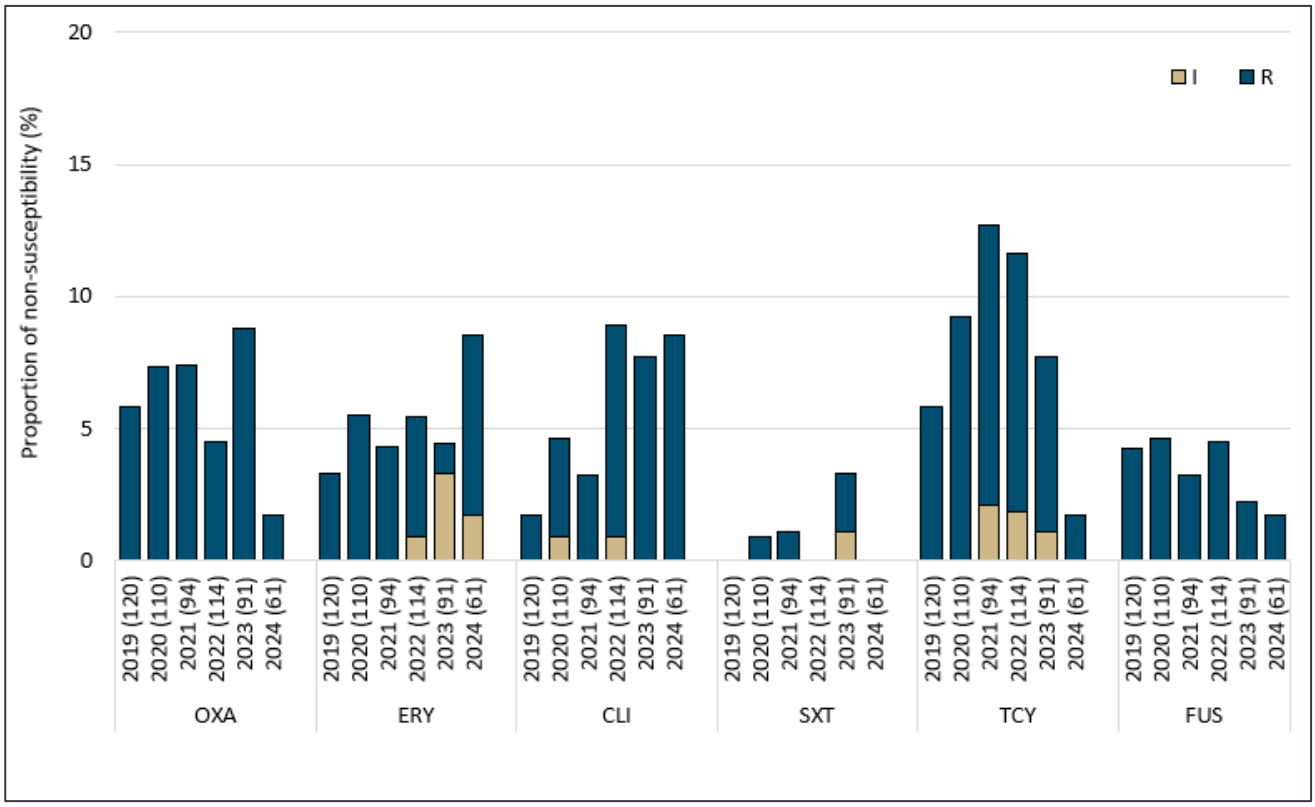

***Figure 5.1**. Antibiotic non-susceptibility (%) in canine, feline, and equine S. aureus in 2019–2024. The number of isolates tested each year is in brackets. In 2024, 42 isolates originated from dogs, 8 from cats, and 11 from horses.*

OXA, oxacillin; ERY, erythromycin; CLI, clindamycin; SXT, trimethoprim-sulfamethoxazole; TCY, tetracycline; FUS, fusidic acid

5.2 *Staphylococcus pseudintermedius* from dogs

The proportion of MRSP isolate, indicated by oxacillin resistance, increased from 2023, being 5% in 2024 (Figure 5.2). However, the proportion has declined drastically during the last decade: in 2014–2016, the proportion of MRSP was 12–14% of all *S. pseudintermedius* isolates (see previous FINRES-Vet reports). Penicillinase production remained high as out of the 298 tested *S. pseudintermedius* isolates in 2024, 81% produced penicillinase, which is a larger proportion than among *S. aureus* isolates ($p<0.00001$).

The slightly increasing trend of non-susceptibility in *S. pseudintermedius* isolates among the tested antibiotics observed in 2023 was no longer continuous in 2024; proportions of non-susceptible isolates decreased slightly for the most part (Figures 5.2 and 5.3). The highest proportions of non-susceptible isolates were noted in doxycycline and tetracycline, being 24.7% in each. Amikacin resistance has been absent several times in canine clinical infections caused by *S. pseudintermedius* which was the case again in 2024.

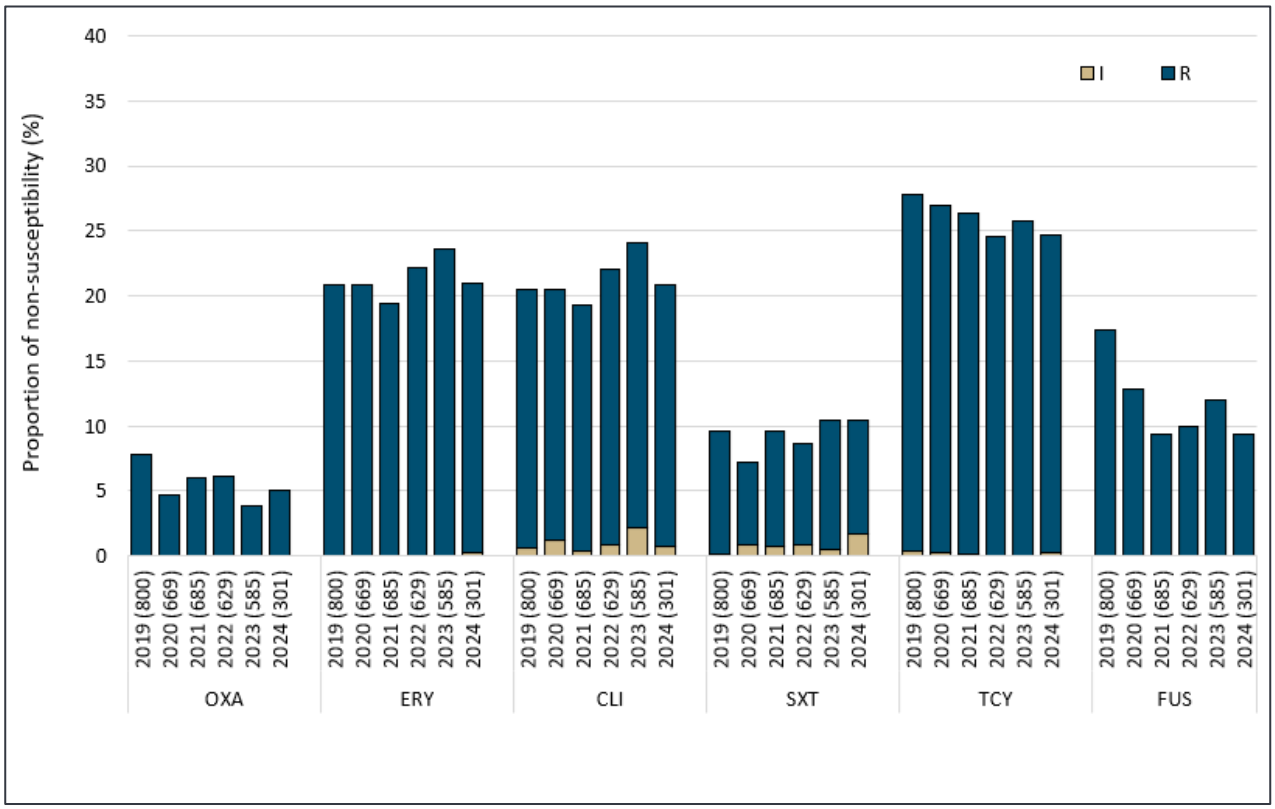

***Figure 5.2**. Antibiotic non-susceptibility (%) for primary antibiotic agents in canine S. pseudintermedius isolates in 2019–2024. The numbers of isolates tested each year is in brackets.*

OXA, oxacillin; ERY, erythromycin; CLI, clindamycin; SXT, trimethoprim-sulfamethoxazole; TCY, tetracycline; FUS, fusidic acid

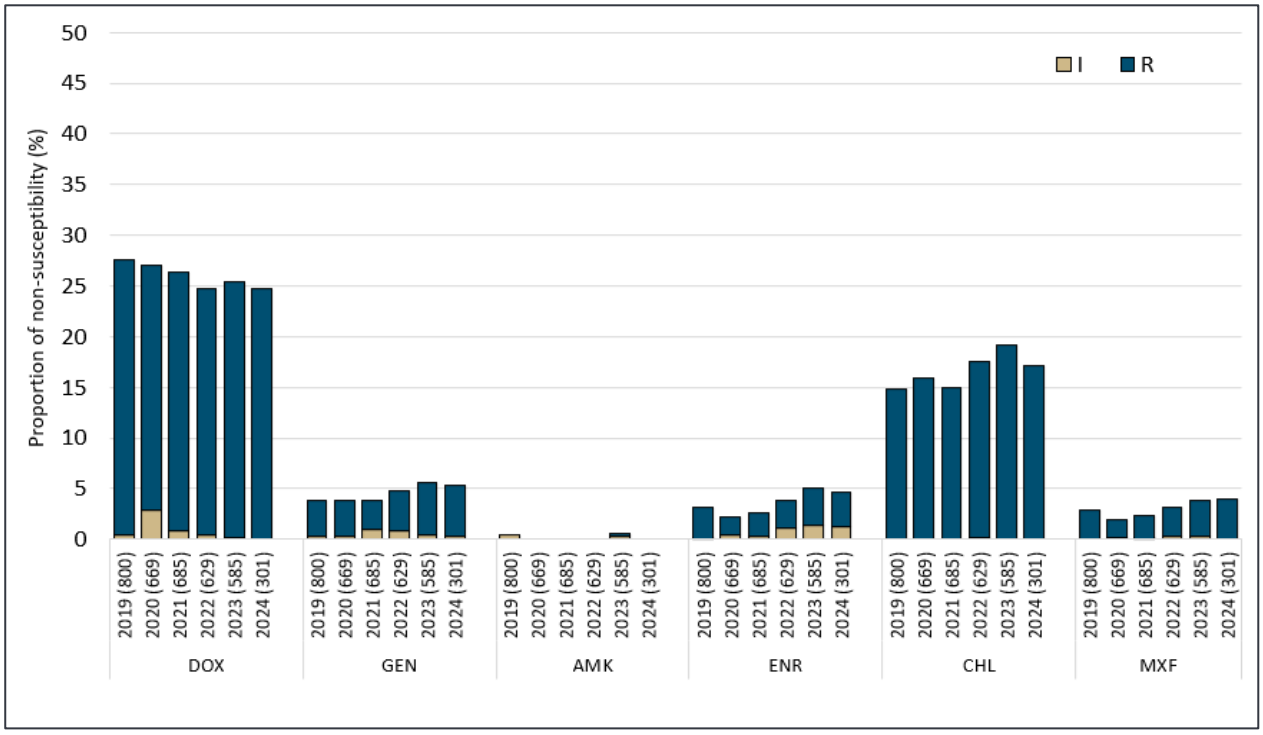

***Figure 5.3**. Antibiotic non-susceptibility (%) for secondary antibiotics in canine S. pseudintermedius isolates in 2019–2024. The number of isolates tested each year is in brackets.*

DOX, doxycycline; GEN, gentamicin; AMK, amikacin; ENR, enrofloxacin; MXF, moxifloxacin; CHL, chloramphenicol

5.2.1 Significance of resistance in *S. pseudintermedius*

S. pseudintermedius belongs to the normal microbiome of the skin and mucous membranes in dogs and rarely in cats. It is an opportunistic pathogen that most often causes skin or wound infections and occasionally urinary infections. The proportion of oxacillin resistance has fluctuated a little but remained at a relatively low level in the past few years. The current overall resistance status remains fair as well. Many of the infections caused by *S. pseudintermedius* can be treated locally and thus the use of antibiotics can be avoided altogether.

As stated earlier, 81% of the isolates produced penicillinase, which is a major proportion. A penicillinase-producing isolate is resistant to many commonly used beta-lactam antibiotics such as amoxicillin and penicillin. *S. pseudintermedius* is a moderately common urinary pathogen in dogs. Since a majority of *S. pseudintermedius* isolates produce penicillinase, knowing this might affect the empirical choice of antibiotic in treating for example sporadic cystitis in a dog, if a coccal species is suspected to have caused the infection.

5.3 *Escherichia coli* from dogs and cats

Resistance figures for canine and feline *E. coli* are presented in Figures 5.4 and 5.5, respectively. In canine and feline *E. coli* isolates, non-susceptibility to ampicillin increased in 2024 compared to 2023. Among feline isolates and ampicillin, proportion of non-susceptible isolates has been highest during the monitoring period for two consecutive years, reaching 44% in 2024. Non-susceptibility to amoxicillin-clavulanic acid also continued to increase in both species. In 2024, around 27% of all canine *E. coli* isolates were classified as resistant to ampicillin, and around 5% were resistant to amoxicillin-clavulanic acid, which could implicate that aminopenicillins still could be used in many cases of infection if treated with an increased dosage. This could be applied at least to urinary bladder infections, as beta-lactams concentrate well in urine, and *E. coli* is the most common pathogen in canine and feline urinary bladder infections.

In 2024, cefpodoxime resistance in canine *E. coli* remained approximately at the same level as in 2023 (4.4% in 2023, 4.2% in 2024, Figures 5.4 and 5.6). Cefpodoxime resistance indicates reduced susceptibility to third generation cephalosporins. The proportion of AmpC-producing isolates increased to 2.6% while the proportion of ESBL-producers decreased to 0.5% (Figure 5.6).

In feline *E. coli* isolates, resistance to cefpodoxime continued to increase third year in a row, being close to 7% in 2024 which is the highest during the monitoring period. In addition to cefpodoxime, ampicillin and amoxicillin-clavulanic acid, proportion of non-susceptible isolates to enrofloxacin reached the highest point of the monitoring period in 2024 (Figure 5.5).

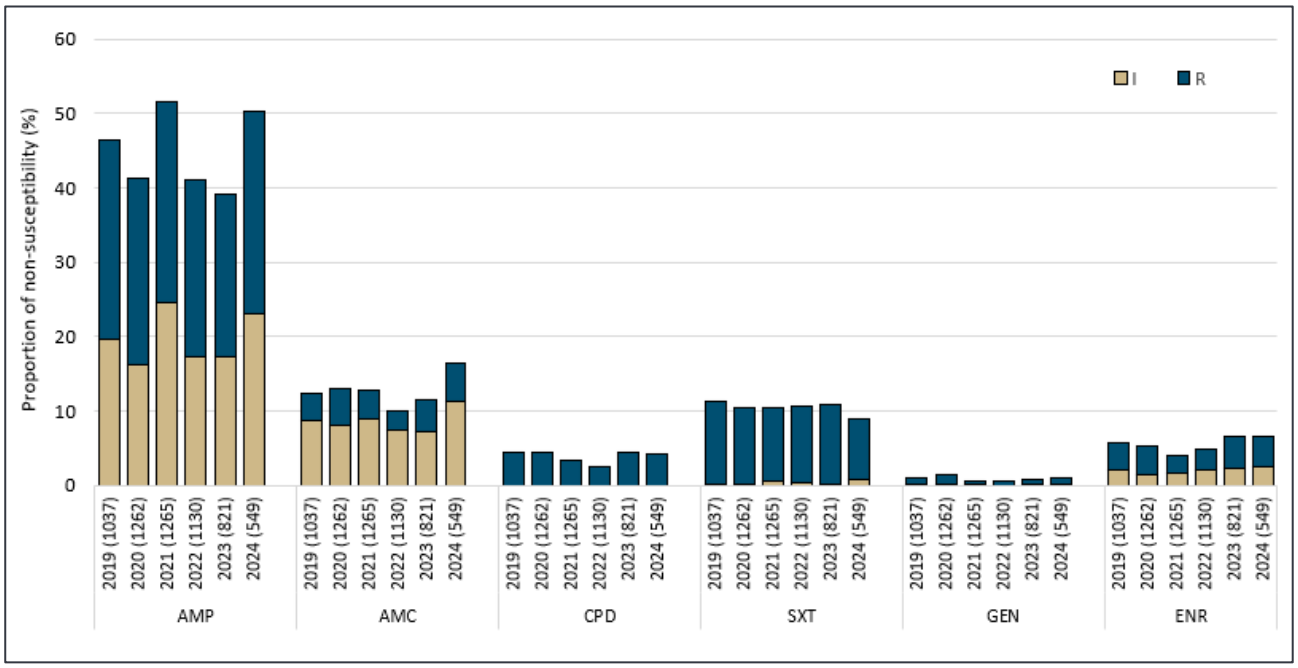

***Figure 5.4**. Antibiotic non-susceptibility (%) in canine E. coli in 2019–2024. The number of isolates tested each year is in brackets.*

AMP, ampicillin; AMC, amoxicillin-clavulanic acid; CPD, cefpodoxime; SXT, trimethoprim-sulfamethoxazole; GEN, gentamicin; ENR, enrofloxacin

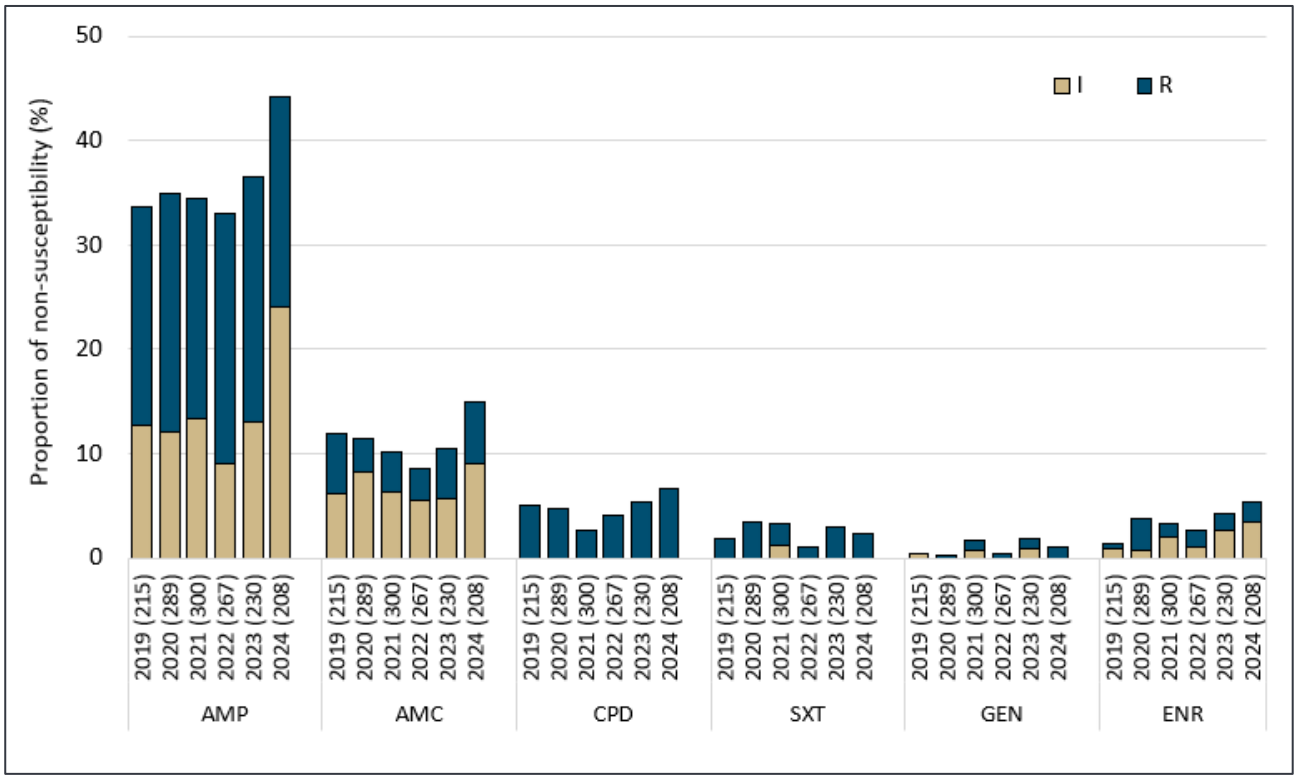

***Figure 5.5**. Antibiotic non-susceptibility (%) in feline E. coli in 2019–2024. The number of isolates tested each year is in brackets.*

AMP, ampicillin; AMC, amoxicillin-clavulanic acid; CPD, cefpodoxime; SXT, trimethoprim-sulfamethoxazole; GEN, gentamicin; ENR, enrofloxacin

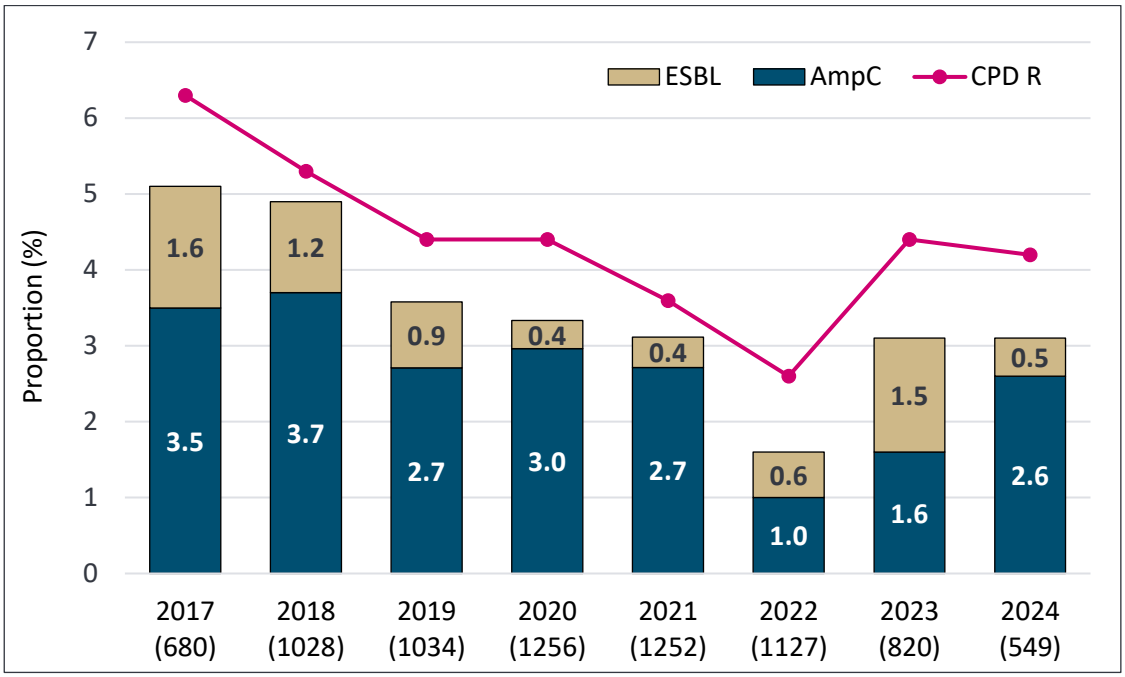

Figure 5.6. *The proportion of isolates with reduced susceptibility to cefpodoxime (CPD), and the proportion of ESBL and AmpC positive isolates in canine E. coli in 2017–2024. The number of isolates tested for CPD each year is in brackets. Only CPD resistant isolates were tested for phenotypic ESBL/AmpC production.*
CPD, cefpodoxime; AmpC and ESBL, extended-spectrum beta-lactamases

5.4 Streptococci from dogs and horses

In 2024, all tested canine *Streptococcus canis* isolates were susceptible to penicillin. Non-susceptibility to tetracycline increased once more slightly compared to 2023, being over 75% in 2024 (Figure 5.7). It is worth noting that from the beginning of 2019, *S. canis* isolates from *otitis externa* specimens were not tested for systemic-only antibiotics (e.g. penicillin, trimethoprim-sulfamethoxazole, erythromycin, and clindamycin). Thus, the number of tested isolates for tetracycline has been greater ever since.

Apart from tetracycline, the development of resistance among other antibiotics in canine *S. canis* isolates appears favorable in 2024. All isolates were susceptible to trimethoprim-sulfamethoxazole, and there was a marked decrease in proportions of isolates non-susceptible to erythromycin (2.9%) and clindamycin (23.9%).

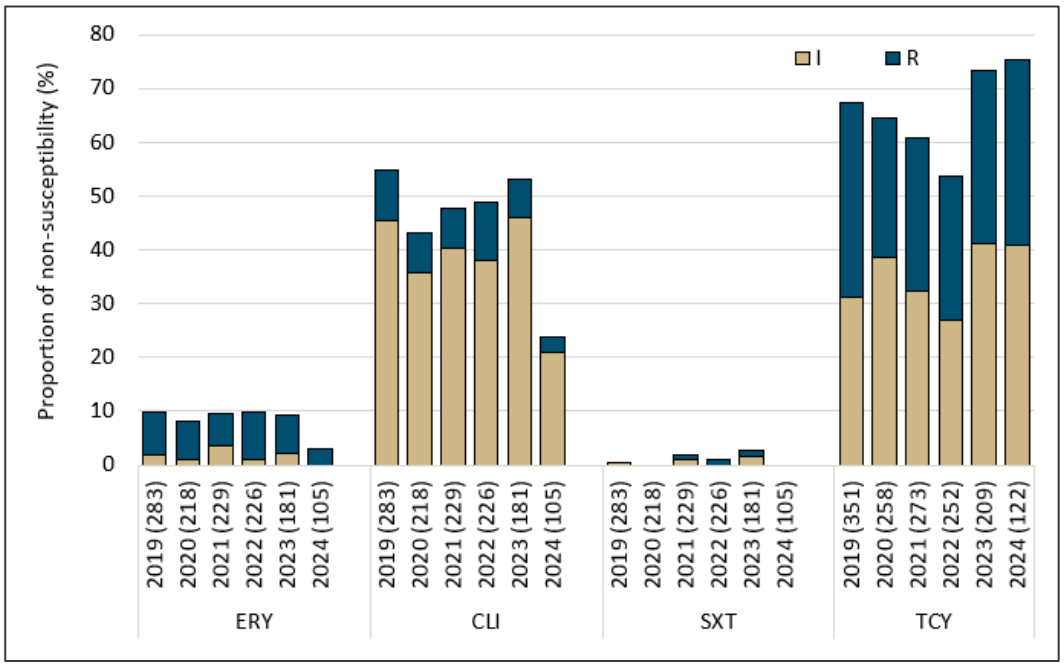

Figure 5.7. *Antibiotic non-susceptibility (%) in canine S. canis isolates in 2019–2024. The number of isolates tested each year is in brackets. The number of tested isolates for tetracycline has been greater than for the other antibiotics (see explanation in main text).*

ERY, erythromycin; CLI, clindamycin; SXT, trimethoprim-sulfamethoxazole; TCY, tetracycline

In 2024, 23 *Streptococcus equi* ssp. *zooepidemicus* isolates were found in equine infection specimens. All isolates were susceptible to penicillin. Proportion of non-susceptibility to trimethoprim-sulfamethoxazole decreased again slightly compared to the few previous years; proportion of resistant isolates was 4.5% in 2024 (Figure 5.8). The development of resistance situation to this antibiotic substance must be monitored carefully due to its importance in the treatment of many equine infections. As in canine *S. canis*, non-susceptibility to tetracycline increased also among equine *S. equi* ssp. *zooepidemicus* compared to 2023, being almost 87% in 2024.

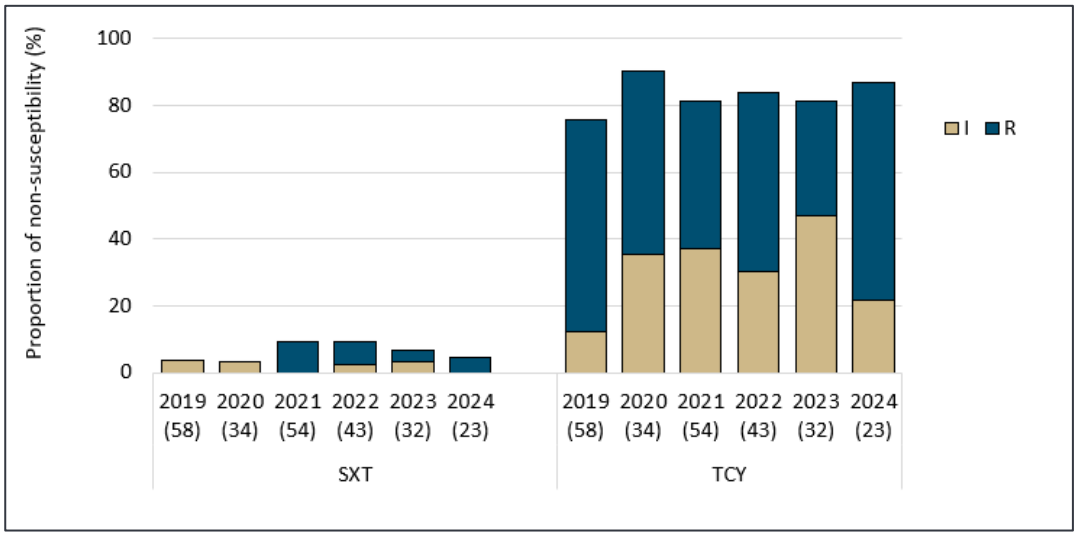

Figure 5.8*. Antibiotic non-susceptibility (%) in equine S. equi ssp. zooepidemicus isolates in 2019–2024. The number of isolates tested each year is in brackets.*

SXT, trimethoprim-sulfamethoxazole; TCY, tetracycline

5.5 *Pseudomonas aeruginosa* from dogs

In 2024, 29 canine clinical infection isolates of *P. aeruginosa* were tested. Non-susceptibility to enrofloxacin has increased for two consecutive years, being around 86% in 2024 (Figure 5.9). However, number of resistant isolates decreased slightly from 32% in 2023 to almost 28% in 2024. By comparison, non-susceptibility to ciprofloxacin decreased to around 10% in 2024, being at the lowest of the monitoring period. After a decrease in gentamicin susceptibility in 2023, number of non-susceptible isolates increased again in 2024 reaching 24% with five intermediate and two resistant isolates. Amikacin susceptibility remained at the same level with proportion of intermediate isolates being over 3%. All isolates were susceptible to tobramycin and no resistance to colistin was detected.

No isolates with decreased susceptibility to meropenem was detected in 2024. In previous years, different *bla*OXA genes, indicative of beta-lactamase resistance, have been found in whole genome sequencing of meropenem-non-susceptible canine *P. aeruginosa* isolates. However, it has remained unclear whether these genes are the cause of meropenem resistance in *P. aeruginosa* species.

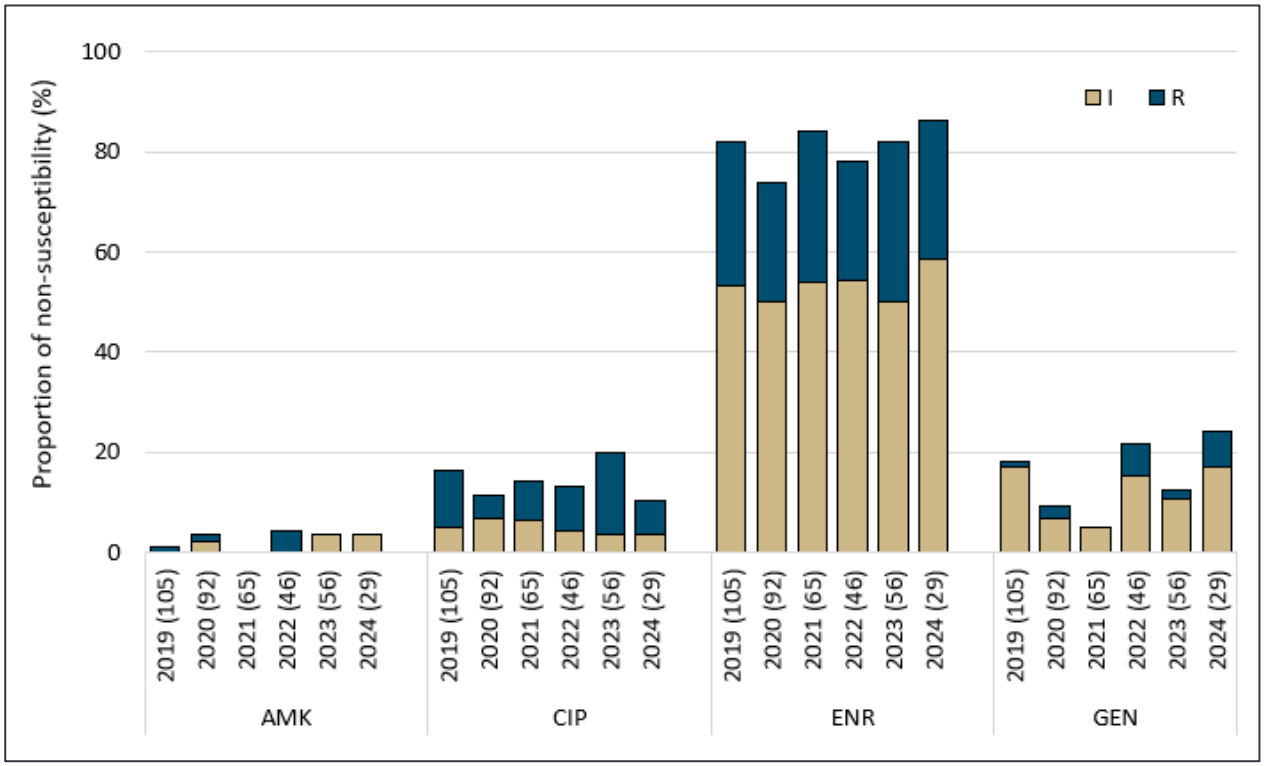

Figure 5.9. *Antibiotic non-susceptibility (%) in canine P. aeruginosa isolates in 2019–2024. The number of isolates tested each year is in brackets.*

AMK, amikacin; CIP, ciprofloxacin; ENR, enrofloxacin; GEN, gentamicin

6 Antibiotic resistance in indicator bacteria from food-producing animals

Resistance in commensal indicator *E. coli* is thought to show the most common resistance traits among the gram-negative bacteria present in the gut microbiota, and to reflect the selection pressure caused by the antibiotics used in the animal population in question. The genomes of indicator bacteria can also function as a reservoir of resistance genes, which may transfer to pathogenic bacteria.

In this report, the results of the indicator *E. coli* from slaughtered, healthy broilers are presented. Also, the occurrence and trends of resistance is evaluated calculating the key outcome indicators of resistance established jointly by ECDC, EFSA and EMA (ECDC, EFSA and EMA, 2017). Details of the sampling and laboratory analysis are described in Appendix 3.

6.1 Indicator *Escherichia coli* from broilers

In 2024, a total of 170 isolates from broilers were tested for antibiotic susceptibility. Resistance was overall low (Table 6.1) and the majority (82%) of the isolates was fully susceptible to the tested antibiotics (Figure 6.2). The most common resistance traits detected were against tetracycline (10%) and sulfamethoxazole (4.7%). Altogether, 1.2% of the isolates were multidrug-resistant (Figure 6.2, Table 6.2). ESBL or AmpC producing *E. coli* isolates were not detected.

After an increase in 2022, resistance to ciprofloxacin, sulfamethoxazole and trimethoprim resistance decreased compared to 2018 (Figure 6.1). Ampicillin resistance has decreased steadily during 2020, 2022 and 2024 while tetracycline resistance has been back at approximately 10% after a dip in 2018.

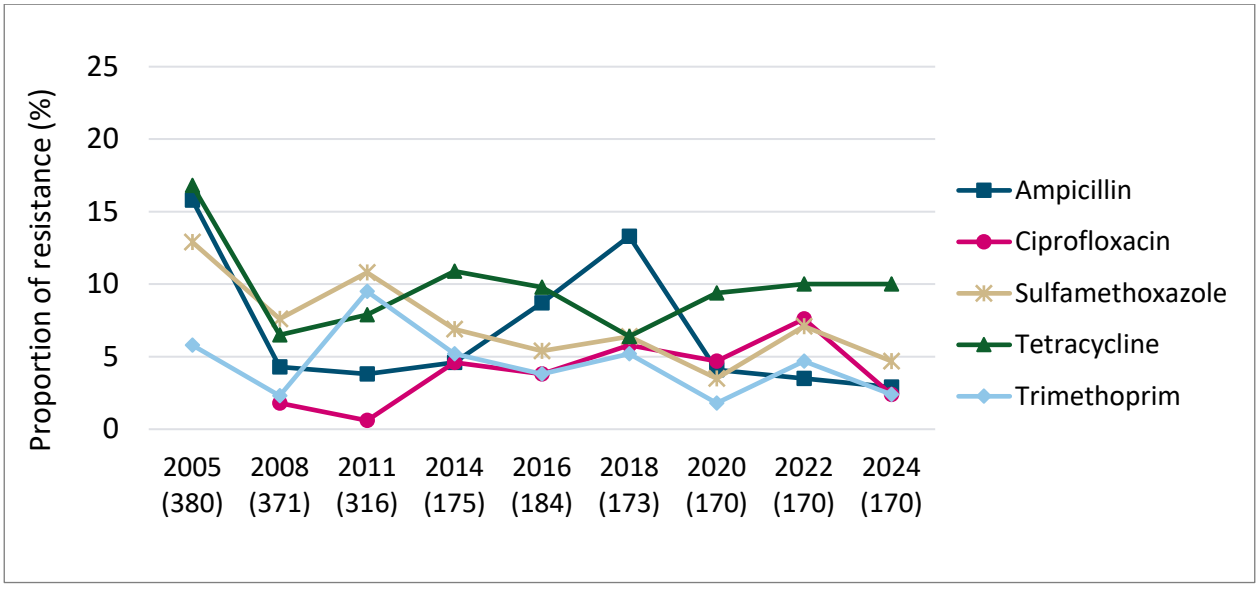

***Figure 6.1**. Resistance in indicator E. coli from broilers to selected antibiotics in 2005–2024. The number of isolates tested each year is in brackets.*

Table 6.1. *Distribution of MICs for indicator Escherichia coli in broilers in 2024 (n=170).*

Substance	%R	95% C.I.	Distribution (%) of MICs (mg/L)																
			0.015	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Amikacin	0	0.0–2.2									95.9	4.1							
Ampicillin	2.9	1.3–6.7							1.2	44.7	50.0	1.2			2.9				
Azithromycin	0	0.0–2.2								6.5	51.8	39.4	2.4						
Cefotaxime	0	0.0–2.2					100												
Ceftazidime	0	0.0–2.2					98.2	1.8											
Chloramphenicol	0	0.0–2.2										94.7	5.3						
Ciprofloxacin	2.4	0.9–5.9	92.9	4.1	0.6	1.2	0.6	0.6											
Colistin	0	0.0–2.2							99.4	0.6									
Gentamicin	1.2	0.3–4.2						72.4	25.9	0.6				1.2					
Meropenem	0	0.0–2.2		100															
Nalidixic acid	2.4	0.9–5.9									97.1	0.6			0.6	1.8			
Sulfamethoxazole[1]	4.7	2.4–9.0										58.8	30.0	6.5					4.7
Tetracycline	10.0	6.3–15.4								82.9	7.1				10.0				
Tigecycline	0	0.0–2.2					99.4	0.6											
Trimethoprim	2.4	0.9–5.9					68.2	26.5	1.8	1.2				2.4					

Bold vertical lines indicate current (4.6.2025) EUCAST epidemiological cut-off (ECOFF) values for resistance. Hatched fields denote range of dilutions tested for each substance. Values above the range denote MIC values greater than the highest concentration in the range. MICs equal to or lower than the lowest concentration tested are given as the lowest concentration. [1]No EUCAST ECOFF is available, therefore, a cut-off value of >64 µg/mL provided by EFSA (EFSA, 2025) is used (dashed vertical line) for resistance monitoring purposes.

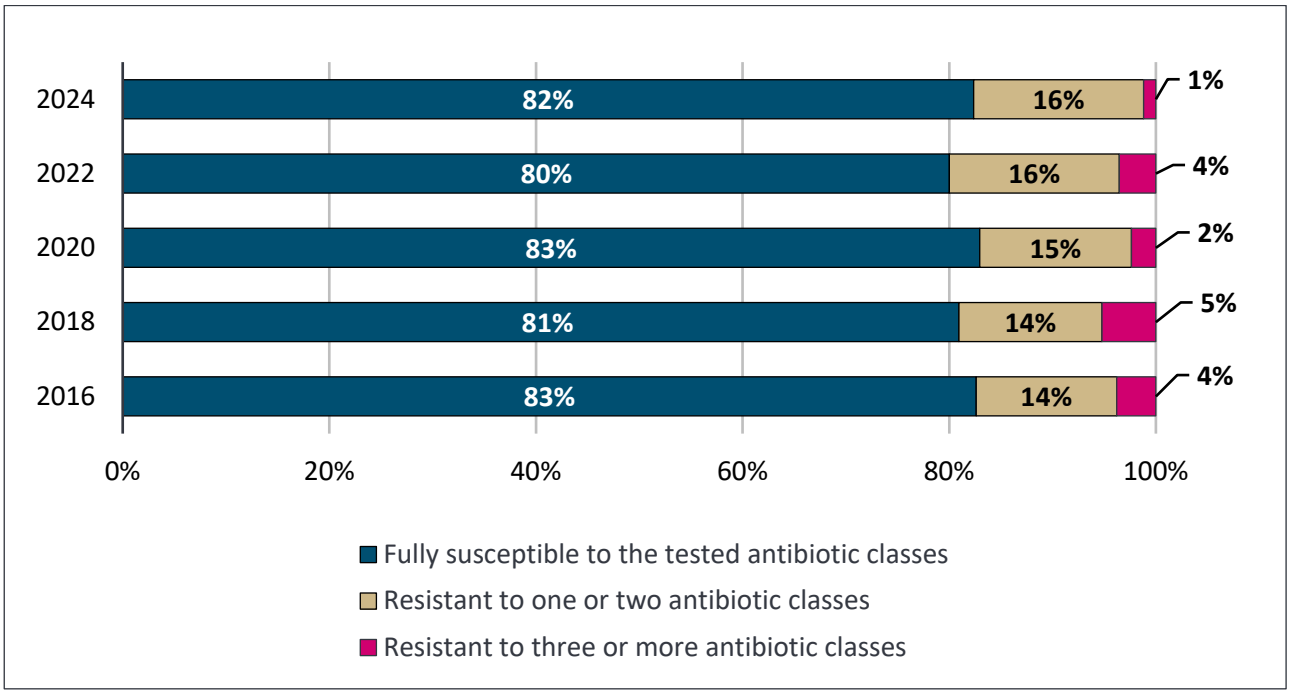

Figure 6.2. *Antibiotic susceptibility of indicator E. coli from broilers in Finland between the years 2016 and 2024. The numbers of tested isolates each year are the same as in Figure 6.1. Antibiotic classes included in the analysis: aminoglycosides, beta-lactams, carbapenems, glycylcyclines, macrolides, phenicols, polymyxins, quinolones, sulfonamides, tetracyclines and diaminopyrimidines (trimethoprim).*

Table 6.2*. Resistance profiles of multidrug-resistant indicator E. coli from broilers 2018, 2020, 2022 and 2024.*

Resistance profile	Nr of isolates in each year			
	2018	2020	2022	2024
TET-SU-TRI-CIP-NAL-GEN-CHL	1			
AMP-TET-SU-TRI-CIP-NAL	1		1	
AMP-SU-TRI-CIP-NAL				2
GEN-TET-SU-CIP-NAL			2	
AMP-SU-CIP-NAL	3	1		
AMP-TET-SU-TRI	3		1	
AMP-CIP-NAL-TET		1		
TET-SU-TRI		1	1	
AMP-SU-TRI	1	1	1	
In total	**9**	**4**	**6**	**2**

AMP, Ampicillin; CHL, chloramphenicol; CIP, ciprofloxacin; GEN, gentamicin; NAL, nalidixic acid; SU, sulfamethoxazole; TET, tetracycline; TRI, trimethoprim.

6.2 Key outcome indicators of resistance

In order to evaluate the development of the antibiotic resistance situation, ECDC, EFSA and EMA jointly published recommendations on antibiotic resistance indicators (ECDC, EFSA and EMA, 2017). These key outcome indicators take also into account the sizes of the food-producing animal populations. In Finland, the assessment is possible for pigs and broilers, as sampling from these populations is carried out at regular intervals in accordance with the harmonised EU programme.

The primary indicator of antibiotic resistance is the proportion of indicator *E. coli* isolates obtained from pigs and broilers, weighted by the size (expressed in PCU) of the two animal populations, that are fully susceptible to the tested antibiotics. The secondary indicators for indicator *E. coli* are the proportion of *E. coli* isolates from the same two animal species, weighted by PCU, that are resistant to at least three antibiotics from different antibiotic groups, and the proportion of *E. coli* isolates from the two animal species, weighted by PCU, that are resistant to ciprofloxacin.

Resistance indicators are calculated for two consecutive years as the resistance in bacteria isolated from broilers and pigs are analysed in alternating years. The proportion of indicator *E. coli* that are completely susceptible to the tested antibiotics has been extremely high (Figure 6.3). Between the years 2016–2022, the proportion varied from 78 to 80%, but in the last two time points (years 2022/2023 and 2023/2024), the proportion of fully susceptible indicator *E. coli* has decreased to 73–74%. On the contrary, the proportion of indicator *E. coli* isolates resistant to at least three different antimicrobial groups has decreased in ten years from around 10% to 4.5%. The proportion of ciprofloxacin resistance has remained between approximately 1 and 3% over the whole monitoring period which started in 2014/2015.

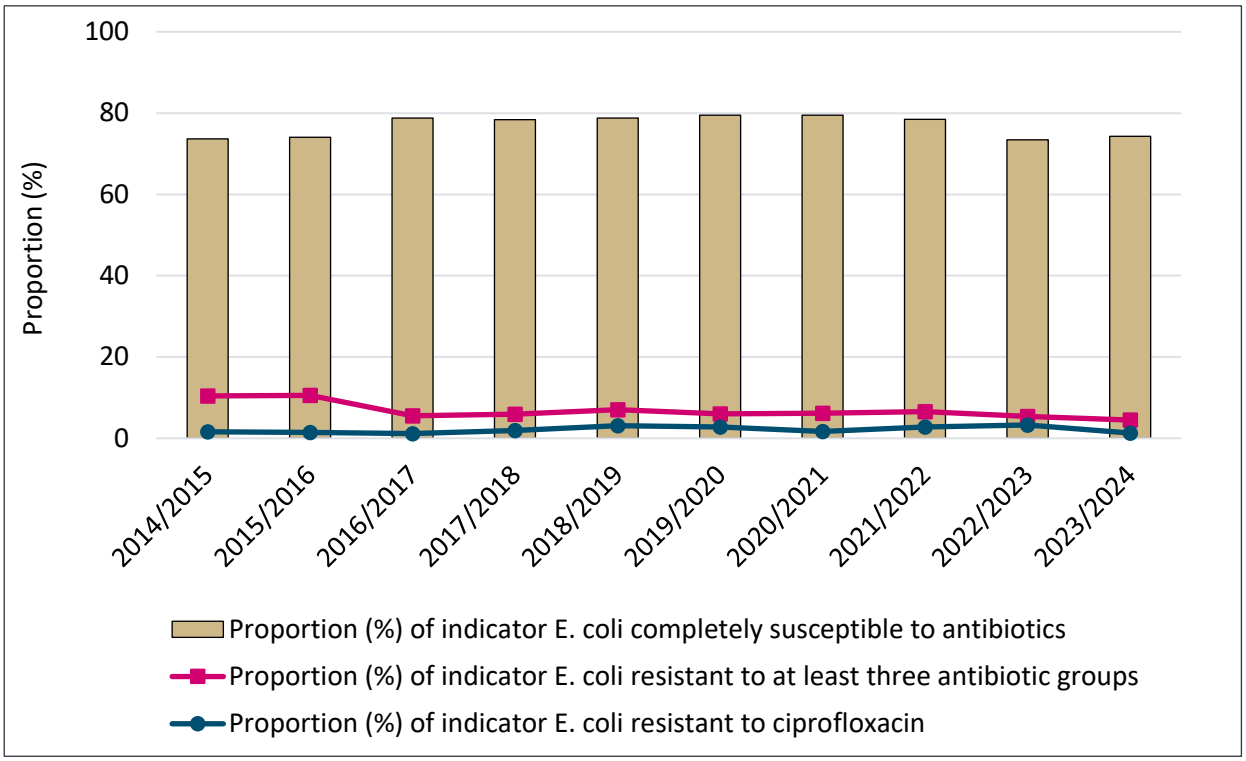

***Figure 6.3**. Outcome indicators of resistance (broilers, pigs). The proportion of indicator E. coli fully susceptible to the tested antibiotics, resistant to at least three different antibiotic groups, and resistant to ciprofloxacin, weighted by PCU.*

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Appendix 1. Population statistics

The population of food-producing animals (as PCU) is presented in Table 17. The number of livestock and farms. and the production of meat and milk in Finland are presented in Tables 18–21 (Source: Luke, the Natural Resources Institute Finland).

***Table A1**. Population of food-producing animals as PCU (1000 tonnes) by species in 2015–2024.*

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Cattle	229	228	222	220	213	207	205	199	197	195
Pigs	163	161	153	142	142	145	145	141	132	133
Poultry	70	73	76	82	83	85	86	87	84	85
Sheep and goats	13	13	13	13	12	12	11	11	10	10
Horses	30	30	30	30	30	30	30	30	29	28
Fish	15	14	15	14	15	15	14	16	15	14
TOTAL, PCU	520	520	508	500	496	494	491	485	467	465

***Table A2.** Number of livestock (in thousands) in Finland in 2015–2024.*

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Dairy cows	285	282	275	271	262	260	254	248	242	234
Suckler cows	59	59	60	60	60	62	64	65	65	63
Cattle > 1 year[1]	264	258	261	252	247	235	238	240	233	226
Calves < 1 year	307	310	297	299	288	290	289	281	281	271
TOTAL, Cattle	915	909	893	882	858	846	844	834	821	794
Boars and sows[2]	127	117	106	104	102	100	100	92	86	85
Pigs > 3 months and < 8 months	579	575	536	508	495	496	504	477	452	449
Piglets < 3 months	537	542	494	477	475	490	503	492	451	453
TOTAL, pigs	1 243	1 235	1 136	1 089	1 072	1 087	1 108	1 061	988	987
Laying hens	3 595	3 599	3 746	3 985	3 900	3 812	3 729	3 866	4056	4041
Chicks	662	748	509	608	647	566	796	665	569	496
Broilers	7 827	8 272	8 047	8 781	9 112	8 507	8 499	8 901	8718	9792
Turkeys	246	260	292	299	263	268	287	283	272	300
Other poultry[3]	597	566	543	468	438	424	520	641	664	650
TOTAL, poultry	12 927	13 445	13 136	14 140	14 360	13 577	13 831	14 356	14 279	15 279

[1] Heifers and bulls in total. [2] Includes boars, sows, and young breeding animals. [3] Including broiler parent hens, cockerels, turkey parents, ducks, geese, guinea fowls, ostriches, ranched ducks, and pheasants. Number of cattle on 1 May. Number of pigs and poultry on 1 Apr. Number of poultry in 2016 not totally comparable with the previous years. Source: OFS: Luke, Number of livestock.

Table A3. *Number of farms in Finland in 2015–2024.*

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Cattle farms	12 389	11 791	11 175	10 530	9 851	9 301	8 787	8 211	7 747	7 213
Pig farms	1 337	1 240	1 102	1 027	963	918	864	798	692	648
Poultry farms	1 310	1 300	1 280	1 243	1 172	1 201	553	475	445	420

Source: OFS: Luke, Number of livestock.

Table A4. *The production of meat and fish (million kg) in Finland in 2015–2024.*

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Beef[1]	86	87	86	87	88	87	86	84	85	87
Pork[1]	192	190	182	169	171	176	176	170	159	161
Poultry[1]	117	125	129	135	139	145	147	147	144	149
Total	397	403	397	391	398	408	409	401	388	397
Fish[2]	15	14	15	14	15	15	15	16	15	17

[1] In slaughterhouses. The production of beef and pork corrected according to the latest statistics. [2] For human consumption, ungutted. Source: OFS: Luke, Meat production and Aquaculture.

Table A5. *The production of milk in Finland in 2015–2024.*

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Milk production; per animal (litres)	8 323	8 406	8 534	8 650	8 810	9 038	8 924	8 888	9 043	9 219
Total milk production (million litres)	2 365	2 359	2 336	2 328	2 305	2 336	2 247	2 193	2 174	2 145

Source: OFS: Luke, Milk and milk products statistics.

Appendix 2. Sales and use of antibiotics for animals

Table A6. *Overall sales of veterinary antibiotics in Finland in 2015–2024, kg active ingredient.*

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Tetracyclines	2 250	2 010	2 268	2 218	2 677	1 830	1 780	1 248	1 592	1 424
Amphenicols	80	87	104	112	117	109	124	110	104	172
Penicillin G and V	4 058	3 544	3 771	3 805	3 705	3 824	3 918	3 661	3 556	3 495
Aminopenicillins	1 498	1 438	1 160	1 020	1 011	934	1 012	826	851	925
Cloxacillin	65	63	45	39	33	39	48	36	31	30
1st gen. cephalosporins	605	513	355	284	227	184	169	129	110	77
3rd gen. cephalosporins	7	3	1	0.5	0.2	0.2	0.2	0.2	0.1	0.1
Sulfonamides and trimethoprim	2 445	2 460	2 216	1 870	2 119	1 646	1 980	1 685	1 781	1 701
Macrolides	596	517	408	411	221	192	190	106	118	131
Lincosamides	165	120	297	184	197	61	56	54	58	62
Aminoglycosides	93	87	73	61	59	42	27	21	24	22
Fluoroquinolones	94	99	80	81	66	70	69	60	59	60
Pleuromutilins	30	23	14	10	3	2	0	0	0	0
Imidazoles						0	5	7	6	5
Total sales	**11 987**	**10 964**	**10 790**	**10 095**	**10 435**	**8 933**	**9 378**	**7 979**	**8 290**	**8 104**

Table A7. *Sales of injectable veterinary antibiotics in Finland in 2015–2024, kg active ingredient.*

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Tetracyclines	640	686	671	642	741	644	602	540	505	498
Amphenicols	6	13	26	15	23	24	25	16	25	23
Penicillin G	3 781	3 230	3 538	3 564	3 479	3 565	3 692	3 484	3 320	3 230
Aminopenicillins	473	453	338	286	279	229	271	215	214	241
1st gen. cephalosporins	0	5	1	1	0	0	0	0	0	0
3rd gen. cephalosporins	7	3	1	0.5	0.2	0.2	0.2	0.2	0.1	0.1
Sulfonamides and trimethoprim	373	322	317	286	292	252	213	202	177	163
Macrolides	15	19	13	10	9	9	7	5	5	5
Lincosamides	26	25	19	18	19	24	21	23	26	30
Aminoglycosides	13	14	12	10	10	12	7	6	7	6
Fluoroquinolones	72	78	63	66	50	56	55	47	46	46
Total sales	**5 406**	**4 849**	**4 999**	**4 899**	**4 902**	**4 815**	**4 893**	**4 538**	**4 325**	**4 242**

Tables A8-A and A8-B. *Sales of orally administered veterinary antibiotics (premixes, oral solutions, oral powders and oral pastes) and sales of veterinary antibiotic tablets by class in Finland 2015–2024, kg active ingredient.*

A8-A. Sales of orally administered products excluding veterinary antibiotic tablets 2015–2024, kg active ingredient. Others = 1st generation cephalosporins and fluoroquinolones for use in companion animals.

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Tetracyclines	1 610	1 324	1 597	1 575	1 936	1 186	1 173	735	1 074	913
Amphenicols	74	74	78	97	94	85	99	94	79	149
Penicillin V	147	190	100	105	94	118	92	53	90	137
Aminopenicillins	123	82	44	47	22	45	19	48	10	9
Sulfonamides and trimethoprim	2 072	2 138	1891	1557	1 813	1 382	1 724	1 458	1 551	1 485
Macrolides	581	498	395	402	212	183	182	101	113	126
Lincosamides	91	48	238	131	146	< 1	< 1	< 1	0	0
Pleuromutilins	30	23	14	10	3	2	0	0	0	0
Others	3	2	2	2	2	2	1	< 1	< 1	< 1
Total sales	**4 731**	**4 379**	**4 359**	**3 925**	**4 322**	**3 002**	**3 290**	**2 490**	**2 917**	**2 820**

A8-B. Sales of orally administered veterinary antibiotic tablets 2015–2024, kg active ingredient. Others = tetracyclines, aminoglycosides and imidazole derivatives.

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Aminopenicillins	894	894	769	681	707	656	721	562	626	674
1st gen. cephalosporins	584	491	339	272	218	180	168	129	110	77
Sulfonamides and trimethoprim	0	0	8	27	14	12	44	25	53	53
Lincosamides	48	46	39	34	33	37	34	31	33	32
Fluoroquinolones	22	21	16	15	15	14	14	13	13	13
Others	62	54	41	32	29	8	10	15	19	18
Total sales	**1 611**	**1 507**	**1 212**	**1 060**	**1 016**	**908**	**991**	**775**	**853**	**867**

Tables A9-A and A9-B. *Sales of intramammaries for veterinary use in Finland 2015–2024, kg active ingredient*

A9-A. *Intramammaries for lactation phase*

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Penicillin	88	80	86	91	87	93	90	87	106	90
Aminopenicillins	7	7	6	5	3	4	1	1	1	1
Cephalexin	18	15	13	9	8	2	0	0	0	0
Cloxacillin	31	29	19	18	15	25	23	19	17	13
Aminoglycosides	0	0	0	0	0	0	0	0	0	0
Macrolides	0	0	0	0	0	0	0	0	0	0
Total lactation phase	**144**	**131**	**123**	**123**	**113**	**124**	**114**	**108**	**125**	**104**

A9-B. *Intramammaries for dry cow period*

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Penicillin	41	44	47	45	45	49	45	36	40	38
Aminopenicillins	2	2	3	1	0	0	0	0	0	0
Cephalexin	0	0	0	0	0	0	0	0	0	0
Cloxacillin	35	34	26	21	18	14	26	17	14	17
Aminoglycosides	18	19	20	20	20	21	19	15	17	16
Total dry cow	**96**	**100**	**97**	**87**	**83**	**85**	**90**	**68**	**71**	**70**

Tables A10-A and A10-B. *Total animal biomass (in tonnes) and total amount of used antibiotics (kg active ingredient) in laying hens, broilers and turkeys in Finland 2023–2024.*

A10-A. Total animal biomass (in tonnes)

	2023	2024
Laying hens (production flocks)	9 575	9 547
Broilers (production flocks)	189 005	191 170
Turkeys (production flocks)	11 640	11 394

A10-B. Total amount of antibiotics used (kg active ingredient)

	2023	2024
Laying hens (production flocks)	16.4	8.1
Broilers (production flocks)	0	0
Turkeys (production flocks)	38.1	38.4

Appendix 3. Materials and methods, resistance monitoring

Sampling strategy

Zoonotic bacteria

Salmonella isolates from food-producing animals were collected as required by the Finnish *Salmonella* control programme. One serotype from each notified incident was included. Isolates from domestic food included also isolates originating from in-house control systems.

Campylobacter were isolated from broilers by the industry in association with the Finnish *Campylobacter* programme for broilers. Samples were taken from healthy animals at the slaughterhouses covering approximately 99% of all broilers slaughtered in Finland. Between 1 June and 31 October, every slaughtered broiler production batch was sampled, and between 1 November and 31 May, the frequency is set annually depending on production volume. From each epidemiological unit (flock), a caecal sample was taken from ten animals and the samples were then combined. All isolates (one isolate per slaughter batch) were included in the antibiotic susceptibility testing.

Animal pathogens

Clinical isolates originated from diagnostic submissions or post-mortem examinations done in the laboratories of the Finnish Food Authority. *Escherichia coli* was isolated from pigs with enteritis, the samples were taken from the contents of the gastrointestinal tract. All isolates examined were confirmed to be enterotoxigenic using PCR for toxin and fimbrial genes. *Brachyspira pilosicoli* isolates were from fecal samples of swine with diarrhoea. *Staphylococcus aureus* from broiler tenosynovitis cases were isolated from post-mortem samples submitted to the Finnish Food Authority. All obtained *S. aureus* isolates were included from the study period. *E. coli* isolates from broilers were from post-mortem samples from parent or production pedigree, and isolated either from bone marrow or heart. *Actinobacillus pleuropneumoniae* isolates originated mostly from post-mortem investigations of lungs most likely from pigs with respiratory disease. Occasional findings from joints were also included in the analysis. Bovine respiratory pathogens were mostly from deep nasopharyngeal swabs from non-medicated calves suffering from acute respiratory disease. Also isolates from post-mortem investigations of cattle lungs were included.

Antibiotic resistance figures from companion animal pathogens were collected from the Clinical Microbiology Laboratory of the Veterinary Teaching Hospital, University of Helsinki. All isolates included in this report originated from clinical specimens.

Indicator bacteria and ESBL/AmpC/carbapenemase-producing *E. coli* in food-producing animals

Indicator *E. coli* was isolated from broiler caecal samples in 2024. From the same samples, ESBL/AmpC and carbapenemase producing *E. coli* were screened. The samples from broilers (n=305) originated from healthy animals at slaughter between February and December. Sampling was evenly distributed throughout the monitoring period. The number of randomly taken samples from each slaughterhouse was proportional to the annual slaughter volume. Samples were collected at the three biggest slaughterhouses accounting for approximately 99% of all broilers slaughtered in Finland. From each epidemiological unit (slaughter batch), one sample consisted of caeca taken from ten animals. The samples were taken aseptically and transported refrigerated to the laboratory within two days. Samples were collected between Monday and

Thursday. Indicator *E. coli* isolates were randomly selected for susceptibility testing from all isolates available at the laboratory. All presumptive ESBL/AmpC/carbapenemase producing *E. coli* were tested for antibiotic susceptibility and by whole-genome sequencing.

ESBL/AmpC/carbapenemase-producing *E. coli* in imported poultry

ESBL/AmpC- and carbapenemase-producing *E. coli* were screened from the imported poultry flocks intended for broiler meat, turkey meat and chicken egg production chains. The sampling is instructed by the Animal Health ETT and includes the majority of imported parent and grandparent flocks. Also, the import of eggs intended for broiler production are screened regularly. The liners of ten transport boxes were collected from each imported flock if possible and sent to the laboratory as soon as possible. If the import day was late Thursday, Friday or Saturday, the liners were moisturized with saline broth and kept at 4°C during the weekend.

ESBL/AmpC/carbapenemase-producing *E. coli* in meat

Randomly selected samples of packed fresh and chilled (not frozen) chicken (n=290) and turkey meat (n=130) were collected at retail between January and December in 2024. All samples were of domestic origin. Sampling was evenly distributed throughout the study period and allocated according to meat batches. Samples collected from retail shops were obtained from eight different NUTS-3 areas, covering approximately 72% of the Finnish population. From the NUTS-3 areas included in the sampling, the number of samples to be collected was proportional to the inhabitant size. Because of the nature of the Finnish market (small size, only a few distributors), same batches of the product can be found throughout the country. Samples were collected from Monday to Thursday except for the biggest NUTS-3 area, where samples were also collected on Fridays. The meat samples were sliced or diced and wrapped in vacuum or in a controlled atmosphere. The samples were transported refrigerated to the laboratory within one day and the temperature of the meat was measured at the laboratory on arrival. One isolate from each epidemiological unit (if available) was selected for susceptibility testing and whole-genome sequencing.

Isolation and identification of bacteria

Zoonotic bacteria

Salmonella spp. were isolated and identified according to a modification of the NMKL standard Nr 71 (1999), according to ISO standard 6579:2002 or ISO standard 6579:2002, Amendment 1/2007, at local food control or slaughterhouse laboratories. Serotyping of the isolates was performed at the Finnish Food Authority, in the Veterinary Bacteriology and Pathology Unit.

C. jejuni and *C. coli* from broilers were isolated at slaughterhouse laboratories and confirmed at the Finnish Food Authority, in the Microbiology Unit, according to ISO 10272-1:2017.

Animal pathogens

Isolation and identification of pathogens from food-producing animals was performed by accredited conventional culture and biochemical/MALDI-TOF methods at the Finnish Food Authority, in the Animal Health Diagnostic Unit.

Identification of pathogens from companion animals was performed by MALDI-TOF method in the Clinical Microbiology Laboratory of the Veterinary Teaching Hospital, University of Helsinki. Pathogens were from various types of specimens, such as superficial and deep pus specimens, urine, respiratory tract, and blood.

Indicator *E. coli*

Caecal content was directly spread on Brilliance™ *E. coli*/coliform Selective Agar (Oxoid) and incubated overnight at 37°C. Typical colonies were subsequently spread on blood agar plates and after an overnight incubation at 37°C, stored at -80°C until susceptibility testing.

Screening of ESBL-, AmpC- and carbapenemase producing *E. coli*

Broiler caecal samples (n=305) taken at slaughterhouses, fresh broiler meat (n=290) and turkey meat (n=130) samples taken at retail, were screened as part of the EU-wide monitoring based on Commission Implementing Decision (EU) 2020/1729 according to the latest EURL protocols. Briefly, 1 g of intestinal content or 25 g of fresh meat was suspended in 10 ml or 225 ml of buffered peptone water (BPW) (Merck, Germany), respectively, and incubated overnight at 37°C. Subsequently, 10 µl of the suspension was spread on MacConkey agar plates (Becton, Dickinson & Company, France) containing 1 mg/l cefotaxime (Sigma-Aldrich, Germany) for the detection of ESBL/AmpC producers, and on CARBA and OXA-48 plates (BioMérieux) for the detection of carbapenemase producers. MacConkey plates were incubated overnight at 44°C, and CARBA and OXA-48 plates overnight at 37°C. Presumptive *E. coli* colonies from the selective plates were confirmed with MALDI-TOF (Maldi Biotyper®, Bruker Daltonics. Germany). The screening of imported poultry flocks was performed using the same methodology by analysing the liners from each imported flock as two pooled samples (liners from 5 transport boxes suspended in 3 liters of BPW).

Susceptibility testing

Verbal descriptions of the resistance levels are those used by EFSA (EFSA, 2010).

Rare	< 0.1%
Very low	0.1% to 1.0%
Low	>1% to 10%
Moderate	>10% to 20%
High	>20% to 50%
Very high	>50% to 70%
Extremely high	>70%

Bacteria from food-producing animals

The susceptibility testing of bacteria from food-producing animals was performed with broth microdilution method according to the Clinical and Laboratory Standards Institute (CLSI) standard VET01 5th ed (CLSI, 2018) using Sensititre™ (TREK Diagnostic Systems Ltd, United Kingdom) microtiter plates except for *Brachyspira* spp. for which MICRONAUT-S Brachyspira MIC (Bruker Daltonics GmbH & Co, Germany) were used. The confirmation of presumptive ESBL/AmpC-producing bacteria was done by the AmpC & ESBL ID Set (D68C, Mast Diagnostics, UK) (pathogenic *E. coli* from food-producing animals) or by the microdilution method using Sensititre™ EUVSEC2 plates (*Salmonella*, indicator *E. coli* and isolates from the ESBL/AmpC screening). Penicillin susceptibility of *S. aureus* was based on beta-lactamase activity tested with Cefinase™ disks (Becton Dickinson, NJ, USA).

Susceptibility testing was performed at the Microbiology Unit and for *Brachyspira* spp. at the Animal Health Diagnostic Unit. Current (4.6.2025) epidemiological cut-off (ECOFF) values were used to separate the wild-type population (referred as susceptible) from non-wild-type isolates (referred as resistant) (Table A11). When available, clinical breakpoints of the CLSI VET01S 7th ed document (CLSI, 2024a) were used to evaluate clinical resistance in animal pathogens. For *Brachyspira* spp., no standardised breakpoints exist, and laboratory-specific breakpoints were used to evaluate clinical resistance.

Table A11. *Cut-off values (mg/L) for resistance used in this report. Values represent EUCAST epidemiological cut-offs (ECOFFs) (4.6.2025). If EUCAST ECOFF was missing or different cut-off value was used, it is stated in the footnote.*

Substance	*Salmonella enterica*	*Escherichia coli*	*Campylobacter coli*	*Campylobacter jejuni*	*Staphylococcus aureus*
Amikacin	>4[1]	>8			
Ampicillin	>4	>8			
Azithromycin	>16	>16			
Cefotaxime	>0.5[1]	>0.25			
Cefoxitin					>4
Ceftazidime	>2	>1			
Chloramphenicol	>16	>16	>16	>16	
Ciprofloxacin	>0.06	>0.06	>0.5	>0.5	
Colistin	[2]	>2			
Enrofloxacin		>0.125			
Ertapenem			[2]	>0.5[3]	
Erythromycin			>8	>4	
Florfenicol		>16			
Gentamicin	>2	>2	>2	>2	
Meropenem	>0.125[3]	>0.06			
Nalidixic acid	>8	>8			
Streptomycin		>16			
Sulfamethoxazole	>256[3]	>64[3]			
Tetracycline	>8	>8	>2	>1	>1
Tigecycline		>0.5			
Trimethoprim	>2[1]	>2			
Trimethoprim/ sulfamethoxazole[4]		>1[5]			>0.25[1]

[1] tentative EUCAST ECOFF, [2] EUCAST ECOFF not available, [3]a cut-off value provided by EFSA (EFSA, 2025) used for resistance monitoring purposes, [4]concentration of trimethoprim given, concentration ratio with sulfamethoxazole 1:20, [5]differs from ECOFF

Bacteria from companion animals

Susceptibility testing of bacteria isolated from companion animals was performed in the Clinical Microbiology Laboratory of the Veterinary Teaching Hospital with a disk diffusion technique with an available CLSI VET01 (5th ed) standard (CLSI, 2018). For all data, clinical breakpoints of the supplement CLSI VET01S 7th ed (CLSI, 2024a) were used to calculate non-susceptibility (intermediate and resistant) percentages. If veterinary breakpoints were not available, the breakpoints available in CLSI M100-S24 (CLSI, 2014) and CLSI M100 34th ed (CLSI, 2024b) were used. Exceptions were: fusidic acid non-susceptibility breakpoint, which was ≤ 23 (EUCAST, 2024); *S. pseudintermedius* non-susceptibility breakpoint for oxacillin, ≤ 19 (EUCAST, 2024); and *S. aureus* non-susceptibility breakpoint for oxacillin, ≤12 (FiRe, 2009). Beta-lactamase activity was tested with Cefinase™ disks (Becton Dickinson, NJ, USA). *S. aureus* with reduced susceptibility to oxacillin or cefoxitin were tested for the presence of the *mecA* gene with polymerase chain reaction (PCR) using primers described in Murakami *et al*. (1991).

Whole-genome sequencing

All presumptive ESBL/AmpC/carbapenemase producing *E. coli* from the specific monitoring of food-producing animals and meat were subjected to whole-genome sequencing. The guidelines of the EURL-AR protocol version 2.2 for whole-genome sequencing and bioinformatic analysis of bacterial isolates related to the EU monitoring of antibiotic resistance were followed using an in-house equipment (Illumina MiSeq) and workflow. The library was prepared using Illumina DNA Prep kit following the manufacturer's instructions. Analysis of the antibiotic resistance genes was performed using ResFinder 4.5.0 (https://www.genomicepidemiology.org/services/).

Quality assurance system

The Animal Health Diagnostic Unit of the Finnish Food Authority participates in external quality assurance programmes for veterinary pathogens and in proficiency tests on isolation. identification and serotyping of *Salmonella*, and the Microbiology Unit participates in proficiency tests for antibiotic susceptibility testing.

For susceptibility tests, the following bacteria were included as quality controls on at least a weekly basis: *E. coli* ATCC 25922, *S. aureus* ATCC 29213, *C. jejuni* ATCC 33560, *Actinobacillus pleuropneumoniae* ATCC 27090 and *Histophilus somni* ATCC 700025. For the *Brachyspira* susceptibility test, *Brachyspira hyodysenteriae* ATCC 31212 was used as a quality control strain.

The Animal Health Diagnostic Unit is accredited for isolation, identification and serotyping of *Salmonella*, and the Microbiology Unit and the Bacteriology laboratory in Seinäjoki using Sensititre™ susceptibility panels in the susceptibility testing according to SFS-EN ISO/IEC 17025, by the Finnish Centre for Metrology and Accreditation.

The Clinical Microbiology Laboratory of the Veterinary Teaching Hospital has an internal quality control scheme with ATCC control strains; the quality control tests are performed on a weekly basis. In addition, the laboratory participates in several external quality control schemes (including identification and susceptibility testing of bacteria) organised by Labquality and Vetqas.

Appendix 4. *Salmonella* serovars isolated from food-producing animals in 2024

Table A12. *Salmonella enterica serovars isolated from the main food-producing animal species in Finland in 2024.*

Serotype	Nr of isolates	Cattle	Pigs	Poultry (Gallus gallus)	Turkeys
S. Typhimurium	27	9	3	15	
S. Enteritidis	5	4	1		
S. Uganda	4		4		
S. Konstanz	3	3			
S. Agony				1	
S. Bareilly				1	
Sum	**41**	**16**	**8**	**17**	**0**

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